3-14-2014

Cloud Computing Implementation Organizational Success in the Department of Defense

Corey J. Perkins

CLOUD COMPUTING IMPLEMENTATION ORGANIZATIONAL SUCCESS IN THE DEPARTMENT OF DEFENSE

THESIS

Corey J. Perkins, Master Sergeant, USAF

AFIT-ENV-14-M-48

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

AFIT-ENV14-M-48

CLOUD COMPUTING IMPLEMENTATION ORGANIZATIONAL SUCCESS IN THE DEPARTMENT OF DEFENSE

THESIS

Presented to the Faculty

Department of Systems and Engineering Management

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Engineering Management

Corey J. Perkins

Master Sergeant, USAF

March 2014

CLOUD COMPUTING IMPLEMENTATION ORGANIZATIONAL SUCCESS IN

THE DEPARTMENT OF DEFENSE

Corey J. Perkins
Master Sergeant, USAF

Approved:

//SIGNED//	24 February, 2014
Lt. Col Darin A. Ladd, Ph.D. (Chairman)	date
//SIGNED//	24 February, 2014
Lt. Col Brent T. Langhals, Ph.D. (Member)	date
//SIGNED//	24 February, 2014
SMSgt Jeffrey C. Sandusky, M.S. (Member)	date

AFIT-ENV-14-M-48

Abstract

The Air Force and Department of Defense (DoD) tend to implement user based IT systems without quantifying whether those systems would be properly utilized by the target populous. Focus is generally emphasized on mission enhancement rather than looking at how or if it will be utilized by organizations. There is no reason to implement cloud computing with the same disregard for acceptance and success. The day of large amounts of data is here and needs to converge with what this thesis investigates, the factors that positively influence organization acceptance and success of cloud computing specifically in the DoD so that is can properly maintain, utilize and store that data. The research focused on that utilization and will better prepare the system engineers to ensure the minimum amount of time for "total" implementation and utilization. An in-depth analysis was conducted to clarify the effects of cloud on organizational success in the DoD. The model developed from this research quantified acceptance and success in regard to the implementation of cloud computing. The model is based on success due to "business model" factors discovered during a Delphi study of industry and DoD experts (Okoli, 2004). One of the chief concerns is that if this technology is fielded without addressing whether and how the organizations will utilize it, then it will flounder without being used as expected, or worse yet, could become a failed technology with respect to the direction the DoD intended. Therefore, a focus on the factors affecting acceptance and success could ultimately inhibit or influence that direction and help us to make better use of this new technology.

For my wife and kids. Over the last eighteen months this would have not been possible without their love, understanding, and support. This experience has made me realize that it is my family support that has made my career and this project a success. I hope you understand the depth of my gratitude and love.

Acknowledgements

As this portion of my career is completed, there are many people I would like to thank. My thesis advisor, I am grateful for your time and patience. My thesis committee, I have learned from our discussions that gave me the direction I needed to complete the thesis. I would like to thank the Air Force Institute of Technology, the Graduate School of Engineering and Management and the Professors and instructors in the Information Resource Management program. I have learned much from my attendance at AFIT.

MSgt Corey Perkins

Table of Contents

Page

List of Figures

Figure Page

List of Tables

Table Page

CLOUD COMPUTING IMPLEMENTATION ORGANIZATIONAL SUCCESS IN THE DEPARTMENT OF DEFENSE

I. Introduction

"The shift to "light technologies," that is, cloud services, which can be deployed rapidly, and shared solutions will result in substantial cost savings, allowing agencies to optimize spending, and allowing agencies to reinvest in their most critical mission needs. Agencies must focus on consolidating existing data centers, reducing the need for infrastructure growth by implementing a "Cloud First" policy for services, and increasing their use of available cloud and shared services" (Vivek Kundra, U.S. Chief Information Officer).

Overview

This section identifies numerous benefits as well as the challenges that are faced when operationalizing a new technology. It also identifies the implementation obstacles that have been encountered in the past and how those obstacles can be overcome. Next, this section describes how far behind industry DoD is, in regards to cloud computing. Finally, this section establishes the research objectives, research questions, and the organization of this thesis.

Benefits

The many benefits of cloud computing research that the DoD may experience include advancement in implementation, efficiency and effectiveness. Those benefits, listed below, are further elaborated in Section II of this paper.

- *Continuous Refresh*
- *Rapid Elasticity*
- *Improved Mission Focus*
- *Lower Barriers to Entry*

Challenges

This study will show how to overcome the many challenges that the DoD faces when implementing a new technological solution such as cloud computing. The Air Force and DoD tend to implement Information Technology (IT) systems without quantifying whether those systems would be properly utilized by the target populous. The emphasis is on mission enhancement, rather than how or if it will be utilized by organizations. There is no reason to assume cloud computing should be implemented with the same disregard for acceptance and success. The day of Big Data is here, and should converge ("Big Data in the Cloud," 2013) with the factors that positively influence organizational acceptance and success of cloud computing, specifically in the DoD, so that data can be properly maintained, utilized and stored, which this thesis will investigate. Big Data was defined by ISACA (Information Systems Audit and Control Association) as:

"…data sets that—due to their size (volume), the speed they are created with (velocity), and the type of information they contain (variety)—are pushing the existing infrastructure to its limits" (Mario Bojilov, President, Board of ISACA-Brisbane).

The thesis research focused on utilization and will better prepare system engineers to ensure minimum time for "total" implementation and utilization. An in-depth analysis was conducted to clarify the effects of cloud computing on organizational success in the DoD. The models developed from this research quantifies acceptance and success in regard to the implementation of cloud computing. The models are based "business model factors" discovered during a Delphi study of industry and DoD experts (Okoli, 2004). One of the chief concerns is if this technology is fielded without addressing whether and how the organizations will utilize it, then it will flounder without being used as expected;

worse, it could become a failed technology with respect to the direction the DoD intended. Therefore, a focus on the factors affecting acceptance and success could ultimately inhibit or influence that direction and help the DoD make better use of this new technology.

Implementation Problems

Technology acceptance theories suggest there are could be implementation obstacles when instituting cloud computing, indicating the importance of this research. If DoD organizations adopt tools identified in this research when implementing a cloud solution, many of these hurdles could be lowered to a manageable level.

The challenges that exist in industry include control, security and privacy, costs, vendor standards, transparency, and reliability. Control is critical to ensuring that users have the ability to adjust the system design based on changing requirements. Security and privacy, identified as critical by DoD experts as a part of this research, are also important in industry. A survey of chief information officers and IT executives by International Data Corporation found that 75% of participants rated security as their top priority; this reflects the importance of security and privacy. Security in all cloud models has been found to affect accessibility, reliability and overall access to a cloud solution (Subashini et al., 2010). Costs, relative to bandwidth, can negate any financial advantages to cloud computing and should be closely analyzed to prevent cost overruns due to over estimating of needs. The amount of vendors in the cloud landscapes enables a disarray of locked-in standards. As new technologies go, these standards will be slowly achieved. The vastness of access to the cloud creates a transparency issue for companies when trying to metric this access to a prospective client. Continuous access creates a reliability issue with new technology, and cloud solutions are no different. These obstacles in industry translate directly to DoD implementation and further research will cement that idea (Leavitt, 2009).

The DoD Cloud Computing Strategy dated July 5, 2012, identifies the DoD strategy regarding any type of implementation. The driving factor behind how implementation will take place pertains to how it will benefit the Joint Information Environment (JIE) through increased mission effectiveness and operational efficiencies (DoD, 2012).

The Defense Information Systems Agency (DISA) is the DoD communications arm that carries the bulk of the workload in implementing new IT endeavors. They have not identified the type of strategy they plan to use and will follow industry guidance upon cloud implementation (Cloud Broker RFI, 2012). This research could be tailored to that implementation as needed.

Research Objectives

The following excerpts emphasize the importance of DISA striving to achieve efficient and successful implementation of a cloud solution. The fact that they have been identified as the DoD provider of that solution further proves that philosophy.

DoD News Release identifying DISA as the cloud service broker:

"DISA has been named as the enterprise cloud service broker to help maintain mission assurance and information interoperability within this new strategy" (DoD New Release, 2012).

DoD Chief Information Officer (CIO) Cloud Computing Strategy guidance:

"Implement cloud computing as the means to deliver the most innovative, efficient, and secure information and IT services in support of the Department's mission, anywhere, anytime, on any authorized device" (DoD Chief Information Officer, 2012).

As cloud computing is a new technological endeavor in the Air Force, the benefits, challenges, and implementation problems, make successful implementation of cloud computing as an IT solution paramount to future mission achievement. The role to execute cloud computing brokerage has been undertaken by DISA and based on DISA's factors of "success" ("GO Cloud Broker," 2012), this research will create a model generated from a Delphi study of DoD and industry experts. The ultimate goal of this research is a viable cloud computing implementation model to use for successful execution.

This research will provide background into cloud computing, to include definition, characteristics, and benefits. More importantly, this research shows what organizational "business associated" factors should be realized by DISA before the brokerage solution is implemented. By DISA addressing these specific factors, they can adjust the implementation strategy to ensure they are mitigated. The research models developed could also be used DoD-wide for future cloud implementation. At the conclusion of this research, recommendations will be made, based on the Delphi study feedback, to aid DISA in its cloud brokerage endeavor providing a viable implementation model to follow.

Based on the DISA COA (Course Of Action) brief ("GO Cloud Broker," 2012), feedback from DISA via teleconference and e-mail the following are the basis for successful implementation:

- *Actual availability of the data and system compared with Service Level Agreement (SLA) requirements*
- *Reliability of the data and system compared to expectations*
- *Maintainability of data and the system compared to expectations*
- *Serviceability - supplier performance compare with contractual conditions*

- *Structure at the organization*
- *Training at the organization*
- *Usability at the organization*
- *Profitability through increased return on mission effectiveness*

There have been numerous research streams investigating technology acceptance theories. These theories will be used to support model development regarding successful cloud computing implementation efforts by DISA. TAM (Technology Acceptance Model), TAM2 (Technology Acceptance Model 2), UTAUT (Unified Theory of Acceptance and Use of Technology), TAM3 (Technology Acceptance Model 3), and M-TAG (Model for Technology Acceptance on Groups) are all appropriate theories that are relevant to this research and the models developed. The theoretical importance of these theories and their applicability to this research will be elaborated in Chapter IV.

Research Questions

Data obtained during this research will answer the following questions regarding the cloud computing brokerage pursuit by DISA. The answers from industry experts will be analyzed through Measures of Effectiveness (MoEs) and provide the basis for the development of the models.

RESEARCH QUESTION 1: *What organizational variables or processes influence successful cloud computing implementation in the DoD?*

RESEARCH QUESTION 2: *How could DISA implement a cloud solution?*

RESEARCH QUESTION 3: *Can a "model" be developed that will assist DISA's strategy for successfully fielding cloud computing in the DoD?*

Thesis Organization

Chapter I introduced the research overview, defined successful cloud computing implementation, identified the research questions being answered by the research, and introduced the supporting theories. Chapter II defines cloud computing in detail and explains cloud models, services, benefits, and characteristics that will be reviewed. Chapter III explains that Grounded Theory and the Delphi method will be used to question DoD and industry experts regarding cloud computing implementation. Chapter IV has the analysis of the responses, theory support, analysis of the variables, and presents models. Chapter V contains the discussion, recommendations, and areas for future research.

II. Background

Cloud Computing Defined

The National Institute of Standards and Technology (NIST) describes cloud computing as:

"A model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model promotes availability and is composed of five essential characteristics, three service models and four deployment models." (Mel and Grance, 2011)

This research does not target the technical aspects of the communications within cloud computing. It is assumed that the reader possesses this technical knowledge, which should enhance the strategic point of view this thesis presents. Knowing the background should assist in implementing the presented models developed from this research.

Cloud computing offers an invaluable pathway to access tremendous amounts of data by the "click of a button." The ability for the cloud to be scalable, reduce costs, decrease points of entry, and increase organizational competencies has made it very attractive to industry. These same attractive traits have led the DoD to start the process of cloud implementation.

Beginning with the onset of Amazon and Google cloud models, the era of Big Data has driven industry and DoD to adapt their way of sharing critical and non-critical information. The characteristics of cloud computing have to be addressed before implementing any type of solution. The inherent characteristics include "continuous refresh, lower costs, on-demand self service, broad network access, resource pooling, rapid elasticity and measured service" (Barcomb, 2009). Four of these characteristics will be discussed further. Continuous refresh, lower costs, and rapid elasticity are later included as benefits.

A cloud solution also offers multiple capabilities depending on the desired effect to the organization. Services such as Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS) are all types of offerings stemming from a cloud solution. These characteristics, combined with one, or all, of the services offer leveraged benefits when properly deployed. Figure 1 shows cloud computing architecture.

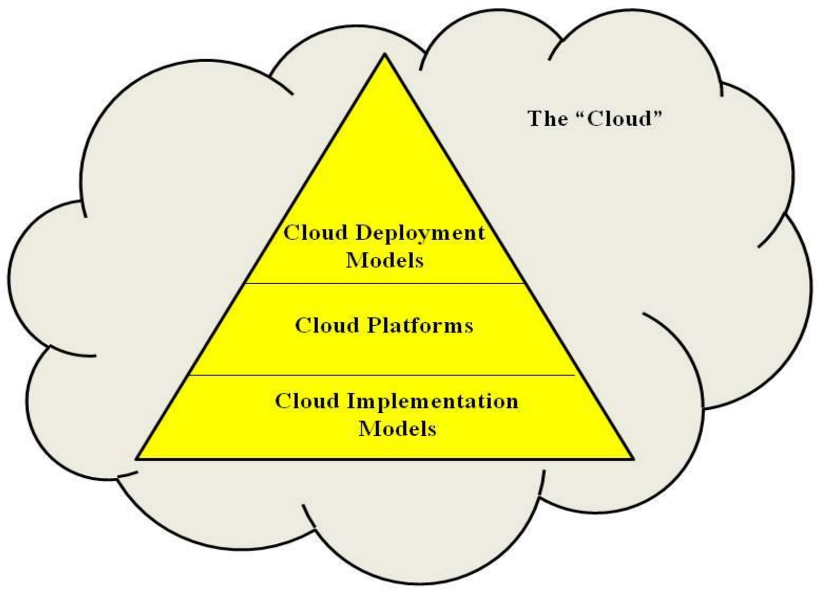


Figure 1. Cloud Computing Architecture

Cloud Computing Platforms

There are three platforms that are deployed by vendors that are available to the consumer. Great care should be taken when choosing a service based on the needs of the customer. Certain services fulfill different requirements of the user at designed levels of control and utilization. Moving to the lower level services, the look and feel of the service emulate the local hardware and software utilization (Barcomb, 2009).

*IaaS***:** The base service is offered to users desiring the most control over the environment. Vendors providing an IaaS service solely provide hardware, giving the user the flexibility to use whatever software their needs require. This service is provided virtually, which limits how the user is able to realize what hardware is being used. This service should be selected by users requiring absolute control over the cloud.

PaaS: This offers the ability for the user to access pre-programmed applications that are provided by the vendor. The applications are often custom coded based on user requirements and transparent to the user. The coded application platform is provided, operated and maintained by the service provider. This service is desired when custom applications are needed because commercial solutions available are not adequate.

SaaS: Here, the provider supplies the software required by the customer. The provider retains the responsibility to install, maintain, update, and operate the software and operating system, as well as the associated hardware that operates the applications. These applications are accessed by the user remotely from a thin client via virtualization of the platform. This limits the user visibility of the underlying hardware. This service is beneficial if the user is not concerned with the hardware, but rather the specific software set needed for their operations. At this time, and per the DISA operations section, this is the service being pursued (Barcomb, 2009).

Cloud Computing Deployment Models

To understand how DISA would implement the models developed from this research, there should be an understanding of the different environments that the platforms could be used in. Ideally, there should be a hierarchical understanding of these environments, leading to the model implementation (Figure 1). There are four different types of deployment available to users that are implemented by vendors via a cloud environment; *Public, Private, Hybrid, and Community* (Figure 2). They each offer their own strengths and weaknesses. Understanding the model types and how they fit together is pivotal to comprehension of the underlying services that exist in a cloud environment. All cloud services, later defined, exists within these deployment types. A public cloud implements service in an environment where the vendor is responsible for all operating expenses. The actual services are provided "publicly" to the user, external to the system, and costs are passed to consumers. A private cloud exists within the organization that requests the services where they can customize as they see fit. A hybrid cloud is a mixture of public and private clouds where organizations only make part of their data available via a public cloud, through the vendor chosen to offer their services, and more critical data is only offered via the private cloud. A community cloud exists within like organizations that have established similarities in their requested services or analogous objectives (Barcomb, 2009).

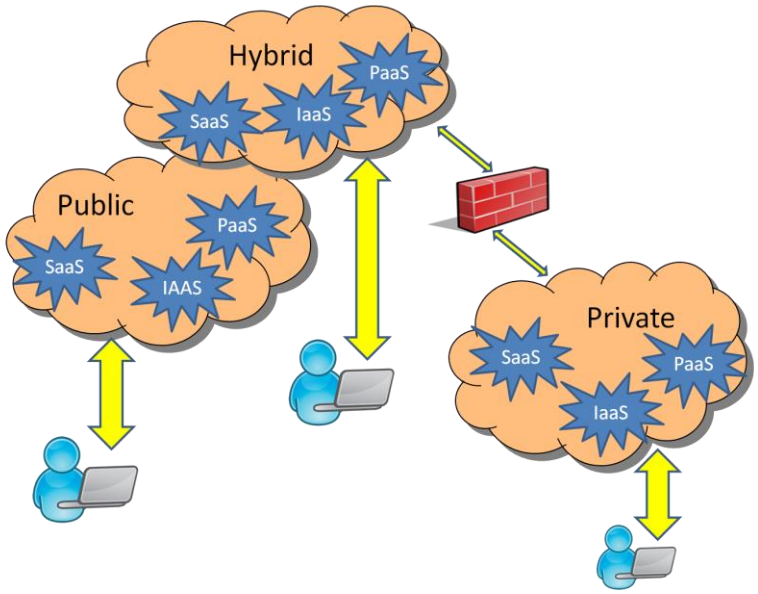


Figure 2. Cloud Computing Models

Cloud Computing Characteristics

Public and private clouds offer many advantages to the IT manager that decides to incorporate cloud services into their system architecture. Four identified characteristics are clarified to explain the benefits (Barcomb, 2009):

1.) On-demand Self Service: On-Demand Self Service allows for 24-7 access with little to no human interaction once an SLA between the customer and provider is in place. The ability to access resources "on the fly" is very attractive to customers and huge benefit.

2.) Broad Network Access: Cloud has ability to provide the network access and bandwidth needed to accommodate a large repository of data. The DoD has a large need for access to Big Data. This bandwidth and access comes at a cost, but with the infrastructure typically already in place (e.g. Google's fiber expansion); the cost is at a great reduction (Brooklyn, 2014).

3.) Resource Pooling: The ability to take users across the spectrum and spread their use over all the resources using technologies such as virtualization, dynamic provisioning, and load balancing offers a distinct benefit to operations and hardware budgets.

4.) Measured Service: This is the ability to measure and quantify the user utilization of the system. This characteristic is pertinent to DoD cloud utilization and worth noting for the overall view of its history and background. These metrics will allow DISA to identify improvement areas.

Cloud Computing Benefits

Cloud computing offers benefits beyond technology used by the DoD to date, and implementation should be viewed by the Air Force as paramount. These benefits could overcome the challenges of access to Big Data, organizational and user affects, and acceptance that were identified in Chapter I. In addition to the below benefits, this research should assist in overcoming those challenges. Following are some of those benefits offered by a cloud solution (Barcomb, 2009):

Continuous Refresh: Within the DoD IT realm, refresh schedules are critical to ensuring efficient operation, budget and manpower forecasts. The current process puts a huge budgetary constraint on managers, further hindering upgradability to IT infrastructure. Cloud services enable smoother, more cost efficient refresh capability due to its inherent virtualization and ability to transition between needed platforms.

Lower Costs: Overall costs in the DoD for IT has skyrocketed in recent years. Cloud offers an inherent saving in its ability to dynamically control users "on-demand", as well as the ability to host multiple users at once. There are spikes in utilization, but the resources are redirected depending on the load, creating an overall reduction in cost to all users.

Rapid Elasticity: This characteristic provides reduced costs to the user by being able add or take way hardware and software resources from specifically allocated areas of use.

Improved Mission Focus: Decoupling an organization from its data and the associated applications for operations reduces the IT burden. This allows the organization to increase focus on the mission by applying resources and costs that were previously associated with maintaining elaborate infrastructures, and data and application maintenance.

Lower Barriers to Entry: Acquisition actions are a concern for DoD due to limited availability of competent contract providers. Cloud solutions give a window of opportunity to smaller contractors offering solutions that they previously could not compete with. Harauz et al describes the benefits of cloud computing to small businesses as a "major selling point" (Harauz, 2009).

DoD Information Assurance (IA) Guidelines

Navigating through numerous IT guidelines an organization can take advantage of cloud computing benefits. NIST and the Federal Information Security Management Act offer general IT governance; however, DoD Directive 8500.01E *"Information Assurance (IA) and DoD directive"* and 8500.2 *"Information Assurance (IA) Implementation"* get to more specifics. All of these documents should be utilized by DISA and other agencies when looking at implementing a cloud solution.

Business Perspective

Cloud computing has changed the international business landscape in industry and, with this research; DISA will see how DoD can follow suit to achieve the same success experienced within the civilian sector. There are many business factors that have been successfully enabled by cloud computing. These factors, which can transfer to the DoD, justify a viable model development resulting from this research.

Businesses can enhance their effectiveness from a cloud service that offers such advantages as eliminating barriers to entry, providing immediate access, lowering IT costs, enabling enterprise service scalability, and pioneering service delivery. Numerous notable organizations, such as Google, IBM, Microsoft, and AT&T, have taken advantage of these benefits. Their successes speak for themselves (Marston et al, 2011). Understandably, the DoD is wary of implementing new technology, but this research, and the track record of successful businesses using the technology, should alleviate those fears and provide a road map to execution

The Government Service Agency, who is moderating the cloud brokerage, has laid out possible DoD benefits that result from various business drivers (Figure 3). Although these business drivers are not definitive, they can be compartmentalized to fit within those previously mentioned.

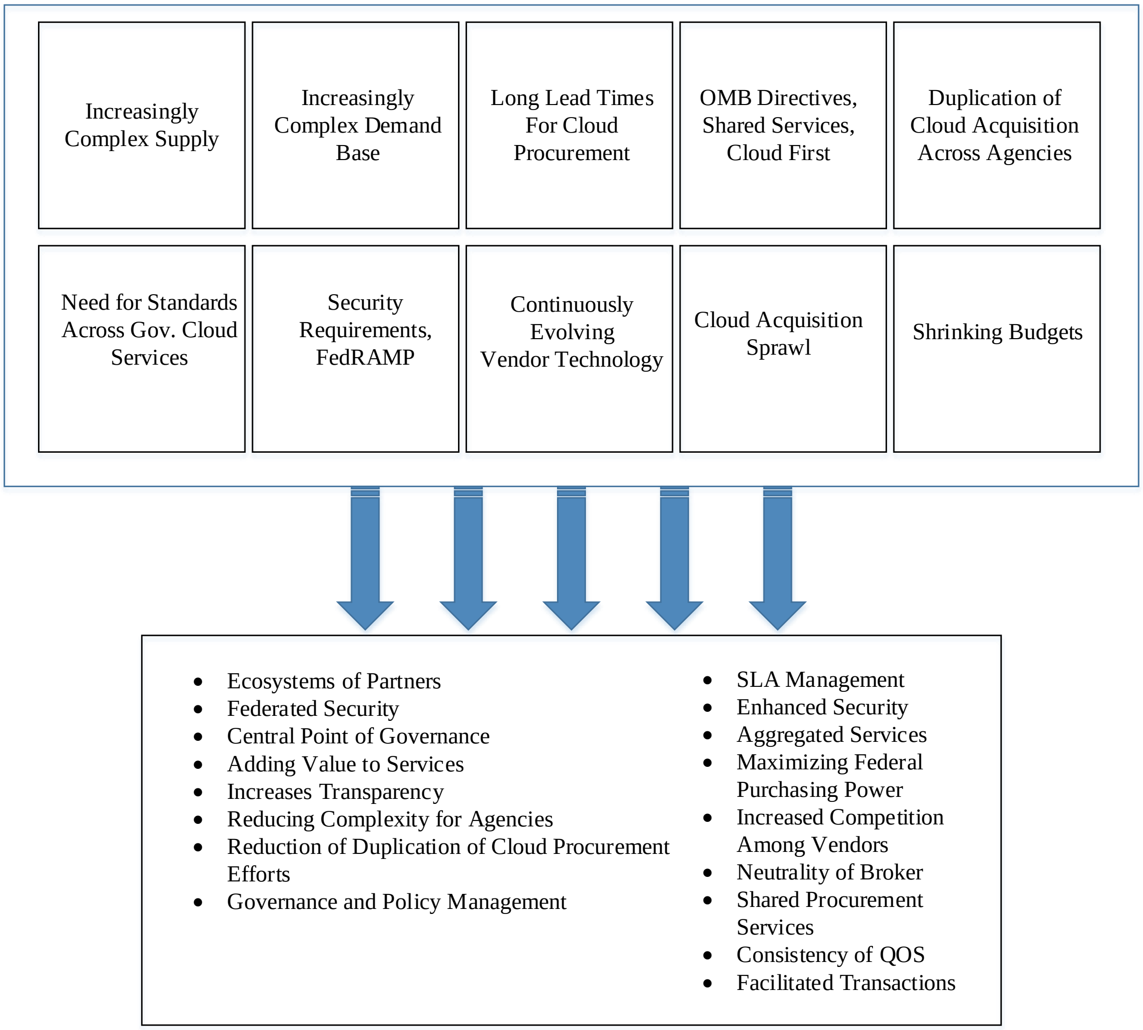


Figure 3. Business Drivers (Adapted from Cloud Brokerage Industry Day, 2012)

Implementation

The path to implementation, if decided upon, is incumbent on DISA and will be an important step critical to the success or failure of planned completion. The following sections will further assist with the planned implementation. A complete implementation strategy, however; is outside the scope of this research. A partial strategy utilizing this research will be discussed in Chapter V while answering research question 2.

Conclusion

As this chapter discussed, cloud computing offers many advantages and capabilities that should be taken advantage of by the DoD. Business factors that are tied to a successful cloud solution and implementation, to include who should design that process and the flexibility it should entail were identified. As Nicholas (Carr, 2005) noted, the biggest impediment to cloud computing "will not be technological but attitudinal". This statement is true when looking at implementing new technologies in the DoD and cloud computing will be no different. This analysis should offer DISA an effective tool to ensure implementation success.

III. Methodology

The Delphi Technique was selected as the methodology of this research paper due to its ability to accurately predict future characteristics or variables that may affect IT (Linstone & Turoff, 2002). Schmidt identifies the Delphi method as a valuable tool in a researcher's toolbox, citing "a lack of a definitive method for conducting the research and a lack of statistical support for the conclusions drawn." The Delphi method strengthens research results due to its ability to represent expert opinions instead of objective facts (Dalkey and Helmer, 1962). Cloud providers keep market research and business models "close to the vest", which makes statistically identifying these factors difficult. By going to the experts directly, these factors can be identified and measured based on how they view cloud services in industry and DoD. MoEs for the business factors that may affect successful implementation will be quantified using the Delphi Technique. Finally, the Delphi method was found to be an effective means in regards to IT studies (Mishra et al, 2002).

The Delphi data were analyzed using Grounded Theory Methodology (Charmaz, 2007). Grounded Theory Methodology is ideal for inductive theory building because it blends the best of qualitative and quantitative methodologies. Grounded Theory is generalizable because it uses systematic sampling procedures, and rigorous because it uses systematic coding procedures while staying "grounded" in the subjects' interpretations prior to enfolding literature (Strauss and Corbin, 1994). Finally, it allows co-creation between the researcher, subjects, and literature by requiring constant comparison between the three, with extensive member checking (Glaser & Strauss, 1967; Glaser, 1978).

In this thesis, Grounded Theory was applied through the Delphi method in three general phases: discovery, analysis, and construction. In the "discovery" phase, elicited texts were generated in the form of the Delphi questionnaires. It was this phase that the Delphi Methodology and Grounded Theory differed the most because, although both methods use systematic sampling procedures, the Delphi Methodology seeks experts first, and usually does not expand participation beyond initial members, whereas Grounded Theory is known for adding participants (i.e., through "snowball sampling") until theoretical sufficiency is reached.

Implementation

The following explains in detail how the Delphi Technique was implemented to achieve satisfactory results from a panel of experts specifically selected due to their experience, knowledge of cloud solutions, and status as managers, developers, and practitioners.

The study started by selecting the panel of experts. A 'first pass', containing a set of pre-determined questions, was sent to the experts, allowing them to respond with open-ended answers (Appendix D). Upon initial sampling, these texts were "analyzed" by coding them in a two-step process (open coding and focused coding) that allowed the researchers to develop shorthand for what the subjects had said, first, in their own words, and next, using words and phrases shared in common between the subjects. This step used constant comparison between subjects, as required by Grounded Theory.

After coding the responses, the process of theoretical coding was used to "construct" diagrams that coalesced all subjects' interpretations, along with researcher inputs (based on an initial literature review that occurred after the open and focused coding processes). The construction process also included the researcher producing brief memos attempting to interpret what was happening. These memos were the genesis of the research text in CH 4 and 5 of this thesis.

A summary of the collected responses was sent to the panel for further clarification regarding their view on the validity of the first responses and comments were requested regarding the preliminary models. The researchers confirmed subjects' interpretations of the theoretical codes--another form of constant comparison. Upon incorporating subjects' ideas, the information systems and organizational literature were again consulted to compare subjects' interpretations, researcher inputs, and literature. The responses from this ‘second pass’ (Appendix D) were then taken and consolidated for use in the development of final models containing the variables identified by the panel.

In the third Delphi round, the resultant theoretical framework was once again presented to Delphi participants. The purpose of this round was to confirm that convergence was reached, satisfying the criteria of both Delphi and Grounded Theory to reach "theoretical sufficiency" (Charmaz, 2007). This last round of inputs served to further enhance the model for the appropriateness of the MoEs.

The five questions asked of experts in the ‘first pass’ were purposefully vague to elicit an in-depth response (Appendix D). This took advantage of the expert's experiences and knowledge. The questions were as follows:

EXPERT QUESTION 1: *What factors do you see as considering successful cloud computing implementation?*

EXPERT QUESTION 2: *What are your key concerns for successful cloud computing utilization?*

EXPERT QUESTION 3: *What are the main obstacles you envision hindering successful cloud computing implementation?*

EXPERT QUESTION 4: *What do you see as differences between the way industry implements a cloud solution to the way DoD should?*

EXPERT QUESTION 5: *How would you overcome those obstacles and differences?*

An analysis was performed by two researchers after the first pass responses were received using Cohen's Kappa (Equation 1) (Cohen, 1960). The recruitment of a second researcher was pivotal to provide a different perspective, additional rigor to the research and increase validation of the variables. The second researcher was previously trained and intimately familiar with the grounded theory, the coding process, and the research. The output from the coding through the equation below is identified in the analysis portion of the next chapter.

$$K = (O - E)/(N - E)$$

Where: *O =Total Agreement*, *E = Total rows/2*, the division representing 50% agreement that would be achieved by random chance, and *N = Total # of rows* in the analysis of comments.

The lower limit of $K = 0$ indicates no agreement between researchers, 0 – 0.20 as slight, 0.21 – 0.40 as fair, 0.41 – 0.60 as moderate, 0.61 – 0.80 as substantial, and 0.81 – 1.0 as almost perfect agreement. The upper limit of $K = +1.00$ would indicate total agreement between researchers (Cohen, 1960; Landis and Koch, 1977).

Knowledge Areas

Guidelines have been established as to how to determine qualified experts. Rigorous steps were identified by Delbecq et al, and the same procedure could be applied to a Delphi study. Since a statistical sample is not required, a qualified panel of selected experts is sufficient. The Delphi study will enable model accuracy if a field of experts is chosen from an array of Knowledge Areas (KAs). In this study, the three KAs are managers, developers and practitioners. Managers will provide an oversight perspective to how cloud environments are strategically implemented to achieve desired results. The developers can elaborate as to how a cloud environment is tactically implemented to achieve the directed user requirements. Practitioners are on the leading edge of cloud implementation and see results at a tactical level of execution. These three perspectives offered representative views within IT that provided adequate knowledgeable responses and resulted in sufficient sampling space for this research.

Using established protocols (Figure 4), experts for the study were established by preparing the Knowledge Resource Nominations Worksheet (KRNW) and setting up the panels for the samples. The panels were classified by the KAs.

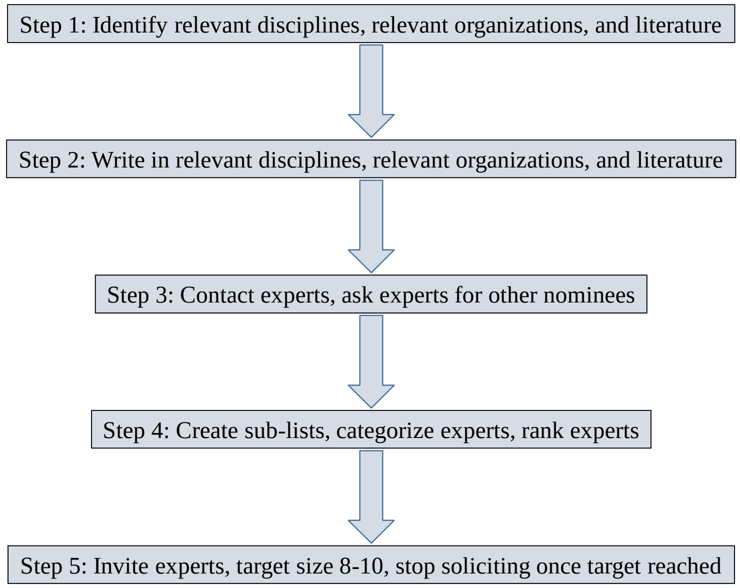


Figure 4. Procedure for selecting experts (adapted from Okoli, 2004)

Managers

This KA was chosen due to their vast experience as IT managers. The oversight and strategic "big picture" that they offer provides the linchpin to ensuring IT is effectively utilized. They have intimate insight into what works and what does not within their organizations.

Developers

This KA was chosen for a technological view relating to the proper creation of IT. How a technology is created dictates how will be used. They possess the experience and insight into the implied effects of the technology in the field through the feedback they receive and readjust future technologies as needed.

Practitioners

This KA offers a "boots on the ground" view of how the technology succeeds or fails. This is the lowest level KA in this study. It offers a critical picture of what will enable a cloud computing solution to ultimately meet the needs of the organization.

Expert Criteria

No set method for declaring an individual an expert has been established for the Delphi method, but five years has been identified as a viable factor (Mitchell, 1991; Rowe and Wright, 1999; Dawson & Brucker, 2001). The experts were chosen fulfill this requirement and many have substantially more experience beyond their knowledge area. The need for industry representation was critical to this research to enable cloud implementation and is important to the DoD, as evidenced by the following statement:

"The DoD Cloud Computing Strategy has been expanded to address use of commercial services in the Department's multi-provider enterprise cloud environment. Adoption and implementation of commercially provided cloud services are being rapidly accelerated with the maturing of the Federal Cloud Computing Initiative, the Federal Risk and Authorization Management Program (FedRAMP), and release of the 2012 National Defense Authorization Act." (Teri M. Takai, DoD Chief Information Officer)

Demographics of the experts vary (Table 1), but are an accurate representation of the KAs identified earlier. Varied experiences were critical in formulating a viable model and lend credibility to the findings of this study.

Table 1: Expert Demographics

Duty Area	Knowledge	Organization	IT Experience	Cloud
Operations	Manager	DISA	17 yrs	1 yr
IT Expert	Practitioner	EITC Corp	Not available	Not
Account	Manager	CSC	5 yrs	3 yrs
Chief	Manager	CSC	25 yrs	13 yrs
IT Expert	Practitioner	AF TENCAP/TCE	15 yrs	2.5 yrs
Cyberspace	Developer	24 AF/A3X	18 yrs	5 yrs
CEO	Manager	Craxel Inc.	Not available	Not
IT Expert	Developer	Next Century	Not available	Not
Program Engineering	Developer	AFL/RCB	2 yrs / 30 yrs acquisitions	2 yrs

Research Instruments

The instruments in this study are used to perform five functions. First, was the administration of the Delphi study through a formal request. Then the KRNW (Figure 4) process was used to select the experts used for the study. Next a data request was deployed to acquire answers from selected experts for analysis. The fourth instrument was executed to analyze that data. Finally, model creation was performed to fit the research.

Delphi request

In accordance with the Air Force Institute of Technology policy regarding human subject research, an Institutional Review Board (IRB) waiver was accomplished (Appendix E). The waiver was approved by the appropriate reviewing authority (Appendix F). This approval enabled the research to progress in a timely manner and was a critical step in this research.

Subject matter expertise

The expert’s subject matter expertise level assisted in ranking, categorizing and fitting the experts in the correct panel of samples, without consideration of their names and demographics. This process of classifying experts allowed for a proper sampling spread across all the KAs. Some experts crossed lines of expertise based on their knowledge and the positions they held as IT professionals.

Data request

The data request, in the form of questions, previously identified in Chapter III, were sent to the experts via questionnaire. The panel was instructed to answer in a set time for responses that allowed for the appropriate amount of detail.

Data collection

Data collection was performed by the researcher. Responses were collected and analyzed using independent factor analysis using Cohen's Kappa (Rosenthal and Rosnow, 2007) mentioned earlier in this section. Data were then grouped together to formulate the ‘second pass’, a response back to the experts for further clarification (Appendix D). The analysis of this data is presented in Chapter IV.

Model creation

Model creation was also accomplished by the researcher. Once the responses from the experts stabilized and a consensus reached, the models were formulated accordingly. This was accomplished within the three to five rounds, as needed (Linstone & Turoff, 2002).

Conclusion

This chapter narrated the specific method used for this research. It expressed how the data was analyzed and how grounded theory supported that analysis. Next it showed how the techniques were implemented in a pass by pass description of the Delphi study. Also, the chapter showed the selection process for the expert panel selection. This chapter then explained how KAs was selected for categorization of the experts. Finally the research instruments used in this research were described. The Delphi Technique was chosen due to its effectiveness in IT research; this chapter conveyed how it will be used.

IV. Analysis, Theory and Results

Overview

This chapter presents the expert comment analysis, theory that supports the research, and the models that resulted. The analysis will show the output from the analysis and display the selected variables and processes that fed the resultant models. The theory will show the technology acceptance theories that provided the foundation for the models. Finally, it will present the developed models, provide detailed explanation of the variables and processes and support via expert comments.

Analysis

The first pass of the survey asked respondents to answer five questions associated with the impact of successful cloud computing implementation (Appendix D). The respondents were asked to be specific and elaborate as much as they deemed necessary. The questions enabled experts to be as flexible as needed in their responses to ensure inputs covered the vast breadth of experience and knowledge symbolic of the expert demographic.

The analysis from the first passes yielded results (Table 4) using Cohen's Kappa (Rosenthal and Rosnow, 2007). This analysis is derived by researchers identifying main points within the comments from the experts (Appendix B). Two researchers then compared their individual results to extrapolate the variables they pulled from the comments.

The limits of agreement, mentioned in Chapter III, are the basis of determining significance. Given the limits of agreement, the K = .96 magnitude factor indicates a match to the extrapolated comments and consensus between researchers with E introducing the possibility of random agreement (Figure 5). These variables (Table 2) were sent out for the second pass (Appendix D).

$$K = (O - E) / (N - E)$$

$N = 100 \quad O = 98 \qquad E = 50\ (100/2)$

$(98 - 50) / (100 - 50) = .96$ agreement

Figure 5. Researcher Agreement

The first responses identified similar variables from both the DoD and industry experts. These variables, derived from the analysis of the comments, were pulled to see how many times the experts mentioned those areas (Table 2) to indicate relevance.

Table 2: Variable Comments

Variables	**# of Times Commented**
Understanding	23
Security	7
Budget	9
Access	12
Environment	27
Reliability	7
Standards	17

The second round of questions requested that the experts rank variables, identified previously, by order of importance with 1 indicating most important (Table 3). The second pass also provided evidence that the preliminary models developed were viable when trying to achieve the desired goal of successful cloud computing. Based on responses, both preliminary models carried a consensus amongst the experts. The process model had the highest level of agreement of 100%, where the experts agreed with minimal to no comments.

Table 3: Variable Rank Order

Rank	Variable	# of Times of Rank	Rank Total
1	Understanding	1,1,3,1,3,1,1,5	16
2	Security	2,2,5,2,4,3,6,2	26
3	Budget	5,5,4,3,1,2,7,3	30
4	Access	4,4,1,4,6,7,3,4	33
5	Environment	3,7,2,7,7,6,2,2	36
6	Reliability	7,3,6,5,2,4,5,5	37
7	Standards	6,7,7,6,5,5,4,4	44

Note: lower rank total reflects the most important factor

Notice the rank of the factors (Table 3) did not fit the amount of times it was commented on (Table 2). There was nothing noted that would add concrete evidence to this effect and will be addressed in recommendations for further research.

In the third and final pass, finalized models were sent to confirm researcher's findings (Appendix D). The preliminary models that were developed in the second pass were further enhanced to incorporate expert inputs. Variables used in the variance model were ranked by the experts in order of importance (Table 3) and installed into the model in that order. The process model needed no change, as there was consensus on that model after the second pass. This final pass resulted in consensus from all experts with comments that would not result in any change to the models that were developed.

Grounded theory requires enfolding the literature as the analysis is being performed. As this analysis was conducted it became evident that technology acceptance theories were a fit for the research. Those supporting theories are elaborated in the next section.

Theory

There are numerous theories that exist for technology acceptance. Various theories were identified for use in designing the models. All theories affect how constructs were selected. Some constructs were a better fit in the variance model, some were a better fit in the process model, and still others fit in both.

The Unified Theory of User Acceptance of Technology (UTUAT), Technology Acceptance Model 3 (TAM3) and Model of Technology Acceptance by Groups (M-TAG) affect which model the constructs were placed in and are the best theories that supported this research. The variables in the variance model were formed after close analysis of expert comments by researchers. These variables include understanding, security, budget, access, reliability, environment, and standards. The process model identified comments from experts as processes and then separated into levels identified as DoD, organizational, technology, and user. This separation was accomplished to delineate where each level exists and analysis of this model will follow accordingly.

Pre-User Acceptance

The variables and processes in both models exist in a variety of constructs regarding technology acceptance in examinations by Bailey and Pearson (1983), Baroudi and Orlikowski (1988), Doll and Torkzadeh (1988), and Ives et al. (1983), and are represented in Appendix A derived from Wixom and Todd (2005). These constructs were formed prior to most user acceptance research streams (*TAM, TAM2, UTAUT, TAM3*) and in turn led to the elaboration of theories linked to this research (*UTAUT, TAM3, M-TAG*).

User Acceptance Theories

User acceptance focuses on analysis of new technologies, such as cloud computing, should be accomplished to enable deployment by managers. User acceptance understanding can enhance the use of appropriate models to support that deployment, implement proper procedures, and promote efficient communications (Kendall, 1997). There are numerous theories that exist for technology acceptance and will serve to aid that necessary analysis.

UTAUT, TAM3 and M-TAG were found to be the best fit to the results found during the research. TAM3 was chosen over TAM (Figure 6) and TAM2, because TAM results have been shown to be unclear and TAM2 does not represent a broad enough scope needed for this research (Legris et al, 2003).

A model for SaaS adoption by Wei-Wen Wu posited in the 2011 article, *"Developing an Explorative Model for SaaS Adoption"*, is noteworthy and will be discussed later in this chapter. IT research has expanded into recent research concerning technology acceptance by groups, notably an article by Saonee Sarker and Joseph Valacich titled *"A Non-Reductionists Approach to Studying Technology Adoption by Groups"* which draws on previous theories into technology acceptance at the group level versus prior user theories. While all of these theories were used to structure the two models in this research, some were more critical than others and will require a more in-depth understanding.

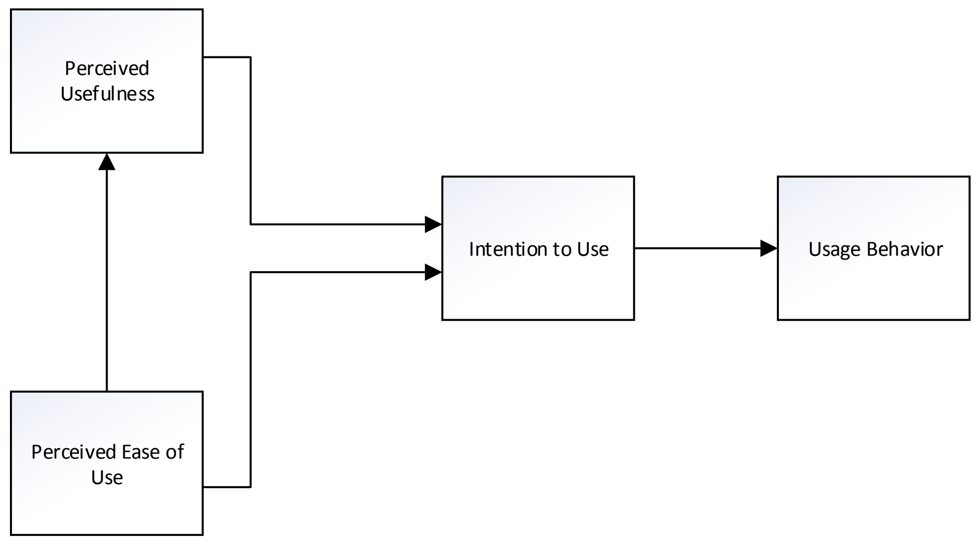


Figure 6. TAM (Adapted from Venkatesh and Davis, 2000)

User Acceptance History

TAM was developed by Fred Davis as one of the first IT user acceptance models formulated and accepted in academic literature. In his research, he articulated ‘Perceived Usefulness’ and ‘Perceived Ease-of-Use’, both defined below (Davis, 1989). These two concepts were the basis of TAM and succeeding models since have provided the connection of behavior to other predictors of usage in that model. TAM, although providing predictability, was still limited by its influence due to its inability to provide feedback regarding value (Taylor and Todd 1995, Venkatesh et al. 2003). That user feedback value would be important for leadership buy-in and effective implementation.

> *Perceived Usefulness (PU): The degree to which a person believes that using a particular system would enhance his or her job performance.*
>
> *Perceived Ease-of-Use (PEOU): The degree to which a person believes that using a particular system would be free from effort.*

Further, there was support identifying the relationship between technology implementation when associated with adoption and continued usage. This was evident after a study of Windows 3.1 implementation (Karahanna et al, 1999). The differences between usage and adoption in the Windows 3.1 research was taken into account when determining the factors and processes in the two models developed within this research. It would seem that non-mandatory usage initially will develop successful cloud implementation.

An additional concept that contributed to creating an acceptance construct was TAM2, an expansion of TAM. Both theories have pushed technology acceptance research further; however, TAM2 (Figure 7) adds three additional variables of subjective norm, voluntariness, and image (Venkatesh and Davis, 2000). Although a direct relationship between TAM2 and the developed research models is not apparent, understanding the theory is germane to the research. As Pfeffer (1982) postulates, an individual "*achieves membership and the social support that such membership affords as well as possible goal attainment which can occur only through group action or group membership.”*

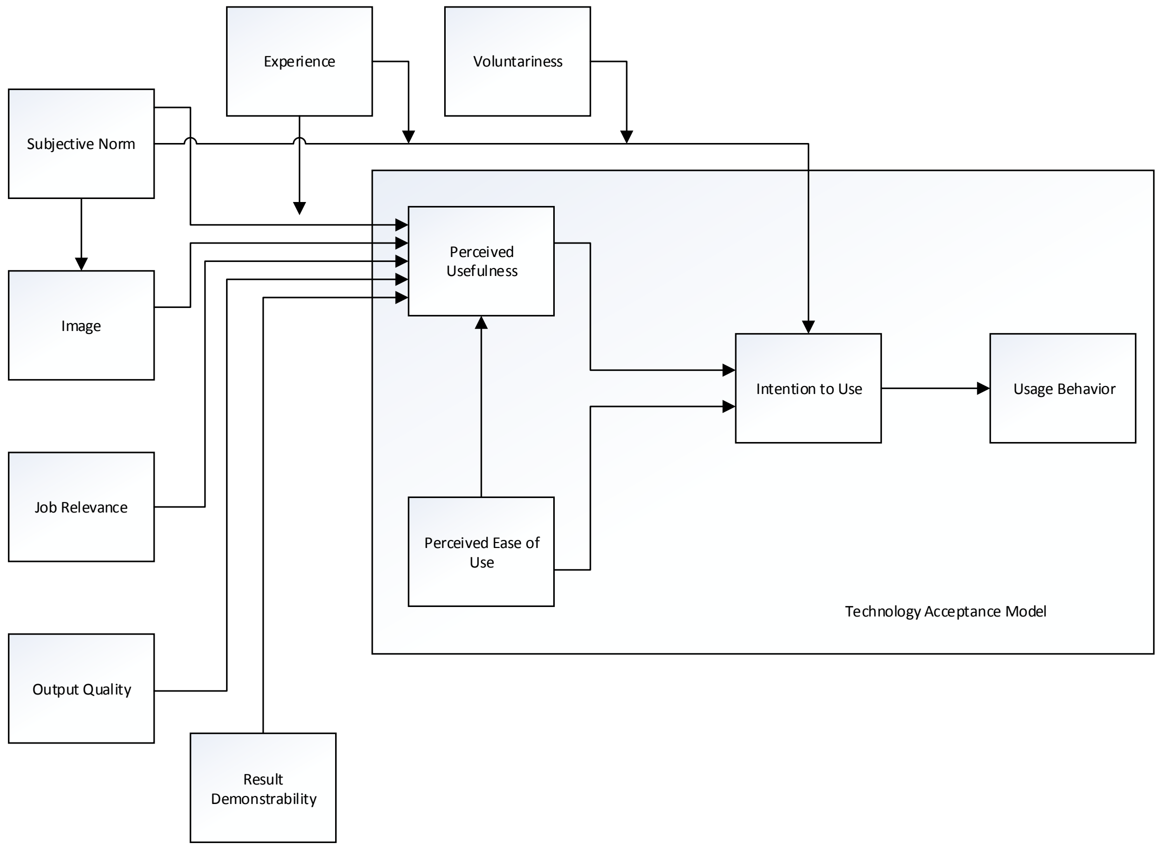


Figure 7. TAM2 (Adapted from Venkatesh and Davis, 2000)

Opitz et al. (2012) ties cloud computing acceptance directly to TAM models via his research article, *"Technology Acceptance of Cloud Computing Empirical Evidence from German IT Department."* He concludes that empirical research was offered to link technology acceptance models to the cloud computing technology that this research is directed towards.

Theories Linked to this Research

TAM and TAM2 have direct tie-ins to this research. However, UTAUT, TAM3 and M-TAG had a more influence on the formation of the two models that were developed. By following the matrix in Appendix A one can see the association between these theories and how they exist within the models is evident.

UTAUT (Figure 8) is a recent acceptance theory that was essential to the production of the two models presented. Part of this theory reinforces the idea of *"job outcome of interest"* as a determinant in successful technology implementation building upon the key UTAUT constructs of performance expectancy, effort expectancy, social influence and facilitating conditions. (Venkatesh, 2003). The construct of job outcome was presented within a synthesis of other technology acceptance theories in *"Dead or Alive? The Development, Trajectory and Future of Technology Adoption Research"* (Venkatesh et al, 2003) and was a key factor when analyzing the various factors affect the models. One of the focuses of UAUT encompasses operational beliefs and the ability to perform ones job via PU and PEOU. This will be addressed in the model explanation in various constructs.

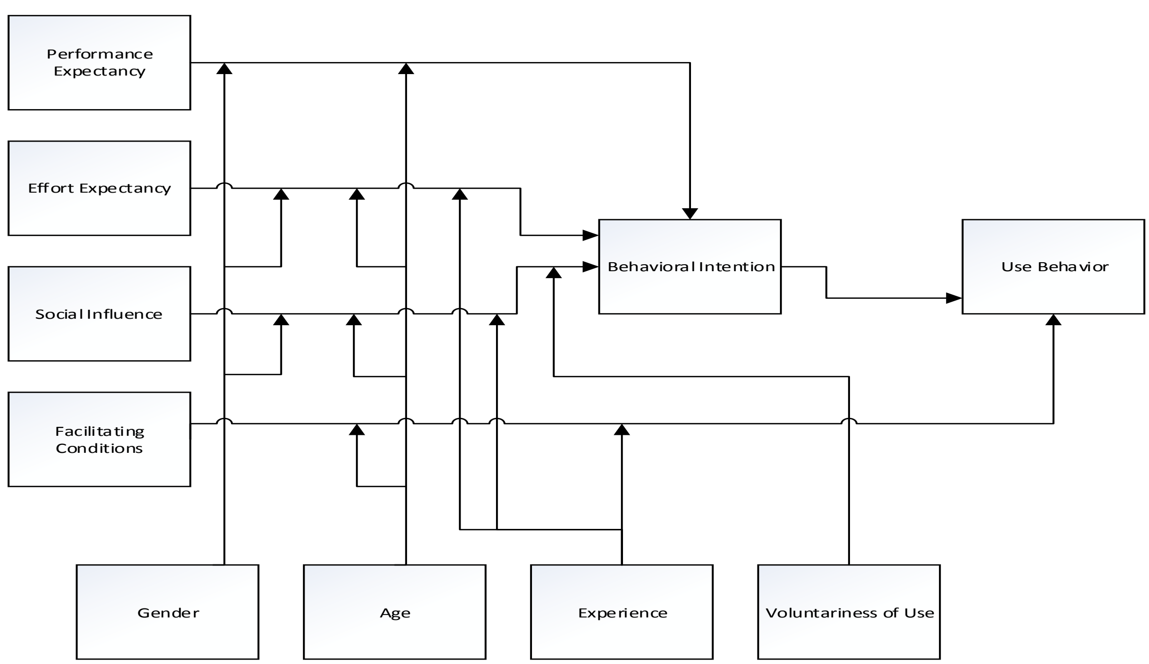


Figure 8. UTAUT (Adapted from Venkatesh et al, 2003)

TAM3 (Figure 9) was developed by combining TAM2 and the components of the model that lead to perceived ease of use (Venkatesh, 2000). It was suggested and found in Venkatesh's *"Technology Acceptance Model 3 and a Research Agenda on Interventions,"* that the components that lead to perceived ease of use do not influence perceived usefulness. This delineation between the two theories is critical to ensuring that TAM3 can present a separate research stream within the community (Venkatesh and Bala, 2008). The linkage between user acceptance and group theories lies in categorizing the items in the models.

TAM3 was employed to formulate the main variables in the variance model that is presented in the results section, although after elaboration from the experts, UTAUT and M-TAG further supported that development. It was found in Venkatash and Bala (2008) that the constructs of understanding, access, reliability, environment, and standards led to acceptance. These ideas are found in the variance model. Expert comments showed that those same constructs exist at the group level. The construct of budget could not be found in any theories. Based on expert comments on this research (Appendix C), it can be concluded that lack of adequate budget could be DoD specific.

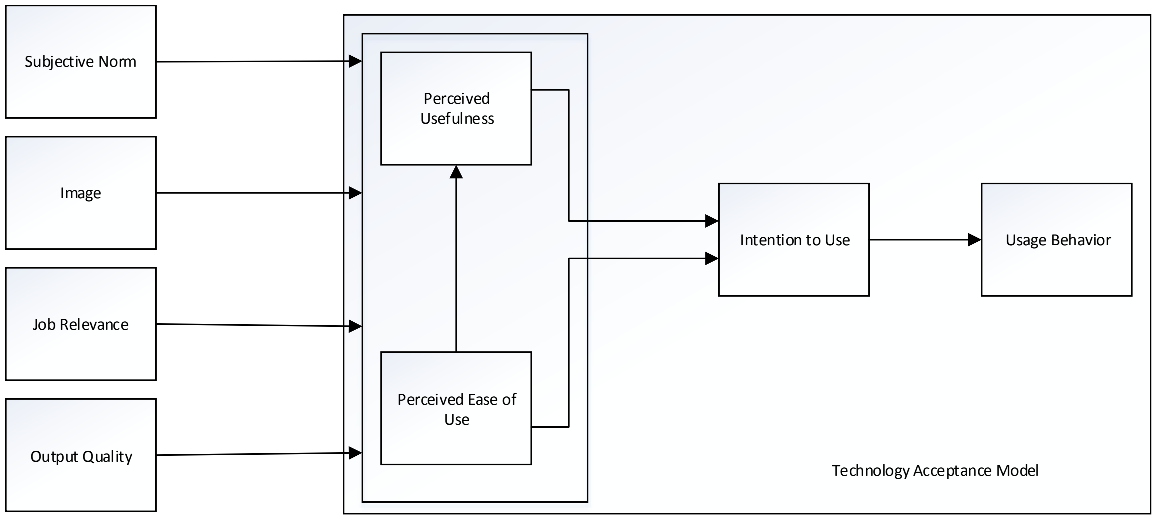


Figure 9. TAM3 (Adapted from Venkatesh and Bala, 2008)

M-TAG was developed recently and has been analyzed in articles about Technology Adoption by Groups (TAG) such as *"Technology Adoption by groups"* (Sarker et el., 2005) as well as the direct production of M-TAG in *"An Alternative to Methodological Individualism: A Non-Reductionist Approach to Studying Technology Adoption by Groups"* (Sarker and Valacich, 2010) (Figure 10). M-TAG was a key theory that fits the process model that is elaborated in a later section. The individual processes within the process model levels of DoD, Organizational, User and Technology also exist within most technology and user acceptance theories (Table 2 and Table 3).

M-TAG also added evidence to the validity of the variables in the variance model. The constructs of understanding, access, reliability, environment, and standards are all user acceptance constructs and were found to have a high correlation to a group's strength of adoption of technology (Sarker and Valacich, 2010). Once again, security and budget are not key constructs in the theory, but were emphasized by experts in their comments during this research.

Using the same constructs as current technology acceptance models, there has been an identified association with MIS (Management of Information Systems) success in Electronic Data Processing systems in small businesses which could affect larger organizations as well (Delone, 1988; Raymond, 1985). Previous research has shown relationships between IT business value and organizational performance, depending on business values such as management practices, structure, and environment (Brynjolfsson et al, 2002; Cooper et al, 2000; Dewan and Kraemer, 2000). This is reflected in this research from the perspective of mission success and budgetary constraints as the business values that exists in the DoD.

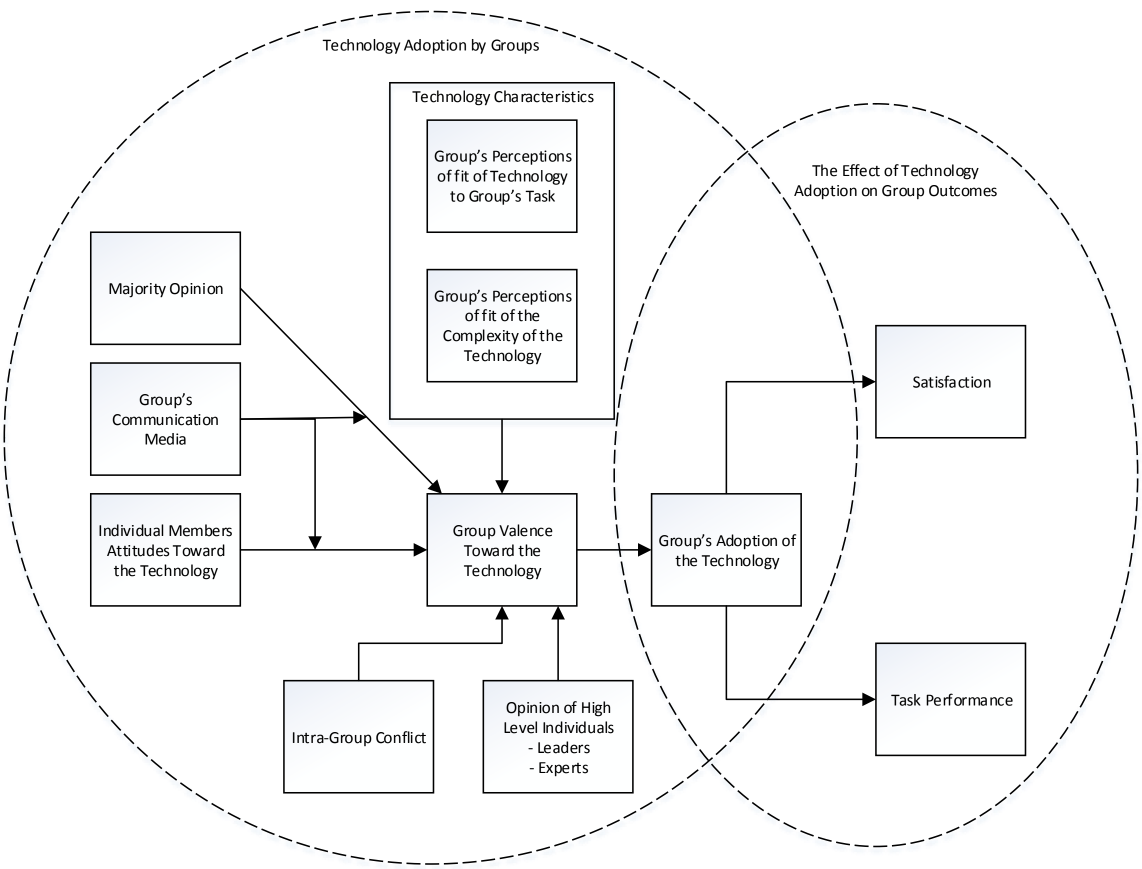


Figure 10. M-TAG (Adapted from Sarker and Valacich, 2010)

Finally, SaaS model adoption should be mentioned since it is the cloud broker service that DISA plans to implement. Few studies have been accomplished regarding SaaS, and as a cloud model, SaaS adoption research should be analyzed in this section. The association of technology adoption constructs associated with marketing efforts, security and trust leading to SaaS adoption, set a good foundation for this research (Wu, 2011). A more in-depth study in the relations between industry and DoD is necessary. This research accomplished that with a good cross sectional selection of experts and is presented in the next section.

Results

The answers from the experts in the three step methodology of the research resulted in two viable models. The first model, referred to as the variance model, expresses variables that could affect the result of successful cloud computing implementation. The second model, identified as the process model, communicates processes that could affect the execution of the cloud. Both of these models answer research question 3, "*Can a "model" be developed that will assist DISA's strategy for successfully fielding cloud computing in the DoD?"* The variables and processes within the two models answer research question 1, *"What organizational variables or processes influence successful cloud computing implementation in the DoD?"* These variables and processes are also listed in Table 4. Research question 2 will be discussed in Chapter V.

Table 4: Variables and Processes

Variables	
Understanding	
Security	
Budget	
Access	
Reliability	
Environment	
Standards	
Processes	
Security enclaves	Existing broker reputation
Combat support	Existing IT staff maturity
Security policy	Existing policy & governance
Contracting process flexibility	Entrepreneurial leadership/vision
Sense of urgency	Education
Service advocacy	Advertising
Old Think	Marketing
Change averse culture	Put the "right stuff" in the cloud
Certification/Accreditation process	Reduce barriers to entry/bureaucracy
Non-monetary value	Development enclaves
Situational awareness	Holistic implementation
Clearly defined requirements	Time/timing/phasing/migration
Flexible configurations	Evolution roadmap
Data integrity	Clear objectives
Security	Incentives
Near-zero latency	Organization support
Reliability	Mature business model
Interoperability	Flexible options
Access to service	Cost savings
Support to users	Productivity improvement
User expectations/understanding	Trust/support for initiative

Models

The previous sections set the foundation, based on literature, of the various theories that support these models, but the "golden thread" to this research lies in UTAUT, TAM3 and M-TAG. Also to note, constructs from the previously discussed theories are all contained in the two models directly or indirectly. The variance model consists of seven constructs and one moderating variable that were categorized based on expert comments and identified from the preceding technology and group acceptance theories. The process model contained four levels (DoD, organizational, technology, and user); within those levels were numerous processes found to be key in data collection in relation to this type of model.

Variance Model

A variance model is a 'cause and effect' model. It provides an explanation of how input variables cause an effect on a dependent variable (Successful Cloud Computing Implementation is the dependent variable in the model). These factors can have a positive or negative effect on that variable, as any number of additional factors could have an effect on the output variable. This type of model can be translated into a mathematical equation.

$$Y = m1X + m2Y + m3XY \ldots .. + b + e$$

Where m = *slope*, X, Y = *variables*, XY = *intersection between two variables in a multivariate model*, b = *intercept* and e = *error*.

The results from the study generated a variance model (Figure 11) with factors that answer research question 1. This model shows the seven factors identified (Table 3) and one moderating variable that was shown to affect one of the factors. Factor support was derived from analyzing comments from experts and was used in the factor breakdown earlier described (Appendix B). The comments explain the affects displayed in the variance model.

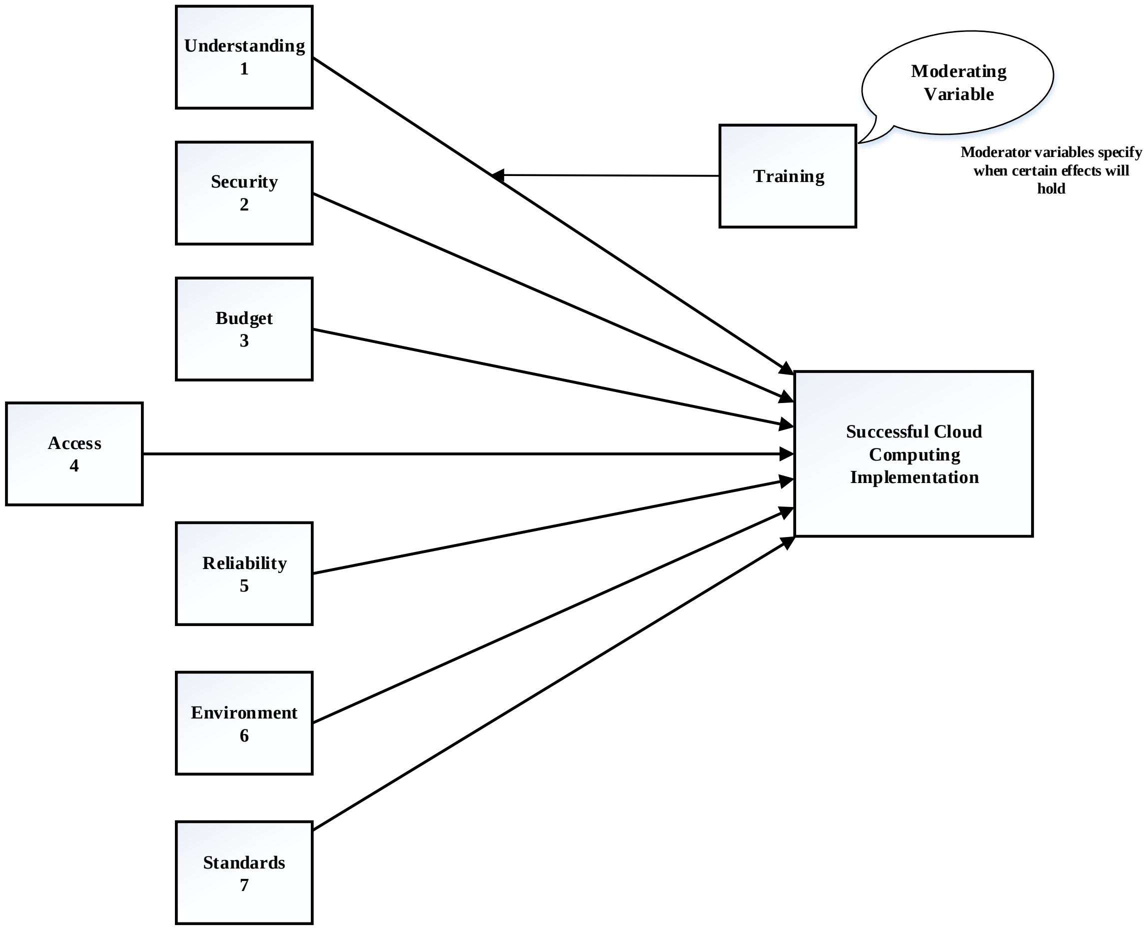


Figure 11. Variance Model

The variance model contained the constructs of understanding, security, budget, access, reliability, standards, and environment, with a moderating variable of training directly impacting understanding. UTAUT, TAM3, and M-TAG all that were based off TAM contributed to the creation of this model. The following few sections describe how those theories tie to this model and how they affect successful implantation.

Understanding

The experts agreed that understanding was the most important variable that predicts successful cloud implementation. Their definition of understanding centered on users knowing what cloud computing is, what it provides (job relevance), what they want from the cloud (result demonstrability), and what constitutes success (output quality) leading to PU and PEOU within TAM2 (Venkatesh and Davis, 2000).

Common understanding. There are many terms being used to describe what "cloud" is/isn't which has caused a significant amount of confusion. A significant portion of the populace only thinks of the "cloud" from Apple, Google, Amazon or IBM commercial offerings to store and access data. They don't understand that there are utility and analytic clouds as well. The picture gets muddier when other terms like "net-centric," "SOA," "IaaS," "PaaS," "SaaS," etc. are discussed. (Expert 4 Response)

The literature supports this because within all theories of TAM a user must first understand what a technology is and what is supposed to do before they can formulate a perception of its usefulness. In all TAM literature perception of usefulness is a strong determinant to behavioral intention to use a technology (Venkatesh et al, 2003). This finding is also supported by task-technology fit literature and TAM3 which states that users perception of the fit between the technology and the tasks could result in successful usage (Ahuja and Thatcher, 2005; Vanketash and Bala, 2008). These two theories imply a third idea which is critical in a cloud context: training.

Training was not specifically identified as one of the main variables. It was added as a moderating variable after various comments addressed the need for the user to understand and use cloud computing and was concurred by experts in later Delphi passes. A moderating variable is a variable that can affect the strength of the relationship between independent and dependent variables. (Cohen and Cohen, 1975). In TAM literature, training is an essential component of a user formulating perceptions about the use of a technology. Also, training was found in the pre-TAM theories as confidence in the system and degree of training (Bailey and Pearson, 1983). Next, training support was found in TAM2 through result demonstrability as well as both TAM2 and TAM3 through output quality (Venkatesh and Bala, 2008). Finally training is evident in M-TAG where *"strong training mechanisms initiated to reduce the group's perceived complexity of the technology may help elevate the valence towards the technology"* (Sarker and Valacich, 2010). Since cloud is new to DoD and is intangible, training will be critical to user understanding

Access

Our experts also identified access to the technology as an important facilitating condition. They defined access as the ability to connect to the system with minimal barriers. This is a training issue as well as a technical issue and is addressed in the TAM literature with the construct ease of use (Davis, 1989; Venkatesh and Davis, 2000). Over time, if access is difficult and hard to acquire then the user will stop using the system.

Environment should be vertically integrated to provide seamless access at both a Infrastructure as a Service level and a Platform as a Service level. Bad choices of mismatched products at each level of the stack will lead to poor adoption. Resource management must be built into the core of the environment to allow for the seamless, automated allocation of resources based on policy and not manual allocation based on trouble ticket like requests to a help desk. (Expert 3 Response)

Reliability

This same argument holds for the reliability of the system which our experts defined as a performance issue. If the system is not reliable over time the user will cease to use it. This is addressed in the TAM literature as perceived ease of use (Davis, 1989; Venkatesh and Davis, 2000).

Reliability: Solution needs to be up all the time (Expert 5 Response)

Security

The experts identified security as the second most important variable leading to successful cloud implementation. They defined security as the ability to trust that the system will protect the information with minimal risk. In the TAM literature security spans three categories: usefulness (TAM/TAM2), ease of use (TAM/TAM2) (Venkatesh and Davis, 2000), and facilitating conditions within UTAUT (Venkatesh et al, 2003). Since security is a critical tool (useful) and a feature (usable), if faith is lost then usage could cease further. If data are breached or system is disabled, usage will not be possible. Hence the elevated importance in a DoD context.

Security. With improved access and availability of data/information, the importance of maintaining the security and integrity of the data becomes paramount. (Expert 4 Response)

Standards

Integrally related to security as well as usability features are standards, since standards impact both. Our experts define standards as policies, processes, and guarantees with respect to services and security. TAM literature (UTAUT) refers to this as facilitating conditions (Venkatesh et al, 2003). Standards both cause and are a product of the environment and have an impact on usage.

Policy. One of the most significant challenges will be to develop the information sharing mindset and implement powerful guidance/standards to force the issue. Despite numerous senior leader decrees, directives and orders, organizations still think they "own" the data. (Expert 4 Response)

Environment

While they showed difficulty converging on one definition of environment they all agreed on the effect that it had. They agreed that it either facilitated or hindered successful cloud computing implementation. Further, they agreed that the DoD environment was problematic. TAM literature (UTAUT) defines environment as a facilitating condition that directly affects usage regardless of user perception (Venkatesh et al, 2003). Environment was also found to be a key variable when studying group relationships to IT structures and provides a positive effect on successful implementation (Reinig and Shin, 2002). Environment, as evident in literature and supported by expert comments, is critical to IT implementation. DISA should be aware of its importance throughout the implementation process of cloud computing.

If the service provided is valuable to the customers using it, the environment will deliver value through higher rates of usage, productivity improvements and other "soft" benefits. (Expert 7 Response)

Budget

The experts agreed that budget was very important (#3 on Table 3). They defined budget as the money spent on a system, the time it took to implement, and the results in terms of return on investment. It seems that TAM (UTAUT) addresses this indirectly as a facilitating condition, for example long lead times to a budget could kill implementation. It seems reasonable that DISA needs to look at the preceding factors to determine a reliable ROI. If this return is not adequate, then cloud computing implementation will flounder as a business model.

The government budget cycle: It works for acquisition programs that span many years, but it's not well suited to ill or undefinable requirements that are subject to change rapidly. To steal a quote from my MILCOM paper "DoD acquisition managers are under constant pressure to maintain currency across their enterprises and meet ever changing requirements over an increasingly complex infrastructure. (Expert 3 Response)

Upon completion of the analysis of the variance models it is apparent that the expert opinions are well supported by the technology acceptance theories. All constructs in the variance model were supported by one or more user acceptance theories (Appendix A). However, it was also apparent that the variance model was not fully explanatory, because it did not take into account the order in which events occurred, nor the levels of the organization in which they occurred. In order to fully capture the richness of the experts' comments, another model was necessary. While a variance model is good at explaining 'what' and 'why', a process model is useful in explaining 'how' and 'when'. Hence, the next step of analysis required construction of an explanatory process model to fully capture expert responses and recommendations.

Process Model

Where a variance model is good at explaining 'what' and 'why', a process model is tailored to explain 'how' and 'when'. A process model provides a rational explanation of the processes by evaluating possible courses, or paths, based on observed factors. It provides "linkage" between those factors, where each standard needs to be fulfilled before moving to the next until the model reaches completion. Often, a process model may contain feedback loops between any identified factors within the model.

The second model generated from the results of the study was a process model (Figure 12). This model shows the processes and how they interact within the model, as well as between differing levels. The processes identified also aid in answering research question 1. Process support was derived from comments from experts and used in the analysis earlier described (Appendix C).

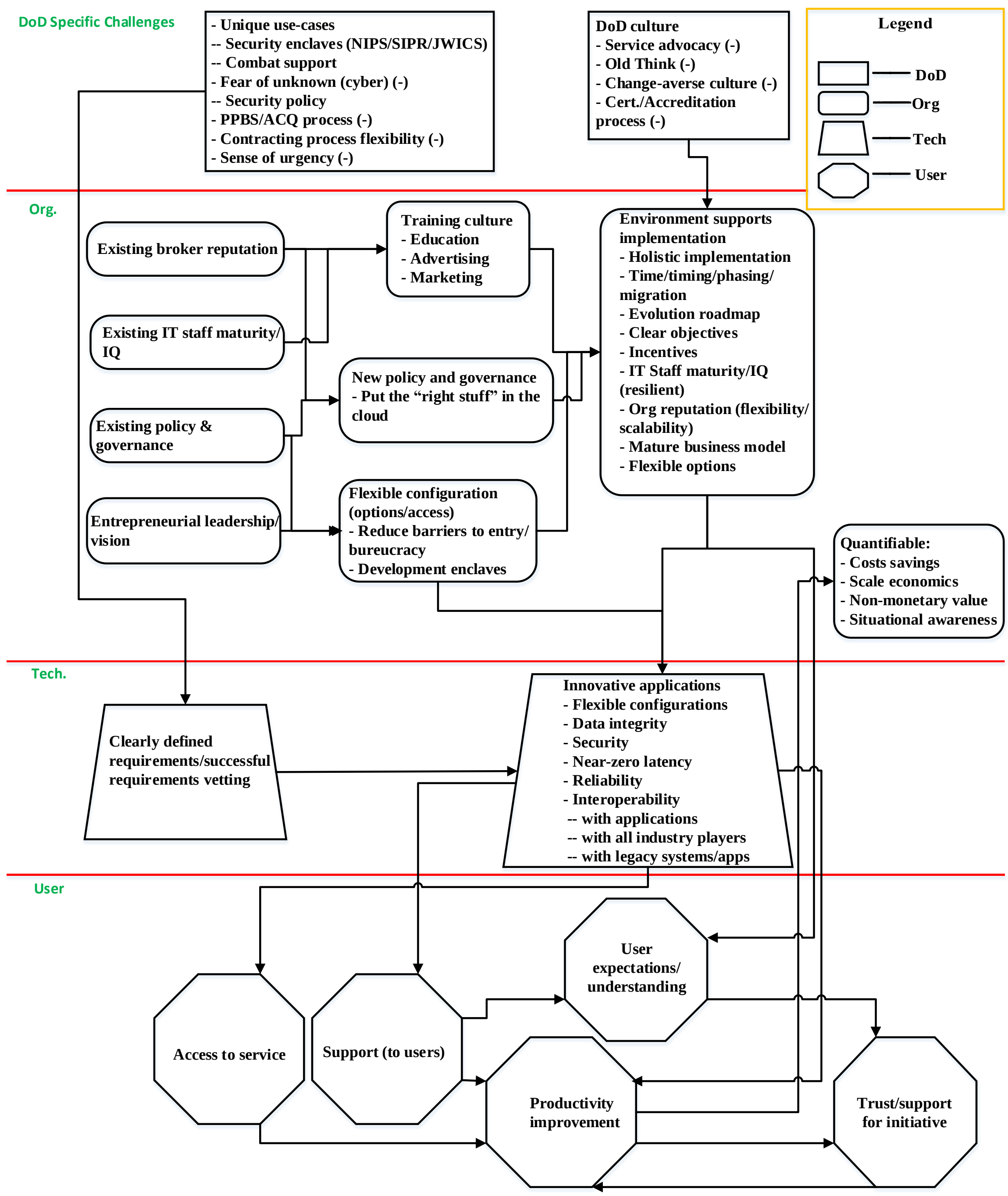


Figure 12. Process Model

In order to simplify the analysis, the process model was broken down into four levels containing multiple processes within and between each level. For ease of explanation, this thesis will discuss this model level by level, highlighting the main processes and how they tie into one another culminating in successful cloud computing implementation. In some cases processes outside the areas of analysis were aggregated. This was accomplished for ease of explanation regarding theory support.

DoD Level

Within the DoD level, the experts defined two challenges of successful could computing implementation that both seem to be uniquely related to the DoD. Both of these challenges produced five effects that trickled downstream in the model (Figure 13).

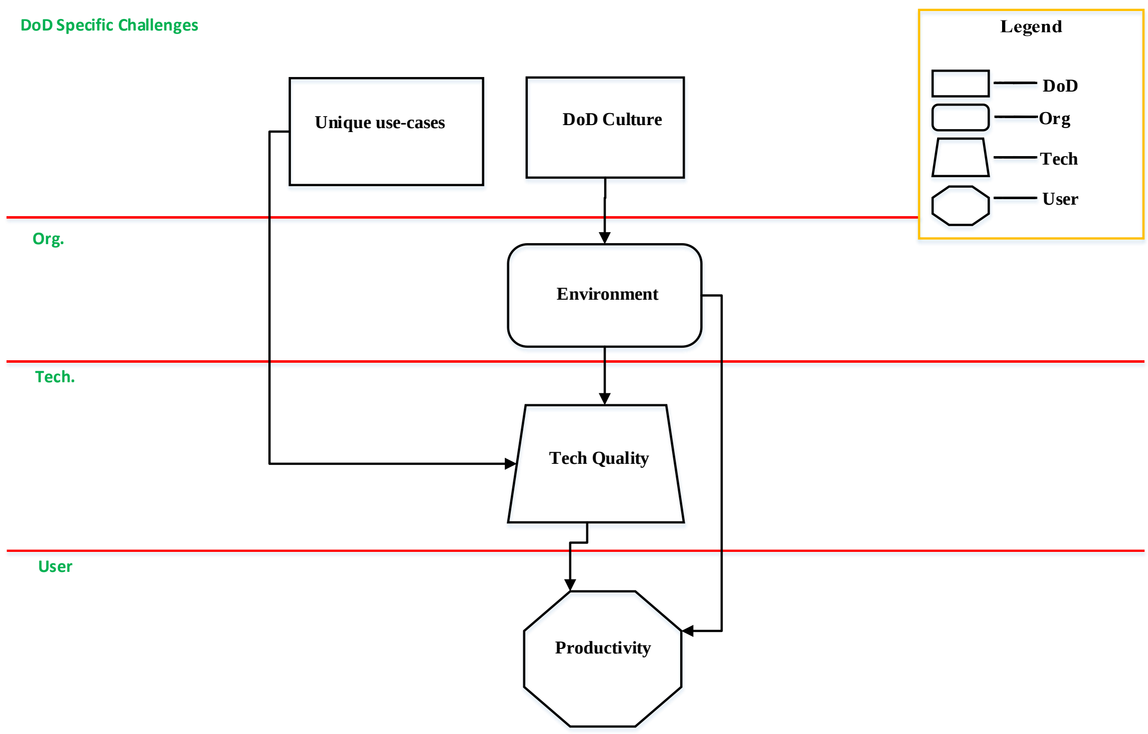


Figure 13. Process Model DoD Level

The top level of DoD specific challenges contains the use cases unique to the military environment. This process was not specifically mentioned in technology acceptance theories, but is germane to this research since it was qualified by the expert panel as important in relation to security and support. The experts defined this as multi-level security, combat support, DoD acquisition process, and contracting flexibility. Within this level, however, fear of the unknown, acquisition process, and DoD culture can cross reference to technology acceptance of groups and organizational success through variables of complexity, uncertainty, and management culture. These factors were found to affect technology acceptance in groups (Raymond, 1990).

In order to explain the effect that DoD unique cases have on cloud technology, we have to understand the purported benefits in industry as compared to DoD. In industry the benefits is turning infrastructure into service, but the only way to do this is to buy a commercial solution. Also ease of access, commercial availability and standard solutions are key benefits of a commercial cloud. The experts agreed that DoD might negate these benefits through unique cases by attempting to modify or recreate commercially available solutions.

The DoD use cases and implementation are different than the Industry use cases. (Expert 6 Response)

Our experts defined the DoD culture with respect to cloud implementation as consisting of service advocacy, fear of change and ominous regulations collectively termed "old think". Taken both individually and as a whole, they anticipated that this would negatively affect the cloud implementation environment. Shein, 1985 expressed culture in three levels consisting of behaviours and artefacts, values, and basic assumptions. Further elaboration of these levels is listed below.

DoD has a culture/people/institutional barrier to think and behaving as a business enterprise in areas where that think could benefit them the most. If you want to be an enterprise, think and behave as one. (Expert 7 Response)

Shein as stated by Lim (1995), essentially argues that culture can shape an internal environment, and in doing so will affect organizational behavior. So if the primary cultural drivers in DoD are negative, then the environment will be unstable or infertile with respect to cloud implementation. Lim's research also argues that the effects of culture extend to the IT environment.

A stable organizational environment affects technology quality by enabling the ability to implement capable technologies in an IT friendly atmosphere (Raymond, 1985). This type of environment could lead to greater ingenuity in IT development resulting in better quality technology. The model also showed an effect between environment and productivity. This association is cemented in the works of Marcoulides and Heck (1993) where a direct correlation was shown between a friendly organizational environment (climate) leading to increased productivity (performance).

My main concerns are lack of a 'good' customer base both for implementation and utilization, organizational churn, and a weak support model. (Expert 6 Response)

From this we can speculate that the organizational environment with respect to cloud implementation will impact the quality of the technology and its implementation and how productive the organization will be as a result of its implementation. Finally, the Technological Imperative Model developed by Orlikowski (1992) emphasizes that technology has a direct relation to organizational dimensions such as individual communication effectiveness, skill levels, job satisfaction, and productivity.

However, if the service provided is valuable to the customers using it, the environment will deliver value through higher rates of usage, productivity improvements and other "soft" benefits. (Expert 7 Response)

This section argued that these constructs, if addressed, pre-implementation, will increase the likelihood of successful cloud computing implementation. Realistically, these are long lead times that we cannot change, so in a DoD implementation you would have to overcome those obstacles.

Organizational Level

The experts identified numerous processes within the organizational level. Those processes were broker reputation, IT maturity, leadership vision, training culture, policy, flexible configuration, environment, and economic factors. These processes produced three effects downstream (Figure 14).

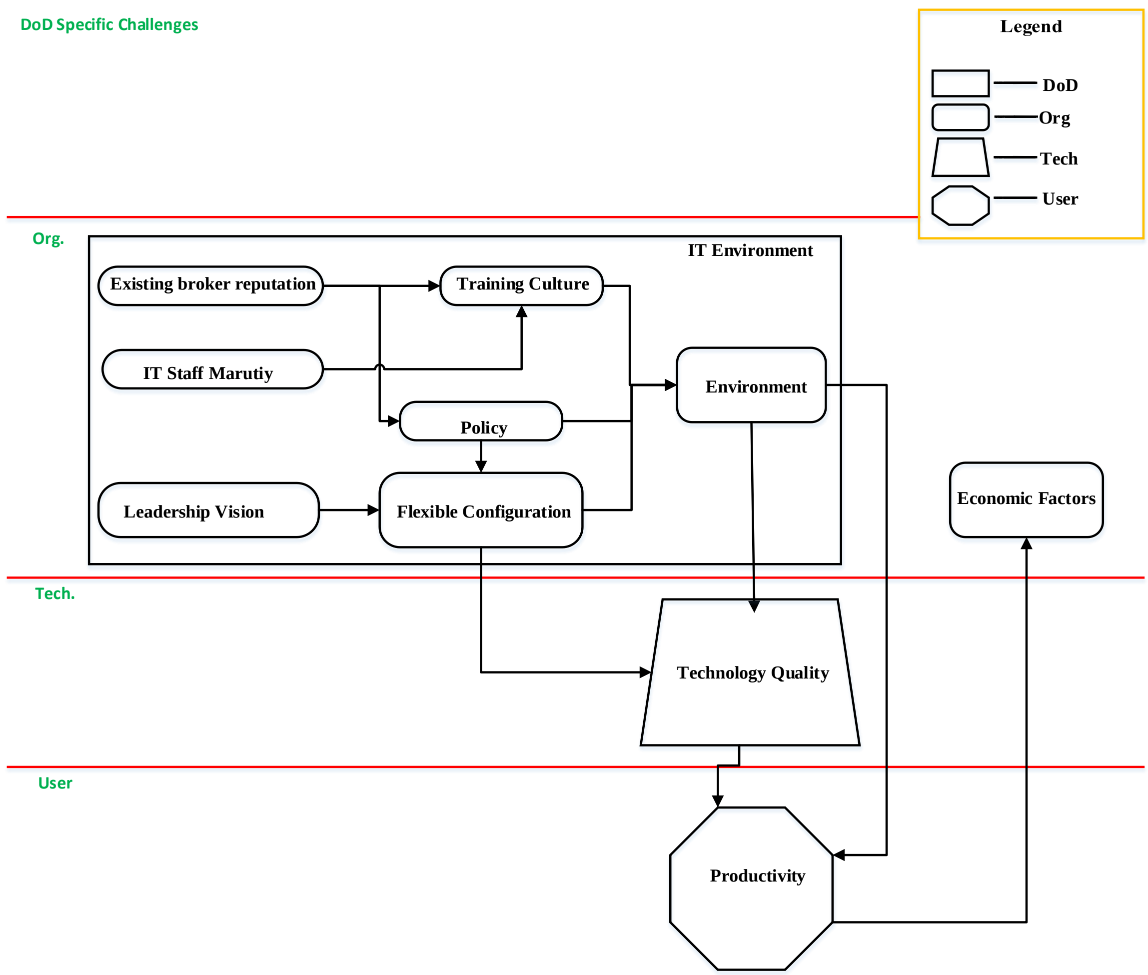


Figure 14. Process Model Organizational Level

The experts identified broker reputation, represented by the below expert comment as a *"sour view of DISA's ability,"* as a likely obstacle during service utilization and that the presence of conflict would impact user perception of whether the "right decision" is made when selecting the broker. The reputation that an individual or group has toward how a broker has implemented technology in the past would impact successful cloud computing implementation (Bailey and Pearson 1983, Sarker and Valacich, 2010). DISA could reduce the impact of this obstacle through effective marketing and propose effective organizational training. This would result in a downstream effect on training culture and the supported environment.

DISA's reputation is likely a road block to service utilization. Many IT/COMM personnel's DISA experience......have a sour view of DISA's ability to provide quality service (HBSS), with low latency (DEPS), and ease of access (we've had CAC authentication blunders). (Expert 5 Response)

IT staff maturity was defined by the experts as a necessary factor to affect successful cloud computing. The experts agreed through model concurrence that this would be a hurdle to overcome if not developed through training. The theory seems to support that as individuals and groups show an 'intention to use' (i.e. more users/more need) then an increasingly competent IT staff is required to maintain the system (Venkatesh et al, 2007). Finally IT staff maturity would drive training and the supported environment.

The factors for successful cloud computing implementations are a 'good' customer, an environment capable of supporting the implementation, minimal environmental inertia (i.e. minimal political churn preventing implementation), and mature technical IQ of all staff involved. (Expert 6 Response)

Leadership vision is paramount to successful cloud implementation and was identified by the expert response below as a challenge that lacks innovation. Industry leadership vision is driven by business models that are designed to achieve increased market shares, where DoD leadership vision drives success based on lives saved and mission success. Executing decisions and providing guidance based on re-vectored DoD visions may overcome this challenge (Chidambaram and Tung, 2005). Leadership vision will affect system configurations and the organizational environment as it becomes more mature, potentially until successful cloud computing implementation is realized.

Leadership. Most military leaders have not been promoted for being innovative. Just as with our federal bureaucracy, change comes very slowly. Commercial adoption of technology is driven by market share and business leaders recognize that if they don't move, they may not be here tomorrow. (Expert 4 Response)

Training culture was not established within initial expert responses, but after pass #2 was incorporated into the models, and was agreed to be a factor. Training culture was present in parts of all theories due to its necessity and effect on other variables such as understanding (Bailey and Pearson, 1983). Training culture would also impact output quality existing in the anchor constructs of TAM3 (Venkatesh and Bala, 2008). This process was argued necessary due to the developmental nature of cloud in the DoD. It would ensure that not only users, but also developers and maintainers are properly prepared.

There will need to be a development cloud……. There will need to be a learning process on how to write the cloud computing resources……… Cloud resource providers will need to ensure that resources are sufficient to provide the desired computational resources to satisfy the users. It will not take many instances of someone unable to get the machines that they need before they will give up and simply buy their own machines. (Expert 2 Response)

Policy guides IT development in both industry and DoD and was defined by experts as a mechanism that puts the 'right stuff' in the cloud. For successful cloud computing implementation to take place strong governance and policy needs to be in place. Policy and guidance, as an external control or 'facilitating conditions' is a driver of design characteristics which can change a user's perceived ease of use (Venkatesh and Bala 2008). The key to policy is to not impede the user or organization so much that it drives them away from using the technology. In the DoD pushing effective policy will be a significant challenge and will impose an effect on the environment.

Policy. One of the most significant challenges will be to develop the information sharing mindset and implement powerful guidance/standards to force the issue. Despite numerous senior leader decrees, directives and orders, organizations still think they "own" the data. (Expert 4 Response)

Flexible configuration not only affects the environment, but also impacts technology quality. Experts identified flexible configuration as needed to adjust for changing architectures, analytic tools, change in business model, and adjust for proprietary data handling to add benefit and access to all data/information. This flexibility is typically experienced in an IT system as facilitating condition that increases its effectiveness by adjusting to user wants and needs (Venkatesh et al, 2003). If DISA is flexible enough in their implementation of cloud then it should be a quality product. If they do not adjust based on user and organizational churn then it could become a cumbersome challenge with dramatic effects on the environment.

Managers must understand that there is no 'out of the box' solution to reducing costs, increasing flexibility or achieving scale by buying something off of the shelf............ Successfully implementing cloud computing solutions requires a change in business mindset that may be far more difficult to achieve than simply convincing someone to buy or acquire a particular technology. (Expert 1 Response)

The environment was affected directly and indirectly by the preceding 6 processes and imposed an effect on technology quality and productivity in other levels of the model. Experts defined the environment as the holistic implementation of all 6 of those processes discussed previously in conjunction with DoD specific culture. The environment construct is reflected in most acceptance theories impacting behavioral intentions, use behavior (UTAUT), perceived usefulness and perceived ease of use (TAM2) (Venkatesh et al, 2003; Venkatesh and Davis, 200). Since the environment is so encompassing in this model, and affects users and organizations in so many ways, it should be addressed as one of the most important processes to achieve successful cloud computing implementation.

Contractors must have the proper incentives in place to provide applications within the cloud computing environment. Technical: Environment should be vertically integrated to provide seamless access at both an Infrastructure as a Service level and a Platform as a Service level. .... Resource management must be built into the core of the environment to allow for the seamless, automated allocation of resources based on policy and not manual allocation based on trouble ticket like requests to a help desk.(Expert 3 Response)

The final process of economic factors in the organizational level of the model was defined by experts as the quantifiable savings and the monetary value of cloud computing. There was no downstream affect from this process, but it is affected by productivity in the user level. Theory has found that IT business value is in its cost reduction driven from productivity enhancement (Melville et al, 2004). In the DoD this is realized in conceptualizing saving lives and maintaining mission assurance, but hard dollar savings can be captured through O & M, hardware, and software savings driven by higher rates of usage if cloud computing implementation is successful.

Cloud computing enables you to conduct certain business activities better and multiplies the impact of better business transactions in three distinct areas; 1) Productivity Improvements, 2) Lowered Total Cost of Ownership (Cost Avoidance) and 3) Hard Dollar Savings through reduced Capital, Plant, and Equipment. Cloud computing is a "Combat Multiplier" and that multiplier is Value. (Expert 7 Response)

Technology Level

At this level of the model, DISA could pursue two paths for cloud computing implementation. The first would be to follow the process model design and incorporate DoD development based on the DoD culture, requirements and use cases if it is "demanded". The second development option would be to follow successful commercial models. The below clarification of the technology level processes should aid in that decision.

Only two constructs were found to be relevant within the technology level of the process model (Figure 15). Defined requirements ties to technology quality and both are affected by the organizational level while impacting productivity at the user level. The effects in the technology level of the process model were fewer than previous levels. The technology level is critical due to the impact it could have on successful cloud commuting implementation. The ability to define requirements in the DoD is a tricky endeavor that should be addressed by leadership.

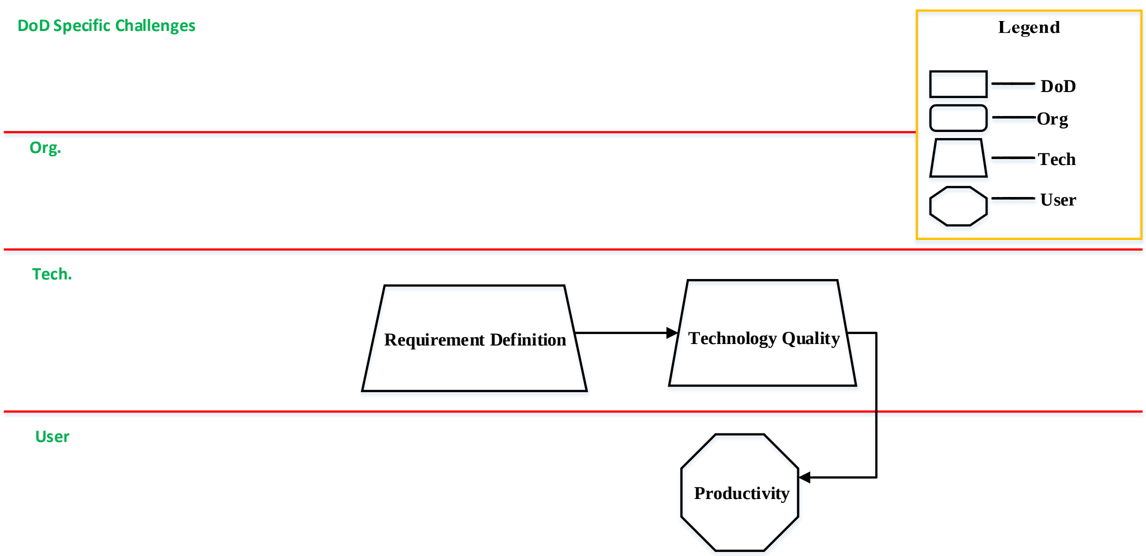


Figure 15. Process Model Technology Level

The relationship between requirements definition and the technology quality could be a crossroads in the implementation path. Not accurately and clearly defining requirements could lead to disaster upon implementation. The experts identified that requirements needed to be successful and properly vetted through appropriate channels.

Industry tends to creep along their development path following requirements along the way and testing intermittently to ensure they are being met. In the DoD, processing requirements can be so cumbersome that they have changed or are no longer effective by the time they are approved. Sproles, 2000 postulates deploying MOEs as an effective tool to determine requirements impact. In the DoD requirements are a driver of effective systems, leading to quality systems (technology). From this we can speculate that MOEs in the DoD could lead to quality technology, lending evidence to the linkage in the model.

Information technologies are driven by the dynamic market trends and can rarely, if ever, be predicted years in advance through a centralized requirements process." 2) Outdated acquisition mindsets: It's actually the mindsets that aren't working. If you study DoD acquisition, there are plenty of "processes" for acquiring programs rapidly, managing risk, and coping with unforeseen changes, but we rarely use them appropriately for implementing modern IT. (Expert 3 Response)

Technology quality is the next process in the model. This process was defined by experts as innovative applications, lending themselves to maintaining data integrity, security, reliability and near zero latency within interoperable systems. Defined requirements are external variables that result from the characteristics of tasks and the system that influence users and groups (Zain et al, 2005). Adjustable requirements add needed flexibility via user input. The resultant user/client buy-in could lead to increased productivity at the user level of the model.

Innovative applications that users find valuable are critically important. Useless or difficult to use software will hinder cloud computing utilization. (Expert 3 Response)

User Level

The user level consists of the processes access, support, understanding, productivity improvement, and support (Figure 16). Four of these constructs exist in the variance model and are based on the same ideas, theories and comments that led to the variables used. The process productivity improvement exists at this level based on support from the M-TAG construct task-technology fit of the complexity of the technology. If the users and organization do not view the complexity of the system as an obstacle, then they could show an increased valence towards that technology (Sarker and Valacich, 2010). This could lead to increased productivity elevating the chances of successful cloud computing implementation.

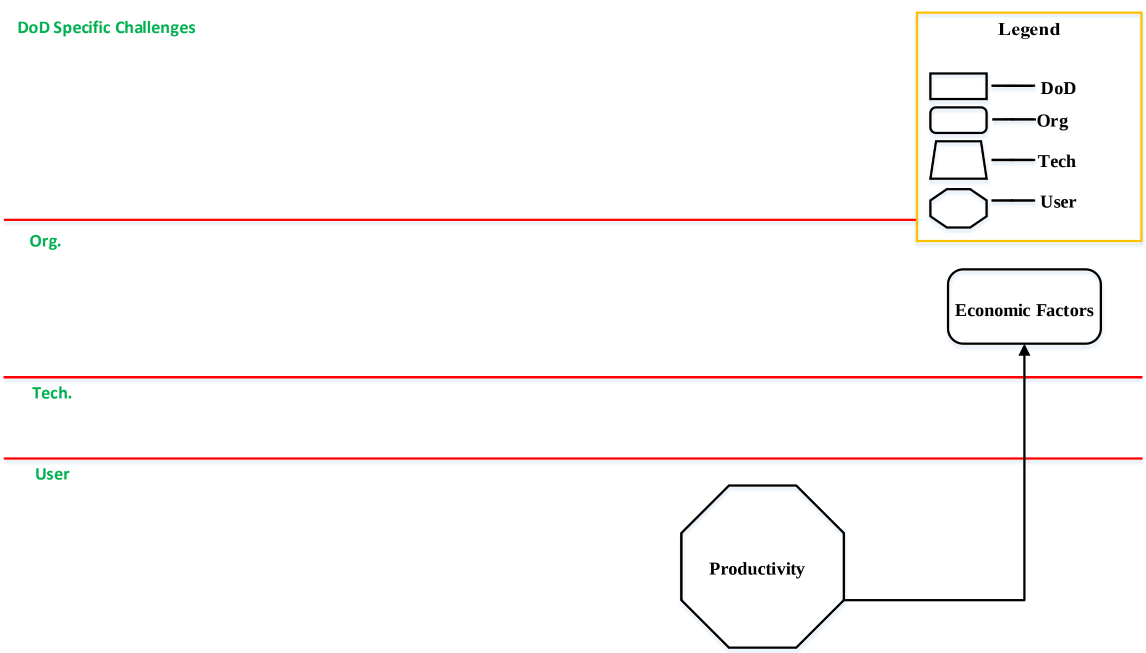


Figure 16. Process Model User Level

Conclusion

If all applicable processes in the model are addressed and linkages between each process followed, successful cloud implementation can be realized. There is a risk of failure to successful implementation if only a subset of the model is executed. There was concurrence on the processes and links from the expert panel, further cementing their importance. Further clarification of variables and processes within these models can be achieved by analyzing the experts' comments (Appendix C).

This chapter showed the analysis, theory and models resulting from three passes of the Delphi study (Appendix D). The first pass was used to identify factors that, if addressed, can achieve successful cloud computing. Those variables were analyzed and deployed via two models in a second pass where the experts clarified the findings. This chapter also identified the variables that should enable a successful cloud implementation strategy and answered research question 1. Those variables determined in this research, led to answering research question 2, determining how DISA could execute implementation and is addressed in Chapter V. Using the results from the first two research questions, viable models were developed, while answering research question 3 from Chapter I. Those models were then introduced in this chapter. Also in this chapter, supported theories of literature were presented. This chapter showed how the models were derived from those theories and the constructs and variables within those models were defined. Concurrence on these models was achieved from the experts via a third pass.

V. Conclusions and Recommendations

Overview

The goal of this research was to develop models for execution of a cloud solution by DISA. That model development was achieved. This chapter now presents answers to the research questions and conclusions from this research. It will also describe any limitations encountered during the Delphi study or any other areas. Finally, it will identify benefits of the study and recommend areas for future research to further expand the subject area.

Limitations

There were some limitations to this research. The sample size for this research was 10 experts, with one dropping out for non-response. As with any research, this sample size could be increased, but care should be taken when reaching theoretical saturation that was mentioned in Chapter III. An increased amount of time between contacts with panel members could have enabled the researcher to go back to the experts for more clarification and details. This additional data could have provided additional validity of the models. Finally, a survey was originally looked at for accomplishing this research. This tool was abandoned due to the cumbersome process for acquiring a survey control number that would have enabled the researcher to accomplish the survey.

Research Question Answers

RESEARCH QUESTION 1:

What organizational variables or processes influence successful cloud computing implementation in the DoD?

Variables and processes that could influence successful cloud computing implementation in the DoD are listed in Table 4.

RESEARCH QUESTION 2:

How could DISA implement a cloud solution?

DISA's cloud implementation process will be critical. This research has given them two potential tools to use prior to execution to ensure that process is as efficient and effective as it allows them to be. This research has provided, but one piece of that implementation process, the rest should be dictated by how DISA answers their COAs. The strategy should be flexible enough to adjust to technology and have DISA-imposed milestones in place in advance.

First, based on expert comments, "there will need to be a development cloud." This development cloud should reflect true implementation by considering this research when building and testing it. This could reduce any learning curve involved and would ensure the right structure is implemented that provides the user and organizations with the resources needed to overcome variables and processes within the research models. The below expert comment reinforces the need for a development cloud to include testing the effects on users and organizations. However, final implementation should reflect two different paths to increase successfulness.

It will not take many instances of someone unable to get the machines that they need before they will give up and simply buy their own machines. (Expert 2 Response)

There are three paths to successful cloud computing implementation that DISA could pursue. The first would be to follow the process model design and incorporate DoD specific development based on the DoD culture, requirements and use cases if it is “demanded”. This has shown to be difficult and cumbersome through such technologies as Sharepoint. The second development option would be to follow successful commercial models. The last, and recommended, would be an implementation that merges both options. By taking into consideration successful commercial implementation and inserting DoD specific requirements where necessary this option seems to be the most attractive. To note; DISA needs to ensure that the ‘olde think’ of the DoD culture does not creep back into the process, losing sight of the end results that mirror industry success.

RESEARCH QUESTION 3:

Can a "model" be developed that will assist DISA's strategy for successfully fielding cloud computing in the DoD?

Two separate models were developed and presented in Figures 11 and 12, respectively, using variables and processes gleaned from research question 1.

Research Conclusions

This research concentrated on user and organizational characteristics. It was done with various user level theories and culminated in a group level theory while showing consistency to the variables throughout. This research concludes that those constructs were consistent based on past theory and expert comments acquired during this research.

Budget was not prevalent throughout literature, but was mentioned enough by experts to give merit to its importance. Based of expert responses it seems there is a disparity between how DoD budgets for new technology compared to industry. The below expert comment expresses how much industry spends on cloud. These budgets put that disparity into perspective.

DARPA's…… 2014 budget submission was ~$2.8B and depending on how you slice and dice them program lines, only about a third of that is IT related. Now, just look at Microsoft's research and development budget for the period ending in June 2012. Microsoft spent almost $10B! That's just one company. Google spends a little less than $2B annually and Intel spends around $2.5B. We simply cannot compete with those numbers and expect to influence the direction of the IT market through direct investment. We really need to figure out how to get on this train rather than complain about not building the tracks. (Expert 5 Response)

For this reason, it seems conclusive that the budgetary obstacle may be more pertinent to DoD IT acceptance and will be advised of future research. A further conclusion can be reached that DoD implementation challenges are different from industry, based on the absence of these that factors in theory.

DoD could be less likely to take individual variables into account. DoD culture has an innate tendency to force technologies into user and organizational environments without first addressing the obstacles that reside within those environments. If this conclusion were to hold true, it is less likely that DISA and the DoD would adopt the process model over the variance model. An alternative to this conclusion would be to deploy the models at different levels. The variance model could be deployed at the organizational/individual level and the process could be implemented at the overarching strategic level i.e. "Big" Air Force or DoD.

Recommendations for Practice

Understanding this research and its ramifications, if the models are executed, inevitably leads an organization to investigate the "best practices" for utilizing this research with a cloud solution. First, keep abreast of changes in the cloud technology landscape. Changes in technology could force developers to rethink implementation strategies and in turn change how these models are fielded. Next managers and developers should stay aware of the programs and services that their "cloud" provides. Not only does this awareness assist in reducing security breaches, but in relation to this research, it allows needed updates and application changes to be executed while realizing user and organizational impacts. Also, ensure policy and guidance is kept current. This is pivotal in the DoD environment to ensure organizations are knowledgeable of what the "cloud" has to offer to the mission. This will give them a stake in the technology and should increase their desire to ensure success. Finally, do not rely on the technology alone to enable success. Incorporating user and organizational variables to ensure the technology is usable and efficient should lead to achieving mission goals.

Cloud computing, like many other technologies, will see success through being implemented aggregately by encompassing multiple programs, business functions, and time. Successful cloud solutions do not win on their own, looking at "what is in it" is key. To enforce this type of aggregation DISA should look at the cloud models and services they provide. DISA should implement multiple cloud models (Private, Public, and Hybrid) as well as multiple services (IaaS, PaaS, SaaS). This should ensure aggregation of programs based on requirements driven by user and organizational influence as well as leadership vision and DoD directives.

Practices for managing cloud provisioning and infrastructure will drive decision making, maintaining long term sustainability, and promote resource reuse. Below are questions to ask that could drive "best practices" in cloud implementation that were posed by the Software Sustainability Institute in *"Best Practice for Using Cloud in Research"* (Hong et al, 2012). These questions could also be investigated by DISA to drive cloud practices.

- *Will the cloud you choose be there for as long as DoD needs it?*
- *For commercial clouds, what happens if you don't pay your bill? Is your content deleted? Are you warned first?*
- *Does the cloud provider manage backups and, if so, how often? If not, then is there a way for you to easily do backups?*
- *Is the help and support offered by the cloud providers adequate for you?*
- *Is there an SLA defining resource availability, downtime, networking bandwidth, etc.?*
- *Do you have a contingency plan for if your cloud were to become unavailable? Is there another infrastructure you could use? Would you have the time, money and effort to migrate your content? What are the consequences if there is no alternative available?*
- *Are you allowed to put your data in the cloud?*
- *Are there any community procedures, institutional policies or legal frameworks you have to comply with in both hosting data on the cloud and transferring applications and data to and from it?*
- *Is the use of a public or community cloud acceptable to your stakeholders?*
- *Does the licensing of your application allow you to deploy and use it in the cloud?*
- *Do you understand the licensing of your application or will you need to consult with advisory bodies e.g. OSS-Watch or JISCLegal?*
- *Is the cloud you use free to use or will you have to pay for it?*
- *Can you estimate how much it will cost you? Is this within your financial abilities? Is this acceptable to your funders?*
- *How will you pay for usage? Are you happy to use your own credit card? Does your institution have a credit card you can use and would be happy for you to do so?*
- *How, and how often, will you monitor your resource usage to ensure you don't incur excessive charges?*
- *How will you manage problems in porting or using software on the cloud?*
- *How much time will you spend trying to get one piece of software working with another?*

- *Do you have a contingency plan in place with alternative options to explore?*
- *When will you decide that you've spent too long and either quit or explore alternative options?*

Recommendations for Future Research

This research is a strong beginning to determining how to implement a cloud computing solution with the optimal results. There is additional research that could provide even further benefits. First, research could be performed to determine any correlation between how many times a variable was mentioned by the experts to how it fit into the models. This would provide a broader understanding of the impact of the comments on how the models were built. The models have been validated by industry and DoD experts, but they could be tested for statistical fit to the desired effect of successful cloud computing implementation. Further quantitative validation when the solution is fielded would be beneficial for both further phases of cloud implementation as well as utilization when other forms of technology are pursued.

Further analysis addressing the multi-level relationship of the constructs that exists within the two research models would be beneficial to further this research. A quantitative analysis of that relationship would aid DISA in determining which factors to put more emphasis on when deploying the models.

It was noted in Chapter IV that technology theories did not conclusively provide supporting evidence regarding budget, but was mentioned as a critical construct by the experts. Research into this disparity could be further pursued to determine its true validity. It could be that the experts identified that construct knowing that cloud computing implementation was only germane to the DoD in this research.

Conclusion

This chapter provided limitations to this research, conclusions, and further research. The capstone to this research lies in the implementation of the models exclusively by DISA before the solution is deployed. In today's environment of tighter budgets, reduced manpower, and cumbersome acquisitions, an efficient cloud computing solution is critical. This research may provide DoD IT managers, practitioners, and developers a valuable tool to ensure this efficiency is achieved in a timely and acceptable timeline. In the end, the mission will not fail, but properly fielded technology will increase mission effectiveness exponentially.

Appendix A: Construct Tie-In

Model Constructs	*Venkatesh et al. (2003)UTAUT*	*Venkatesh and Bala (2008)TAM3*	*Sarker and Valacich (2010)M-TAG*	**Bailey and Pearson (1983)**	**Ives et al. (1983)**	**Baroudi and Orlikowski (1988)**	**Doll and Tokzadeh (1988)**
(VM)Understanding	X	X	X	X	X	X	
(VM)Security				X			
(VM)Budget							
(VM)Access	X	X	X	X	X		
(VM)Reliability	X			X	X	X	X
(VM)Environment		X	X	X	X	X	
(VM)Standards		X	X	X	X		X
(VM)Training		X	X	X			
DoD SPECIFIC							
(PM)Unique Use Cases							
(PM)Fear of Unknown	X	X	X	X	X		
(PM)ACQ Process				X	X		
(PM)Contract Flexibility				X	X		
(PM)Sense of Urgency	X	X	X	X	X		X
(PM)DoD Culture	X	X	X	X	X	X	
ORGANIZATIONAL							
(PM)Broker Rep.			X	X			
(PM)IT Staff Maturity	X	X	X	X	X		
(PM)Existing Policy & Gov.		X	X	X	X		
(PM)Leadership/Vision	X	X		X	X		
(PM)Training Culture	X	X	X	X	X	X	
(PM)New Policy & Gov.		X		X	X		
(PM)Flexible Config.			X	X	X		
(PM)Implementation Environment	X		X	X	X	X	
(PM)Quantifiable Economics	X		X				
TECHNICAL							
(PM)Defined Requirements	X	X	X	X	X		
(PM)Innovative Apps.	X		X	X			
USER							
(PM)Access	X		X	X	X		
(PM)Support	X	X	X	X	X	X	X
1)Expecations/Understanding	X	X	X	X	X	X	X
(PM)Productivity Improvement			X	X	X	X	X
(PM)Trust/Support	X	X	X	X	X		

Notes
PM = exists in process model
VM = exists in variance model

Appendix B: Factor Comment Support

Factor	Comment
Understanding	
	Incentive to use cloud computing
	Common Understanding
	User understanding
	Recognize the business aspects…productivity improvements, lowered total cost of ownership and hard dollar savings
	Understanding and definition
	Manager Understanding of metrics
	Weak support model
	Not everything belongs in the cloud
	Discovery…what is present and where to go
	Outdated Acquisition Mindset
	Cyber Threat "Awareness" vs "Understanding"
	Inability to quantify gains
	Old think
	Unbiased brokering service
	Unclear/ambiguous requirements
	Leaders not understanding the benfits short of a ROI
	Customer knowing what they want…reliability, security, efficiencies, effectiveness
	Leverage Cloud Benefits
	Learning process to write RFPs, proposals, and contracts
	Change the incentive structure
	Implement aggressiv timelines
	Simplify scope and requirements
	If DoD wants to be an enterprise then think and behave as one
Security	Trust
	Security
	Security
	Security priority
	DoD requires security
	Risk
	Different security protoocls in DoD
Budget	Sufficient Time for Investment
	Cost
	Min. overhead
	Government Budget Cycle
	DoD funding
	Illusion of a vast monetary ROI

	Pices driven up due to inlfated units because of geographic location
	Leverage a larger IT budget
	Long term contracts with exit clauses for non-performance
Access	Aggregate Programs into the cloud
	Limit Restrictions
	Access
	Data access
	Sharing Resources
	Min. barrier to entry
	Application restrictions
	Ability to implement across NIPR and SIPR
	DoD requires compartmentalization
	Computational services
	Ensure sufficient resources
	Managed service approach vs. buying individual capability
Reliability	Define Intangibles (Scalability and Flexibility)
	Interconnectivity
	Reliability
	Performance
	Interconnectivity
	Levels of performance expectations
	DoD requires stability
Environmnent	Cloud as a Business Process
	"Good" customer environment
	Environment supports implementation, min. environmental inertia, and technical IQ of staff
	Excessive beaurocracy creating excessive timeline
	Innovative applications
	Adequate advertising/marketing
	DISA reputation
	Lack of "good" customer base for implementation and utilization
	Organizational churn
	Mature business model/enterprise business model
	Service advocacy
	Unsupportive customer
	Technically immature environment
	Lack of organizational support
	DoD is change adverse
	Inducstry used best effort
	Incentives for industry companies to build applications
	Sense of urgency
	Leadership

	Maintain situational awareness to the extent that DoD has grown
	DoD acquires solution before defining the problem
	Industry defines problem from vsarious views that provide highest value
	Industry uses long term partners with required espertise
	DoD has doubt…they must "check and control everything"
	Seek out the little guys
	DoD needs to get out of cloud business and offer cloud as contract service
	DoD partners and agencies should partner together to deliver cloud cap. for max reuse
Standards	No standard between DoD agencies
	No standard SLAs that provide "best value"
	Policy
	Conflict of interest, DISA is the cloud broker and cloud provider
	Outdated Policies
	Acquisition process
	Migration/evolution from existing PoRs
	Evolution Roadmap
	Provided service level vs. service level paid for
	Complicated ATO and DAA porcess to be on networks
	DoD use cases and implementation are different
	C & A, IA controls, and ATO'd environments delay implementation
	Undustry focuses on SLAs not what lies "behind the door"
	Development cloud and an ATO cloud
	Agencies honor community C & A accreditation approval
	Commercial based SLAs
	Standard levels of service

Appendix C: Expert Comments

Below are the responses from pass one listed question-by-question. All responses have been stripped of data indentifying the respondent. Please read them carefully taking these inputs into consideration when filling out Part B.

EXPERT QUESTION 1 :

What factors should be considered for successful cloud computing implementation?

Expert 1 Response

Cloud Computing is a Business Process more than a technology: Fundamentally, implementing cloud computing solutions is about business processes, not buying technologies. Managers must understand that there is no 'out of the box' solution to reducing costs, increasing flexibility or achieving scale by buying something off of the shelf. It is true that this business model is only possible because of great technological improvements, particularly in the areas of: persistent communications, increased bandwidth, high-performance commodity processing hardware and massive distributed storage. Ultimately, technology is only a necessary, but not sufficient condition for cloud computing success. Successfully implementing cloud computing solutions requires a change in business mindset that may be far more difficult to achieve than simply convincing someone to buy or acquire a particular technology.

Programs win in the aggregate, not in isolation: Another critical piece of the puzzle is recognizing that success with cloud generally comes from the aggregation of implementing cloud practices over many programs and business functions. Especially, if the metric for success is cost savings, then this factor holds true even more. Transitioning any particular program to a cloud solution will not likely generate any cost savings if the cloud solution only hosts that one program. For example, the most basic reason that IAAS works is because of multitenancy. If a company implements an IAAS solution, but only hosts one program on that architecture, then that individual program carries all of the capital expenditure burden for not only it's application components, but also for the infrastructure. Without multitenancy in IAAS solutions, the system goes underutilized and the unit cost per computation goes up. If that architecture hosts multiple program simultaneously and performs adequate load sharing (another semi fundamental attribute of cloud architectures) then those capital expenses can be spread across multiple business lines and programs reducing the total burden.

"The aggregate" is not just about multiple programs, but also about time: Another seemingly fundamental aspect of cloud computing is that there will likely be upfront transition/implementation costs that will require management to treat IT as an investment rather than simply as quick fix. This is especially difficult in the government where promises of future savings are rarely fulfilled. To implement a successful cloud computing architecture, managers must realize that there will be costs to build/test/standardize/manage infrastructure, recode/retest software, and many other upfront costs that will need to be addressed. Cost savings will likely only manifest themselves after a sufficient period of time to recuperate the initial investment. The decision gets complicated because for the initial period of time, the cost of continuing with the established architecture will likely be cheaper than paying for the costs associated with transitioning to the cloud. That cost delta takes time to overcome.

Defining the intangible metrics for success: Cost is the easiest and most quantifiable metric, but flexibility and scalability are likely as, or perhaps more, important. Unfortunately, it is very difficult to articulate the “requirement” for either of these areas. It is easy to spot when previous decisions impose severe restrictions to current operations, but it’s much more difficult to determine which decisions today will create the biggest ripples down the road. Hindsight is 20/20 and the expedient needs often outweigh the long-term best answers. Fortunately, we have many commercial companies, such as Amazon and Google, (and also simply the Internet at large) as thriving examples of what properly implemented flexibility and scalability can achieve.

Trust: This is the most important factor of all. Cloud computing is about sharing, otherwise there would be no need to move beyond the stove-piped programs that we are so used to. At least in the government, our entire acquisition system is based on hierarchy and accountability. The program manager is responsible for the execution of their entire system. In the old model, trust is established through control (as if the two were truly synonymous). Yet, the modern IT ecosystem does not resemble this model. For example, Netflix hosts video content on Amazon.com. Amazon presents those feeds to Tier 1 ISPs who send them onto many other ISPs. Your ISP serves them through your Motorola Surfboard to your Cisco Router to your Dell Laptop, running Microsoft Windows for playback in a Google Chrome browser. Netflix only ‘owns’ a very small aspect of that system and must trust (to a reasonable degree) all of the other non-affiliated components along the way. Much of the trust model in this example is established through Service Level Agreements (SLAs) and mangers must grow to accept that third-party providers will perform to the degree outlined in those SLAs.

Expert 2 Response

The framework and implementation needs to be absent of restrictions on what can run. The user has a problem that they want to solve, and the cloud computing infrastructure has to make it as easy (or nearly as easy) to implement as on dedicated hardware. We settled on Amazon EC2 because we could run basically whatever we wanted/needed to, which is not the case in Microsoft's or Google's offering.

The users have to confidence that they will have access to the resources when they need them. When you buy a rack of servers for your project, they are 'yours' and you can (in theory) use them at any time instantly. Reality is different but the sense of control is there. I have started a large number of Amazon EC2 machines (>100 simultaneous 8-core machines) and never had a problem, so I think
that whatever I need I can get.

Expert 3 Response

Incentives: Organizations must have the proper incentives to utilize cloud computing. Contractors must have the proper incentives in place to provide applications within the cloud computing environment. Technical: Environment should be vertically integrated to provide seamless access at both a Infrastructure as a Service level and a Platform as a Service level. Bad choices of mismatched products at each level of the stack will lead to poor adoption. Resource management must be built into the core of the environment to allow for the seamless, automated allocation of resources based on policy and not manual allocation based on trouble ticket like requests to a help desk.

Expert 4 Response

Common understanding. There are many terms being used to describe what "cloud" is/isn't which has caused a significant amount of confusion. A significant portion of the populace only think of the “cloud” from Apple, Google, Amazon or IBM commercial offerings to store and access data. They don’t understand that there are utility and analytic clouds as well. The picture gets muddier when other terms like "net-centric," "SOA," "IaaS," "PaaS," "SaaS," etc. are discussed.

Interconnectivity. Just as cellular service, email and Internet providers evolved through a phase where it was difficult to talk across the proprietary networks without significant costs, cloud architectures must do the same.

Data access. There isn't enough money to convert existing data stores to Accumulo/Big Table so we need to be able to access and integrate data from "legacy" systems M2M with near zero data latency. Our warfighters have come to expect the same kind of unhindered information access in their professional work that they enjoy in their private lives.

Expert 5 Response

Reliability: Solution needs to be up all the time

Performance: Low latency from the standpoint of uploads, downloads, and use of the cloud for computing/applications

Security: Traditional IA security as well as data integrity

Cost: Cost needs to be reasonable. If we can’t save money with the cloud solution, then why use it?

User understanding – What do the user’s know about cloud computing? Does it meet or beat their expectations? Do they understand non-monetary benefits (e.g., data access anywhere in the world, etc)

Expert 6 Response

The factors for successful cloud computing implementations are a ‘good’ customer, an environment capable of supporting the implementation, minimal environmental inertia (i.e. minimal political churn preventing implementation), and mature technical IQ of all staff involved.

Expert 7 Response

Using cloud computing is more of a business decision than a technology decision. Cloud computing enables you to conduct certain business activities better and multiplies the impact of better business transactions in three distinct areas; 1) Productivity Improvements, 2)Lowered Total Cost of Ownership (Cost Avoidance) and 3)Hard Dollar Savings through reduced Capital, Plant, and Equipment. Cloud computing is a “Combat Multiplier” and that multiplier is Value. To implement successfully you must have a strong Policy and Governance Structure, A Business Model/Process Architecture, and a Solution Architecture.

Expert 8 Response

Understanding and definition- across the board the term "cloud" has different definitions and even when the definitions "appear" similar, the intent and what is included can be substantially different. Commercial vs Army vs USAF vs DoD- no standard. Means

SLAs(service level agreements) and pricing are all over the map vs clear standards that can be evaluated and priced to ensure "best value" and common levels of predictable delivery.

EXPERT QUESTIONS 2:

What are key concerns for successful cloud computing utilization?

Expert 1 Response

Unfortunately, many of the "factors" that I identified above are also the primary concerns. Take, for instance, an example where two or more users agree to share the cost of a common hardware infrastructure. Who gets priority when there is contention for resources? This may be something that users can agree to in the design phase, but it may be much more difficult for the "losing" program to explain to their customers or their supervisors when their program does not perform in operations as it would have if the underlying infrastructure had been dedicated and purposefully built for their sole use.

Properly understanding the statistical nature of all aspects of cloud computing will help managers make sound long-term, cost/performance trades, but these sound decisions in the past may not pass the test when the rubber meets the road. I often ask people a couple of simple questions to highlight this phenomenon. First, I ask when was the last time their Gmail account was down? Most will say never. Second, I'll ask when was the last time their work e-mail was down, most will remember these outages quite vividly. Yet the times when Gmail or Amazon Web Services do go down it is a huge news event. For some reason we seem inherently comfortable with mistakes, so long as they are our own, but we fail to capitalize on the opportunities for better performance when someone else may impose mistakes upon us, even if there will be far fewer mistakes overall. This mindset needs to go if we want to be successful in this arena.

Expert 2 Response

Technically, the overhead needs to be kept to a minimum and the barrier to entry needs to be kept low enough that any application could feasibly be 'moved to the cloud'. For example, I was presented with computational resources for a particular project where the physical machines were sufficient. However, they required me to use a platform, namely Oracle Grid Engine, to manage the software that was not a good fit for my application. The result was a loss of time and money.

Programmatically, for commercial cloud computing, I know that I can get the machines that I need and know how much to pay for them (X cents per hour, I know how many hours I am using, and at the end of the month, Amazon sends me a bill). For a DoD cloud computing implementation, my concern is that it will be wrapped with so many gatekeepers and layers of bureaucracy that it will be almost impossible to get the machines I need in a timely manner, when I need them, and at a project cost that is reasonable.

Expert 3 Response

Innovative applications that users find valuable are critically important. Useless or difficult to use software will hinder cloud computing utilization.

Expert 4 Response

Clear Objectives. "Cloud" technologies offer tremendous promise; however, it seems that the "buzz" has overtaken critical evaluation of what is to be achieved. What is the "cloud" to provide? Is it for data center consolidation, large data analytics, web-services, cyber-security, etc.?

Policy. One of the most significant challenges will be to develop the information sharing mindset and implement powerful guidance/standards to force the issue. Despite numerous senior leader decrees, directives and orders, organizations still think they "own" the data.

Security. With improved access and availability of data/information, the importance of maintaining security and integrity of the data becomes paramount.

Interconnectivity. A lot of companies are having a hard time adjusting to a new business model for DoD information systems. Many are proposing to simply build more proprietary data handling architectures and analytic tools with no real added benefit of providing ubiquitous access to all data/information.

Expert 5 Response

Adequate advertising/marketing to ensure the customer understands the utility of the cloud and the DoD brokering process.

For the DoD, a big concern is likely the fact that DISA is the broker for cloud as directed by the DoD CIO, and at the same time, DISA is a cloud provider. This is an inherent conflict of interest that will raise concern when a DISA cloud service is chosen when the user doesn't feel it's the right decision.

DISA's reputation is likely a road block to service utilization. Many IT/COMM personnel's DISA experience, whether with Host Base Security System (HBSS), DoD Enterprise Email (DEE, US Army the first adopters), or Defense Enterprise Portal Services (DEPS – SharePoint services), have a sour view of DISA's ability to provide quality service (HBSS), with low latency (DEPS), and ease of access (we've had CAC authentication blunders) is an area of concern.

Expert 6 Response

My main concerns are lack of a 'good' customer base both for implementation and utilization, organizational churn, and a weak support model.

Expert 7 Response

Security- You must pick the right computing model for security to be as effective as possible. Do not select a public cloud and expect it to be as secure as a trusted private cloud.

Not everything belongs in a cloud. The most effective implementations are enterprise-wide common business tasks with high demand and high transaction rates.

Most implementation fail because they did not have a mature business model/enterprise business model from the start.

Expert 8 Response

Technical ability to execute is not the major challenge- two major issues evolve around (1) "discovery"- what is present and what is to move to a/the cloud (2) levels of performance- expectations- goes back to defining and establishing what is to be delivered for the agreed upon level of effort/price.

EXPERT QUESTION 3:

What main obstacles would hinder successful cloud computing implementation?

Expert 1 Response

The government budget cycle: It works for acquisition programs that span many years, but it not well suited to ill or undefinable requirements that are subject to change rapidly. To steal a quote from my MILCOM paper "DoD acquisition managers are under constant pressure to maintain currency across their enterprises and meet ever changing requirements over an increasingly complex infrastructure. It is extremely difficult to achieve such lofty goals under layers of bureaucracy and a six-year Planning, Programming, Budgeting, and Execution (PPBE) cycle. Information technologies are driven by the dynamic market trends and can rarely, if ever, be predicted years in advance through a centralized requirements process." 2) Outdated acquisition mindsets*:* It's actually the mindsets that aren't working. If you study DOD acquisition, there are plenty of "processes" for acquiring programs rapidly, managing risk, and coping with unforeseen changes, but we rarely use them appropriately for implementing modern IT.

Outdated policies: This probably flows from the previous obstacle, since the mindsets create the mental schema's that inform the policies, but it's real nonetheless. The Federal CIO office has made quite a few important strides in the area of cloud and now the rest of the government needs to catch up… especially the DoD. The DIACAP policies practically discourage change and force vendors to modify their commercial implementations to such extremes that we become the sole customer for many products. As soon as our path forks from the broader market, we are doomed to foot the bill for all of the associated costs... we lose all of the economies of scale. We are our often our own worst enemy here.

The threat of "cyber"*:* We have seen a tremendous increase in the "awareness" of the cyber threat over the last five years, but awareness and understanding are two entirely different things. Fear plus technological illiteracy equal irrationality. Rather than embracing new opportunities, I'm afraid that fear of the unknown will cause us to further hunker down in the old, comfortable ways of doing business (ones that are often technologically much less secure, but organizationally more accountable).

Expert 2 Response

The inability to run necessary applications (in their current form) such as restrictions on language/resources available.

An inability to quantify the gains (in time and/or money) in implementing a solution using the cloud.

Expert 3 Response

I believe that the acquisition process of not only the cloud computing environment itself but for the applications themselves is the main obstacle to successful cloud computing implementation. The acquisition of the cloud computing environment must ensure a true open environment for applications and not an environment that locks in certain industry players or teams and locks out small players. New application are more likely to come from new or hungry companies as opposed to the large contractors - which will attempt to game the acquisition process. Attempts to port legacy software may hinder the success of cloud computing because it will be expensive. The current incentive structure for the incumbents with the existing contracts are for it to be difficult and expensive.

Expert 4 Response

Old think. Too many policies from acquisition, IT management, IC vs. DoD, large Programs of Record, etc. aren't enabled to rapidly develop, transition and evolve to maximize the advantages of "cloud" technologies.

Service advocacy. Senior leaders appear reluctant to commit to this "new" technology without some kind of demonstration but without their "buy-in" it is difficult to solicit for data access, acquire funds or start breaking glass on how we currently collect, manage, evaluate and distribute information.

Migration/evolution from existing PoRs. There are a number of extremely large programs that could benefit significantly in cost, performance and schedule if they adopted "cloud" technologies. The issue is that they are large PoRs with very sizable contractual commitments and are either unwilling or unable to embrace the opportunities. An example of this is the JMS program. Current cost of the system is approaching $750M with no end in sight. Implementing a "cloud-based" solution could be done for approximately $125M in 24 months with senior leader advocacy.

Evolution Roadmap. The DNI has developed a strategy. The DoD CIO has a strategy as does each IC agency. The challenge is that implementation is currently being downward directed and the path to interconnected systems is so dynamic that developers are having a difficult time staying in synch with the enterprise.

Expert 5 Response

DoD funding, DoD cost for SIPR solutions (note that there are, I believe, two commercial SIPR cloud providers, but will be in direct competition with DISA).

Unbiased cloud service brokering processes.

Requirements gathering and vetting and ultimately translated into the right service, right vendor, right cost, etc.

The ability to implement private, public, and hybrid cloud solutions across 2 security enclaves (NIPR & SIPR) and the need for a JWICs solution.

Expert 6 Response

The main obstacles are unclear / ambiguous requirements, an unsupportive customer, a technically immature environment (both environment and IT IQ), and lack of overall organizational support.

Expert 7 Response

The expectation of a vast monetary ROI from cloud computing is an illusion. The proper measure of a successful implementation is VALUE and how value should be measured becomes the key critical driver. Cloud computing is delivering a service and to be successful the service must be of value to the customer. The truth of the matter is cloud services could cost more to deliver than the legacy system it is replacing. However, if the service provided is valuable to the customers using it, the environment will deliver value through higher rates of usage, productivity improvements and other "soft" benefits. Classic ROI does not do well in a cloud environment. Some leaders will not understand that.

Expert 8 Response

Customer/client actually knowing what they want/what they expect for the price/level of effort and to establish long term partnerships to allow for continued growth/effectiveness/efficiencies. Many times the client/customer is not sure of what they currently have and therefore not sure of the business case for change- how do they ensure they get what they need and do so in a more cost efficient, reliable manner- with the level of security and future capability that is required.

EXPERT QUESTION 4:

What are the differences between the way industry implements a cloud solution to the way DoD should?

Expert 1 Response

The DOD is not risk averse, its change averse… otherwise we wouldn't accept all of the risks associated with our current IT architectures. Industry is far better at managing risk, when it comes to IT services than the DOD. We often eschew private enterprise because of their desire for profit and we assume that they "cut corners" on security. I have found just the opposite to be true for many established cloud computing vendors. In the cloud computing space, there are not significant barriers preventing consumers from switching from one provider to another. A sufficient security breech could result in a tremendous loss of revenue as consumers make that change. These financial realities make security a top priority.

Expert 2 Response

Industry tends to run on a best effort. The DoD would require stability, security, and compartmentalization of the cloud in order to protect assets and information.

Many DOD projects do not just have an external security concern, but also an internal one. Since I do development, what I run on my servers is something that I should not have to go through a huge effort to get onto the cloud servers. When I have access to a rack of servers, correctly separated from the rest of the network, then I can put software on it during development, but there would seem to be issues in doing that with a shared resource in a DoD environment. Also, it is not the case that development can be done on a noncloud computing environment, approved (getting an ATO) and then putting it on the cloud.

The cost allocation for computational resources is also very different. A commercial project or a DoD contract project sets aside a certain amount of ODCs and they are used to buy equipment. Using a cloud computing solution confuses the situation since they are closer to services, and so there needs to be a shift in the way that the money is spent, and project managers, COTRs, contracting officers need to understand it.

Expert 3 Response

Industry has much larger numbers of companies to build cloud applications and these companies have incentives to do so. DoD has a relatively tiny number and these companies have no incentive other than the labor dollars they will get paid to do so. Development labor is a small fraction of the revenue of these companies - so an environment that reduces their O&M revenue will make cloud computing very difficult for these companies to truly get on board with.

Expert 4 Response

Sense of urgency. Time is money in the business world. If a solution can save money while simultaneously saving time, they're much more willing to take the risks. Additionally, businesses are constantly challenged by their competitors so they don't have the luxury of exhaustively studying their options like the DoD.

Risk. Industry tends to build a little, test a little and adjust the course of development. DoD, on the other hand, spends so much time investigating the options that by the time a requirements document is presented for bids, the requirements will frequently be unable to reflect the current state of technology. There is some merit to this because DoD generally measures risk by lives saved versus dollars spent but it's almost to the point of stagnating progress.

Leadership. Most military leaders have not been promoted for being innovative. Just as with our federal bureaucracy, change comes very slowly. Commercial adoption of technology is driven by market share and business leaders recognize that if they don't move, they may not be here tomorrow.

Expert 5 Response

From the Operations Community is maintaining situational awareness to the granularity the DoD has grown to expect.

Actual service level provided vice service level paid for. For example, DISA hosts applications in the Defense Enterprise Computing Centers (DECCs), and these systems have a Mission Assurance Category (MAC) applied to them which has an associated cost. If the Marine Corp Online systems goes down, a general officer to general officer call is made, and it is treated as a MAC I (mission critical, restoration time within a few hours, etc) even though the USMC isn't paying for that level of service (which has no MAC associated with it, which means we have say 4 days to address the problem).

DoD has different security rules/processes than commercial providers, and I think ours tend to be more strict, which may drive up our cost, increase implementation time, etc.

Traditionally, the DoD isn't about making money and some of our organizations are inflated due to geographic location. This drives the price up, and I think it will be hard for us to compete financially with commercial providers.

DoD often has complicated ATO and DAA processes to operate systems on a DoD network. The commercial sector may not have this issue. It certainly affects our ability to be agile around customer needs.

Expert 6 Response

The DoD has been adopting capabilities in a manner that Industry has been delivering them. The DoD use cases and implementation are different than the Industry use cases. In addition, the emphasis on C&A, IA controls, and ATO'd environments delay most if not timely implementations.

Expert 7 Response

DoD seems to acquire a solution before they have defined the problem it's supposed to solve. Industry will define the problem from various perspectives and then explore solutions that deliver the highest value for the most reasonable price.

Expert 8 Response

Commercial industry finds a long term partner who is a proven expert in the field (has the experience and the capability), hands over the mission, looks for long term associations where benefits are shared (e.g. the commercial provider saves the client money and makes money from that savings- direct benefits from quality work and providing efficiencies and improved performance). Commercial clients focus on the SLAs and not what is behind the door- the reason they hired an expert to do the work. DoD has a since of doubt- they must check and control everything vs. a managed services approach based on delivery of a product of the quality and capability required and at a price incentivized by performance and efficiency/cost savings.

EXPERT QUESTION: 5

How could those obstacles and differences be overcome?

Expert 1 Response

Embrace sequestration! Our fiscally constrained environment will force us to chart new territory (at least new to the DOD). The good news is that we have many examples of how private industry is successfully leveraging cloud implementations to their great benefit. All we need to do is follow. That's hard for us, especially since we are the industry driver in most other aspects of the DOD (fighter airplanes, most satellites, tanks, etc). This isn't so in the information technology space. We are a drop in the overall bucket. For example, according to DARPA's website (www.darpa.mil/WorkArea/DownloadAsset.aspx?id=2147486441), their 2014 budget submission was ~$2.8B and depending on how you slice and dice their program lines, only about a third of that is IT related. Now, look at just Microsoft's research and development budget for the period ending in June 2012. Microsoft spent almost $10B! That's just one company. Google spends a little less than $2B annually and Intel spends around $2.5B. We simply cannot compete with those numbers and expect to influence the direction of the IT market through direct investment. We really need to figure out how to get on this train rather than complain about not building the tracks.

Expert 2 Response

There will need to be a development cloud (with development network or unconnected connectivity) and an Approved To Operate cloud. There will need to be a learning process on how to write the cloud computing resources into RFPs, proposals, and contracts. Cloud resource providers will need to ensure that resources are sufficient to provide the desired computational resources (and memory and disk space) to satisfy the users. It will not take many instances of someone unable to get the machines that they need before they will give up and simply buy their own machines.

Expert 3 Response

I'm not sure how to overcome these obstacles. The incentive structure probably has to somehow be changed.

Expert 4 Response

Implement aggressive timelines with manageable and measurable milestones to deliver real capabilities incrementally. Don't try to build the whole house at once.

Seek out the little guys. There are hundreds of very small businesses that are hungry to deliver capabilities very cheaply and very quickly. I don't think anyone would equate the large DoD corporations as agile or nimble nor are they willing to sign a contract for six months for $200k. That's not how they became multi-billion dollar companies. That's how you build an F-35.

Simplify scope and requirements. Again, build a little and test a little to build momentum.

Expert 5 Response

The DoD needs to get out of the Cloud business, and offer it as a contract service. Don't try to compete by providing a private cloud on NIPR and all classes of clouds on SIPR. DoD (DISA) should establish security and NetOps criteria and simply broker the services (have contracts available for users, and assist in matching user requirements to providers).

Expert 6 Response

DoD partners and agencies should partner together to build a community that delivers cloud capabilities that can be easily shared for maximum reuse. The community should also engage in following community practices for ATO for 'type accreditation' where any organization and agency that is developing capabilities that achieves accreditation should be able to apply these capabilities. Unfortunately, every agency has its own rules for C&A but should honor a community accreditation approval.

Expert 7 Response

In my view DoD is moving in the right direction. The obstacles faced by DoD fall for the most part in thinking and behaving. The business enterprise of DoD is not that different from a large multinational/global company. Both must have HR, Logistics, Finance, Infrastructure, and other common business functions. DoD has a culture/people/institutional barrier to think and behaving as a business enterprise in areas where that think could benefit them the most. If you want to be an enterprise, think and behave as one.

Expert 8 Response

Managed services approach vs. buying individual capability, long term contracts with clear exit clauses for non-performance, commercially based SLAs, and standard levels of service across the organizations vs. constantly treating every org is a one-off.

Appendix D: Delphi Questionnaires

CLOUD COMPUTING IMPLEMENTATION ORGANIZATIONAL SUCCESS IN THE AIR FORCE

Demographic Questionnaire

Name:
Date:
Title:
Organization:

Instructions

This questionnaire collects specific demographic information, but only generalities will be used when the data is presented. All data will be aggregated or otherwise processed before public release. I understand that the names and associated data I collect must be protected at all times, only be known to the researchers, and managed according to the AFIT interview protocol.
All data will only be handled by the researcher and advising committee. Please feel free to contact me with any questions at 937-541-8169 or e-mail corey.perkins@us.af.mil.

Please answer the following questions

1. In your current position and in regards to cloud computing are you a developer, practitioner, or manager?

2. In your current position are you associated with Industry, the Air Force or the Army?

3. How many years of experience do you have in the IT realm?

4. How many years of experience do you have in the research area of cloud computing success? Delphi Questions

Greetings, welcome, and again thank you for participating! Below are five questions addressing areas of research in regards to cloud computing success. Once received and an alyzed the 2nd pass of questions will follow. Please read the questions carefully, elaborate as much asneeded for each question and *be as specific as possible*. Feel free to ask for explanation onanything you do not understand.
Provide responses to corey.perkins@us.af.mil NLT 21 June, 2013.

QUESTION 1 :
What factors do you see as considering successful cloud computing implementation?

QUESTION 2:
What are your key concerns for successful cloud computing utilization?

QUESTION 3:
What are the main obstacles you envision hindering successful cloud computing implementation?

QUESTION 4:
What do you see as differences between the way industry implements a cloud solution to the way DoD should?

QUESTION 5:
How would you overcome those obstacles and differences?

FOLLOW UP QUESTION:
Is there anything else not covered that could be added?

CLOUD COMPUTING IMPLEMENTATION ORGANIZATIONAL SUCCESS IN THE AIR FORCE

Delphi 2nd Pass

Greetings, welcome, and again thank you for participating! This the second round of the Delphi study. In this round, you are given the responses from round one, our categorization of those responses, as well as two models that attempt to capture causality and process flow. What we ask in this round is that you review the responses, categorization, and models, and then answer the nine numbered questions. Depending on the desired level of effort, this round should take between one and two hours. In the interest of preserving your time, we made some of the questions optional (noted as "EXTRA CREDIT"), as we realize they may take more than the allotted time.

We appreciate your patience as we analyzed the data from Round 1. Upon completion of Round 2 (which should not take as much time as the intervening weeks between Round 1 and Round 2), the finalized model(s) will be resent out for a 3rd pass—essentially a confirmation that we have converged on a final model. Feel free to ask for explanation on anything you do not understand.

As before, all data will be aggregated or otherwise processed before public release. Names and associated data will be protected at all times, only known to the researchers, and managed according to the AFIT interview protocol. All data will only be handled by the researcher and advising committee. Please feel free to contact me with any questions at 937-541-8169. Provide responses to corey.perkins@us.af.mil NLT 30 August, 2013.

Part A :

Below are the responses from pass one listed question-by-question. All responses have been stripped of data indentifying the respondent. Please read them carefully taking these inputs into consideration when filling out Part B.

EXPERT QUESTION 1 :

What factors should be considered for successful cloud computing implementation?

Expert 1 Response

Cloud Computing is a Business Process more than a technology: Fundamentally, implementing cloud computing solutions is about business processes, not buying technologies. Managers must understand that there is no 'out of the box' solution to reducing costs, increasing flexibility or achieving scale by buying something off of the shelf. It is true that this business model is only possible because of great technological improvements, particularly in the areas of: persistent communications, increased bandwidth, high-performance commodity processing hardware and massive distributed storage. Ultimately, technology is only a necessary, but not sufficient condition for cloud computing success. Successfully implementing cloud computing solutions requires a change in business mindset that may be far more difficult to achieve than simply convincing someone to buy or acquire a particular technology.

Programs win in the aggregate, not in isolation: Another critical piece of the puzzle is recognizing that success with cloud generally comes from the aggregation of implementing cloud practices over many programs and business functions. Especially, if the metric for success is cost savings, then this factor holds true even more. Transitioning any particular program to a cloud solution will not likely generate any cost savings if the cloud solution only hosts that one program. For example, the most basic reason that IAAS works is because of multitenancy. If a company implements an IAAS solution, but only hosts one program on that architecture, then that individual program carries all of the capital expenditure burden for not only it's application components, but also for the infrastructure. Without multitenancy in IAAS solutions, the system goes underutilized and the unit cost per computation goes up. If that architecture hosts multiple program simultaneously and performs adequate load sharing (another semi fundamental attribute of cloud architectures) then those capital expenses can be spread across multiple business lines and programs reducing the total burden.

"The aggregate" is not just about multiple programs, but also about time: Another seemingly fundamental aspect of cloud computing is that there will likely be upfront transition/implementation costs that will require management to treat IT as an investment rather than simply as quick fix. This is especially difficult in the government where promises of future savings are rarely fulfilled. To implement a successful cloud computing architecture, managers must realize that there will be costs to build/test/standardize/manage infrastructure, recode/retest software, and many other upfront costs that will need to be addressed. Cost savings will likely only manifest themselves after a sufficient period of time to recuperate the initial investment. The decision gets complicated because for the initial period of time, the cost of continuing with the established architecture will likely be cheaper than paying for the costs associated with transitioning to the cloud. That cost delta takes time to overcome.

Defining the intangible metrics for success: Cost is the easiest and most quantifiable metric, but flexibility and scalability are likely as, or perhaps more, important. Unfortunately, it is very difficult to articulate the "requirement" for either of these areas. It is easy to spot when previous decisions impose severe restrictions to current operations, but it's much more difficult to determine which decisions today will create the biggest ripples down the road. Hindsight is 20/20 and the expedient needs often outweigh the long-term best answers. Fortunately, we have many commercial companies, such as Amazon and Google, (and also simply the Internet at large) as thriving examples of what properly implemented flexibility and scalability can achieve.

Trust: This is the most important factor of all. Cloud computing is about sharing, otherwise there would be no need to move beyond the stove-piped programs that we are so used to. At least in the government, our entire acquisition system is based on hierarchy and accountability. The program manager is responsible for the execution of their entire system. In the old model, trust is established through control (as if the two were truly synonymous). Yet, the modern IT ecosystem does not resemble this model. For example, Netflix hosts video content on Amazon.com. Amazon presents those feeds to Tier 1 ISPs who send them onto many other ISPs. Your ISP serves them through your Motorola Surfboard to your Cisco Router to your Dell Laptop, running Microsoft Windows for playback in a Google Chrome browser. Netflix only 'owns' a very small aspect of that system and must trust (to a reasonable degree) all of the other non-affiliated components along the way. Much of the trust model in this example is established through Service Level Agreements (SLAs) and mangers must grow to accept that third-party providers will perform to the degree outlined in those SLAs.

Expert 2 Response

The framework and implementation needs to be absent of restrictions on what can run. The user has a problem that they want to solve, and the cloud computing infrastructure has to make it as easy (or nearly as easy) to implement as on dedicated hardware. We settled on Amazon EC2 because we could run basically whatever we wanted/needed to, which is not the case in Microsoft's or Google's offering.

The users have to confidence that they will have access to the resources when they need them. When you buy a rack of servers for your project, they are 'yours' and you can (in theory) use them at any time instantly. Reality is different but the sense of control is there. I have started a large number of Amazon EC2 machines (>100 simultaneous 8-core machines) and never had a problem, so I think that whatever I need I can get.

Expert 3 Response

Incentives: Organizations must have the proper incentives to utilize cloud computing. Contractors must have the proper incentives in place to provide applications within the cloud computing environment. Technical: Environment should be vertically integrated to provide seamless access at both a Infrastructure as a Service level and a Platform as a Service level. Bad choices of mismatched products at each level of the stack will lead to poor adoption. Resource management must be built into the core of the environment to allow for the seamless, automated allocation of resources based on policy and not manual allocation based on trouble ticket like requests to a help desk.

Expert 4 Response

Common understanding. There are many terms being used to describe what "cloud" is/isn't which has caused a significant amount of confusion. A significant portion of the populace only think of the “cloud” from Apple, Google, Amazon or IBM commercial offerings to store and access data. They don’t understand that there are utility and analytic clouds as well. The picture gets muddier when other terms like "net-centric," "SOA," "IaaS," "PaaS," "SaaS," etc. are discussed.

Interconnectivity. Just as cellular service, email and Internet providers evolved through a phase where it was difficult to talk across the proprietary networks without significant costs, cloud architectures must do the same.

Data access. There isn't enough money to convert existing data stores to Accumulo/Big Table so we need to be able to access and integrate data from "legacy" systems M2M with near zero data latency. Our warfighters have come to expect the same kind of unhindered information access in their professional work that they enjoy in their private lives.

Expert 5 Response

Reliability: Solution needs to be up all the time

Performance: Low latency from the standpoint of uploads, downloads, and use of the cloud for computing/applications

Security: Traditional IA security as well as data integrity

Cost: Cost needs to be reasonable. If we can't save money with the cloud solution, then why use it?

User understanding – What do the user's know about cloud computing? Does it meet or beat their expectations? Do they understand non-monetary benefits (e.g., data access anywhere in the world, etc)

Expert 6 Response

The factors for successful cloud computing implementations are a 'good' customer, an environment capable of supporting the implementation, minimal environmental inertia (i.e. minimal political churn preventing implementation), and mature technical IQ of all staff involved.

Expert 7 Response

Using cloud computing is more of a business decision than a technology decision. Cloud computing enables you to conduct certain business activities better and multiplies the impact of better business transactions in three distinct areas; 1) Productivity Improvements, 2)Lowered Total Cost of Ownership (Cost Avoidance) and 3)Hard Dollar Savings through reduced Capital, Plant, and Equipment. Cloud computing is a "Combat Multiplier" and that multiplier is Value. To implement successfully you must have a strong Policy and Governance Structure, A Business Model/Process Architecture, and a Solution Architecture.

Expert 8 Response

Understanding and definition- across the board the term "cloud" has different definitions and even when the definitions "appear" similar, the intent and what is included can be substantially different. Commercial vs Army vs USAF vs DoD- no standard. Means SLAs (service level agreements) and pricing are all over the map vs clear standards that can be evaluated and priced to ensure "best value" and common levels of predictable delivery.

EXPERT QUESTIONS 2:

What are key concerns for successful cloud computing utilization?

Expert 1 Response

Unfortunately, many of the "factors" that I identified above are also the primary concerns. Take, for instance, an example where two or more users agree to share the cost of a common hardware infrastructure. Who gets priority when there is contention for resources? This may be something that users can agree to in the design phase, but it may be much more difficult for the "losing" program to explain to their customers or their supervisors when their program does not perform in operations as it would have if the underlying infrastructure had been dedicated and purposefully built for their sole use.

Properly understanding the statistical nature of all aspects of cloud computing will help managers make sound long-term, cost/performance trades, but these sound decisions in the past may not pass the test when the rubber meets the road. I often ask people a couple of simple questions to highlight this phenomenon. First, I ask when was the last time their Gmail account was down? Most will say never. Second, I'll ask when was the last time their work e-mail was down, most will remember these outages quite vividly. Yet the times when Gmail or Amazon Web Services do go down it is a huge news event. For some reason we seem inherently comfortable with mistakes, so long as they are our own, but we fail to capitalize on the opportunities for better performance when someone else may impose mistakes upon us, even if there will be far fewer mistakes overall. This mindset needs to go if we want to be successful in this arena.

Expert 2 Response

Technically, the overhead needs to be kept to a minimum and the barrier to entry needs to be kept low enough that any application could feasibly be 'moved to the cloud'. For example, I was presented with computational resources for a particular project where the physical machines were sufficient. However, they required me to use a platform, namely Oracle Grid Engine, to manage the software that was not a good fit for my application. The result was a loss of time and money.

Programmatically, for commercial cloud computing, I know that I can get the machines that I need and know how much to pay for them (X cents per hour, I know how many hours I am using, and at the end of the month, Amazon sends me a bill). For a DoD cloud computing implementation, my concern is that it will be wrapped with so many gatekeepers and layers of bureaucracy that it will be almost impossible to get the machines I need in a timely manner, when I need them, and at a project cost that is reasonable.

Expert 3 Response

Innovative applications that users find valuable are critically important. Useless or difficult to use software will hinder cloud computing utilization.

Expert 4 Response

Clear Objectives. "Cloud" technologies offer tremendous promise; however, it seems that the "buzz" has overtaken critical evaluation of what is to be achieved. What is the "cloud" to provide? Is it for data center consolidation, large data analytics, web-services, cyber-security, etc.?

Policy. One of the most significant challenges will be to develop the information sharing mindset and implement powerful guidance/standards to force the issue. Despite numerous senior leader decrees, directives and orders, organizations still think they “own” the data.

Security. With improved access and availability of data/information, the importance of maintaining security and integrity of the data becomes paramount.

Interconnectivity. A lot of companies are having a hard time adjusting to a new business model for DoD information systems. Many are proposing to simply build more proprietary data handling architectures and analytic tools with no real added benefit of providing ubiquitous access to all data/information.

Expert 5 Response

Adequate advertising/marketing to ensure the customer understands the utility of the cloud and the DoD brokering process.

For the DoD, a big concern is likely the fact that DISA is the broker for cloud as directed by the DoD CIO, and at the same time, DISA is a cloud provider. This is an inherent conflict of interest that will raise concern when a DISA cloud service is chosen when the user doesn't feel it's the right decision.

DISA's reputation is likely a road block to service utilization. Many IT/COMM personnel's DISA experience, whether with Host Base Security System (HBSS), DoD Enterprise Email (DEE, US Army the first adopters), or Defense Enterprise Portal Services (DEPS – SharePoint services), have a sour view of DISA's ability to provide quality service (HBSS), with low latency (DEPS), and ease of access (we've had CAC authentication blunders) is an area of concern.

Expert 6 Response

My main concerns are lack of a 'good' customer base both for implementation and utilization, organizational churn, and a weak support model.

Expert 7 Response

Security- You must pick the right computing model for security to be as effective as possible. Do not select a public cloud and expect it to be as secure as a trusted private cloud.

Not everything belongs in a cloud. The most effective implementations are enterprise-wide common business tasks with high demand and high transaction rates.

Most implementation fail because they did not have a mature business model/enterprise business model from the start.

Expert 8 Response

Technical ability to execute is not the major challenge- two major issues evolve around (1) "discovery"- what is present and what is to move to a/the cloud (2) levels of performance-expectations- goes back to defining and establishing what is to be delivered for the agreed upon level of effort/price.

EXPERT QUESTION 3:

What main obstacles would hinder successful cloud computing implementation?

Expert 1 Response

The government budget cycle: It works for acquisition programs that span many years, but it not well suited to ill or undefinable requirements that are subject to change rapidly. To steal a quote from my MILCOM paper "DoD acquisition managers are under constant pressure to maintain currency across their enterprises and meet ever changing requirements over an increasingly complex infrastructure. It is extremely difficult to achieve such lofty goals under layers of bureaucracy and a six-year Planning, Programming, Budgeting, and Execution (PPBE) cycle. Information technologies are driven by the dynamic market trends and can rarely, if ever, be predicted years in advance through a centralized requirements process." 2) Outdated acquisition mindsets*:* It's actually the mindsets that aren't working. If you study DOD acquisition, there are plenty of "processes" for acquiring programs rapidly, managing risk, and coping with unforeseen changes, but we rarely use them appropriately for implementing modern IT.

Outdated policies: This probably flows from the previous obstacle, since the mindsets create the mental schema's that inform the policies, but it's real nonetheless. The Federal CIO office has made quite a few important strides in the area of cloud and now the rest of the government needs to catch up… especially the DoD. The DIACAP policies practically discourage change and force vendors to modify their commercial implementations to such extremes that we become the sole customer for many products. As soon as our path forks from the broader market, we are doomed to foot the bill for all of the associated costs... we lose all of the economies of scale. We are our often our own worst enemy here.

The threat of "cyber"*:* We have seen a tremendous increase in the "awareness" of the cyber threat over the last five years, but awareness and understanding are two entirely different things. Fear plus technological illiteracy equal irrationality. Rather than embracing new opportunities, I'm afraid that fear of the unknown will cause us to further hunker down in the old, comfortable ways of doing business (ones that are often technologically much less secure, but organizationally more accountable).

Expert 2 Response

The inability to run necessary applications (in their current form) such as restrictions on language/resources available.

An inability to quantify the gains (in time and/or money) in implementing a solution using the cloud.

Expert 3 Response

I believe that the acquisition process of not only the cloud computing environment itself but for the applications themselves is the main obstacle to successful cloud computing implementation. The acquisition of the cloud computing environment must ensure a true open environment for applications and not an environment that locks in certain industry players or teams and locks out small players. New application are more likely to come from new or hungry companies as opposed to the large contractors - which will attempt to game the acquisition process. Attempts to port legacy software may hinder the success of cloud computing because it will be expensive. The current incentive structure for the incumbents with the existing contracts are for it to be difficult and expensive.

Expert 4 Response

Old think. Too many policies from acquisition, IT management, IC vs. DoD, large Programs of Record, etc. aren't enabled to rapidly develop, transition and evolve to maximize the advantages of "cloud" technologies.

Service advocacy. Senior leaders appear reluctant to commit to this "new" technology without some kind of demonstration but without their "buy-in" it is difficult to solicit for data access, acquire funds or start breaking glass on how we currently collect, manage, evaluate and distribute information.

Migration/evolution from existing PoRs. There are a number of extremely large programs that could benefit significantly in cost, performance and schedule if they adopted "cloud" technologies. The issue is that they are large PoRs with very sizable contractual commitments and are either unwilling or unable to embrace the opportunities. An example of this is the JMS program. Current cost of the system is approaching $750M with no end in sight. Implementing a "cloud-based" solution could be done for approximately $125M in 24 months with senior leader advocacy.

Evolution Roadmap. The DNI has developed a strategy. The DoD CIO has a strategy as does each IC agency. The challenge is that implementation is currently being downward directed and the path to interconnected systems is so dynamic that developers are having a difficult time staying in synch with the enterprise.

Expert 5 Response

DoD funding, DoD cost for SIPR solutions (note that there are, I believe, two commercial SIPR cloud providers, but will be in direct competition with DISA).

Unbiased cloud service brokering processes.

Requirements gathering and vetting and ultimately translated into the right service, right vendor, right cost, etc.

The ability to implement private, public, and hybrid cloud solutions across 2 security enclaves (NIPR & SIPR) and the need for a JWICs solution.

Expert 6 Response

The main obstacles are unclear / ambiguous requirements, an unsupportive customer, a technically immature environment (both environment and IT IQ), and lack of overall organizational support.

Expert 7 Response

The expectation of a vast monetary ROI from cloud computing is an illusion. The proper measure of a successful implementation is VALUE and how value should be measured becomes the key critical driver. Cloud computing is delivering a service and to be successful the service must be of value to the customer. The truth of the matter is cloud services could cost more to deliver than the legacy system it is replacing. However, if the service provided is valuable to the customers using it, the environment will deliver value through higher rates of usage, productivity improvements and other "soft" benefits. Classic ROI does not do well in a cloud environment. Some leaders will not understand that.

Expert 8 Response

Customer/client actually knowing what they want/what they expect for the price/level of effort and to establish long term partnerships to allow for continued growth/effectiveness/efficiencies. Many times the client/customer is not sure of what they currently have and therefore not sure of the business case for change- how do they ensure they get what they need and do so in a more cost efficient, reliable manner- with the level of security and future capability that is required.

EXPERT QUESTION 4:

What are the differences between the way industry implements a cloud solution to the way DoD should?

Expert 1 Response

The DOD is not risk averse, its change averse… otherwise we wouldn't accept all of the risks associated with our current IT architectures. Industry is far better at managing risk, when it comes to IT services than the DOD. We often eschew private enterprise because of their desire for profit and we assume that they "cut corners" on security. I have found just the opposite to be true for many established cloud computing vendors. In the cloud computing space, there are not significant barriers preventing consumers from switching from one provider to another. A sufficient security breech could result in a tremendous loss of revenue as consumers make that change. These financial realities make security a top priority.

Expert 2 Response

Industry tends to run on a best effort. The DoD would require stability, security, and compartmentalization of the cloud in order to protect assets and information.

Many DOD projects do not just have an external security concern, but also an internal one. Since I do development, what I run on my servers is something that I should not have to go through a huge effort to get onto the cloud servers. When I have access to a rack of servers, correctly separated from the rest of the network, then I can put software on it during development, but there would seem to be issues in doing that with a shared resource in a DoD environment. Also, it is not the case that development can be done on a noncloud computing environment, approved (getting an ATO) and then putting it on the cloud.

The cost allocation for computational resources is also very different. A commercial project or a DoD contract project sets aside a certain amount of ODCs and they are used to buy equipment. Using a cloud computing solution confuses the situation since they are closer to services, and so there needs to be a shift in the way that the money is spent, and project managers, COTRs, contracting officers need to understand it.

Expert 3 Response

Industry has much larger numbers of companies to build cloud applications and these companies have incentives to do so. DoD has a relatively tiny number and these companies have no incentive other than the labor dollars they will get paid to do so. Development labor is a small fraction of the revenue of these companies - so an environment that reduces their O&M revenue will make cloud computing very difficult for these companies to truly get on board with.

Expert 4 Response

Sense of urgency. Time is money in the business world. If a solution can save money while simultaneously saving time, they're much more willing to take the risks. Additionally, businesses are constantly challenged by their competitors so they don't have the luxury of exhaustively studying their options like the DoD.

Risk. Industry tends to build a little, test a little and adjust the course of development. DoD, on the other hand, spends so much time investigating the options that by the time a requirements document is presented for bids, the requirements will frequently be unable to reflect the current state of technology. There is some merit to this because DoD generally measures risk by lives saved versus dollars spent but it's almost to the point of stagnating progress.

Leadership. Most military leaders have not been promoted for being innovative. Just as with our federal bureaucracy, change comes very slowly. Commercial adoption of technology is driven by market share and business leaders recognize that if they don't move, they may not be here tomorrow.

Expert 5 Response

From the Operations Community is maintaining situational awareness to the granularity the DoD has grown to expect.

Actual service level provided vice service level paid for. For example, DISA hosts applications in the Defense Enterprise Computing Centers (DECCs), and these systems have a Mission Assurance Category (MAC) applied to them which has an associated cost. If the Marine Corp Online systems goes down, a general officer to general officer call is made, and it is treated as a MAC I (mission critical, restoration time within a few hours, etc) even though the USMC isn't paying for that level of service (which has no MAC associated with it, which means we have say 4 days to address the problem).

DoD has different security rules/processes than commercial providers, and I think ours tend to be more strict, which may drive up our cost, increase implementation time, etc.

Traditionally, the DoD isn't about making money and some of our organizations are inflated due to geographic location. This drives the price up, and I think it will be hard for us to compete financially with commercial providers.

DoD often has complicated ATO and DAA processes to operate systems on a DoD network. The commercial sector may not have this issue. It certainly affects our ability to be agile around customer needs.

Expert 6 Response

The DoD has been adopting capabilities in a manner that Industry has been delivering them. The DoD use cases and implementation are different than the Industry use cases. In addition, the emphasis on C&A, IA controls, and ATO'd environments delay most if not timely implementations.

Expert 7 Response

DoD seems to acquire a solution before they have defined the problem it's supposed to solve. Industry will define the problem from various perspectives and then explore solutions that deliver the highest value for the most reasonable price.

Expert 8 Response

Commercial industry finds a long term partner who is a proven expert in the field (has the experience and the capability), hands over the mission, looks for long term associations where benefits are shared (e.g. the commercial provider saves the client money and makes money from that savings- direct benefits from quality work and providing efficiencies and improved performance). Commercial clients focus on the SLAs and not what is behind the door- the reason they hired an expert to do the work. DoD has a since of doubt- they must check and control everything vs. a managed services approach based on delivery of a product of the quality and capability required and at a price incentivized by performance and efficiency/cost savings.

EXPERT QUESTION: 5

How could those obstacles and differences be overcome?

Expert 1 Response

Embrace sequestration! Our fiscally constrained environment will force us to chart new territory (at least new to the DOD). The good news is that we have many examples of how private industry is successfully leveraging cloud implementations to their great benefit. All we need to do is follow. That's hard for us, especially since we are the industry driver in most other aspects of the DOD (fighter airplanes, most satellites, tanks, etc). This isn't so in the information technology space. We are a drop in the overall bucket. For example, according to DARPA's website (www.darpa.mil/WorkArea/DownloadAsset.aspx?id=2147486441), their 2014 budget submission was ~$2.8B and depending on how you slice and dice their program lines, only about a third of that is IT related. Now, look at just Microsoft's research and development budget for the period ending in June 2012. Microsoft spent almost $10B! That's just one company. Google spends a little less than $2B annually and Intel spends around $2.5B. We simply cannot compete with those numbers and expect to influence the direction of the IT market through direct investment. We really need to figure out how to get on this train rather than complain about not building the tracks.

Expert 2 Response

There will need to be a development cloud (with development network or unconnected connectivity) and an Approved To Operate cloud. There will need to be a learning process on how to write the cloud computing resources into RFPs, proposals, and contracts. Cloud resource providers will need to ensure that resources are sufficient to provide the desired computational resources (and memory and disk space) to satisfy the users. It will not take many instances of someone unable to get the machines that they need before they will give up and simply buy their own machines.

Expert 3 Response

I'm not sure how to overcome these obstacles. The incentive structure probably has to somehow be changed.

Expert 4 Response

Implement aggressive timelines with manageable and measurable milestones to deliver real capabilities incrementally. Don't try to build the whole house at once.

Seek out the little guys. There are hundreds of very small businesses that are hungry to deliver capabilities very cheaply and very quickly. I don't think anyone would equate the large DoD corporations as agile or nimble nor are they willing to sign a contract for six months for $200k. That's not how they became multi-billion dollar companies. That's how you build an F-35.

Simplify scope and requirements. Again, build a little and test a little to build momentum.

Expert 5 Response

The DoD needs to get out of the Cloud business, and offer it as a contract service. Don't try to compete by providing a private cloud on NIPR and all classes of clouds on SIPR. DoD (DISA) should establish security and NetOps criteria and simply broker the services (have contracts available for users, and assist in matching user requirements to providers).

Expert 6 Response

DoD partners and agencies should partner together to build a community that delivers cloud capabilities that can be easily shared for maximum reuse. The community should also engage in following community practices for ATO for 'type accreditation' where any organization and agency that is developing capabilities that achieves accreditation should be able to apply these capabilities. Unfortunately, every agency has its own rules for C&A but should honor a community accreditation approval.

Expert 7 Response

In my view DoD is moving in the right direction. The obstacles faced by DoD fall for the most part in thinking and behaving. The business enterprise of DoD is not that different from a large multinational/global company. Both must have HR, Logistics, Finance, Infrastructure, and other common business functions. DoD has a culture/people/institutional barrier to think and behaving as a business enterprise in areas where that think could benefit them the most. If you want to be an enterprise, think and behave as one.

Expert 8 Response

Managed services approach vs. buying individual capability, long term contracts with clear exit clauses for non-performance, commercially based SLAs, and standard levels of service across the organizations vs. constantly treating every org is a one-off.

Part B :

This section contains three items: first, a table listing what we think may be the main seven drivers of Cloud Implementation success, based on the responses. Second, a model showing how these items may lead to success. Third, a process model showing how success is bred, and the general order of events in which the task progresses. The instructions for each of these sections is listed at the top of each section. As you accomplish this, keep in mind the task: *determine what will cause "successful cloud computing implementation in the Air Force."*

B1. These tables contain categorized causes based on expert responses. They also contain inputs that were identified to support the cause (hyperlinked to where they were mentioned within the responses, by ctrl-click you can view an elaboration about the input). Once validated by the experts these causes will be incorporated into the model. Please comment on the following:
For each of the sub-items, please note whether you feel it will positively effect cloud computing success (+), negatively effect (-), or perhaps both (+/-), and add explanations as desired.
Rank each cause from 1-7 for successful cloud computing implementation in the Air Force.
EXTRA CREDIT. Do you agree with the categories and the items they contain? If not, please modify them or create your own categorization.
EXTRA CREDIT. Did we miss something, or is there anything you would like to add based on review of each others' comments (written comments)?

Cause		Supporting Inputs (References to expert responses)	Pos. or Neg. Effect	Effect
Access			?	Cloud computing success
		Aggregate Programs into the cloud		
		Limit Restrictions		
		Access		
		Data access		
		Sharing Resources		
		Min. barrier to entry		
		Application restrictions		
		Ability to implement across NIPR and SIPR		
		DoD requires compartmentalization		
		Computational services		
		Ensure sufficient resources		
		Managed service approach vs. buying individual capability		

Cause		Supporting Inputs (References to expert responses)	Pos. or Neg. Effect	Effect
Reliability			?	Cloud computing success
		Define Intangibles (Scalability and Flexibility)		
		Interconnectivity		
		Reliability		
		Performance		
		Interconnectivity		
		Levels of performance expectations		
		DoD requires stability		

Cause		Supporting Inputs (References to expert responses)	Pos. or Neg. Effect	Effect
Budget				Cloud computing success
		Sufficient Time for Investment		
		Cost		
		Min. overhead		
		Government Budget Cycle		
		DoD funding		
		Illusion of a vast monetary ROI		
		Prices driven up due to inflated units because of geographic location		
		Leverage a larger IT budget		
		Long term contracts with exit clauses for non-performance		

Cause		Supporting Inputs (References to expert responses)	Pos. or Neg. Effect	Effect
Understanding			?	Cloud computing success
		Incentive to use cloud computing		
		Common Understanding		
		User understanding		
		Recognize the business aspects…productivity improvements, lowered total cost of ownership and hard dollar savings		
		Understanding and definition		
		Manager Understanding of metrics		
		Weak support model		
		Not everything belongs in the cloud		
		Discovery…what is present and where to go		
		Outdated Acquisition Mindset		
		Cyber Threat "Awareness" vs "Understanding"		
		Inability to quantify gains		
		Old think		
		Unbiased brokering service		
		Unclear/ambiguous requirements		
		Leaders not understanding the benefits short of a ROI		
		Customer knowing what they want…reliability, security, efficiencies, effectiveness		
		Leverage Cloud Benefits		
		Learning process to write RFPs, proposals, and contracts		
		Change the incentive structure		
		Implement aggressive timelines		
		Simplify scope and requirements		
		If DoD wants to be an enterprise then think and behave as one		

Cause		Supporting Inputs (References to expert responses)	Pos. or Neg. Effect	Effect
Security			?	Cloud computing success
		Trust		
		Security		
		Security		
		Security priority		
		DoD requires security		
		Risk		
		Different security protocols in DoD		

Cause		Supporting Inputs (References to expert responses)	Pos. or Neg. Effect	Effect
Standards			?	Cloud computing success
		No standard between DoD agencies		
		No standard SLAs that provide "best value"		
		Policy		
		Conflict of interest, DISA is the cloud broker and cloud provider		
		Outdated Policies		
		Acquisition process		
		Migration/evolution from existing PoRs (??)		
		Evolution Roadmap		
		Provided service level vs. service level paid for		
		Complicated ATO and DAA process to be on networks		
		DoD use cases and implementation are different		
		C & A, IA controls, and ATO'd environments delay implementation		
		Industry focuses on SLAs not what lies "behind the door"		
		Development cloud and an ATO cloud		
		Agencies honor community C & A accreditation approval		
		Commercial based SLAs		
		Standard levels of service		

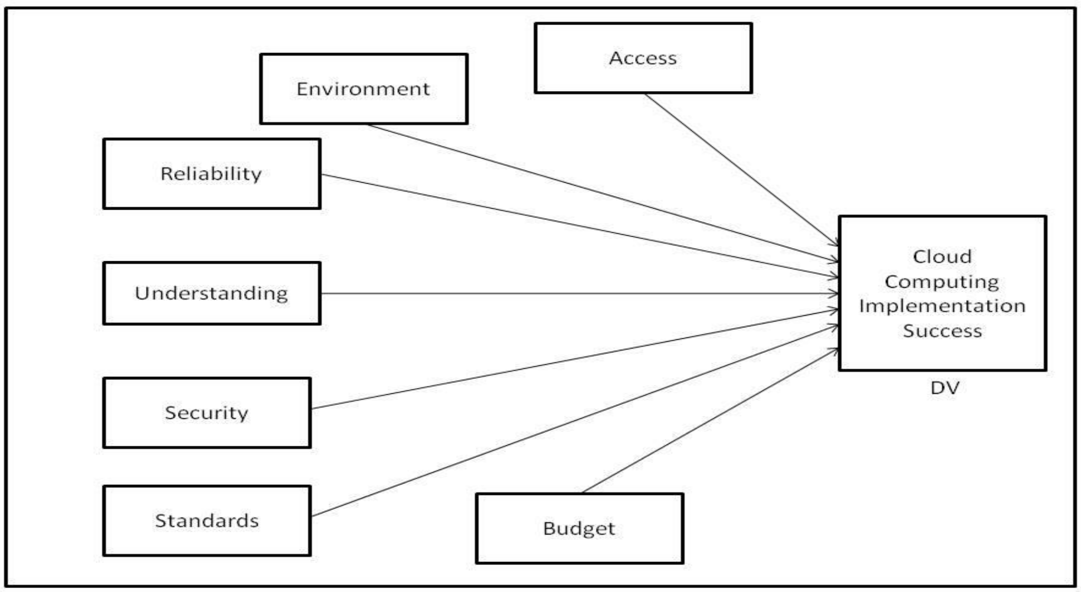
Cause		Supporting Inputs (References to expert responses)	Pos. or Neg. Effect	Effect
Environment			?	Cloud computing success
		Cloud as a Business Process		
		"Good" customer environment		
		Environment supports implementation, min. environmental inertia, and technical IQ of staff		
		Excessive beaurocracy creating excessive timeline		
		Innovative applications		
		Adequate advertising/marketing		
		DISA reputation		
		Lack of "good" customer base for implementation and utilization		
		Organizational churn		
		Mature business model/enterprise business model		
		Service advocacy		
		Unsupportive customer		
		Technically immature environment		
		Lack of organizational support		
		DoD is change adverse		
		Industry uses best effort		
		Incentives for industry to build applications		
		Sense of urgency		
		Leadership		
		Maintain situational awareness to the extent that DoD has grown		
		DoD acquires solution before defining the problem		
		Industry defines problem from various views that provide highest value		
		Industry uses long term partners with required expertise		
		DoD doubt....they must "check and control everything"		
		Seek out the little guys		
		DoD needs to get out of cloud business and offer cloud as contract service		
		DoD partners and agencies should partner together to deliver cloud cap. for max reuse		

B2. A "variance" model is a "cause and effect" model. It provides an explanation of how input variables "cause" an output—or dependent—variable (Cloud Computing Implementation Success, labeled as the "DV" in the model). These factors can have a positive or negative effect on that variable, also any number of additional factors could have an effect on the output variable. This type of model can be translated into a mathematical equation (Y = X + Z + … n).

Do you agree with the categories/model? If not, please feel free to produce your own model of the type shown, or use pen-and-ink to alter it in a way that makes more sense from your perspective.

For each of the input variables, please note whether you feel it will positively effect cloud computing success (+), negatively effect (-), or perhaps both (+/-), and add explanations as desired (feel free to write the symbols next to the arrows on the diagram).

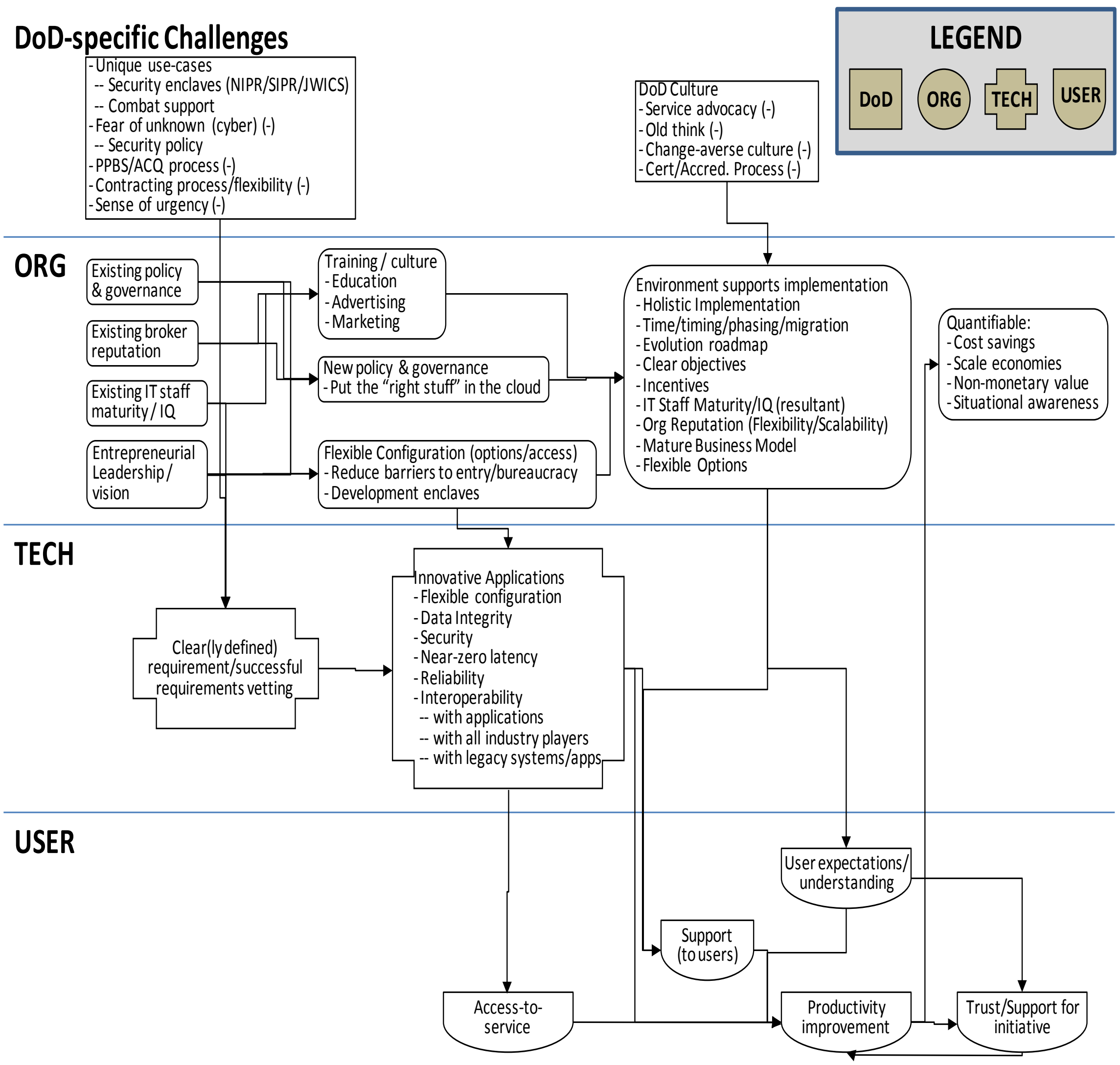
EXTRA CREDIT. Is there anything you would like to add based on review of each other's comments (written comments)?



B3. A process model provides a rational explanation of processes by evaluating possible courses or paths based observed factors. It provides "linkage" between those factors, where one needs to be fulfilled before moving to the next until the model is complete. Also, process models may contain feedback loops between any identified factors within the model.

Do you agree with the categories/model? If not, please feel free to produce your own model of the type shown, or use pen-and-ink to alter it in a way that makes more sense from your perspective.

EXTRA CREDIT. Is there anything you would like to add based on review of each other's comments (written comments)?



CLOUD COMPUTING IMPLEMENTATION ORGANIZATIONAL SUCCESS IN THE AIR FORCE

Delphi 3rd Pass

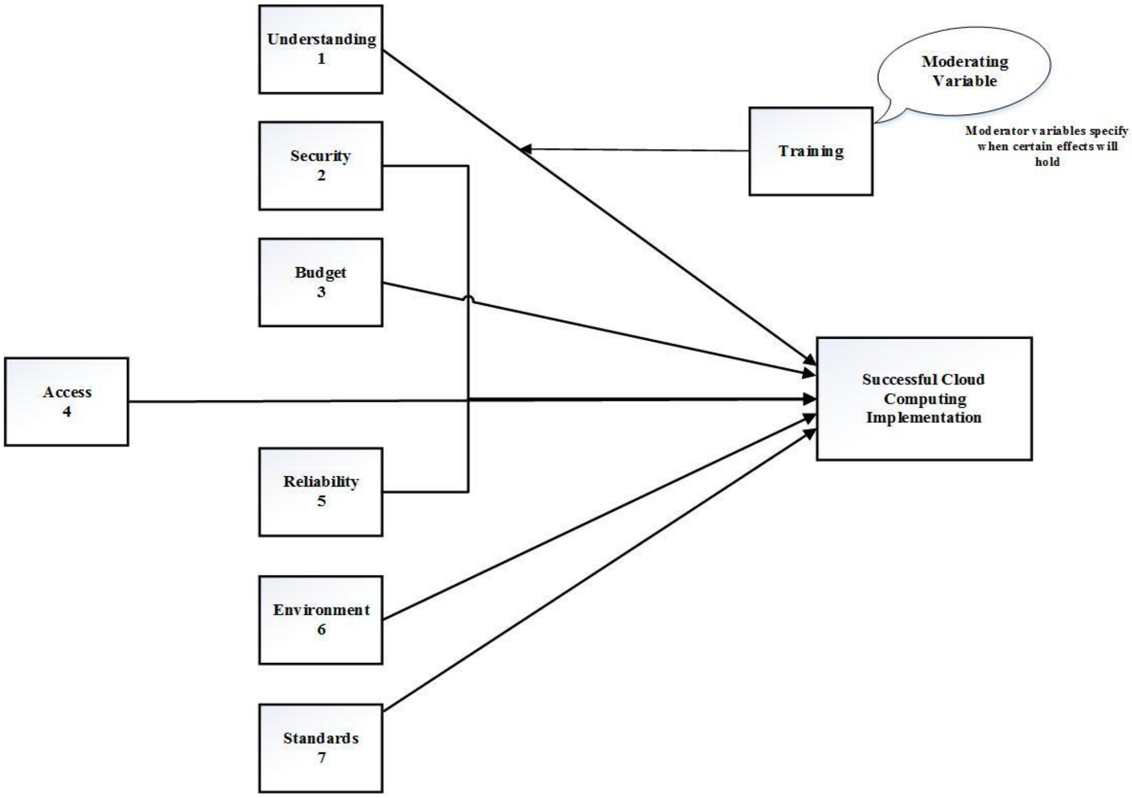
Greetings, welcome, and again thank you for participating! This the 3rd and last round of the Delphi study. In this round, you are given the final models to review. What we ask in this round is that you review the models and select concur or concur with comments in the identified section. Depending on the desired level of effort, this round should take no more than 15 minutes. In the interest of preserving time, no response will be taken as a concurrence to both models.

We appreciate your patience as we analyzed the data from Round 1 and Round 2. Upon completion of Round 3, these finalized model(s) will be represented in the research thesis—essentially a confirmation that we have converged on final models. Feel free to ask for explanation on anything you do not understand.

As before, all data will be aggregated or otherwise processed before public release. Names and associated data will be protected at all times, only known to the researchers, and managed according to the AFIT interview protocol. All data will only be handled by the researcher and advising committee. Please feel free to contact me with any questions at 937-541-8169. **Provide responses to corey.perkins@us.af.mil NLT 15 November, 2013.**

Part A :Variance Model

A "variance" model is a "cause and effect" model. It provides an explanation of how input variables "cause" an output—or dependent—variable (Cloud Computing Implementation Success, labeled as the "DV" in the model). These factors can have a positive or negative effect on that variable, also any number of additional factors could have an effect on the output variable. This type of model can be translated into a mathematical equation (Y = X + Z + … n).



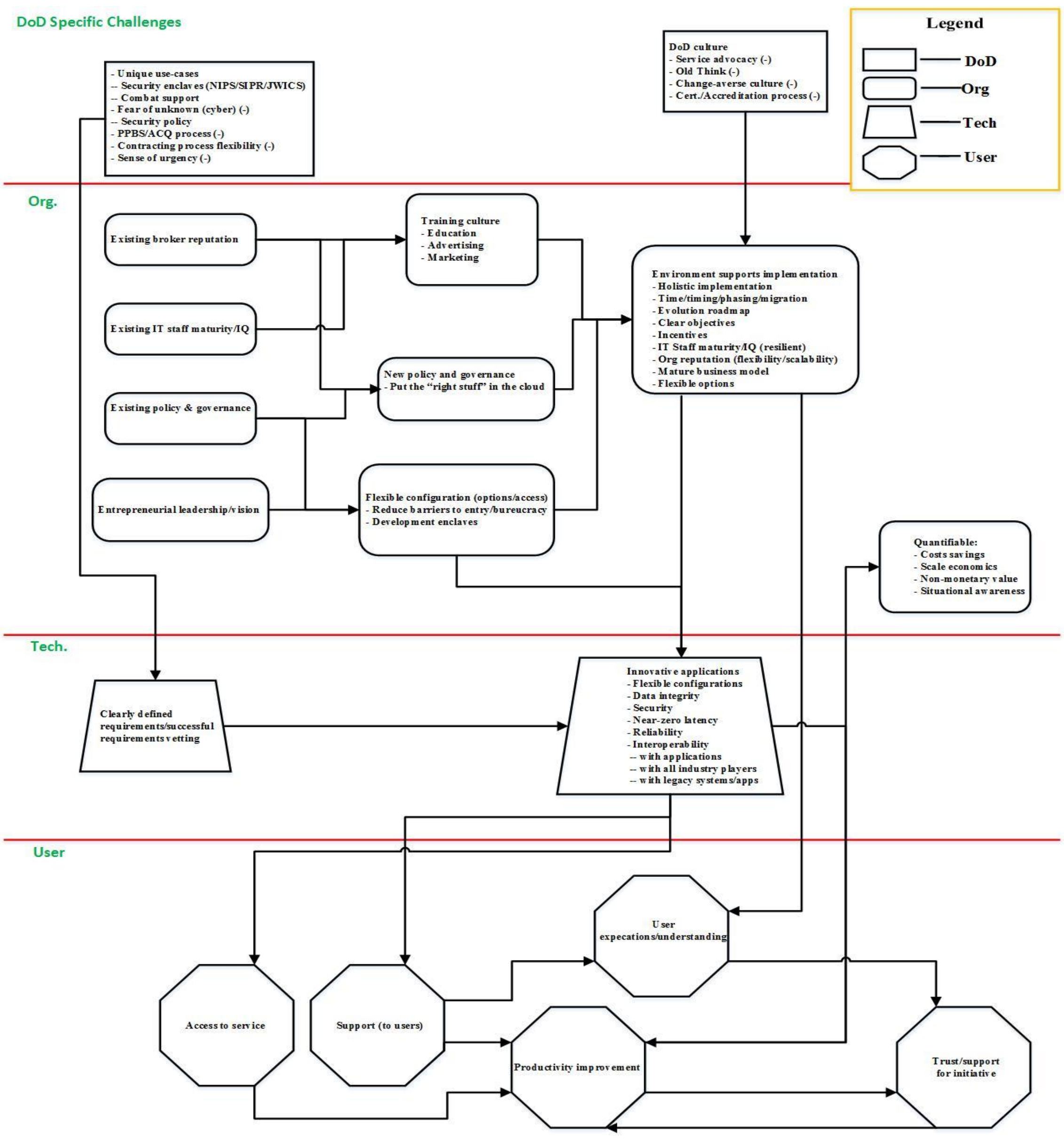
Please select option and input comments as needed.

☐ Concur

☐ Concur with Comments

Part B : Process Model

A process model provides a rational explanation of processes by evaluating possible courses or paths based observed factors. It provides "linkage" between those factors, where one needs to be fulfilled before moving to the next until the model is complete. Also, process models may contain feedback loops between any identified factors within the model.



Please select option and input comments as needed.

☐ Concur

☐ Concur with Comments

Appendix E: IRB Waiver Request

6 May 2013

MEMORANDUM FOR 711 HPW/IR (AFRL IRB)

FROM: AFIT/ENV (Lt Col Darin Ladd)
2950 Hobson Way
WPAFB OH, 45433-7765

SUBJECT: Request for exemption from human experimentation requirements (32 CFR 219, DoDD 3216.2 and AFI 40-402) for cloud computing Delphi study.

1. This exemption request is based on the Code of Federal Regulations, title 32, part 219, section 101, paragraph (b). The following information is provided to show cause for this exemption.

2. Purpose. The purpose of this study is to ask experts questions regarding cloud computing implementation. The questions will be asked using the Delphi research method utilizing multiple passes to formulate accurate results. Aggregated results and sporadic quotations may be published in a peer-reviewed project management outlet.

3. Subjects. The subjects chosen for these questions are experts in DoD and throughout industry. Demographic information is not available for these subjects, and random sampling is not used to identify participants—although snowball sampling may be used. The actual number of subjects will vary; however, between 7 and 10 individuals may participate.

4. Timeframe: May 15, 2013 - March 1, 2014

5. Data collected: This study will collect specific demographic information, but only generalities will be used when the data is presented. The only information collected from participants is that at attachments (Tabs 1-2). All data will be aggregated or otherwise processed before public release. Interview consent forms will be stored separate from interview responses, reducing the possibility that responses may be linked with individual participants. Answers will be stored digitally to allow the researcher to properly review responses (especially quotes). Responses will be kept for the required 24 months, and then destroyed. I understand that the names and associated data I collect must be protected at all times, only be known to the researchers, and managed according to the AFIT interview protocol. All data will only be handled by the following researcher and advising committee:

Researcher/Student: MSgt Corey J. Perkins
Primary Investigator/Committee Chair: Lt Col Darin A. Ladd
Committee Members: Lt Col Brent T. Langhals and SMSgt Jeffrey C. Sandusky

6. Risks to Subjects: The primary risk is disclosure of individual responses or private information. In the case of quotations, it may be possible for a reader to identify an individual based on his/her quotation. For this reason, the researcher will allow the participants to review and redact their quotations, if desired. The subjects discussed are lawful and mostly non-sensitive; however, the participants are more senior leaders for whom, if their candid responses were linked to their person, could cause discomfort but likely not adverse action. If a subject's future response reasonably places them at risk of criminal or civil liability or is damaging to their financial standing, employability, or reputation, I understand that I am required to immediately file an adverse event report with the IRB office.

7. Informed consent: All subjects voluntarily participate. No adverse action is taken against those who choose not to participate. Subjects are made aware of the nature and purpose of the research, sponsors of

the research, and disposition of the survey results using the attached consent form (Tab 4). A copy of the Privacy Act Statement of 1974 is presented for their review.

8. Please feel free to contact me with any questions at 785-6565, x4228, or darin.ladd@afit.edu.

X

DARIN, A. Ladd, Lt Col, Ph. D., USAF
Director, Communications & Information, AFIT

2 Attachments:
1. Delphi Questions
2. Delphi Consent Form

Tab 1: Delphi Questions

Research Questionnaire

Proposed questions to experts:

EXPERT QUESTION 1:

What factors should be considered for successful cloud computing implementation?

EXPERT QUESTIONS 2:

What are key concerns for successful cloud computing utilization?

EXPERT QUESTION 3:

What main obstacles would hinder successful cloud computing implementation?

EXPERT QUESTION 4:

What are the differences between the way industry implements a cloud solution to the way DoD should?

EXPERT QUESTION: 5

How could those obstacles and differences be overcome?

FOLLOW UP QUESTION:

Is there anything else not covered that could be added?

Tab 2: Delphi Consent Form

6 May, 2013

Greetings! You are being asked to take part in a research study carried out by MSgt Corey J. Perkins, a student at the Air Force Institute of Technology (AFIT). This form explains the study and your part in it if you decide to join. Please read the form carefully. Feel free to ask for explanation on anything you do not understand. If you join the study, you can change your mind later or quit at any time, without any penalty or loss of services or benefits.

Study Title: Cloud Computing Implementation Organizational Success In The Air Force.

Primary Researcher:

Name	Title/Department	E-mail	Telephone
Darin Ladd	Director, Communications & Information, AFIT	Darin.ladd@afit.edu	DSN: 785-6565, x4228

What is this study about? This research study investigates the factors that will affect the successful implementation of cloud computing Software as a Service in the Air Force by the Defense Information Service Agency (DISA). You are being asked to take part in this study because you are in a position to answer the q questions of interest. Taking part in the study will take about 30-45 minutes per session over 3-4 sessions.

What will I be asked to do if I am in this study? If you take part in the study, you will be asked to answer five questions in multiple "passes." Each pass should not take more that 30-45 minutes of your time. The passes will be conducted electronically via e-mail with the researcher. On the first pass experts will be given two weeks to answer a set of pre-determined "vague" questions that will be asked to give the experts a chance to elaborate their answers. Once the answers are received, they are collected, analyzed and like factors will be grouped together. One week later a summary of the collected responses will be sent to the panel for further clarification regarding their view on validity of the first responses. The experts will once again get two weeks to respond to the "second pass." Within one week this additional data will be consolidated into a model containing the identified factors. On the "third pass" the model is sent back out to the panel for validity and comment, once again it should be returned within a two week period. This last round of inputs from the panel will further enhance the model for the appropriateness of the Measures of Effectiveness (MoEs). All three passes should be complete by 30 July, 2013.

Are there any benefits to me if I am in this study? Though experts will not be identified, the information collected pertinent to the research will be encapsulated in a thesis. This thesis will be presented to DISA and will emphasize the areas to be focused during implementation. This model will evolve and could be provided as guidance to industry vendors that are outsourced by DISA for the cloud solution. That insight will allow industry vendors to provide a valuable and effective solution.

Are there any risks to me if I am in this study? Because this research requests your subjective opinion regarding success factors, some of the information sought might be considered sensitive, and may cause discomfort. For this reason, you may refuse to answer any question at any time, and likewise may stop at any time. The answers will be stored digitally, with all identifying information stripped from them. It is important to note that it might still be possible for a reader of the final written product to attribute results to a given individual and/or organization. You will be given an opportunity to review this information and make a reasoned judgment of the risks of divulging such information.

Will my information be kept private? The data for this study will be kept confidential to the extent allowed by federal and state law. No published results will identify you, and your name will not be associated with the findings. Under certain circumstances, information that identifies you may be released for internal and external reviews of this project. The digital file containing the responses, as well as the study write-up will be secured. Your information will only be released, if requested, to authorized members of the AFIT Institutional Review Board, to ensure research compliance with federal and state law. Your information will not be released to any other entity. The results of this study may be published or presented at professional meetings, but the identities of all research participants will remain anonymous. The data for this study will be kept as required by AFIT policy, after which time the digital file containing the interview will be destroyed.

Are there any costs or payments for being in this study? There will be no costs in this study.

Who can I talk to if I have questions? If you have questions about this study or the information in this form, please contact the researcher using the contact information provided above. If you have questions about your rights as a research participant, or would like to report a concern or complaint about this study, please contact the WPAFB Institutional Review Board at (937) 255-3636, x4543 or e-mail HumanSubjects@afit.edu, or regular mail at: Wright Research Site IRB, 711 HPW/IR, 2245 Monahan Way, Wright-Patterson AFB, OH 45433

What are my rights as a research study volunteer? Your participation in this research study is completely voluntary. You may choose not to be a part of this study. There will be no penalty to you if you choose not to take part. You may choose not to answer specific questions or to stop participating at any time.

What does my signature on this consent form mean? Your signature on this form means that: a) you understand the information given to you, b) you have been able to ask the researcher questions and state any concerns, c) the researcher has responded to your questions and concerns, d) you believe you understand the research study and the potential benefits and risks involved.

Statement of Consent: I give my voluntary consent to take part in this study. I will be given a copy of this consent document for my records.

Signature of Participant	Printed Name of Participant	Date

Statement of Person Obtaining Informed Consent: I carefully explained to the person taking part in the study what he or she can expect. I certify that when this person signs this form, to the best of my knowledge, he or she understands the purpose, procedures, potential benefits, and potential risks of participation. I also certify that he or she: a) speaks the language used to explain this research, b) reads well enough to understand this form, c) does not have any problems that could make it hard to understand what it means to take part in this research.

Signature of Researcher	Printed Name of Researcher	Date

Appendix F: IRB Waiver Approval

30 May 2013

MEMORANDUM FOR LT COL DARIN A. LADD,

FROM: William A. Cunningham, Ph.D.
AFIT IRB Research Reviewer
2950 Hobson Way
Wright-Patterson AFB, OH 45433-7765

SUBJECT: Approval for exemption request from human experimentation requirements (32 CFR 219, DoDD 3216.2 and AFI 40-402) for Cloud Computing Implementation Organizational Success In The Air Force.

Your request was based on the Code of Federal Regulations, title 32, part 219, section 101, paragraph (b) (2) Research activities that involve the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior unless: (i) Information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) Any disclosure of the human subjects’ responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects’ financial standing, employability, or reputation.

Your study qualifies for this exemption because you are not collecting sensitive data, which could reasonably damage the subjects’ financial standing, employability, or reputation. Further, the demographic data you are collecting cannot realistically be expected to map a given response to a specific subject.

This determination pertains only to the Federal, Department of Defense, and Air Force regulations that govern the use of human subjects in research. Further, if a subject’s future response reasonably places them at risk of criminal or civil liability or is damaging to their financial standing, employability, or reputation, you are required to file an adverse event report with this office immediately.

WILLIAM A. CUNNINGHAM, PH.D.
AFIT Research Reviewer

Bibliography

Ahuja, M. and Thatcher, J. (2005). *"Moving Beyond Intentions and Toward Theory of Trying Effects of Work Environment and Gender on Post-Adoption Information Technology Use."* MIS quarterly, Vol. 29, pp. 427-459.

Bailey and Pearson. (1983). *"Development of a Tool for Measuring and Analyzing Computer Satisfaction."* Management Science, Vol. 29, No. 5, pp. 530-545.

Barcomb et al. (2011). "*A Case for DoD Application of Public Cloud Computing Services*."

Baroudi and Orlikowski. (1988). *"A Short-Form Measure of User Information Satisfaction: A Psychometric Evaluation and Notes on Use."* Journal of Management of Information Science, Vol. 4, No. 4, pp. 44-59.

Big Data in the Cloud: Converging Technologies. (2013). "*Solution Brief*." Intel IT Center.

Bojilov, Mario (2013). "*Big Data Defined*." ISACA Now. Retrieved from http://www.isaca.org/Knowledge-Center/Blog/Lists/Posts/Post.aspx?ID=299.

Brooklyn, Jon. (2014). “Google Fiber Chooses Nine Metro Areas for Possible Expansion.” Retrieved from http://arstechnica.com/business/2014/02/google-fiber-chooses-nine-metro-areas-for-possible-expansion/

Brynjolfsson, E. (1993). *"The Productivity Paradox of Information Technology."* Communications of the ACM, Vol. 36, No. 12, pp 66-77.

Carr, NG. (2005). "*The End of Corporate Computing*." MIT Sloan Management Review Vol. 46, No. 3.

Charmaz, K. and Belgrave L. (2003) *"Qualitative Interviewing and Grounded Theory Analysis."* Sage, Thousand Oaks, CA, pp.311-330.

Chidambaram, L. and Tung, L. (2005). *"Is Out of Sight, Out of Mind? An Empirical Study of Social Loafing in Technology-Supported Groups."* Information Systems Research, Vol. 16, No. 2, pp. 149-168.

Cloud Broker RFI Q and A. (2012). DISA.

Cloud Brokerage Industry Day. (2102). *"Cloud Brokerage Overview."* GSA Federal Acquisition Service.

Cooper et al. (200). *"Data Warehousing Supports Corporate Strategy at First American Corporation."* MIS quarterly, Vol. 24 No. 4, pp. 547-567.

Cohen, J. and Cohen, P. (1975) *"Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences."* Lawrence Earlbaum.

Cohen, J. (1960). *"A Coefficient of Agreement of Nominal Scales."* Educational and Psychological Measurement. Vol. 20, Issue 1, pp 37-46, April 1960.

Dalkey, N.C. & Helmer. (1962). *An Experimental Application of the Delphi Method to the Use of Experts.* Management Science, 9, 458-467.

Davis, F. D. (1989), *"Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology"*. MIS Quarterly. 13(3), 319–340.

DeLone, W. (1988). *"Determinants of Success for Computer Usage in Small Business."* MIS Quarterly, pp. 51-61, March 1988.

Delbecq A.L, A.H. Van de Ven, D.H. Gustafson. (1975). "*Group Techniques for Program Planning: A Guide to Nominal Group and Delphi Processes."* Scott, Foresman and Company.

Dewan, S. and Kraemer, K.L. (2000). *"Information Technology Productivity: Evidence from Country-Level Data."* Management Science, Vol. 46, No. 4, pp. 548-562.

Dialogic. (2010). *"Introduction to Cloud Computing".* Dialogic Corporation, White Paper

DoD. (2012). *"DOD Releases Cloud Computing Strategy; Designates DISA as the Enterprise Cloud Service Broker."* DoD News Release. DoD Public Affairs.

DoD. (2003) *"DoD Directive 8500.2, Information Assurance Implementation."*

DoD. (2009). *"DoD Directive 8500.01E, Information Security."*

DoD, Chief Information Officer. (2012). *"Cloud Computing Strategy."*

Doll and Torkzadeh. (1988). *"The Measure of End-Use Computing Satisfaction."* Management of Information Systems Quarterly, Vol. 12, No. 2, pp 259-274.

Glaser, B. and Strrauss A. (1967) *"The Discovery of Grounded Theory: Strategies for Qualitative Research."* London: Wiedenfeld and Nicholson (81).

Glaser, Barney G. (1978) "*Theoretical Sensitivity: Advances in the Methodology of Grounded Theory*." Sociology Press, Vol. 2. Mill Valley, CA:

GO Cloud Broker Team. (2012). "*Cloud Broker COA Brief*." DISA.

Harauz J. et al. (2009). "*Data Security in the World of Cloud Computing*." IEEE Security & Privacy Magazine, Vol. 7, pp. 61-64, July 2009.

Hong et al. (2012). *"Best Practice for Using Cloud in Research."* Software Sustainability Institute. retreived from http://www.software.ac.uk/resources/guides/cloud-for-research-practice.

Ives et al. (1983). *"The Measurement of User Information Satisfaction."* Communication of the Association for Computing Machinery, Vol. 26, No. 10, pp. 785-793.

Karahanna et al. (1999). *"Information Technology Adoption Across Time"*. MIS Quarterly, Vol. 23, No. 2, pp. 183-213. June 1999.

Kendell, Kenneth. (1997). *"The Significance of Information systems Research on Emerging Technologies: Seven Information Technologies that Promise to Improve Managerial Effectiveness."* Decision Sciences, Vol. 28, No. 4, pp. 775-792.

Kundra, V. (2010). *"25 Point Implementation Plan To Reform Federal Information Technology Management."* *r*etrieved from http://www.cio.gov/documents/StateOfCloudComputingReport-FINALv3 508.pdf. p 5.

Landis J.R.; & Koch, G.G. (1977). *"The Measurement of Observer Agreement for Categorical Data"*. Biometrics, Vol. 33 No, 1, pp. 159–174.

Leavitt, Neal. (2009). "*Is Cloud Computing Really Ready for Prime Time?."* IEE Computer Society, January, 2009.

Legris et al. (2003). "*Why Do People Use Information Technology? A Crtical Review of the Technology Acceptance Model"*. Information & Management 40, 191 - 204.

Lim, B. (1995). *"Examining the Organizational Culture and Organizational Performance Link."* Leadership & Organizational Development Journal. Vol. 16, No. 5, pp. 16-21.

Linstone, H., Turoff, M. (2002). "*The Delphi Method: Techniques and Applications*." Retrieved from is.njit.edu/pubs/delphibook/delphibook.pdf.

Mell P. and Grance T. (2011). "*The NIST Definition of Cloud Computing."* NIST.

Marcoulides and Heck. (1993). *"Organizational Culture and Performance: Proposing and Testing a Model."* Organization Science. Vol. 4, No. 2, pp. 209-225.

Marston et al. (2011). *"Cloud Computing - The Business Perspective."* Science Direct, Vol. 51, pp. 176-189.

Melville et al. (2004). *"Information Technology and Organizational Performance an Integrative Model of IT Business Value"*. MIS Quarterly, January 2004.

Mishra, S. Deshmukh, S., & Vrat, P. (2002). "*Matching of Technological Forecasting Technique to a Technology."* Technological Forecasting & Social Change, 69, 1- 27.

Mitchell, V. (1991). "*The Delphi Technique: An Exposition and Application."* Technology Analysis & Strategic Management." 3(4), 333-358.

Okoli, Chitu and Pawloski, Suzanne D. (2004*)." The Delphi method as a research tool: an example, design considerations and application*." Information & Management Science Direct.

Opitz et al. (2012). *"Technology Acceptance of Cloud Computing: Empirical Evidence from German IT Departments."* System Science *(HICSS)*, 2012 45th Hawaii International Conference , pp.593-602, Jan. 2012.

Orlikowski, W. J. (1992). *"The Duality of Technology: Rethinking the Concept of Technology in Organizations."* Organization Science. Vol. 3, No. 3, pp. 398-427.

Pfeffer, J. (1982). "*Organizations and Organization Theory*." Boston: Pitman.

Raymond L. (1985). *"Organizational Characteristics and MIS Success in the Context of Small Business."* MIS Quarterly, Vol. 9, No. 1, pp. 37-52

Raymond L. (1990). *"Organizational Context and Information Systems Success: A Contingency Approach."* Journal of Management Information Systems, Vol. 6, No. 4, pp. 5020.

Sarker and Valacich. (2010). *"A Non-Reductionists Approach to Studying Technology Adoption by Groups".* MIS Quarterly, Vol. 34 pp. 779-808, December 2010.

Sarker et al. (2005). *"Technology Adoption by Groups" A Valence Perspective".* Journal of the Association for Information Systems, Vol. 6, No. 2, pp. 37-71, February 2005.

Schmidt R.C. (1997). "*Managing Delphi surveys using nonparametric statistical techniques."* Decision Sciences 28 (3). pp. 763–774.

Schein, E. (1985). "*Organizational Culture and Leadership."* Jossey-Bass, San Francisco, CA.

Sproles, N. (2000). *“Coming to Grips with Measures of Effectiveness.”* Systems Engineering and Evluation Centre, University of South Australia, pp. 51-58

Strauss, A. and Corbin J. (1994) *"Grounded Theory Methodology."* Handbook of qualitative research. pp.273-285.

Subashini et al. (2010). *"A Survey on Security Issues in Service Delivery Models of Cloud Computing".* Journal of Network and Computer Applications 34(2011), pp. 1-11

Taylor and Todd. (1995). *"Understanding Information Technology Usage: A Test of Competing Models."* Information Systems Res, Vol. 6, pp. 144–176.

Venkatesh and Bala. (2008). *"Technology Acceptance Model 3 and a Research Agenda on Interventions."* Decision Sciences, Vol. 39, No. 2, pp 273-315, May, 2008.

Venkatesh, and Davis. (2000), *"A Theoretical Extension of the Technology Acceptance Model: Four longitudinal field studies",* Management Science, Vol. 46 No. 2, pp. 186–204.

Venkatesh, et al. (2003). *"User Acceptance of Information Technology: Toward a Unified View."* MIS Quarterly, Vol. 27, pp. 425–478.

Venkatesh, et al. (2007). *"Dead or Alive? The Development, Trajectory and Future of Technology Adoption Research."* Journal of the Association from Information Systems, Vol. 8, Issue 4, pp. 276–286.

Wixom and Todd. (2005). *"A Theoretical Integration of User Satisfaction and Technological Acceptance".* Information Systems Research, Vol. 16, No. 1, pp. 85-102, March 2005.

Wu, W-W. (2011). *"Developing an Explorative Model for SaaS Adoption."* Experts System with Applications Vol. 38, pp. 15057-15064.

Zain et al. (2005). "The Relationship Between Information Technology Acceptance and Organizational Agility in Malaysia." Information & Management, Vol. 42, pp. 829-839.

Vita

Master Sergeant Perkins was born on Camp LaJeune, North Carolina and grew up in Piqua, Ohio. He graduated from Piqua High School and entered the Air Force 6 September, 1991. After completing Basic Military Training School Sergeant Perkins completed his technical training as a Wideband Radio Electronics Technician at Keesler AFB. He has served at numerous locations (listed below) spanning numerous levels of authority throughout 22 years of service in the United States Air Force.

Sergeant Perkins is currently a student at the Air Force Institute of Technology (AFIT) pursuing a Master of Science Degree in Engineering Management. Prior to attending AFIT, Sergeant Perkins served as Project Manager, 435th Communications Squadron, Ramstin AB, Germany. In this duty he served as the lead project manager for the European Defense Red Switch Network, Air Force's only Teleport facility, and the Air Force's largest Technical Control Facility. He has also has served as Section Chief, Non-Commissioned Officer in Charge, and numerous other management and supervisory positions creating a vast breadth of IT and Telecomm experience.

SF 298 Form

REPORT DOCUMENTATION PAGE | *Form Approved OMB No. 0704-0188*

1. REPORT DATE *(DD-MM-YYYY)*: 27-03-2014

2. REPORT TYPE: Master's Thesis

3. DATES COVERED *(From - To)*: May 2012 - Mar 2014

4. TITLE AND SUBTITLE
Cloud Computing Implementation Organizational Success in the Department of Defense

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Perkins, Corey J., Master Sergeant, USAF

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Air Force Institute of Technology
Graduate School of Engineering and Management (AFIT/EN)
2950 Hobson Way
WPAFB OH 45422-7765

8. PERFORMING ORGANIZATION REPORT NUMBER
AFIT-ENV-14-M-48

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
LtCol Michael J. Mendenhall, Ph. D.
DISA Operations Technical Directorate (DISA OP4)
Operational Requirements Section (OP412)
6910 Cooper Avenue, Fort Meade, MD 20755
Phone: (301) 225 - 3553

10. SPONSOR/MONITOR'S ACRONYM(S)
DISA GO

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
DISTRIBUTION STATEMENT A: APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

13. SUPPLEMENTARY NOTES
This work is declared a work of the U.S. Government and is not subject to copyright in the United States.

14. ABSTRACT
The DoD tends to implement user based IT systems without quantifying whether those systems would be properly utilized by the target populous. Focus is generally emphasized on mission enhancement rather than looking at how or if it will be utilized by organizations. There would appear to be no reason for cloud computing to be implemented with the same disregard for acceptance and success. The day of large amounts of data is here and needs to converge with what this thesis investigates, the factors that positively influence organization acceptance and success of cloud computing specifically in the DoD so that is can properly maintain, utilize and store that data. This research focused in depth on that utilization.

15. SUBJECT TERMS
DoD, DISA, Cloud Computing, SaaS, TAM, TAM2, TAM3, UTAUT, M-TAG

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Lt. Col Darin A. Ladd (SC)
					19b. TELEPHONE NUMBER *(Include area code)*
U	U	U	UU	133	(937)255-6565, x3668 darin.ladd@afit.edu

Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18