Incorporating Enterprise Architecture in the Supply Chain

by

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Abstract

Diffusion of innovation literature proposes a variety of conditions and antecedents that may facilitate the complete incorporation of a technological innovation into an organization. To date, no one study assimilates the myriad factors that theory and past research has identified as potentially affecting incorporation into a unified model. In addition, many of these proposed factors have not been empirically tested to determine if they predict or facilitate incorporation of technological innovation into an organization. This dissertation serves as an initial investigation into the factors that may facilitate the organizational incorporation of a technological innovation. Whereas earlier studies employ a stage-model approach to address this topic, this study begins with the development of a unified model of technological incorporation, which provides insight regarding the factors that may contribute to the incorporation of enterprise architecture into the supply chain. Using this model and the factors identified in extant research, the significance of 17 factors is tested to determine which are related to the incorporation of enterprise architecture into organizations in the supply chain.

This dissertation is organized into five chapters. The introduction chapter provides the background and motivation for this study's topic. The second chapter provides the conceptual basis for the remainder of the dissertation and builds a unified framework of technological innovation incorporation. The third chapter covers the research design and methodology. The fourth chapter begins with a summary of the data and concludes with the presentation of the model results and the results of the hypothesis

tests. In chapter five, the implications of these findings for theory and practice are discussed. The dissertation ends with a discussion of the study's limitations and potential future research directions.

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The views expressed in this dissertation are those of the author and do not reflect the official policy or position of the United States Air Force, Department of Defense, or the United States Government.

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Chapter 1: Introduction

Throughout the current recessionary period and beyond, organizations that judiciously invest in strategic assets - even as they seek to cut operations costs - are likely to outperform those organizations that simply cut costs alone (Gulati, Nohria, & Wohlgezogen, 2010). Achieving proper balance of this dichotomy via determining where to cut costs and where to invest can be challenging for any firm. To meet this challenge, many firms look to adopt technological innovations that promise to achieve both ends by allowing them to create more products and attain higher service levels while expending fewer resources (Prahalad & Mashelkar, 2010). However, the mere adoption of an innovation by an organization does not necessarily guarantee that the innovation is being utilized effectively (if at all). Instead, the innovation must be incorporated to some degree within the organization in order to realize the anticipated benefits of the innovation.

An innovation is defined by Rogers as, "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (2003, p. 12) whereas a technology is "a design for instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a desired outcome" (2003, p. 13). As such, nearly any contemporary idea, practice, or product that an organization wishes to adopt and employ for the purpose of obtaining gains in performance can be thought of as a technological innovation. The diffusion of such innovations are often considered in the supply chain literature (Patterson, Grimm, & Corsi, 2004). For example, electronic data

interchange (EDI) is an information technology used to exchange information and data across organizations (Germain & Droge, 1995) that is addressed as a technological innovation in a variety of studies (e.g. Ahmad & Schroeder, 2001; Crum, Premkumar, & Ramamurthy, 1996; Hazen & Byrd, 2012; Narayanan, Marucheck, & Handfield, 2009; Truman, 2000). In addition, ideas such as cross-docking and containerization are technological innovations that have been discussed in the logistics literature (Grawe, 2009). Indeed, technological innovations take on many forms and functions. However, most technological innovations follow the same organizational diffusion process in the supply chain (Patterson, Grimm, & Corsi, 2003). This process ushers the adopting organization from first realizing a perceived need for innovation, all the way through the incorporation of the innovation into the organization's governance structure and work processes (Rogers, 2003; Zmud & Apple, 1992). Indeed, the complete incorporation of a technological innovation within a target organization is the end state of the organizational diffusion process; thus, achieving incorporation should be the goal of organizations seeking to realize the anticipated benefits of an adopted innovation.

Incorporation

Incorporation is defined as "the implementation activities directed towards embedding an adopted innovation within an organization" (Zmud & Apple, 1992, p. 149). Recent literature suggests that innovation research is predominantly focused on the pre-adoption or initiation stages of the innovation diffusion process and that research is generally lacking in regard to post-adoption outcomes and behaviors (Jasperson, Carter,

& Zmud, 2005; Mishra & Agarwal, 2010). As such, the concept of incorporation is an area that is not fully developed.

Incorporation of technological innovation is a complex phenomenon. Literature over the past two decades has sought to identify the many factors that facilitate or indicate the incorporation of an innovation. Most of these studies address incorporation via investigating adjustments to organizational governance systems (e.g. Yin, 1981) or the degree of use of the innovation (e.g. Hart & Saunders, 1998; Liang, Saraf, Hu, & Xue, 2007; Massetti & Zmud, 1996; Purvis, Sambamurthy, & Zmud, 2001). However, none of these studies include an exhaustive investigation of all of the proposed factors that comprise incorporation. This dissertation further develops and extends the incorporation literature via investigating the many factors proposed in the literature to contribute to the incorporation of technological innovation. This dissertation derives relevant factors from literature to create a unified framework of technological innovation incorporation. Then, using a contemporary artifact as the focus of the investigation, enterprise architecture (EA), these factors are empirically tested to determine which factors are significantly related to incorporation.

Enterprise Architecture

EA is a comprehensive framework that defines the business, the information necessary to operate the business, the technologies necessary to support the business operations, and the transitional process necessary for implementing new technologies in response to changing business needs (Federal Chief Information Officer Council, 1999). EA is a blueprint or manual that, once commissioned, provides a unified plan regarding

how an organization is to utilize information technology (IT) to support its business objectives (Federal Chief Information Officer Council, 2001). Once incorporated by an organization, an EA may serve a variety of purposes, to include facilitating a transition to an enterprise system or guiding IT procurement and implementation decisions.

Because EA can be complex and, by nature, spans the entire organizational enterprise, common architecture frameworks such as the Zachman Framework (Zachman, 1987) or The Open Group Architecture Framework (TOGAF) are often referenced by organizations looking to create and adopt EA. These frameworks identify and address such architecture components as IT product descriptions, stakeholders, organizational functions, design methodology, reference models, and classification (Long, 2009) and are used as a reference to build a customized EA. Although helpful in drafting an EA, these frameworks offer little guidance regarding how to incorporate EA into an organization such that the firm may realize anticipated performance benefits.

Use of EA helps to fulfill organizational goals and objectives via better, faster, and cheaper IT (Rico, 2006). An EA captures the essential elements of an organization. Because the essentials are more stable than specific operational solutions, EA is helpful in ensuring the organization keeps aligned with its core strategy while allowing for flexibility and adaptability necessary to meet current needs (Lankhorst, 2009). Indeed, research suggests that implementation of EA supports IT efficiency and flexibility (Schmidt & Buxmann, 2011). Although research suggests many ways in which EA may add organizational value (Tamm, Seddon, Shanks, & Reynolds, 2011), EA may be especially important in creating a resilient supply chain (Sheffi, 2005; Sheffi & Rice Jr, 2005) in that it postures a firm to rapidly embrace and exploit market changes via

enhancing flexibility (Choi, Kang, Chae, & Kim, 2008). For example, Chae et al. (2007) demonstrate that EA enhances agility and increases opportunities for collaboration with partner firms. Furthermore, additional research even suggests treating an entire supply chain as an enterprise, thus integrating EA throughout several firms (Liu, Zhang, & Hu, 2005).

IT usage affects nearly every function and echelon of both the individual organization and supply chain. For example, line workers may input operational data into an information system (IS) database while executives utilize another IS to generate financial and organizational performance reports. EA is used as a roadmap to determine how these systems are to integrate to become more efficient and effective, while remaining flexible. Because IT often spans a variety of functions and echelons in an organization, incorporating a technological innovation such as EA into a supply chain organization may require a great deal of resources and take many years (Archer, 2006; Moller, Chaudhry, & Jorgensen, 2008). Unfortunately, research regarding the factors that may contribute to incorporation of any technological innovation, including EA, is rather scarce. This dissertation offers an initial investigation into how EA may be incorporated into supply chain organizations.

Research Questions and Purpose

The purpose of this dissertation is to discover the factors that affect the incorporation of EA into an adopting organization. To accomplish this purpose, this dissertation explores two research questions. First, what factors are suggested in the literature to facilitate the organizational incorporation of any technological innovation?

Second, what factors are shown to be significantly related to the organizational incorporation of EA in the supply chain environment? The first question is investigated via thorough review of extant literature and development of a framework of technology incorporation. The second question is investigated via an empirical study that will test the significance of the factors identified in the literature to the incorporation of EA in supply chain organizations.

Overview of Dissertation

This dissertation is comprised of five chapters. Each of these chapters is now briefly introduced. To begin, foundational literature is reviewed in Chapter 2. This review assimilates and describes the extant literature regarding an organization's incorporation of technological innovation. This chapter begins with an overview of the organizational diffusion process. Then, literature which identifies and develops the three post-adoption steps of the organizational diffusion process that are posited to lead to incorporation is reviewed. These factors are shown to be (1) technology acceptance, (2) routinization, and (3) assimilation. Sub-components and operational definitions of each of these three factors are also discussed. The chapter concludes with the development and presentation of a unified framework of technological innovation incorporation.

Chapter 3 is devoted to developing hypotheses and describing the research method. Using the framework and theoretical justifications established in Chapter 2, a series of hypotheses are developed. Each of the 17 hypotheses addresses the relevance of a particular factor that is suggested in the literature to affect incorporation. Upon development of the hypotheses, the study's research model is presented. Next, the survey

method for data collection is discussed. In this study, a web-based questionnaire was built, validated, and deployed, which consists primarily of existing measures. However, validated measures do not exist for some of the constructs under investigation. Thus, development of these measures is also described in this section. Next, the target population, which consists of individuals who are familiar with an organization that has adopted an EA, is discussed. This leads to a discussion of the sampling technique and data collection procedures employed. Chapter 3 concludes with a discussion of how multivariate regression was used to analyze the data, along with potential threats to the validity of this study and how they are addressed.

Chapter 4 reports the findings of the study. Data descriptives, tests for statistical assumptions, and the results of hypothesis testing are presented. The concluding chapter of the dissertation, Chapter 5, summarizes the study and its findings. This chapter also addresses the theoretical and practical implications of this research effort, along with opportunities for future research.

Chapter 2: Foundational Literature and Framework Development

To date, no single study assimilates the many factors that are posited to facilitate incorporation into a unified model. As such, this dissertation begins with a review of the incorporation literature and the development of a unified framework of technological innovation incorporation. This review and subsequent framework will provide the background regarding the factors that contribute to the complete incorporation of a technological innovation into an organization. Incorporation is the end state of the organizational diffusion process. Thus, incorporation requires that the innovation become a normal, enduring component in the organization such that it loses its identity and is no longer considered to be new. In this dissertation, incorporation is defined as "the implementation activities directed towards embedding an adopted innovation within an organization" (Zmud & Apple, 1992, p. 149). Extant innovation diffusion literature suggests that incorporation is the culmination of three post-adoption stages of the organizational innovation process (Saga & Zmud, 1994). The first factor is *technology acceptance*, which concerns the intent to use or actual usage of a technology by members of an organization (Venkatesh, Morris, Davis, & Davis, 2003). The second factor is *routinization*, which concerns how an organization's governance systems are adjusted to accommodate the innovation (Yin, 1979, 1981; Zmud & Apple, 1992). The third factor is *assimilation*, which concerns the extent to which an innovation has diffused across organizational processes (Purvis, et al., 2001). These factors are often discussed in the literature and have been used as both independent and dependent variables across a

variety of diffusion studies (e.g. Liang, et al., 2007; Zmud & Apple, 1992). However, the three factors have not been unified and examined in any single study to investigate how they may affect incorporation.

In order to develop these three factors and frame the context of this study, the remainder of Chapter 2 is organized as follows. First, using Rogers' (2003) five stage framework as a guide, the organizational diffusion process is reviewed in order to provide adequate context as to the role of incorporation in innovation diffusion. Each step of the organizational diffusion process is briefly discussed, which provides an overview as to how organizations move from first learning of an innovation, through sustaining its use within the organization. Second, literature regarding the idea of technology acceptance is reviewed. Technology acceptance has been an area of vast exploration in the literature. Using contemporary frameworks of technology acceptance as a guide, this section summarizes this literature to date, which results in a discussion of the four proposed antecedents of technology acceptance that may contribute to the organizational incorporation of technological innovation. Third, the concept of routinization is examined. Just as with technology acceptance, the antecedents of routinization are extrapolated from the literature and explained. Fourth, the concept of assimilation is discussed, which culminates in a discussion of the four proposed dimensions that comprise this construct. Finally, a framework of technology incorporation is presented, which integrates the findings of this literature review such that further research in this area may commence. This framework serves to summarize the theoretical underpinnings of this dissertation and is the basis of hypothesis development in Chapter 3.

Organizational Diffusion Process

Regardless of the technological innovation that an organization chooses to adopt, a series of stages within the innovation diffusion process is followed. This process ushers the adopting organization from first realizing a perceived need for innovation, all the way through the incorporation of the innovation into the organization's governance structure and work processes (Rogers, 2003; Zmud & Apple, 1992). Two complementary models of organizational diffusion can be found in the literature. Rogers (2003) offers a general model of innovation in organizations whereas Cooper and Zmud (1990) describe a model specific to IT implementation. Although some of the steps exude differing nomenclatures, both models describe the same phenomenon in a complementary fashion. Thus, for the purpose of this dissertation, Rogers' (2003) stage model is adopted. However, the description of each stage of the process is accompanied by the terms and definitions used by Cooper and Zmud (1990) in order to add clarity and demonstrate the relevance of Rogers' (2003) model in the context of IT implementation.

The organizational diffusion process begins when an organization identifies a need or problem and then searches for an innovation to provide the solution. However, problem/solution identification is often not immediate because organizations require ample time to realize their own shortcomings and research available innovations (Schroeder, 1989). Sometimes the solution can even precede the problem, such as when an organization is made aware of an innovation that is fashionable or has the potential to provide a desired opportunity (March, 1981; Wildemuth, 1992). Regardless of the length of time that this stage requires or whether or not problem identification precedes solution identification, the action of searching for ways to improve the organization is the first

stage in the innovation diffusion process, which is referred to by Rogers as *agenda-setting* (2003). This stage is referred to by Cooper and Zmud (1990) as *initiation*, which, similar to Rogers's (2003) description of this stage, they describe as environmental scanning of organizational problems and potential opportunities.

The next stage in the process involves fitting a desirable innovation to the needs of the organization. Rogers (2003) refers to this stage as *matching* and asserts that both the risks and rewards of adopting the innovation must be measured to determine the feasibility of the innovation to provide a usable solution. Being able to effectively address an organizational need and mesh with existing organizational programs or processes is critical to the complete incorporation and sustainability of the innovation within the organization (Goodman & Steckler, 1989). At the end of this stage in the organizational innovation diffusion process, the organization makes the conscious decision to adopt the desired innovation. The organization also acquires the innovation and its requisite facilitative resources, and begins to put the innovation to use in this stage. This stage is referred to by Cooper and Zmud (1990) as *adoption*, which they describe as the decision to invest resources necessary to implement the innovation.

Whereas the first two stages described above require an organization to scan the environment and work somewhat extrinsically to research and acquire a technological innovation, the next stages in the innovation diffusion process take an internal focus on the organization. Specifically, the organization looks to re-invent the newly-acquired innovation to meet its explicit needs while simultaneously adjusting the structure and processes within the organization to accommodate the innovation. Rogers (2003) refers to this stage as *redefining/restructuring*. Similarly, Cooper and Zmud (1990) refer to this

stage as *adaptation*. In this stage, both Rogers (2003) and Cooper and Zmud (1990) note that the organization and the innovation are expected to mutually adapt in a manner such that it facilitates the rapid and effective adoption of the innovation.

Next, the innovation is implemented steadily throughout the organization. Because this is the stage where an organization's members gradually gain a clear and common understanding of the innovation and its implications, Rogers (2003) refers to this stage as *clarifying*. Research suggests that rapid or forceful implementation practices at this stage can lead to subpar incorporation or even outright rejection of the innovation by the organization's constituents (Rogers, Peterson, & McOwiti, 2002). Instead, the organization and the innovation's champion(s) should methodically employ the innovation to target personnel and processes throughout the organization. The majority of extant literature regarding user acceptance of technology is focused on this stage of the diffusion process, which is also referred to as *acceptance* by Cooper and Zmud (1990) and others (e.g. Saga & Zmud, 1994). Because the concept of technology acceptance is used throughout this dissertation, *acceptance* will be the term used throughout the remainder of this manuscript to describe this step of the process.

At this point in the organizational innovation process, the innovation has been implemented as intended. The final stage of the process involves steps toward making the innovation a normal, enduring component in the organization such that it loses its identity and is no longer considered to be new. This final stage directly precedes the end goal of the organizational diffusion process, which is incorporation. However, this final stage of the process and the end state of the diffusion process are the cause of some ambiguity in existing literatures, as differing terms and definitions have been applied.

For example, Dean, Yoon, and Susman (1992) refer to the final stage of the process as *formalization*. Additionally, Ritti and Silver utilize the term *institutionalized* (in lieu of incorporation) to denote innovations that have "become taken for granted as appropriate and necessary features of an organization" (1986, p. 25). However, for the purpose of this dissertation, the end state of the organizational diffusion process will be referred to as *incorporation*. In addition, the stages of the process that directly precede incorporation will be referred to as *routinization* and *assimilation*. Because the idea of incorporation is one of the primary foci of this dissertation, care is taken to describe and compare the differing terms and definitions, and to demonstrate why incorporation is the most appropriate term.

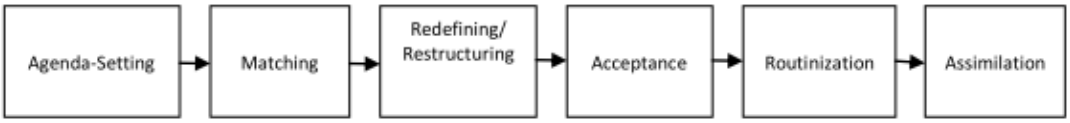
Rogers refers to the final stage of the organizational innovation process as *routinizing* and asserts that "routinizing occurs when an innovation has become incorporated into the regular activities of the organization and has lost its separate identity. At that point, the innovation process is completed" (2003, pp. 428-429). However, Cooper and Zmud (1990) dissect this final step into two parts, which they label routinization and *infusion*. Cooper and Zmud (1990) assert that routinization embodies changes in the organizational governance system whereas infusion describes using the innovation to its fullest possible potential (Sullivan, 1995). Zmud and Apple (1992, p. 149) refer to the aggregation of routinization and infusion as leading to incorporation, which they define as "the implementation activities directed towards embedding an adopted innovation within an organization." Additionally, Apple and Zmud's (1992) study demonstrated the divergence of routinization and infusion as two distinct constructs. As such, this dissertation adopts Zmud and Apple's (1992) term

incorporation and their accompanying definition to describe the end state of the organizational innovation process, which is preceded by both routinization and infusion. In more recent literature, the term *assimilation* is used in lieu of infusion (Liang, et al., 2007; Purvis, et al., 2001); thus, this dissertation also adopts this term to describe the final stage of the organizational diffusion process.

Although the incorporation stage is the end state of the organizational innovation diffusion process, an additional concept termed *sustainability* should also be addressed. Sustainability is defined as "the degree to which an innovation continues to be used after initial efforts to secure adoption are completed" (Rogers, 2003, p. 429). The incorporation of an innovation within an organization does not necessarily guarantee sustainability. For example, the organization may abandon an innovation well after it has been incorporated if it later deems that the innovation is not adequately addressing the needs it was adopted to fill, the innovation proves to be costly or impractical to sustain, or if it is superseded by a new innovation. Thus, incorporation is a necessary but not a sufficient condition of sustainability.

Figure 1 depicts the organizational innovation diffusion process as described by Rogers (2003) and Cooper and Zmud (1990) in the preceding paragraphs. For the purpose of clarity and to remain consistent with the discussion above, the *routinizing* stage of Rogers' (2003) model is dissected further into both *routinization* and *assimilation*. In addition, the *clarifying* stage is instead labeled *acceptance*, in accordance with Cooper and Zmud (1990).

Figure 1: Organizational Innovation Diffusion Process



Acceptance

Although work in the management information systems (MIS) field has emphasized the importance of individual acceptance of technology (e.g. Davis, Bagozzi, & Warshaw, 1989; Moore & Benbasat, 1991, 1996; Venkatesh & Davis, 2000; Venkatesh, et al., 2003), the role of technology acceptance in incorporation has not been vastly explored. The degree to which members of an organization view an organizationally adopted technological innovation affects how well they allow the innovation to become incorporated into their organization. Acceptance is the antecedent of incorporation that addresses how an organization's constituents perceive the technological innovation in their organization.

Explaining user acceptance of technological innovations is one of the most well-developed topics in extant MIS literature (Hu, Chau, Sheng, & Tam, 1999). Rooted in behavioral research from the fields of psychology and sociology (e.g. Ajzen, 1991; Bandura, 1986; Fishbein & Ajzen, 1975), a variety of theoretical models have been developed that seek to predict an individual's intention to use technology (e.g. Compeau & Higgins, 1995; Davis, et al., 1989; Taylor & Todd, 1995a; Thompson, Higgins, & Howell, 1991). In an effort to integrate elements of the existing information technology acceptance models and the theories in which they are derived, Venkatesh, et al. (2003) formulated the unified theory of acceptance and use of technology (UTAUT). This

unified model has been shown to explain 70 percent of the variance in user intention to use information technology (Venkatesh, et al., 2003) and is currently one of the dominant models in this research area. The model contains four constructs that are posited to be direct determinants of user acceptance. Given that Venkatesh, et al. (2003) has assimilated the literature in this area to derive and empirically demonstrate the relevance of these four dimensions to user acceptance of technology, this study adopts these four dimensions to explain acceptance. These dimensions are (1) performance expectancy, (2) effort expectancy, (3) social influence, and (4) facilitating conditions.

Performance expectancy is defined in this dissertation as the degree to which an organization's constituents believe that using the innovation will help them to attain gains in job performance (derived fromVenkatesh, et al., 2003, p. 447). The performance expectancy construct is derived from a variety of root constructs found in earlier technology acceptance literature, to include perceived usefulness (Davis, 1989; Davis, et al., 1989), extrinsic motivation (Davis, Bagozzi, & Warshaw, 1992), job-fit (Thompson, et al., 1991), relative advantage (Moore & Benbasat, 1991), and outcome expectations (Compeau & Higgins, 1995; Compeau, Higgins, & Huff, 1999).

Effort expectancy is defined in this dissertation as the degree of ease associated with the use of the innovation (derived from Venkatesh, et al., 2003, p. 450). The effort expectancy construct is derived from three root constructs utilized in earlier technology acceptance literature. These root constructs are perceived ease of use (Davis, 1989; Davis, et al., 1989), complexity (Thompson, et al., 1991), and ease of use (Moore & Benbasat, 1991).

Social influence is defined in this dissertation as the degree to which an organization's constituents perceive that important agents believe they should use the innovation (derived from Venkatesh, et al., 2003, p. 451). The social influence construct is derived from root constructs used in extant sociology, psychology, and MIS literature. These root constructs are subjective norm (Ajzen, 1991; Fishbein & Ajzen, 1975; Mathieson, 1991; Taylor & Todd, 1995a, 1995b), social factors (Thompson, et al., 1991), and image (Moore & Benbasat, 1991).

Facilitating conditions is defined in this dissertation as the degree to which an organization's constituents believe that an organizational and technical infrastructure exists to support use of the innovation (derived from Venkatesh, et al., 2003, p. 453). The facilitating conditions construct is derived from root constructs in the psychology and technology acceptance literatures, to include perceived behavioral control (Ajzen, 1991; Taylor & Todd, 1995a, 1995b), facilitating conditions (Thompson, et al., 1991), and compatibility (Moore & Benbasat, 1991).

In sum, these four constructs, (1) performance expectancy, (2) effort expectancy, (3) social influence, and (4) facilitating conditions, have been shown to help explain technology acceptance and are adopted in this study to achieve this purpose. Notably, these constructs are often addressed at the individual level of analysis, whereas individual adoption of technology is the dependent variable. In this dissertation, acceptance is treated as an organizational-level factor; this dissertation is concerned with how well, on average, an organization's constituents accept the innovation. The operational definitions of these constructs are reported in Table 1.

Table 1: Acceptance Factors

Factor	Operational Definition
Performance	Degree to which an organization's constituents believe that using the innovation helps them to attain gains in job performance
Effort	Degree of ease that an organization's constituents associate with the use of the innovation
Social influence	Degree to which an organization's constituents perceive that important agents believe they should use the innovation
Facilitating conditions	Degree to which an organization's constituents believe that an organizational and technical infrastructure exists to support use of the innovation

Routinization

Zmud and Apple (1992, p. 149) define routinization as "the permanent adjustment of an organization's governance system to account for the incorporation of a technology," which is the definition adopted for use in this dissertation. The first significant contribution in the area of routinization involved a longitudinal study of several technological innovations in a variety of settings for the purpose of investigating how these innovations became routinized into their respective organization of adoption (Yin, Quick, Bateman, & Marks, 1978). Yin et al. (1978) identified ten events required to achieve organizational routinization, which became the basis for further elaboration and exploration in this area (Yin, 1979, 1981). These ten events, or factors, will now be discussed in detail.

The first factor of routinization to be discussed is *equipment turnover* and is defined in this dissertation as procedures for acquiring new generations of equipment needed to update the innovation. Not only must initial efforts be made to acquire new

equipment or to retrofit existing systems to accommodate the innovation, but the practice of continually updating the equipment must become integral to the organization. This factor is especially important for technologies that evolve rapidly, such as computing and communications technologies. However, even innovations comprised of relatively stable (in the sense of being completely mature or slowly evolving) technologies require acquisition of additional units at a later time or replacement of original equipment (Yin, et al., 1978). Thus, changes to the organizational governance system to account for routine acquisition of equipment needed to update the innovation are required for an innovation to become routinized.

The second factor of routinization to be discussed is *support by local funds* and is defined in this dissertation as when the normal budgeting process accounts for all expenditures required to sustain the innovation. Many innovations are first funded by external sources, to include parent or governmental organizations (Yin, et al., 1978). Other innovations are initially funded from within an organization, but with special monies, such as funds set aside for research and development or special projects. This factor of routinization entails the transfer of funding from these initial, non-routine sources to an organization's routine operating budget.

The third factor of routinization to be discussed is *organizational status* and is defined in this dissertation as when the innovation and associated practices are located in the appropriate organizational unit. Newly adopted innovations are often initially interpreted as special projects that are championed by a specific individual, group, or organizational unit. However, sometimes the innovation remains to be interpreted as a special project and, as such, does not become indoctrinated into the correct organizational

unit. Failure to reside in the appropriate organizational unit can impede routinization as the innovation is not given the proper organizational status. Yin et al. (1978) offer the following guidance regarding where to position an innovation. If the innovation displaces an existing function, then the innovation should be integrated into the organizational unit that administered the function that it replaced. If the innovation provides a new function, then a new organizational unit should be created to administer the new function.

The fourth factor of routinization to be discussed is *supply and maintenance* and is defined in this dissertation as the ability for supplies and repairs to be obtained according to normal organizational procedures. Similar to the factor regarding equipment turnover, requisite supplies and maintenance capabilities must not only be available, but acquired via normal organizational procedures. In regard to maintenance, this includes the establishment of long-term service agreements or the assignment of maintenance responsibilities to a unit within the organization. In regard to supplies, this may include the ability to acquire all required supplies via normal purchasing activities.

The fifth factor of routinization to be discussed is *personnel certification*, which is defined in this dissertation as the organization's ability to hire and sustain individuals qualified to work with the innovation. Depending on the type of innovation, current employees may simply require update or modification to their existing job skills. Another possibility is that the job skills required to effectively operate the innovation may be new to the organization yet still exist in the employment market. Finally, the innovation may be so advanced that new personnel specialties must be created. Regardless of the level of certification required or the initial changes or additions to the

composition of personnel, the organizational governance system must change to accommodate the hiring and sustainment of employees qualified to work with the innovation.

These first five factors, as described above, comprise what Yin et al. (1978) refer to as the *expansion stage* of routinization. The expansion stage and its underlying factors facilitate the continued growth of the innovation within the organization and, relative to additional factors of routinization, have the ability to be achieved rather quickly. The next five factors, as will be described below, comprise what Yin et al. (1978) refer to as the *disappearance stage* of routinization. At the conclusion of this second and final stage of routinization, the innovation loses its identity as an innovation and is instead regarded as a standard part of the organization, in regard to the organization's governance system. However, the two stages, expansion and disappearance, may overlap to some degree. The factors that contribute to the disappearance stage are not necessarily dependent on the events of the expansion stage. Yin et al. (1978) merely point out that the factors of routinization may be categorized into these two sub-components, yet all ten factors contribute to routinization. The factors that comprise the disappearance stage will now be discussed.

The sixth factor of routinization to be discussed is *formal guidance*, which is defined in this dissertation as the formal regulations and governing ordinance that address the innovation. Yin et al. (1978) found that innovations were integrated into the organization in part by becoming a part of its rules of governance and/or standard operating procedures. These changes in guidance may be made early in the innovation adoption process, such that the organization directs usage of the innovation, or further

along in the routinization process, such as when an organization realizes the need to periodically update its guidance. Regardless, the inclusion of the innovation in official instructions helps to solidify an organization's acceptance of the innovation as a standard practice and routinize the innovation.

The seventh factor of routinization to be discussed is *training program*, which is defined in this dissertation as the establishment of an ongoing training program in support of the innovation. Although initial familiarization and training sessions likely accompany the adoption of any innovation, the training program factor suggests that the organization must establish routine training such that individuals new to the organization may learn about the innovation and existing employees can receive refresher training, if needed. The proper positioning and recurrence of the training activity should be considered by the organization. For some innovations, it may require that training become embedded into a member's initial training (e.g. a police academy). For other innovations, it may behoove the organization to contract training via third party training agencies. However, regardless of the strategy employed, the training program must become a standard practice within the organization such that it is readily available to members of the organization who may require the training.

The eighth factor of routinization to be discussed is *promotion of key personnel*, which is defined in this dissertation as when persons familiar with the innovation have been promoted into positions of greater authority such that they may support the innovation further. As Yin, et al. (1978) assert, this factor is most relevant in organizations where promotion from within the ranks is favored over lateral entry into middle or upper level managerial roles. However, whenever a person familiar with an

innovation is promoted into a position of greater authority in any organization, the likelihood that the innovation will be solidified within the organization increases. An additional way that promotions of key personnel help to routinize an innovation is concerned with the transfer of practitioners familiar with the innovation to another organizational unit. This individual may help to spread knowledge of the innovation throughout other organizational units and/or make the skills required to utilize the innovation requisite criteria for similar promotions or transfers. In sum, whenever those familiar with an innovation are promoted or moved throughout the organization, support for the innovation often diffuses.

The ninth factor of routinization to be discussed is *turnover of key personnel*, which is defined in this dissertation as the continued utilization of the innovation after the original personnel involved in adoption and implementation have moved on. If turnover of key personnel occurs too early, then the likelihood of routinization becomes threatened. If turnover occurs well after adoption of the innovation or never at all, then the innovation runs the risk of becoming permanently associated with a small group or unit instead of becoming associated with the organization as a whole. Under this later scenario, when key personnel finally transfer, the innovation may be lost with them, even if it had been in use for a great length of time. Thus, how and when key personnel turnover plays a key role in how well an innovation may become routinized. Yin, et al. (1978) suggest that it is best to have little turnover at the onset of adoption and increasingly more turnover as the innovation becomes more routinized. However, regardless of how or when turnover occurs, the innovation must endure turnover of key personnel in order for it to become routinized.

The tenth factor of routinization to be discussed is *widespread use*, which is defined in this dissertation as when the innovation is applied to all functions in which it is relevant. If the innovation is only being used by a small subset of potential users, the innovation may not be seen as relevant to the organization as a whole. To become a standard practice, the innovation must be used by all personnel and processes in which it is practically relevant. Measures of the widespread use factor are thus dependent upon the specific circumstances of the innovation and the organization of adoption.

Although a part of Yin et al.'s (1978) initial conceptualization of routinization, the idea of "degree of use" of an innovation is instead encompassed by the term "assimilation" in the contemporary literature. As defined above, routinization is concerned with changes to the organizational governance structure to account for the new innovation. Given this definition, research extending Yin et al.'s (1978) work has suggested that the degree of use of an innovation is distinct from routinization (Zmud & Apple, 1992). This may be attributed to the idea that use of the innovation is not necessarily associated with the governance system of an organization but is instead associated with the work processes of the organization. Because one of the contributions of this dissertation is to assimilate extant literature and better clarify the meaning of key constructs that comprise incorporation (acceptance, routinization, and assimilation), widespread use will no longer be included as a factor of routinization for the purpose of this dissertation. The following section regarding assimilation will discuss this matter in greater detail and will further explain the concept of "use."

With the exception of widespread use, as discussed above, the factors described in this section address changes to the governance system of an organization and are thus

representative of the routinization construct. Table 2 lists the nine factors of routinization and their operational definitions used in this dissertation.

Table 2: Routinization Factors

Factor	Operational Definition
Equipment turnover	Procedures are established for acquiring new generations of equipment needed to update the innovation
Support by local funds	All facets of the innovation are supported by the normal budgeting process
Organizational status	The innovation and associated practices are located in the appropriate organizational unit
Supply and maintenance	Supplies and repairs can be obtained according to normal organizational procedures
Personnel certification	The ability to hire and sustain individuals qualified to work with the innovation
Formal guidance	Formal regulations and governing ordinance are established/updated to account for the innovation
Training program	Initial and/or recurring training for the innovation is established
Promotion of key personnel	Persons familiar with the innovation have been promoted into positions of greater authority such that they may support the innovation further
Turnover of key personnel	The innovation continues to be utilized after the original personnel involved in adoption and implementation have moved on

Although more contemporary literature refers to the tenants of routinization for use in investigating related constructs (e.g. Barab, Redman, & Froman, 1998; Fagen & Flay, 2009; Goodman, McLeroy, Steckler, & Hoyle, 1993), no further contributions that greatly enhance or alter the understanding of the factors regarding routinization have been made since Yin (1979, 1981) and Yin et al.'s (1978) seminal work. However, as will be discussed in the section below regarding assimilation, additional work relating to and building from the concept of routinization does reside in the stream of assimilation research.

Assimilation

Zmud and Apple (1992) find evidence to support the assertion that routinization is only one of two factors that contribute to the final stage of the organizational diffusion model. Zmud and Apple (1992) posit that adjustments in an organization's work systems and the technological configurations to which they belong are distinguished from routinization, which is solely concerned with adjustments to an organization's governance systems. They refer to this elaborated use of the innovation in work systems as "infusion," which they define as "the extent to which the full potential of the innovation has been embedded within an organization's operational or managerial work systems" (Zmud & Apple, 1992, p. 149). In sum, Zmud and Apple (1992) find empirical evidence to support the divergence of routinization and infusion and argue that these two components combine to create incorporation.

Yin, et al.'s (1978) concept of widespread use is arguably the most ambiguous of the factors of routinization that were identified in his research. As such, most of the work regarding post-adoption stages of organizational diffusion and extending Yin (1979, 1981) and Yin et al.'s (1978) work in routinization focuses on this area. Over time, the literature has examined the concept of infusion more deeply. Zmud and Apple (1992) measured the infusion of a technological innovation via examining increasingly advanced and distinct configurations of employment of the technological innovation. In essence, they measured the degree of use of the innovation. In a similar manner, Saga (1994) investigated infusion and also found that it may be characterized by varying levels of and degrees of use. In accordance with this early work, others have employed degree of use

as a benchmark for infusion of a technological innovation (Massetti & Zmud, 1996). The measure of degree of use of an innovation in an organization is commonly referred to in the contemporary literature as the level of assimilation, in lieu of infusion (e.g. Liang, et al., 2007; Purvis, et al., 2001). Building on the work and definitions of previous authors (Cooper & Zmud, 1990; Fichman & Kemerer, 1997; Tornatzky & Klein, 1982), Purvis et al. (2001, p. 121) define assimilation as "the extent to which the use of the technology diffuses across the organizational projects or work processes." This definition is adopted for the purpose of this dissertation.

Technology assimilation research asserts that prospective users of a technology in an organizational setting encounter challenges in understanding the technology and how it can be incorporated into their work processes and practices (Attewell, 1992; Saga & Zmud, 1994). To this end, many research efforts in this area have been devoted to understanding the antecedents and determinants of an individual's use (Damanpour, 1991; Kwon & Zmud, 1987). However, this dissertation is concerned with measuring what is often the independent variable in these studies: the actual use of the technology. To this end, the remainder of the discussion regarding assimilation will address how use of technology is measured in extant literature.

Liang, et al. (2007) studied the effects of institutional pressures and top management on the assimilation of enterprise systems. Their search for literature to use as the basis of developing a scale to measure the study's independent variable, assimilation, uncovered a variety of articles in this stream of research (e.g. Hart & Saunders, 1998; Iacovou, Benbasat, & Dexter, 1995). The method adopted by Liang, et al. (2007) for measuring assimilation was based on a measure used by Massetti and Zmud

(1996) for measuring EDI use. Others have since adopted Massetti and Zmud's (1996) method in additional research efforts (e.g. Hart & Saunders, 1998) for measuring assimilation of technological artifacts.

Massetti and Zmud (1996) identify and define the various facets of usage. To measure the extent of usage of EDI in a firm's work processes (i.e. assimilation), Massetti and Zmud (1996) divide usage into four specific dimensions. The first dimension is *volume*, which they define as "the extent to which a firm's document exchanges are handled through EDI connections" (Massetti & Zmud, 1996, p. 335). The second dimension is *diversity*, which they define as "the extent to which different types of a firm's business documents are handled through EDI connections" (Massetti & Zmud, 1996, p. 335). The third dimension is *breadth*, which they define as "the extent to which a firm has developed EDI connections with each of its trading partners" (Massetti & Zmud, 1996, p. 335). The fourth dimension is *depth*, which they define as "the extent to which a firm's business processes are intertwined with those of its trading partner through EDI connections" (Massetti & Zmud, 1996, p. 335). As discussed above, these definitions have been used as the basis of measurement of assimilation in additional studies (e.g. Hart & Saunders, 1998; Liang, et al., 2007). As such, this study adopts these four dimensions of usage to comprise the construct of assimilation.

Because definitions of the four dimensions have been given artifact-specific definitions in previous research, this dissertation modifies the existing definitions offered by Massetti and Zmud (1996) to be more generic and thus applicable to most technological innovation artifacts. Table 3 lists these four factors of the assimilation construct and their operational definitions used in this dissertation.

Table 3: Assimilation Factors

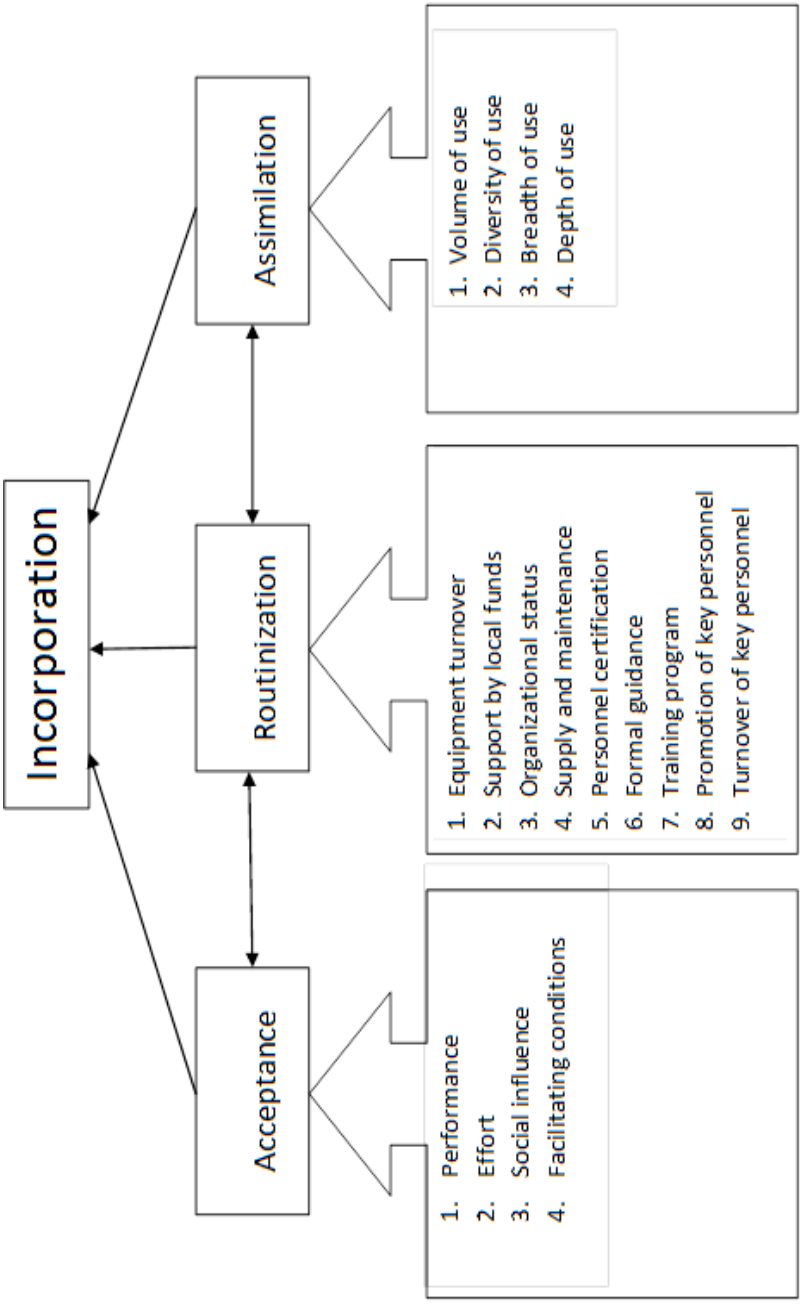
Factor	Operational Definition
Volume	The amount of overall use of the innovation within the organization
Diversity	The extent to which different organizational processes utilize the innovation
Breadth	The extent to which the organization collaborates within and between agencies regarding the innovation
Depth	The vertical impact of the innovation on the organization's business processes

Unified Framework of Technological Innovation Incorporation

Considering the literature discussed in this chapter, it follows that three factors facilitate the incorporation of any technological innovation into an organization. The first factor, acceptance, is concerned with how an organization's constituents perceive the innovation. The second factor, routinization, is concerned with how an organization's governance system is adjusted to account for the incorporation of a technology (Zmud & Apple, 1992). The third factor, assimilation, is concerned with the extent to which the use of the technology diffuses across organizational projects or work processes (Purvis, et al., 2001).

The literature reviewed in this chapter may be synthesized into a unified framework of technological innovation incorporation (UFTII). As illustrated in Figure 2, the proposed UFTII incorporates the three factors that serve as post-adoption steps in the organizational diffusion stage model (Cooper & Zmud, 1990; Rogers, 2003), and thus facilitate incorporation: acceptance, routinization, and assimilation. The UFTII further dissects these three constructs into their constituent components.

Figure 2: Unified Framework of Technological Innovation Incorporation



Summary

The UFTII framework and the supporting literature in Chapter 2 provide the theoretical background necessary to understand the concept of incorporation of technological innovation. Using the UFTII and the operational definitions of its components, Chapter 3 develops testable hypotheses and describes the research method employed in this dissertation.

Chapter 3: Research Design and Methodology

The purpose of this research effort is to examine the factors that have been demonstrated to affect technology acceptance, routinization, and assimilation to determine which of these factors affect a supply chain organization's incorporation of enterprise architecture. In this chapter, extant literature is used as the basis for developing the study's hypotheses. Each hypothesis is associated with an independent variable. Measurement of this variable is discussed after each hypothesis is stated. Next, measures of the dependent variable, incorporation of EA, are discussed. This leads to a presentation of the study's research model. The remainder of the chapter will describe all aspects of data collection and analysis, to include potential threats to the validity of this study.

Hypotheses Regarding Acceptance Factors

If a technological innovation is to be incorporated, literature suggests that it must first be accepted. A wide variety of literature emphasizes the importance of technology acceptance (e.g. Davis, et al., 1989; Moore & Benbasat, 1991, 1996; Venkatesh & Davis, 2000; Venkatesh, et al., 2003). Although explaining user acceptance of technological innovations is one of the most well-developed topics in extant MIS literature (Hu, et al., 1999), the role of technology acceptance in incorporation has not been vastly explored. It follows that the degree to which members accept an organizationally adopted

technological innovation affects how well the innovation becomes incorporated into their organization.

As described in the development of the UFTII, Venkatesh, et al. (2003) integrate extant models of technology acceptance to formulate the UTAUT. The UTAUT suggests four antecedents to user acceptance; the UTAUT and accompanying measures have been demonstrated in technology acceptance research to be generally effective. This dissertation investigates these four dimensions to determine their relevance to incorporation. These dimensions provide the basis of the first four hypotheses, and are (1) performance expectancy, (2) effort expectancy, (3) social influence, and (4) facilitating conditions.

Performance expectancy is defined in this dissertation as the degree to which an organization's constituents believe that using the innovation will help them to attain gains in job performance (derived fromVenkatesh, et al., 2003, p. 447). The performance expectancy construct is derived from a variety of root constructs found in earlier technology acceptance literature, to include perceived usefulness (Davis, 1989; Davis, et al., 1989), extrinsic motivation (Davis, et al., 1992), job-fit (Thompson, et al., 1991), relative advantage (Moore & Benbasat, 1991), and outcome expectations (Compeau & Higgins, 1995; Compeau, et al., 1999). An organization adopts a new technology in order to increase performance. Thus, if members of the organization do not anticipate any performance benefits from EA, then the organization is less likely to incorporate the EA.

> *H1: Higher levels of performance expectancy will correlate to higher levels of EA incorporation.*

Effort expectancy is defined in this dissertation as the degree of ease associated with the use of the innovation (derived from Venkatesh, et al., 2003, p. 450). The effort expectancy construct is derived from three root constructs utilized in earlier technology acceptance literature. These root constructs are perceived ease of use (Davis, 1989; Davis, et al., 1989), complexity (Thompson, et al., 1991), and ease of use (Moore & Benbasat, 1991). UTAUT suggests that an innovation must be perceived as requiring little effort to use if it is to be accepted. Thus, it follows that members of an organization should perceive an EA as being generally usable if it is to be incorporated. If members of an organization perceive a disparity between the time and effort required to employ EA and the potential gains in performance promised by the EA, then they are less likely to accept it, thus inferring that the EA is less likely to be incorporated.

H2: Lower levels of effort expectancy will correlate to higher levels of EA incorporation.

Social influence is defined in this dissertation as the degree to which an organization's constituents perceive that important agents believe they should use the innovation (derived from Venkatesh, et al., 2003, p. 451). The social influence construct is derived from root constructs used in extant sociology, psychology, and MIS literature. These root constructs are subjective norm (Ajzen, 1991; Fishbein & Ajzen, 1975; Mathieson, 1991; Taylor & Todd, 1995a, 1995b), social factors (Thompson, et al., 1991), and image (Moore & Benbasat, 1991). Because UTAUT research suggests that social influence is a significant predictor of a user's intent to use a technological innovation, social influence will likely also be related to incorporation.

H3: Higher levels of social influence will correlate to higher levels of EA incorporation.

Facilitating conditions is defined in this dissertation as the degree to which an organization's constituents believe that an organizational and technical infrastructure exists to support use of the innovation (derived from Venkatesh, et al., 2003, p. 453). The facilitating conditions construct is derived from root constructs in the psychology and technology acceptance literatures, to include perceived behavioral control (Ajzen, 1991; Taylor & Todd, 1995a, 1995b), facilitating conditions (Thompson, et al., 1991), and compatibility (Moore & Benbasat, 1991). Facilitating conditions often refer to an organization's access to resources and support required to effectively employ an innovation. If these facilitating conditions are not perceived by an organization's constituents to be present within the adopting organization, then EA is less likely to be accepted or incorporated.

H4: Higher levels of facilitating conditions will correlate to higher levels of EA incorporation.

Measures of Acceptance

Existing measures were used for investigation of the above hypotheses. Four items each were used to measure performance expectancy, effort expectancy, social influence and facilitating conditions by Venkatesh et al. (2003). Internal consistency reliability was reported to be .91, .94, .92, and .85 respectively (Venkatesh, et al., 2003). These items were adapted for context and used in this study. Notably, one item for facilitating conditions was reverse scored. Because Venkatesh et al. (2003) encountered problems with all of the reverse-scored items in their study, this one item was modified to facilitate positive scoring. In addition, items were modified to reflect an organizational level of analysis. Participants rated their level of agreement with each item using a 7-

point, Likert-type scale ranging from "Strongly Disagree" to "Strongly Agree." Table 4 lists the 16 items used to measure the four acceptance dimensions.

Table 4: Measures of Acceptance

Performance Expectancy

1. Members of the organization find EA to be useful in their job
2. Using EA enables members of the organization to accomplish tasks more quickly
3. Using EA increases productivity
4. Members of the organization who embrace EA are more likely to be promoted or given a raise

Effort Expectancy

1. How one is to interact with and employ the EA is clear and understandable
2. Members of the organization find it easy to become skillful in employing EA
3. Members of the organization find EA easy to understand and use
4. Learning to work within the guidelines of EA is easy

Social Influence

1. Influential people in this organization believe that EA should be used
2. Those who I believe to be important believe that EA should be used
3. The senior management of the organization has been helpful regarding use of EA
4. In general, the organization has supported use of the EA

Facilitating Conditions

1. The organization has the resources necessary to use EA
2. The organization has the knowledge necessary to use EA
3. EA is compatible with other organizational systems
4. A specific person or group is available to provide assistance with difficulties related to EA

Hypotheses Regarding Routinization Factors

An innovation becomes routinized when an organization's governance structure has been permanently adjusted to account for the innovation (Zmud & Apple, 1992). Thus, routinization plays an integral role in the incorporation of a technological

innovation. As discussed in Chapter 2 of this dissertation, the work by Yin and colleagues (Yin, 1979, 1981; Yin, et al., 1978) constitutes the most comprehensive effort toward understanding routinization. As such, the factors of routinization presented by Yin and colleagues serve as the basis for the next nine hypotheses.

Yin et al. (1981) posit that an organization must develop and implement procedures for acquiring new generations of equipment needed to update the innovation. Not only must initial efforts be made to acquire new equipment or to retrofit existing systems to accommodate the innovation, but the practice of continually updating the equipment must become integral to the organization. In reference to this dissertation's artifact, EA is not comprised of actual hardware components. However, hardware and software products are often utilized to operationalize the EA within an organization. For example, enterprise systems, such as enterprise resource planning (ERP) systems are often implemented in an effort to integrate internal and external information throughout an entire enterprise, to include supply chains (Davenport, 1998, 2000a, 2000b; Davenport & Brooks, 2004). Thus, changes to the organizational governance system to account for routine acquisition of equipment needed to update components that operationalize EA are posited to affect incorporation of EA.

H5: The presence of established equipment turnover procedures for equipment that facilitates EA will correlate to greater levels of EA incorporation.

Yin's (1981) findings suggest that the normal budgeting process must account for all expenditures required to sustain the innovation in order for it to become routinized. Many innovations are first funded by external sources, to include parent or governmental organizations (Yin, et al., 1978). Other innovations are initially funded from within an organization, but with special monies, such as funds set aside for research and

development or special projects. Thus, in order for EA and its constituent components, such as an enterprise system, to become incorporated into an organization, local and routine funding must be available and allocated for sustainment.

H6: The availability of local funds to support EA will correlate to higher levels of EA incorporation.

Yin (1981) posits that an innovation and associated practices must be located in the appropriate organizational unit in order for the innovation to become routinized. Newly adopted innovations are often initially seen as pet projects that are championed by a specific individual, group, or organizational unit. However, if the innovation remains to be interpreted as a special project, it will not become indoctrinated into the correct organizational unit. Failure to reside in the appropriate organizational unit can impede routinization as the innovation is not given the proper organizational status. Many may interpret an EA as something that concerns only those in the IT function of the firm. However, EA should be recognized as a strategic tool that supports the firm as a whole. Thus, responsibility for all aspects of EA should be entrusted to those in the strategic levels of the organization if it is to be incorporated.

H7: EA's status as a strategic-level asset will correlate to greater levels of EA incorporation.

Related to the ideas that EA must be supported by local funds and routine equipment turnover must be accounted for, Yin's (1981) research suggests that normal organization procedures must account for required maintenance to sustain the innovation if it is to be routinized. In regard to EA, this includes the establishment of procedures to periodically update the EA to account for organizational change. Indeed, EA is a living document. Although firm strategies and overarching objectives should rarely change,

how the firm implements these strategies and how it chooses to exploit IT may adjust over time. Thus, procedures must be identified to keep EA current.

H8: Established, routine procedures for review and update of the EA will correlate to greater levels of EA incorporation.

An organization must have the ability to hire and sustain individuals qualified to work with the innovation in order for it to be routinized (Yin, 1981). Depending on the type of innovation, current employees may need to only update their existing job skills. Another possibility is that the job skills required to effectively operate the innovation may be new to the organization yet still exist in the employment market. Finally, the innovation may be so advanced that new personnel specialties must be created. Regardless of the level of certification required or the initial changes or additions to the composition of personnel, the organizational governance system must change to accommodate the hiring and sustainment of employees qualified to work with the innovation. In the case of EA, an organization will undoubtedly require qualified information and business architects to craft and sustain the EA. In addition, individuals affected most by adoption of EA (IT professionals and executives) may require additional job skills to effectively utilize EA. A firm's human resources department must account for these updated job skills when looking to acquire new employees.

H9: Establishment of personnel classifications that account for the organization's use of an EA will correlate to greater levels of EA incorporation.

Formal regulations and governing ordinance must be updated or established to address the innovation if it is to become routinized (Yin, 1981). Yin et al. (1978) found that innovations were integrated into the organization in part by becoming a part of its rules of governance and/or standard operating procedures. These changes in guidance

may be made early in the innovation adoption process, such that the organization directs usage of the innovation, or further along in the routinization process, such as when an organization realizes the need to periodically update its guidance. Regardless of when these changes are made, EA should be accounted for in an organization's governing regulations if it is to become incorporated.

H10: An organization's use of governing regulations that address EA will correlate to greater levels of EA incorporation.

Yin (1981) suggests that an ongoing training program in support of the innovation must be established if the innovation is to become routinized. Although initial familiarization and training sessions may accompany the adoption of any innovation, the organization must also establish routine training such that individuals new to the organization may learn about the innovation and existing employees can receive refresher training, if needed. This training program must become a standard practice within the organization such that it is readily available to members of the organization who may require the training. In the case of EA, an organization should provide necessary training for all members of an organization who make strategic decisions and/or are charged with procuring or maintaining an organization's IT.

H11: The degree to which an organizational EA training program is established will correlate to greater levels of EA incorporation.

When persons familiar with the adopted innovation have been promoted into positions of greater authority such that they may support the innovation further, Yin et al. (1978) assert that the innovation is more likely to become routinized. This factor is likely most relevant in organizations where promotion from within the ranks is favored over lateral entry into middle or upper level managerial roles. However, whenever a person

familiar with an innovation is promoted into a position of greater power in any organization, the likelihood that the innovation will be solidified increases. This type of promotion may help to spread knowledge of the innovation throughout other organizational units and/or make the skills required to utilize the innovation requisite criteria for similar promotions or transfers. If someone familiar with EA is promoted or moved within an organization, support for the EA should also transfer with him or her. An example of this may be when someone in an organization's IT function who was responsible for creating or implementing EA is promoted to an executive function. In accord with Yin's (1981) findings, this would suggest that organizational support for EA would intensify, which would help to promote incorporation.

H12: Promotion of individuals who support EA will correlate to greater levels of EA incorporation.

Finally, Yin (1981) contends that continued utilization of the innovation after the original personnel involved in adoption and implementation have moved on is critical for routinization. If turnover of key personnel occurs too early, then the likelihood of routinization may become threatened. If turnover occurs well after adoption of the innovation or never at all, then the innovation runs the risk of becoming permanently associated with a small group or unit instead of becoming associated with the organization as a whole. Under this later scenario, when key personnel finally transfer, the innovation may be lost with them, even if it had been in use for a great length of time. Thus, how and when key personnel turnover may play a key role in how well an innovation may become routinized. However, regardless of when turnover happens, Yin, et al. (1978) suggest that an innovation is routinized if it endures turnover of the personnel originally associated with its adoption. As such, whether or not EA is likely to

endure turnover of the IT professionals and executives originally responsible for adoption of EA may be a key indicator of whether or not EA is incorporated.

> *H13: The greater the degree to which EA is unaffected by the turnover of those responsible for the organization's adoption of EA will correlate to a greater degree of EA incorporation.*

Measures of Routinization

Regarding measures of the nine routinization factors, items were adapted from multiple studies (Saga, 1994; Yin, 1981; Zmud & Apple, 1992) where the factors of routinization were investigated. For example, in regard to "equipment turnover," Yin (1981, p. 21) asked, "Have procedures been established for purchasing/leasing the new generations of equipment needed to update the innovation?" This item was adapted to the context of this dissertation to ask participants to rate their level of agreement with the statement, "The organization has established routine procedures to update tangible components required to support EA." As another example, Zmud and Apple's (1992) study regarding bar code scanner routinization measured "support by local funds" by asking participants to simply indicate whether or not scanners were supported by local operating budgets. Similarly, this dissertation measured "support by local funds" via asking participants to indicate their agreement with the item, "EA and its facilitating systems are completely supported by routine funding." Similar adaptation of items from the studies mentioned above resulted in the items used in this dissertation to measure routinization.

Table 5 lists the items used to measure the nine routinization factors. Participants were asked to rate their level of agreement with each item using a 7-point, Likert-type scale ranging from "Strongly Disagree" to "Strongly Agree."

Table 5: Measures of Routinization

Equipment Turnover

1. The organization has established routine procedures to update the systems required to support the EA (i.e. enterprise systems, etc.)
2. Updating the EA or its facilitating systems is not a problem
3. Procedures for purchasing new generations of equipment needed to update EA or its facilitating system are in place
4. The organization has plans in place to facilitate equipment turnover for EA and its associated systems

Support by Local Funds

1. EA and its facilitating systems are completely supported by routine funding
2. Funds to support EA initiatives are readily available in the organization
3. EA and its facilitating systems are supported by internal, budgeted funds
4. Requests for additional funding are not required to support EA

Organizational Status

1. EA is driven by our organization's strategy
2. EA is positioned as a strategic asset in the organization
3. The highest level of management is responsible, in general, for all facets of the EA
4. In my opinion, the strategic plan for our organization is encompassed by the EA

Supply and Maintenance

1. The organization has routine procedures to review and update the EA, as needed
2. There are specific individuals in the organization that are responsible for maintaining the EA
3. The organization has a "help desk" or similar function to support EA
4. Supplies to support EA and its facilitating systems are easy to come by

Personnel Certification

1. The appropriate personnel classifications/job descriptions account for skills required to administer EA
2. There are positions in the organization that require expertise with EA
3. Experience with EA is required of new hires who seek to fill certain positions in the organization
4. There is an adequate number of manpower positions to support EA

Formal Guidance

1. The organization's governing regulations address use of EA
2. There exists formal guidance that describes how EA is to be used
3. Applicable organizational policies account for use of EA
4. Referring to EA when making decisions regarding IT is mandatory in the organization

Training Program

1. The organization has established a program for educating employees about EA
2. The organization has established a training program for EA
3. New personnel are provided training regarding EA
4. Members of the organization can readily obtain training and/or education regarding EA from the organization

Promotion of Key Personnel

1. Personnel associated with EA have been promoted to higher levels in the organization
2. It is desirable to be associated with EA
3. If individuals associated with EA are promoted, they continue to champion EA
4. There are senior managers who are experienced with EA

Turnover of Key Personnel

1. EA has survived a turnover in key personnel
2. Even after the initial champions of EA have left the organization, EA continues to endure
3. The survival of EA is not dependent on just a few key personnel
4. Those originally associated with bringing EA to the organization were in their positions long enough to bring EA on-line

Hypotheses Regarding Assimilation Factors

Research suggests that assimilation is the final stage of the organizational innovation diffusion process (Saga, 1994; Saga & Zmud, 1994; Zmud & Apple, 1992). Assimilation is defined as "the extent to which the use of the technology diffuses across the organizational projects or work processes" (Purvis, et al., 2001, p. 121). Technology assimilation literature asserts that, although individuals in an organization may intend to use the innovation (acceptance) and the governance structure of the organization has changed to accommodate the innovation (routinization), members of an organization may not understand *how* the innovation may be incorporated into the organization's processes and practices (Attewell, 1992; Saga & Zmud, 1994). When this is the case, the innovation is not widely used in the organization and thus, cannot be fully incorporated. Thus, research in this area often uses assimilation as a dependent variable when investigating the determinants of widespread use (Damanpour, 1991; Kwon & Zmud, 1987).

An example of research investigating the determinants of widespread use is found in Liang, et al. (2007), who studied the effects of institutional pressures and top management on the assimilation of enterprise systems. In measuring their dependent variable, assimilation, Liang, et al. (2007) found that assimilation is often comprised of multiple dimensions, depending upon the type of innovation being investigated (e.g. Hart & Saunders, 1998; Iacovou, et al., 1995; Massetti & Zmud, 1996; Saga, 1994). Indeed, assimilation is often investigated via determining an organization's volume, diversity, breadth, and depth of use (e.g. Hart & Saunders, 1998; Massetti & Zmud, 1996).

Massetti and Zmud (1996) identified four dimensions of usage that applied to their study of EDI. The first dimension is *volume*, which they define as "the extent to which a firm's document exchanges are handled through EDI connections" (Massetti & Zmud, 1996, p. 335). The second facet is *diversity*, which they define as "the extent to which different types of a firm's business documents are handled through EDI connections" (Massetti & Zmud, 1996, p. 335). The third facet is *breadth*, which they define as "the extent to which a firm has developed EDI connections with each of its trading partners" (Massetti & Zmud, 1996, p. 335). The fourth facet is *depth*, which they define as "the extent to which a firm's business processes are intertwined with those of its trading partner through EDI connections" (Massetti & Zmud, 1996, p. 335).

Again, the measure of degree of use of an innovation in an organization is commonly referred to as the level of assimilation (e.g. Liang, et al., 2007; Purvis, et al., 2001). Because the organizational innovation diffusion process is not complete unless the innovation is being widely used within the organization, the actual use of EA by all organizational functions and processes in which it applies should thus be a key determinant as to how well an innovation has been incorporated.

H14: Greater volume of EA use will correlate to EA incorporation.

H15: Greater diversity of EA use will correlate to EA incorporation.

H16: Greater breadth of EA use will correlate to EA incorporation.

H17: Greater depth of EA use will correlate to EA incorporation.

Measures of Assimilation

Measures of assimilation were adapted from existing instruments (Liang, et al., 2007; Massetti & Zmud, 1996). However, in both of these cited studies, one item was used to measure each dimension of assimilation. Thus, literature content, existing items, and operational definitions of volume, diversity, breadth, and depth were used as the basis to generate additional items to measure assimilation in this study. Items were adapted to fit the context of this study and multiple items were generated for each of the four assimilation measures. For example, Liang et al. (2007, p. 81) measured "diversity" by asking participants to indicate, "Number of functional areas that are using the ERP system." In this dissertation, one of the items used to measure diversity is, "All functional areas of the organization are integrated within EA." Table 6 lists the items used to measure the four assimilation dimensions. All items were measured using a 7-point, Likert-type scale ranging from "Strongly Disagree" to "Strongly Agree."

Table 6: Measures of Assimilation

Volume
1. EA is always considered when discussing IT
2. EA is referred to often
3. The organization uses EA extensively
Diversity
1. All functional areas of the organization are integrated within EA
2. EA is considered when modifying any business process within the organization
3. EA guides usage of all of the information technologies used in the organization
Breadth
1. EA is used to guide collaboration with outside organizations
2. EA is used to foster inter-organizational relationships
3. EA ties together different organizational units

Depth

1. Employees at all levels consult EA for appropriate guidance
2. Everyone in the organization knows about EA
3. The lowest organizational levels (e.g. operational) refer to EA

Dependent Variable

This study's dependent variable is "incorporation of EA." Although the definition of incorporation is generally accepted and understood, a valid and reliable measure of incorporation was not found in existing literature. Thus, a measure of incorporation specific to this study's artifact (EA) was developed and tested. An instrument development process outlined by Hinken (2005) was followed to create a content-valid measure of this study's dependent variable. This consisted of generating potential questionnaire items and conducting a quantitative content validity assessment employing subject matter experts (SMEs).

A theoretical definition of a construct can be used as a guide for item development (Hinkin, 2005; Schwab, 1980). Incorporation is defined as "the implementation activities directed towards embedding an adopted innovation within an organization" (Zmud & Apple, 1992, p. 149). EA is defined as a comprehensive framework that defines the business, the information necessary to operate the business, the technologies necessary to support the business operations, and the transitional process necessary for implementing new technologies in response to changing business needs (Federal Chief Information Officer Council, 1999). Using these two definitions, a series of potential questionnaire items were generated. The number of items needed to capture the full domain of a construct varies; however, in order to minimize response bias caused

by fatigue or boredom, an instrument should not only be valid and reliable, but parsimonious (Schmitt & Stults, 1985; Schriesheim & Eisenbach, 1990). Thus, the target number of items to measure incorporation was five. Adhering to Hinkin's (2005) advice to generate at least twice as many items as will be required in the final instrument, 10 items were generated.

In order to determine adequate content validity of the generated items, a procedure similar to that employed by Bernerth, Armenakis, Feild, Giles, and Walker (2007) was used. SMEs were solicited from two sources and asked to rate the appropriateness of each item via a web-based questionnaire. First, academicians who are familiar with the topics of innovation or EA were sought. Next, consultants who specialize in EA were solicited from a large IT consulting firm. Potential participants were e-mailed a link to a web-based questionnaire (see Appendix). Of the 30 SMEs solicited for participation, nine academicians and 11 practitioners participated for a total of 20 SMEs and a response rate of 66.7%.

The panel of SMEs was provided definitions of both incorporation and EA. These experts were then asked to rate each item to determine how well it captured the domain of EA incorporation. The response scale provided was: 1 = does not capture the definition; 2 = captures some of the definition; 3 = captures most of the definition.

As proposed by Lawshe (1975), the content validity ratio (CVR) was calculated for each item. The CVR is calculated using the following formula:

$$\text{CVR} = (n_e - N/2) / (N/2)$$

Whereas n_e is the number of experts who rated the item as captures most of the definition and N is the total number of SMEs. Given this formula, the CVR of each item will fall

between 1.0 (perfectly content valid according to the SMEs) and -1.0 (perfectly content invalid according to the SMEs).

With a panel of 20 SMEs, a minimum CVR value of 0.42 ($p < .05$) is required to indicate that an item has sufficient content validity (Lawshe, 1975). In addition, Hinkin (1998) suggests at least 75% respondent agreement is attained for an item to provide evidence of content adequacy. Accordingly, only items with at least 75% agreement and CVR of 0.42 or higher were retained. This process resulted in the retention of six of the ten original items. Table 7 lists the items that were used to measure incorporation of EA. Participants rated their agreement with the following items on a 7-point, Likert-type scale ranging from "Strongly Disagree" to "Strongly Agree."

Table 7: Measure of Incorporation

1. This organization provides the benchmark for how EA should be employed
2. This organization uses its EA to make strategic-level decisions that involve IT
3. EA is deeply embedded into the organization
4. EA is fully institutionalized by the organization
5. This organizations uses its EA to make decisions regarding the integration of IT and business objectives
6. The tenets of EA use are embodied by this organization

Research Model

This study's research model is an operationalization of the theoretical model proposed in Chapter 2. If incorporation is the culmination of acceptance, routinization, and assimilation, then the factors identified in extant literature that are thought to facilitate acceptance, routinization, and assimilation should all be positively related to incorporation. Thus, each of these proposed factors are direct antecedents to incorporation in this study's research model, which is illustrated in Figure 3. In reference

to the UFTII, Hypotheses 1 through 4 concern the acceptance factors; Hypotheses 5 through 13 concern the routinization factors; Hypotheses 14 through 17 concern the assimilation factors. Figure 4 illustrates how this dissertation's research model operationalizes the UFTII.

Figure 3: Research Model

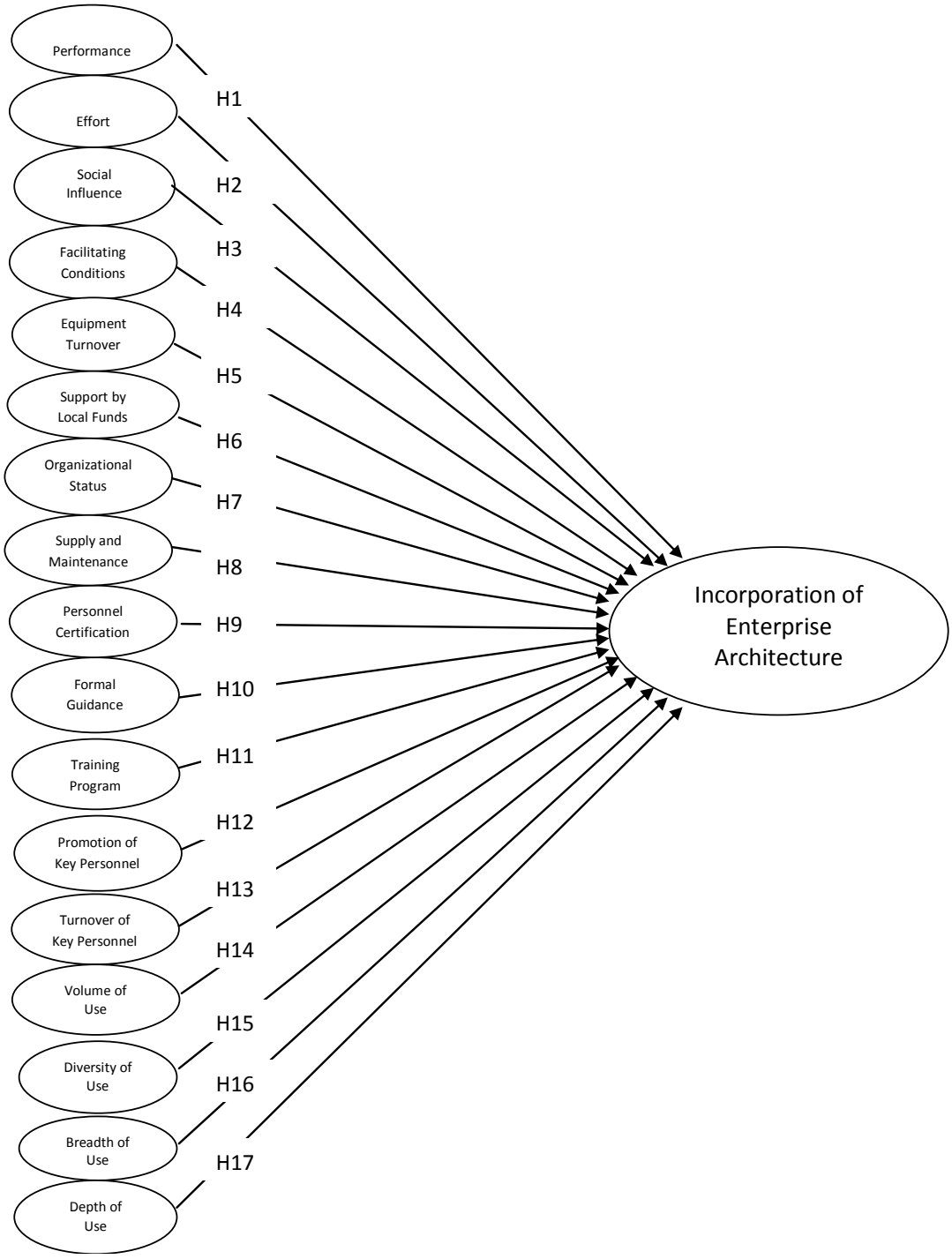
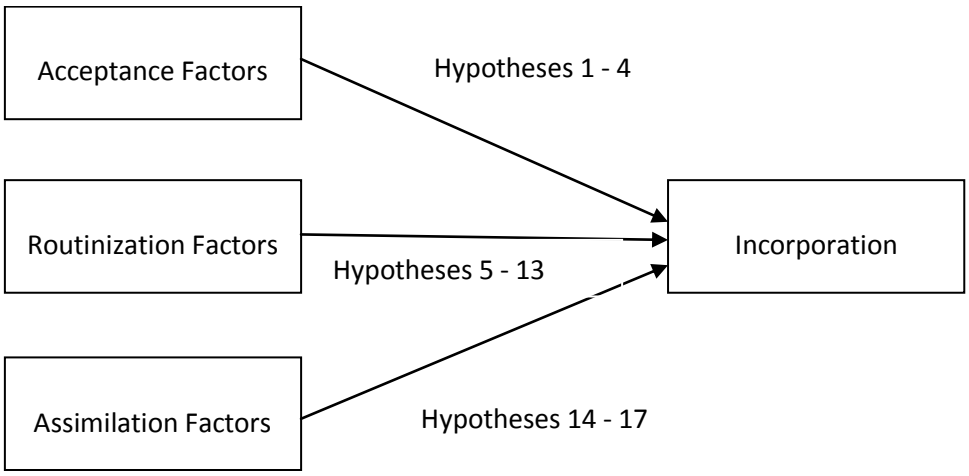


Figure 4: Operationalization of the UFTII in this Dissertation



Instrument Development

The measures identified earlier in this chapter were consolidated into a single survey instrument. The web-based instrument was hosted by Qualtrics, which is an online survey software provider and host. In addition to the items used to measure the constructs under investigation, individual and organizational demographic data were solicited. These demographics are captured in Table 8. In addition, qualifying questions regarding the participant's knowledge of the target organization were asked at the beginning of the survey in order to filter out potential participants who lack knowledge of either EA or the organization in which they chose to rate. For instance, participants were asked, (1) "Do you have a general understanding of Enterprise Architecture (EA)? We define EA as a comprehensive framework which defines the business, the information necessary to operate the business, the technologies necessary to support the business operations, and the transitional process necessary for implementing new technologies in response to changing business needs." They were also asked, (2) "Are you intimately

familiar (i.e., have worked in, consulted for, etc.) with an organization that uses or is trying to use EA? If so, would you be able to answer basic questions regarding the organization's use/implementation of EA?" Negative responses to either question terminated the survey. Additional participant screening procedures will be addressed later in the discussion of this study's assumptions.

Table 8: Demographics Solicited

Demographics	
Organizational	Individual
Name	Age
Size	Gender
Ownership: Public, private, government	Years with organization
Type of business	Years of experience with EA
Gross profits	Position
Annual sales	
Time since adoption	
Country of origin	
Supply chain function(s)	

In addition to the survey instrument, an information letter was drafted in accordance with the Auburn University Institutional Review Board guidelines. The information letter included a description of the research project, the estimated time commitment for participants, and information regarding participant rights. The letter served as the first page of the online survey; participants consented to participation by clicking an arrow at the bottom of the page, which took them to the remainder of the survey.

Pilot Test

A two-phase pilot test was conducted. Throughout the pilot testing, special attention was given to the validity and reliability of the newly created measure of incorporation, which was employed in this study. In the first phase, several colleagues from both academia and industry were invited to complete the survey instrument. Interviews were conducted with each participant to garner feedback regarding the functionality and ease of use of the website, the wording and clarity of the questionnaire, and any other concerns recognized by the participant.

In the second phase of the pilot test, the information letter and link to the web-based instrument (see Appendix) were e-mailed to an executive at a consulting firm that specializes in EA implementation in order to gather data for preliminary analysis. The survey and information letter were forwarded to consultants who have experience with EA. E-mails were sent to 159 potential participants. After two weeks, 16 responses were collected. A reminder was sent after two weeks of data collection, which resulted in 8 additional responses for a total response rate of 15.1%. Data resulting from the completed surveys was analyzed using various techniques in order to determine if the instrument and the measures in which it is comprised performed adequately.

Little's missing completely at random (MCAR) test was conducted to determine if any patterns exist in missing data, which may indicate problems with some of the constructs or items. The results of the Little's MCAR test were insignificant, which indicates that the missing data are not dependent on observed or missing values. Next, factor analysis was conducted to determine if items were loading appropriately on the constructs that they are intended to measure. Although the sample size (N = 24) was

relatively small, the items generally loaded well on their intended construct and not on other constructs, which indicates convergent and discriminant validity. As such, no remedial action (i.e., rewording items, removing items, etc.) was deemed necessary. In addition to examining how well items load on their intended factor, review of the unrotated factor solution generated by exploratory factor analysis can aid in determining whether common method bias may be a validity threat (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Podsakoff & Organ, 1986). If the unrotated factor solution reveals no general factor that accounts for more than 50% of the variance, then common method bias may be discounted as a likely validity threat (Podsakoff & Organ, 1986). The unrotated factor solution derived from principal components analysis, as reported in Table 9, indicates 16 factors with eigenvalues greater than one and no factor accounts for 50% or more of the variance. Given these results from the pilot test, the instrument design and potential sample frame appeared to be robust to common method bias. More discussion regarding efforts to allay common method bias and other validity threats will take place later in this chapter.

Table 9: Unrotated Factor Solution for Pilot Test Data: Variance Explained

Factor	% Variance	Cumulative %
1	36.892	36.892
2	12.263	49.156
3	10.563	59.719
4	7.139	66.858
5	6.255	73.113
6	4.912	78.025
7	4.459	82.484
8	3.768	86.252
9	3.059	89.312
10	2.772	92.084
11	2.389	94.472
12	1.872	96.345
13	1.293	97.638
14	0.999	98.636
15	0.858	99.494
16	0.506	100

Cronbach's alphas for each construct and standard deviations for each item were also examined in order to identify any potential problems. The calculated standard deviations for the 7-point Likert-scale items indicated no obvious issues; the largest standard deviation was 1.76 and the smallest standard deviation was greater than one. This indicates adequate levels of variance in responses. Reliability of measures was assessed by calculating Cronbach's alpha for each construct. The results of this reliability assessment are illustrated in Table 10. Some constructs had alphas in the low .7's and one construct had an alpha just below .70 (Assimilation_Diversity of Use). However, because Cronbach's alpha is a function of sample size and these calculations were conducted using only 24 responses, it was determined that the pilot test results indicated that the measures display adequate levels of reliability and will likely perform well with the full sample.

Table 10: Reliability Measures for Pilot Test

Construct	Number of Items	Cronbach's alpha
Acceptance_Performance	4	0.850
Acceptance_Effort	4	0.834
Acceptance_Social Influence	4	0.933
Acceptance_Facilitating Conditions	4	0.909
Routinization_Equipment Turnover	4	0.896
Routinization_Support by Local Funds	4	0.820
Routinization_Organizational Status	4	0.925
Routinization_Supply and Maintenance	4	0.747
Routinization_Personnel Certification	4	0.748
Routinization_Formal Guidance	4	0.839
Routinization_Training Program	4	0.904
Routinization_Promotion of Key Personnel	4	0.779
Routinization_Turnover of Key Personnel	4	0.810
Assimilation_Volume of Use	3	0.882
Assimilation_Diversity of Use	3	0.679
Assimilation_Breadth of Use	3	0.908
Assimilation_Depth of Use	3	0.836
Incorporation	6	0.889

In summary, analysis of the pilot test results indicated no cause for concern. As such, no changes were made to the survey instrument after the second phase of the pilot test. Because no changes were made to the instrument and the pilot test sample frame resides within the target population for this study (as described below), the results of the pilot test were combined with the results garnered from the primary data collection effort and used in this study's analysis.

Sample Frame

In this dissertation, a supply chain organization is defined as an organization that is part of a set of organizations that are linked to one or more upstream or downstream partners to facilitate the flow of products or services for the purpose of creating value for

stakeholders and customers (Lambert, 2008; Mentzer et al., 2001). The target population for this study consists of any individual who is familiar with a supply chain organization that has adopted an EA. In addition, the individual must be aware of the enterprise architecture and how it is employed in the organization. Because of the nature of the survey questions, company executives, experienced consultants, and IT architects are highly sought for the sampling frame. Thus, members of various EA-affiliated LinkedIn groups were targeted as a potential sample frame.

LinkedIn is an online, professional social networking site that has been in use since 2003. Each of the 100 million plus registered users is able to build a personal LinkedIn web page that is designed to highlight professional accomplishments and abilities. The LinkedIn service also facilitates over 800,000 interest groups, which cover a wide range of professional topics. Some of these interest groups are specific to the topic of EA. For example, the "Enterprise Architecture Network" consists of over 55,000 members who share a common interest in EA. Members include chief information officers, chief technology officers, enterprise architects, business architects, IT and corporate governance staffs, and others. Related LinkedIn groups include "Enterprise Architecture Forum" and "The IT Architect Network." All three of these LinkedIn groups that are affiliated with EA were solicited.

An information letter and link to the online survey was posted in the aforementioned LinkedIn groups. Each group and discussion thread in which the survey link was posted was observed daily so that participants or group members who required clarification or additional guidance regarding the survey may obtain timely feedback. Reminders in the form of additional discussion group postings were given at two week

intervals and data collection lasted for four weeks. Unfortunately, this sample frame and procedure was unfruitful and yielded only eight responses. Of these responses, none of the organizations identified were considered to be a part of a supply chain (more discussion regarding how this distinction was made is located in the "Assumptions" section). Thus, an additional sampling frame was sought.

Qualtrics Panels is a pay-per-response data collection service that is designed to find a qualified panel of respondents to complete a given research survey. Upon speaking with an account representative, it was uncovered that a panel could be reached that consists of potential participants from this research study's target population. Specifically, IT professionals and chief information officers were targeted for this sample frame. As a service, Qualtrics Panels finds qualified respondents, distributes the survey, and screens potential participants. Respondents are paid a nominal fee for their participation. In short, this study's sample frame consists of IT professionals that work at a variety of organizations across the globe and have been contacted by and agreed with Qualtrics Panels to be a respondent.

Data Collection

A-priori power analysis indicated that a minimum of 146 participants are required to obtain a power of .80 for investigating the proposed research model at the .05 level of significance, assuming a conservative model R^2 estimate of .15 (Soper, 2011). To solicit this number of responses, the following data collection scheme was employed.

Qualtrics hosted the data collection instrument and accompanying IRB information letter. Upon signing a contract for service, Qualtrics Panels proofed the

survey and added various filter mechanisms throughout to ensure that respondents were knowledgeable regarding both EA and an organization that employs EA. Participants were asked, (1) "Do you have a general understanding of Enterprise Architecture (EA)? We define EA as a comprehensive framework which defines the business, the information necessary to operate the business, the technologies necessary to support the business operations, and the transitional process necessary for implementing new technologies in response to changing business needs." They were also asked, (2) "Are you intimately familiar (i.e., have worked in, consulted for, etc.) with an organization that uses or is trying to use EA? If so, would you be able to answer basic questions regarding the organization's use/implementation of EA?" Negative responses to either question terminated the survey.

Qualtrics Panels also employs filters that enhance the quality of responses and reduce common method bias by ensuring that respondents are attentive. These filters consist of randomly-dispersed questionnaire items that appear similar to the content items, yet ask questions that pertain to how well the participant is reading the question. Wrong answers to these questions dismiss the respondent. After introducing filters and function-checking the survey instrument, Qualtrics distributed a link to the survey to potential participants.

In order to ensure, at a minimum, the number of respondents required to conduct multivariate regression analysis, Qualtrics Panels was asked to provide 200 complete responses. Based on the professional nature of the sample frame, the rate charged per response was $7.20. Data collection commenced once the instrument was function-checked and filters were integrated. The length of time required for data collection was

contingent upon how quickly the 200 complete responses could be gathered. All data collected via the Qualtrics instrument was assimilated in real time on the Qualtrics server and access was available throughout the entire data collection period. The data were downloaded from the server daily throughout the duration of data collection to mitigate any risk of the data being lost or corrupted by a third party. The data were also examined daily for quality of responses and any suspicious responses were reported to the Qualtrics Panel representative.

Data collection lasted for two weeks. During this time frame 225 complete responses were collected. Of these, 25 were removed because of concerns with quality, such as demographics that did not fit the sample frame, no variability in any of the case values, or taking such a short amount of time to complete the survey that questions were obviously not read and considered. In summary, this sample frame yielded 200 usable responses out of 1,006 initially solicited for a response rate of 19.9%.

These 200 responses were combined with the 24 pilot test responses to be used for analysis. From this number, responses from duplicate organizations were deleted; only the first response from each organization was used. However, these duplicate responses were used to address potential single key-informant bias, as will be described later in this chapter. In addition to removing duplicate responses, responses regarding organizations that were not a part of a supply chain (as defined in the following section) were also removed. Removal of duplicate and non-supply chain responses resulted in deleting 34 responses. Thus, the final sample size for this dissertation is 190.

Assumptions

This dissertation assumes that participants have adequate knowledge of EA and the organization in which they are rating. To limit the consequences of not meeting these assumptions, only individuals who are known to be knowledgeable of EA were solicited. This was accomplished via following the sampling strategy outlined earlier. In addition, qualifying questions regarding the participant's knowledge of the target organization served to exclude participants who may not be qualified to rate the organizational attributes under investigation in this study. Participants were asked, (1) "Do you have a general understanding of Enterprise Architecture (EA)? We define EA as a comprehensive framework which defines the business, the information necessary to operate the business, the technologies necessary to support the business operations, and the transitional process necessary for implementing new technologies in response to changing business needs." They were also asked, (2) "Are you intimately familiar (i.e., have worked in, consulted for, etc.) with an organization that uses or is trying to use EA? If so, would you be able to answer basic questions regarding the organization's use/implementation of EA?" Negative responses to either question terminated the survey.

In addition, to ensure that only firms that serve a supply chain function were represented, respondents were asked to identify the supply chain processes in which the firm participates. In reference to the Supply Chain Operations Reference (SCOR®) model (Supply Chain Council, 2011). Participants were asked to indicate whether the organization was involved in planning, sourcing, making, delivering, or returning products or services. Definitions of these functions were provided, as shown in Table 11.

The option of "none of the above" was also given. Cases in which the participant indicated "none of the above" were collected for use in future research. However, these cases were removed from this dissertation's analysis.

Table 11: Supply Chain Functions

Function	Definition
Plan	Processes that balance aggregate demand and supply to develop a course of action which best meets sourcing, production, and delivery requirements.
Source	Processes that procure goods and services to meet planned or actual demand.
Make	Processes that transform product to a finished state to meet planned or actual demand
Deliver	Processes that facilitate the transport of finished goods and services to meet planned or actual demand, typically including order management, transportation management, and distribution management.
Return	Processes associated with returning or receiving returned products for any reason. These processes extend into post-delivery customer support.

Validity Threats

Several artifacts potentially threaten the validity of any research effort. In reference to a study that employs a quantitative survey-method, these validity threats include non-response bias, common method bias, single-informant bias, and bias arising from missing data. In this section, the measures taken to reduce these validity threats are discussed.

Non-Response Bias

Non-response bias was measured using wave analysis as suggested by Rogelberg and Stanton (2007). Data from late responders (those who responded in the second week

of data collection) was compared with data received from early responders (those who responded in the first week of data collection). Theoretically, the constructs under investigation do not depend on one's propensity to respond to a survey instrument; thus, non-response bias was not anticipated to be a threat. However, this threat was still addressed in this study. Comparison of a random selection of 20% of the survey items via two-way t-tests indicated no significant differences in responses, which further confirms that non-response bias may not be a significant validity threat to this study.

Common Method Bias

Because both independent and dependent variables were measured via survey instrument, common method bias must be addressed (Schmitt, 1994). The best way to control for common method bias is to consider use of procedures to allay such biases when designing the study and the data collection instrument (Podsakoff, et al., 2003). Thus, in this dissertation, effort was put forth in the design phase of the study to control for common method bias in lieu of counting solely on statistical control methods in the analysis phase. As suggested in previous research regarding methods to reduce common method bias, controls employed in this study include protecting respondent anonymity, providing clear directions, and assuring respondents that it is acceptable to leave an item blank if they do not understand the context or feel qualified to answer (Podsakoff, et al., 2003). In addition, comprehensive pilot testing of the survey instrument was conducted in order to increase the clarity and readability of items, reduce item complexity and ambiguity, and reduce the presence of technical jargon and unfamiliar wording; all of which help to reduce the threat of common method bias (Hinkin, 1995, 1998, 2005;

Peterson, 2000; Spector, 1987, 1992). Also, the filter questions inserted into the body of the survey by Qualtrics (as described above) also served to reduce common method bias. Finally, because negatively worded items have been demonstrated to be a source of common method bias (Harrison & McLaughlin, 1991; Podsakoff, et al., 2003; Schmitt & Stults, 1985; Schmitt & Stults, 1986) and additional research has shown such items to be problematic (Hazen, Overstreet, Jones-Farmer, & Feild, 2012), negatively worded items were not used in this study.

Common method bias was considered and controlled for in the design phase of the study. Although such efforts should allay significant bias, common method bias should still be tested for during the analysis phase to determine if indeed bias occurred and, if so, what remedial corrective measures should be employed (Podsakoff, et al., 2003). As referred to by Podsakoff and Organ (1986), Harman's one factor test (Brewer, Campbell, & Crano, 1970; Greene & Organ, 1973; Harman, 1960) was used to determine if common method bias is a threat to the validity of this study's results. To conduct this test, data were subjected to an exploratory factor analysis. If the unrotated factor solution reveals no general factor that accounts for more than 50% of the variance, then common method bias may be discounted as a likely validity threat (Podsakoff & Organ, 1986). The unrotated factor solution, as reported in Table 12, indicates 15 factors with eigenvalues greater than one; no factor accounts for 50% or more of the variance. In addition, when subjected to varimax rotation, the results corroborate the finding that the items load on several distinct factors, as shown in Table 13.

Table 12: Unrotated Factor Solution: Variance Explained

Factor	% Variance	Cumulative %
1	48.19	48.19
2	5.17	53.37
3	4.41	57.77
4	3.10	60.87
5	2.84	63.72
6	2.31	66.03
7	2.15	68.18
8	1.76	69.94
9	1.56	71.50
10	1.54	73.04
11	1.42	74.45
12	1.23	75.69
13	1.19	76.88
14	1.06	77.94
15	1.01	78.95

Table 13: Factor Solution with Varimax Rotation: Variance Explained

Factor	% Variance	Cumulative %
1	15.96	15.96
2	15.07	31.02
3	10.52	41.55
4	8.28	49.83
5	5.80	55.63
6	5.20	60.83
7	4.73	65.55
8	2.37	67.92
9	1.87	69.79
10	1.83	71.62
11	1.82	73.44
12	1.74	75.18
13	1.69	76.88

Finally, research suggests that, when testing multivariate linear relationships, common method bias generally decreases when additional independent variables that

may suffer from some levels of common method bias are included in the regression equation (Siemsen, Roth, & Oliveira, 2010). Thus the inclusion of 17 independent variables in the multivariate regression model tested in this study may help to allay the effect of any common method bias present in the data. In sum, this study was designed to mitigate potential common method bias; common method bias was tested for and found not to be problematic when compared to commonly-accepted heuristics; and any potential bias was controlled for as part of the study's data analysis procedure. Thus, common method bias is thought to not present a validity threat to this study's findings.

Single Key-Informants

The use of single key-informants may sometimes be problematic (Bagozzi, Yi, & Phillips, 1991; Kumar, Stern, & Anderson, 1993). Because a single informant rated the attributes of an organization and its EA based on his or her perception, potential single informant bias must be assessed. This bias has been addressed in recent literature by comparing responses from multiple participants that provided ratings for the same variable (Ashenbaum & Terpend, 2010). It is possible that this study's sample frame (largely IT professionals) is biased toward the success of EA. However, it is assumed that this bias would remain consistent throughout measurement of all variables and should therefore not represent a problem regarding analyzing relationships between constructs, which is the purpose of this study. Nonetheless, effects of this bias were examined by comparing responses from non-IT professionals (i.e., executives) with the IT professionals that responded to our survey. In the sample, 59 of the 190 responses (31.1%) were obtained from non-IT professionals. T-tests at the construct level indicated

that some variables were statistically different across response groups. However, none of the differences were larger than .45 (on a 7-point Likert-type scale). Because we found some differences, we conducted a regression analysis to determine if these differences affected the nature of relationships tested in this study. The results of this analysis indicate that the findings are not dependent upon whether the respondent is an IT professional. This suggests that single-informant bias may not be a significant threat to the validity of this study.

Another problem with using single informants pertains to the reliability of using just one informant to rate several attributes of an organization. As mentioned previously (and as anticipated in our research design) some organizations were represented by more than one respondent. Thus, to gauge the degree to which respondents in our sample provided generalizable measurement of the constructs under examination, duplicate responses were compared. This comparison was completed from the perspective of coding reliability; we calculated measures of agreement at the construct level between participants who rated the same organization. Depending upon the number of duplicates per organization, appropriate methods for calculating agreement using Krippendorff's alpha were followed (Krippendorff, 2004). Responses across informants were generally homogeneous; most alphas were calculated to be greater than .80, with none being less than .70. In sum, the analysis suggests no obvious forms of bias or cases where informants for the same organization disagree to a great extent regarding the constructs under consideration.

Missing Data

The dataset was analyzed for missing values in SPSS 19, using the missing values analysis function. The analysis indicated that less than 2% of values were missing. Little's MCAR test was non-significant, which indicates that missing data do not depend on observed or missing data (Kline, 2011). As such, Estimation, Maximization (EM) was used to impute the missing values. Because only a small amount of missing data was present, there was no pattern to the missing data, and a sophisticated imputation mechanism was used, missing data should not present a validity threat to this study.

Additional Data Preparation

In addition to addressing potential validity threats and addressing missing data, further data preparation was required. To begin, standard data cleansing procedures were conducted. For instance, the demographics were examined to ensure that the values entered were within an appropriate range. For example, in four cases, the fill-in response to the item, "Years of experience with Target Organization (please round to nearest year)" was responded to with the actual year in which the participant began to affiliate with the organization in lieu of number of years of experience with the organization. In these instances, the year entered was subtracted from the year of data gathering (2011) and the result was imputed into the appropriate cell. Similar errors were corrected throughout the demographics.

Because all measures used are reflective, new variables were created by finding the mean of the items used to measure each given construct. For example, to create the study variable "Assimilation_Breadth of Use," the three items used to measure breadth of

use were added together. This value was divided by three and the resulting value was used to represent the measure of "Assimilation_Breadth of Use" for that case. These calculated variables (17 independent variables and one dependent variable) were used as the basis for data analysis. Notably, data analysis took place at this construct level, not the item level.

Data Analysis

This study employed multivariate regression for data analysis. After initial treatment of the data and tests for assumptions, data analysis was conducted via use of SPSS version 19 software. More discussion regarding the data preparation and assumption checks is presented in Chapter 4, Findings. Using regression, the independent variables were analyzed to determine which are statistically related to incorporation. This test provides the basis for accepting or rejecting the study's hypotheses. These findings are presented in Chapter 4.

Summary

Chapter 3 began with the development and presentation of this study's hypotheses. Hypotheses were developed and categorized in accordance with the stage of organizational diffusion in which they were identified: acceptance, routinization, or assimilation. Next, the proposed items to measure each independent variable were presented. This was followed by a discussion of the dependent variable, incorporation, and the development of items proposed to measure the construct. The research model, which demonstrates how these 17 hypotheses are investigated, was then presented. The

specifics of data collection and analysis were then addressed, to include development of a web-based questionnaire, identification of a target population, data gathering procedure, and the statistical techniques proposed to test this dissertation's hypotheses. Finally, this chapter ends with an overview of the assumptions and potential validity threats of the study and the techniques proposed to test for and mitigate such threats.

Chapter 4: Findings

In this chapter, the dissertation results are presented. To begin, the sample demographics are offered. This includes individual-level demographics of all participants (i.e., gender, age, etc.) and descriptives of the organizations that are the focus of this investigation (i.e., annual profits, etc.). The construct-level descriptives, such as mean responses and Cronbach's alpha will then be presented and discussed. Then, a brief discussion of potential control variables is given. Next, the statistical assumptions necessary for multivariate regression are described, which leads to the presentation of several analyses used to test for such assumptions. Finally, the results of the stepwise, multivariate linear regression are presented. These results serve as the basis for accepting or rejecting each of the study's hypotheses.

Sample Demographics

The individual participants in this study display diverse demographic traits. For instance, participants' ages ranged from 26 to 75 years old and participants had anywhere from one to 40 years of experience with EA. It is hoped that such diversity may help to increase the generalizability of the results of this study. Table 14 provides all relevant participant demographics.

Table 14: Participant Demographics

Demographic	Count	Percent
Gender		
Male	145	76.3%
Female	45	23.7%
Age		
18-25	0	0.0%
26-35	59	31.1%
36-45	61	32.1%
46-55	44	23.2%
56-65	21	11.1%
66-75	2	1.1%
76+	0	0.0%
Years Experience with EA		
<5	50	26.3%
5-10	86	45.3%
11-20	40	21.1%
21-30	9	4.7%
31+	4	2.1%
Affiliation with Target Organization		
IT Professional in Organization	131	68.9%
Mangement Position within Organization	27	14.2%
Consultant	21	11.1%
Other	11	5.8%
Years Experience with Target Organization		
<5	55	28.9%
5-10	84	44.2%
11-20	34	17.9%
21-30	12	6.3%
31+	4	2.1%

Note: N = 190; not all participants provided all demographics; not all counts sum to 190; not all percentages add to 100% because of rounding

The size and types of organizations represented was also rather broad. For instance, organizations from five continents (North America, South America, Africa, Asia, and Europe) with number of employees ranging from 12 to 800,000 were

represented in the sample. Table 15 reports the sample descriptives at the organizational level.

Table 15: Organizational Descriptives

Descriptive	Count	Percent
Country of Origin		
United States	158	83.2%
Other	32	16.8%
Employees		
< 100	14	7.4%
101-1,000	71	37.4%
1,001-10,000	38	20.0%
10,001-100,000	58	30.5%
> 100,000	9	4.7%
Ownership		
Publicly Traded	56	29.5%
Private	89	46.8%
Government	26	13.7%
Joint Venture	2	1.1%
Non-Profit	11	5.8%
Other	6	3.2%
Organization Type		
Manufacturing	54	28.4%
Service	86	45.3%
Defense	8	4.2%
Other	42	22.1%
Gross Profits		
< $100,000	7	3.7%
$100,000 - $1 Million	26	13.7%
$1-10 Million	31	16.3%
$10 Million - $100 Million	39	20.5%
> $100 Million	50	26.3%
Unknown/unsure/does not apply	37	19.5%
Annual Sales		
< $100,000	8	4.2%
$100,000 - $1 Million	20	10.5%
$1-10 Million	27	14.2%
$10 Million - $100 Million	29	15.3%
$100 Million - $1 Billion	31	16.3%

> $1 Billion	30	15.8%
Unknown/unsure/does not apply	41	21.6%
Years since Adopted EA		
<5	55	28.9%
5-10	101	53.2%
11-20	24	12.6%
21-30	8	4.2%
31+	2	1.1%
Organization's Supply Chain Function (multiple categories allowed for each organization)		
Plan	125	65.8%
Source	118	62.1%
Make	93	48.9%
Deliver	113	59.5%
Return	61	32.1%

Note: N = 190; not all participants provided all demographics; not all counts sum to 190; not all percentages add to 100% because of rounding

Construct-Level Descriptives

In regard to reliability, the measures employed in this study performed well. Cronbach's alpha for each multi-item measure was calculated to be greater than .80, which indicates adequate reliability (Cronbach, 1951). Table 16 illustrates the descriptive properties of each independent variable and the dependent variable. Table 17 illustrates the correlation matrix between all study variables, to include potential control variables.

Table 16: Construct Descriptives

Construct	Number of Items	Cronbach's alpha	Mean	Standard Deviation
Acceptance_Performance	4	0.89	5.28	1.13
Acceptance_Effort	4	0.92	5.00	1.25
Acceptance_Social Influence	4	0.90	5.51	1.16
Acceptance_Facilitating Conditions	4	0.91	5.29	1.23
Routinization_Equipment Turnover	4	0.88	5.05	1.24
Routinization_Support by Local Funds	4	0.90	4.87	1.33
Routinization_Organizational Status	4	0.92	5.08	1.32
Routinization_Supply and Maintenance	4	0.86	5.11	1.25
Routinization_Personnel Certification	4	0.83	5.05	1.23
Routinization_Formal Guidance	4	0.92	5.12	1.36
Routinization_Training Program	4	0.93	5.03	1.40
Routinization_Promotion of Key Personnel	4	0.87	5.11	1.18
Routinization_Turnover of Key Personnel	4	0.87	5.15	1.19
Assimilation_Volume of Use	3	0.86	5.10	1.29
Assimilation_Diversity of Use	3	0.87	4.74	1.50
Assimilation_Breadth of Use	3	0.90	4.92	1.39
Assimilation_Depth of Use	3	0.89	4.71	1.50
Incorporation	6	0.93	5.10	1.24

Table 17: Construct-level Correlation Matrix

Construct	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1 Number of Employees	1.000																					
2 Gross Profits	0.071	1.000																				
3 Annual Sales	0.133	0.720**	1.000																			
4 Time since Adoption of EA	-0.001	0.255**	0.260**	1.000																		
5 Acceptance_Performance	0.024	0.073	0.145*	0.191**	1.000																	
6 Acceptance_Effort	0.041	0.015	0.067	0.132	0.771**	1.000																
7 Acceptance_Social Influence	0.035	0.082	0.090	0.107	0.812**	0.676**	1.000															
8 Acceptance_Facilitating Conditions	0.078	0.096	0.116	0.171*	0.766**	0.790**	0.764**	1.000														
9 Routinization_Equipment Turnover	0.075	0.074	0.074	0.167*	0.702**	0.731**	0.693**	0.797**	1.000													
10 Routinization_Support by Local Funds	0.081	0.121	0.118	0.174*	0.557**	0.664**	0.567**	0.757**	0.779**	1.000												
11 Routinization_Organizational Status	0.048	0.006	0.046	0.149*	0.671**	0.681**	0.730**	0.779**	0.828**	0.740**	1.000											
12 Routinization_Supply and Maintenance	-0.012	0.087	0.077	0.195**	0.610**	0.665**	0.673**	0.771**	0.814**	0.791**	0.833**	1.000										
13 Routinization_Personnel Certification	0.086	0.015	0.096	0.155*	0.634**	0.661**	0.613**	0.709**	0.740**	0.692**	0.731**	0.721**	1.000									
14 Routinization_Formal Guidance	0.012	0.043	0.082	0.148*	0.627**	0.663**	0.585**	0.683**	0.695**	0.656**	0.666**	0.721**	0.836**	1.000								
15 Routinization_Training Program	-0.015	-0.012	0.021	0.175*	0.610**	0.638**	0.548**	0.657**	0.677**	0.639**	0.709**	0.719**	0.778**	0.795**	1.000							
16 Routinization_Promotion	0.031	0.002	0.048	0.119	0.673**	0.581**	0.646**	0.615**	0.691**	0.615**	0.661**	0.655**	0.801**	0.774**	0.689**	1.000						
17 Routinization_Turnover	-0.001	0.026	0.036	0.173*	0.624**	0.622**	0.666**	0.657**	0.684**	0.683**	0.701**	0.709**	0.738**	0.712**	0.712**	0.771**	1.000					
18 Assimilation_Volume of Use	-0.020	0.041	0.036	0.150*	0.543**	0.583**	0.582**	.0604**	0.651**	0.606**	0.672**	0.658**	0.656**	0.722**	0.618**	0.686**	0.687**	1.000				
19 Assimilation_Diversity of Use	-0.023	-0.013	0.037	0.125	0.489**	0.603**	0.463**	0.589**	0.609**	0.604**	0.694**	0.612**	0.650**	0.634**	0.636**	0.618**	0.596**	0.758**	1.000			
20 Assimilation_Breadth of Use	-0.026	0.040	0.067	0.169*	0.566**	0.626**	0.553**	0.658**	0.666**	0.586**	0.660**	0.634**	0.641**	0.675**	0.659**	0.634**	0.613**	0.777**	0.749**	1.000		
21 Assimilation_Depth of Use	0.048	-0.043	0.017	0.145*	0.527**	0.571**	0.449**	0.569**	.0600**	0.621**	0.631**	0.579**	0.652**	0.618**	0.621**	0.607**	0.592**	0.755**	0.744**	0.714**	1.000	
22 Incorporation	0.035	0.018	0.034	0.163*	0.569**	0.637**	0.571**	0.674**	0.741**	0.694**	0.726**	0.712**	0.734**	0.756**	0.667**	0.712**	0.686**	0.804**	0.786**	0.814**	0.774**	1.000

* Correlation is significant at .05 level (2-tailed)

** Correlation is significant at .01 level (2 tailed)

Control Variables

Theory and research suggests that variables such as organization size and time since adoption may significantly affect diffusion of any innovation (Rogers, 2003). Therefore, in this study, various measures of firm size were used as controls, as described in the methods section. These variables include annual sales, gross profits, and number of employees. In addition, time since adoption of EA (measured in years) is also used as a control. Descriptives regarding these control variables can be found earlier in this chapter, in Table 15. Because this analysis is concerned only with the organizational level of analysis, no individual demographic information was used for control purposes.

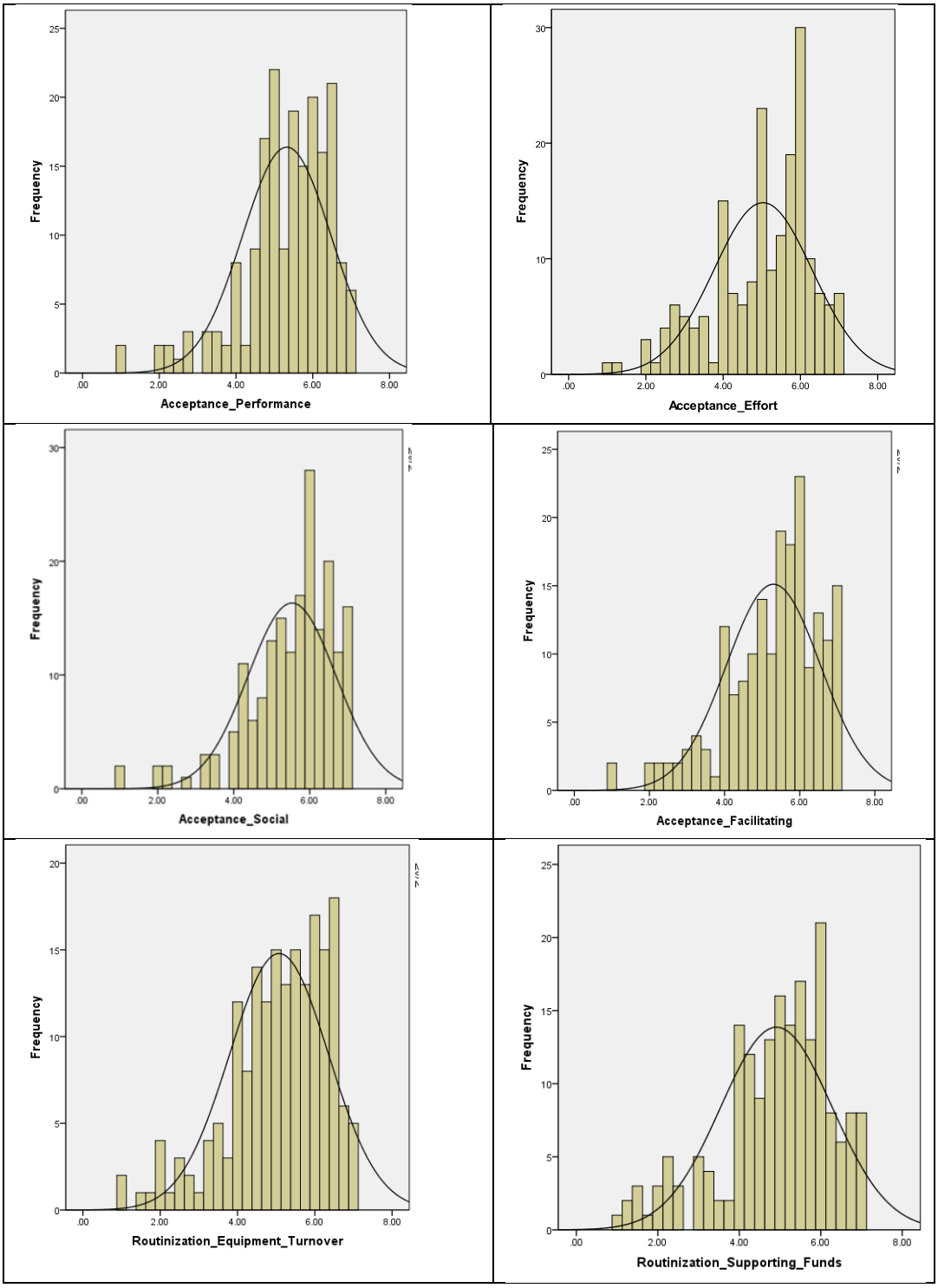
Assumption Checks

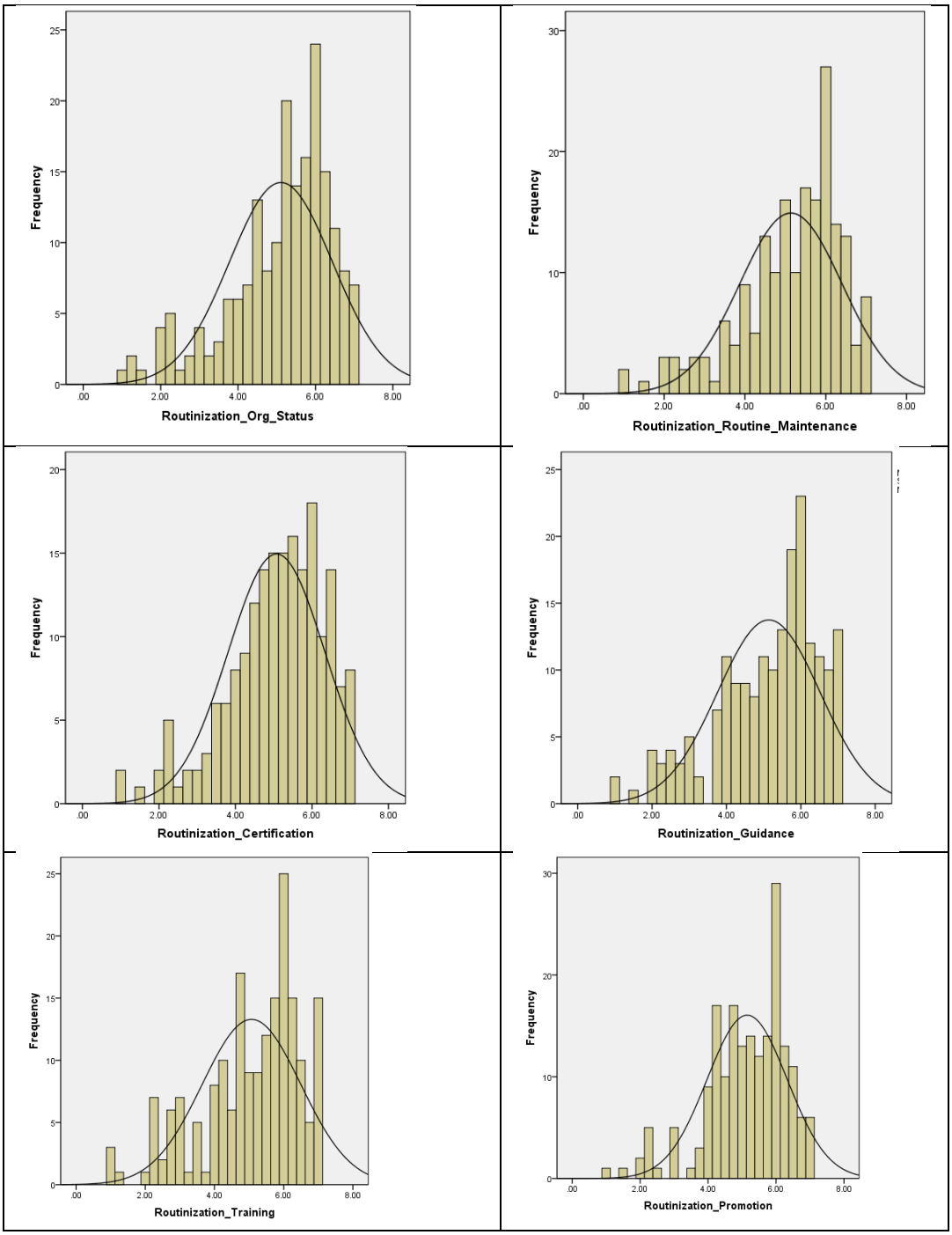
If model assumptions are severely violated, tests of predictive significance cannot be trusted; statistical inference is not appropriate if model assumptions are not met (Hair Jr, Black, Babin, & Anderson, 2010). In the case of multiple linear regression, these assumptions include normality, independence, homogeneity (constancy of error variance), and linearity (Kutner, Nachtsheim, Neter, & Li, 2005). Outliers must also be considered when using multivariate regression (Hair Jr, Black, Babin, Anderson, & Tatham, 2010). What follows is an analysis of these assumptions.

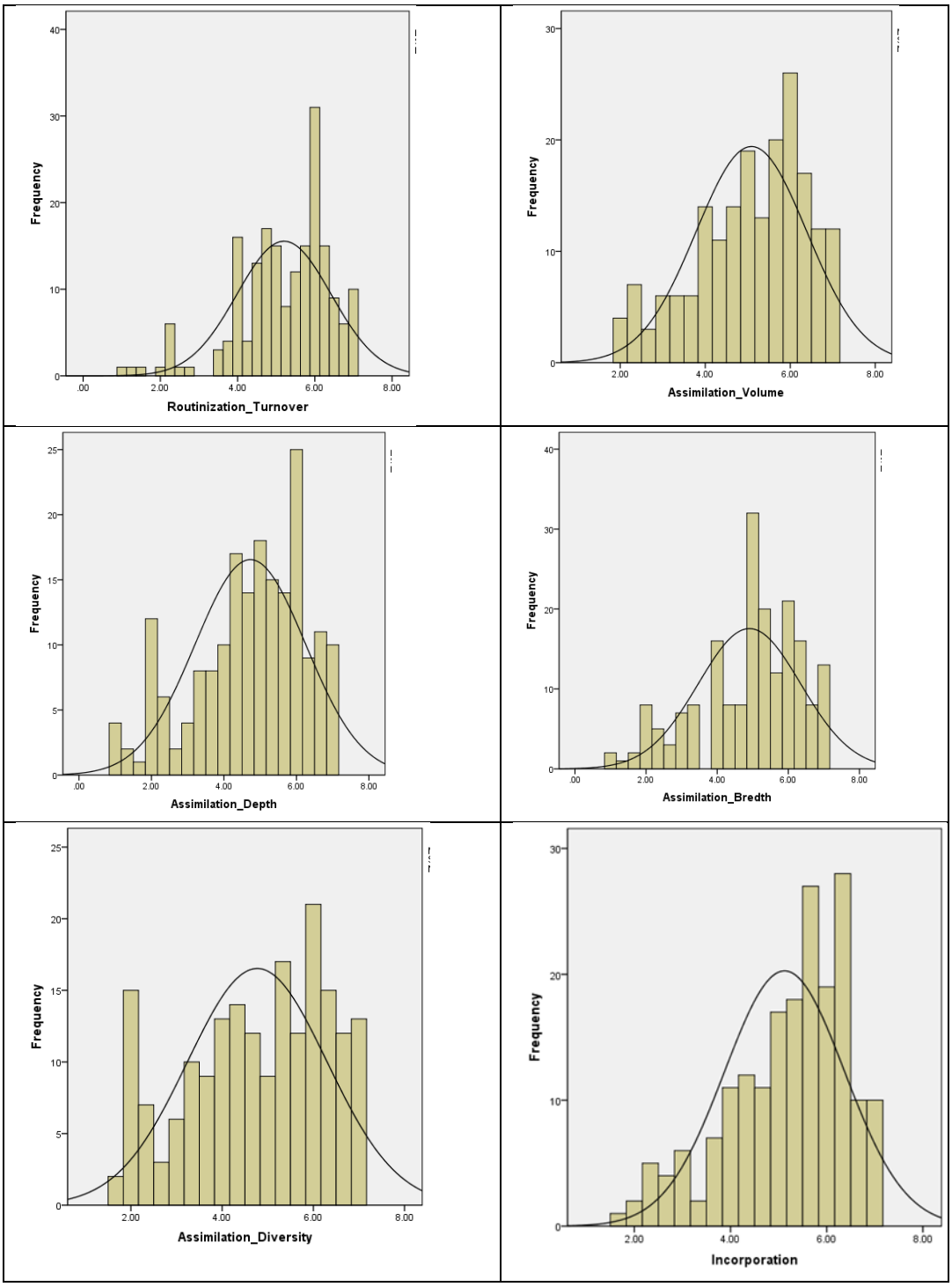
Normality

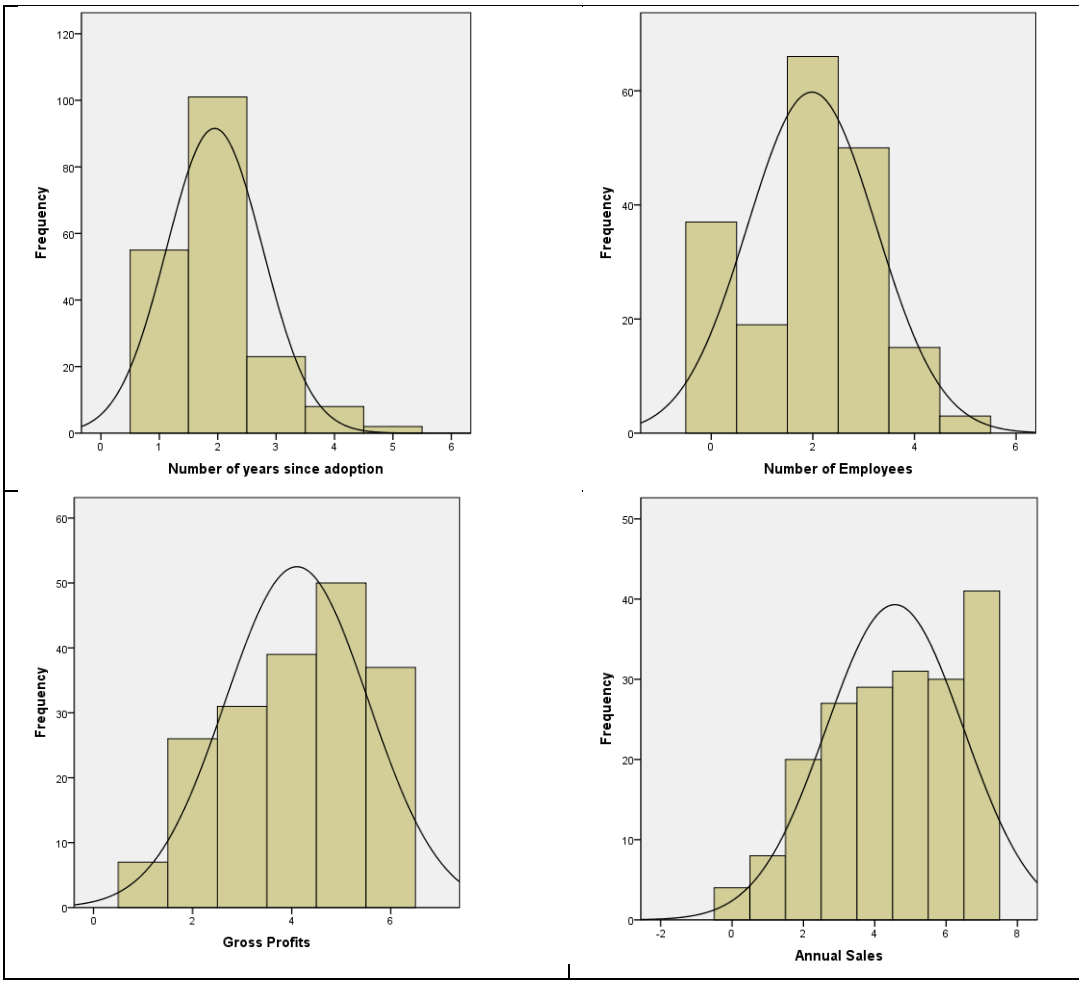
To begin, each variable, to include independent, dependent, and control variables, were assessed for normality by creating histograms. Figure 5 illustrates these histograms with the normal curve overlaid.

Figure 5: Histograms of Each Variable




Frequency
Routinization_Org_Status
Routinization_Routine_Maintenance
Routinization_Certification
Routinization_Guidance
Routinization_Training
Routinization_Promotion

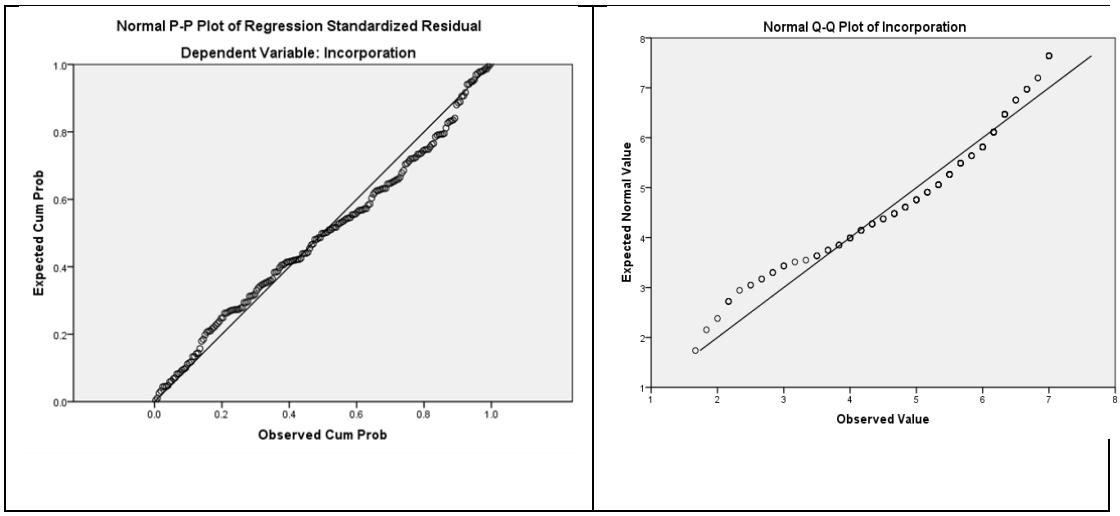

Frequency
Routinization_Turnover
Assimilation_Volume
Assimilation_Depth
Assimilation_Bredth
Assimilation_Diversity
Incorporation



As demonstrated by the histograms illustrated in Figure 5, none of the study variables grossly depart from normality (i.e., none are bimodal or suffer from extreme skewness or kurtosis). As such, these data plots provide sufficient evidence of normality at the variable level and suggest that transformations for individual variables are not necessary. To further assess normality of the hypothesized model, a normal probability plot and normal quartile plot were constructed. The normal probability plot was constructed using the standardized residuals from the full model. In this study, the full model refers to the model that includes all hypothesized predictors and control variables.

The distribution of residuals around the trend line as seen in both plots provide evidence of normality for the hypothesized model (Kutner, et al., 2005).

Figure 6: Normal Plots



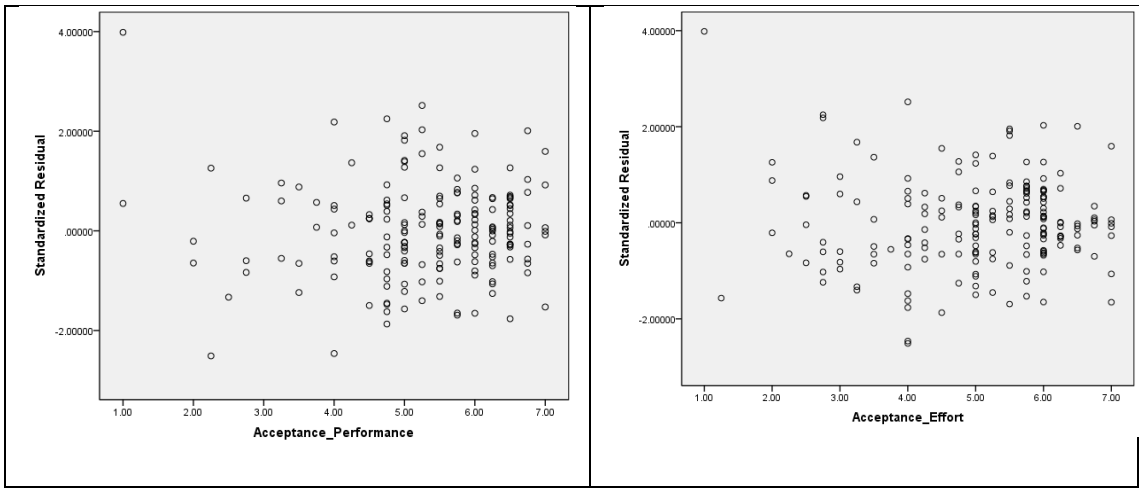
Independence

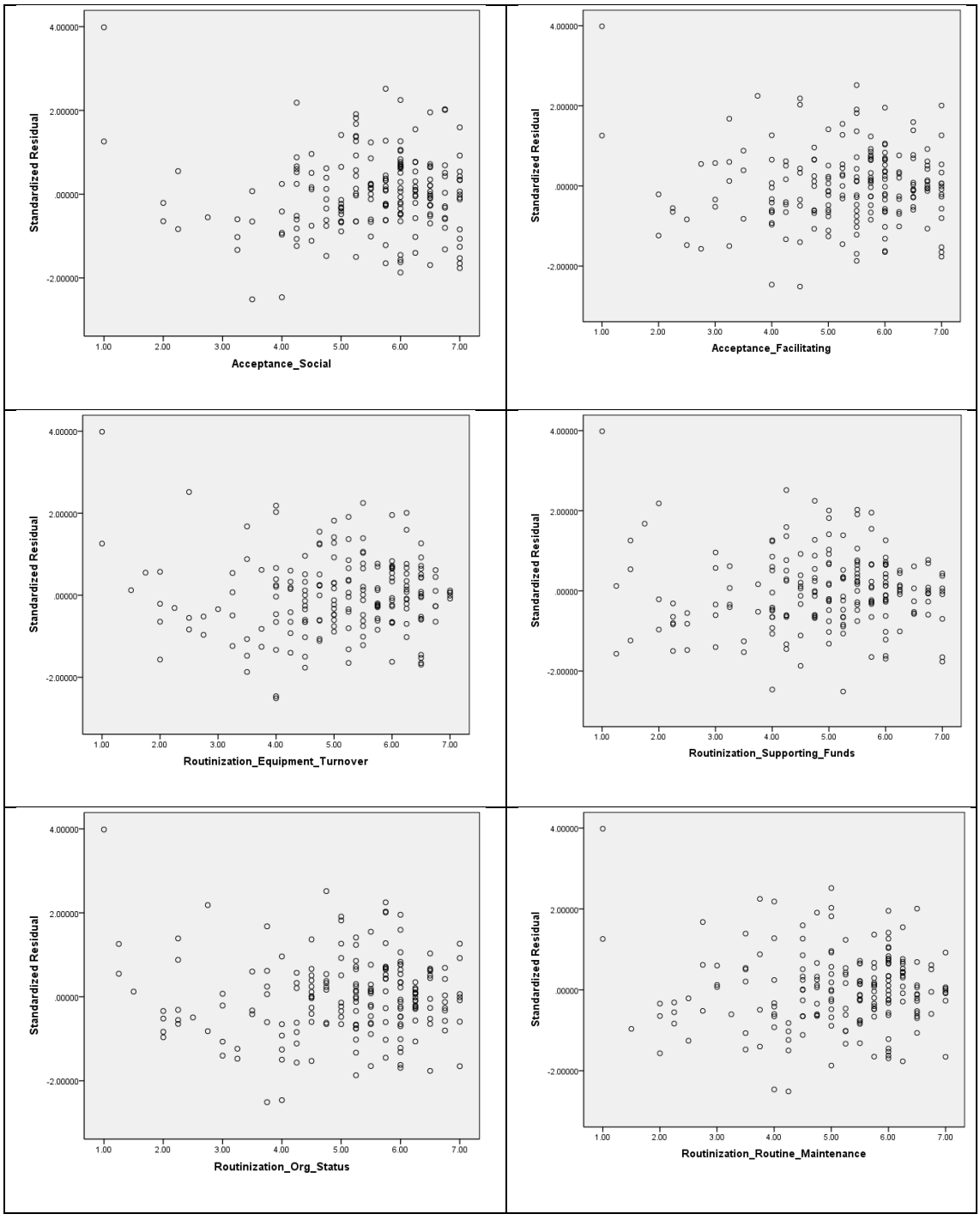
The standardized residuals were also used to check the Gauss-Markov regression assumptions of independence, homoscedasticity, and linearity. Because no organization is represented more than once and respondents were not a part of any specific group or higher-order organization (once responses from duplicate organizations were removed), the assumption of independence should not present a problem in regard to respondents. Although, theoretically, the independence assumption should not be a problem, this assumption was also tested statistically. The Durbin-Watson coefficient was calculated to be 2.202, which provides evidence at the .05 level of significance to support the assertion that the independence assumption is not violated (Durbin & Watson, 1951).

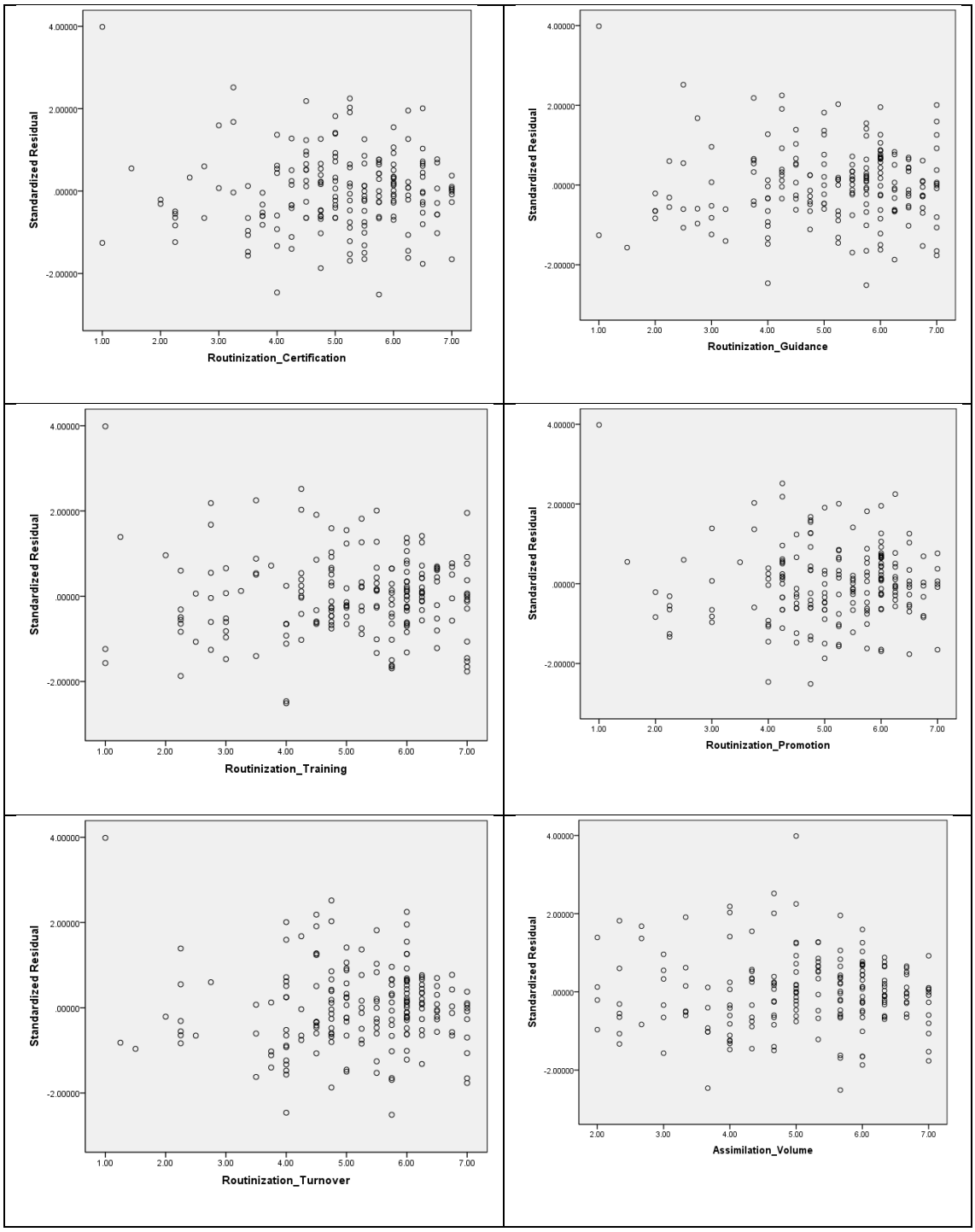
Linearity

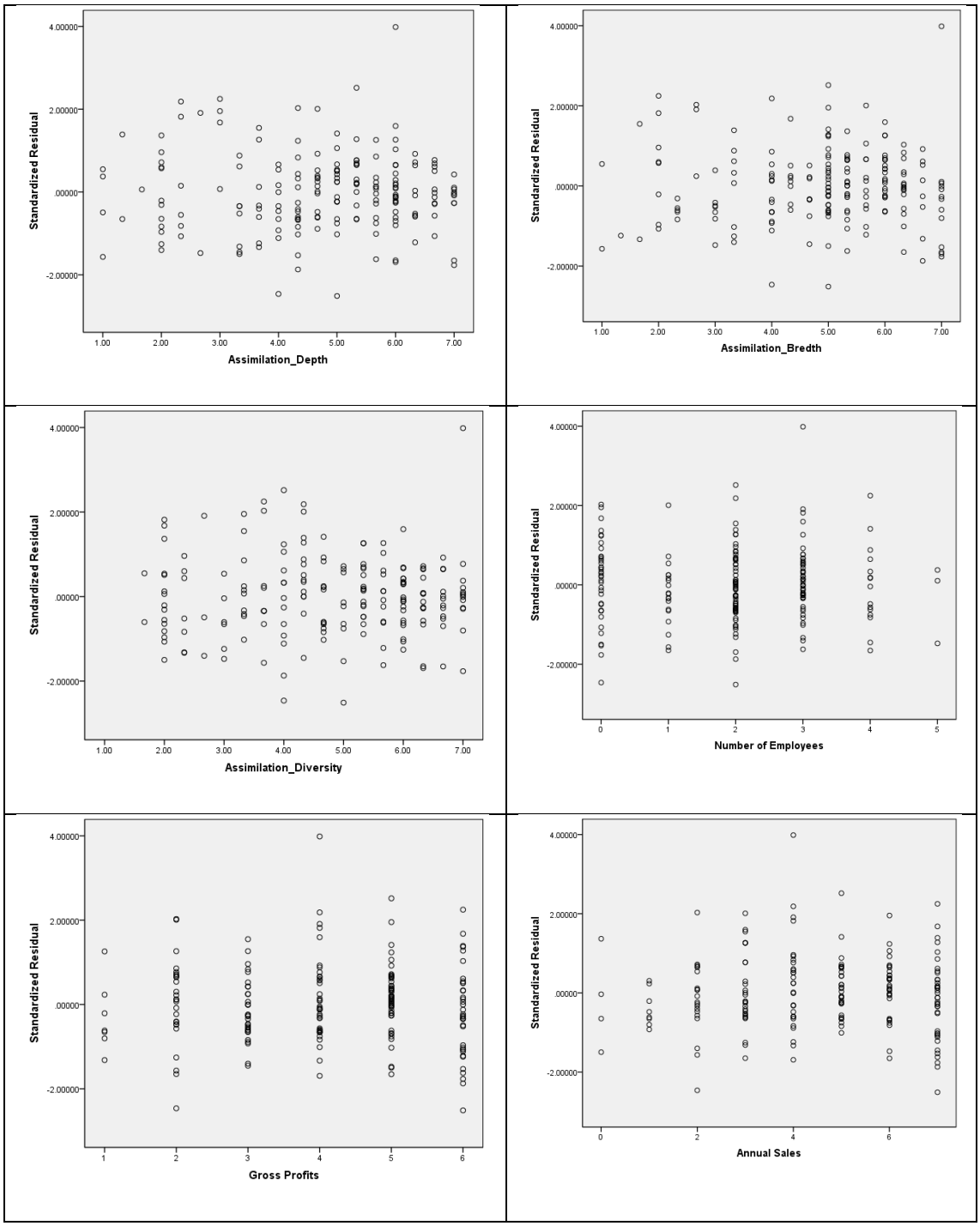
Plots of the residuals against each independent variable can help to determine whether the nature of the relationship between the independent variables and the dependent variable is linear, and thus the appropriateness of linear regression (Kutner, et al., 2005). If not linear, then multivariate linear regression may not be an appropriate data analysis method. Figure 7 illustrates plots of each of the independent variables against the standardized residuals. Also included are plots of the control variables against the standardized residuals. Because the residuals generally fall within a horizontal band centered around zero and display no systematic tendencies, the linearity assumption appears to be met (Kutner, et al., 2005).

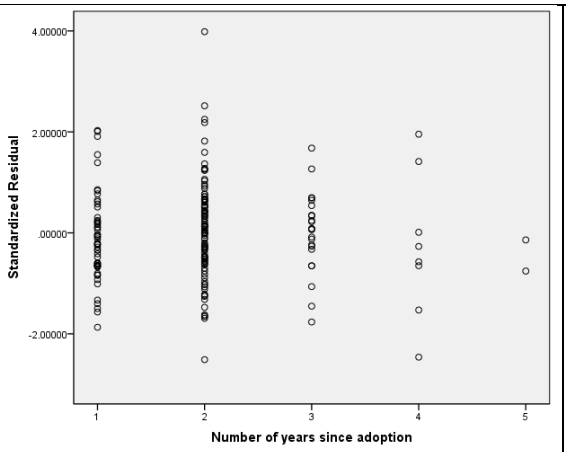
Figure 7: Plots of Standardized Residuals against Independent Variables




Standardized Residual
4.00000
2.00000
.00000
-2.00000
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Acceptance_Social
Acceptance_Facilitating
Routinization_Equipment_Turnover
Routinization_Supporting_Funds
Routinization_Org_Status
Routinization_Routine_Maintenance


Standardized Residual
4.00000
2.00000
.00000
-2.00000
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Routinization_Certification
Routinization_Guidance
Routinization_Training
Routinization_Promotion
Routinization_Turnover
Assimilation_Volume

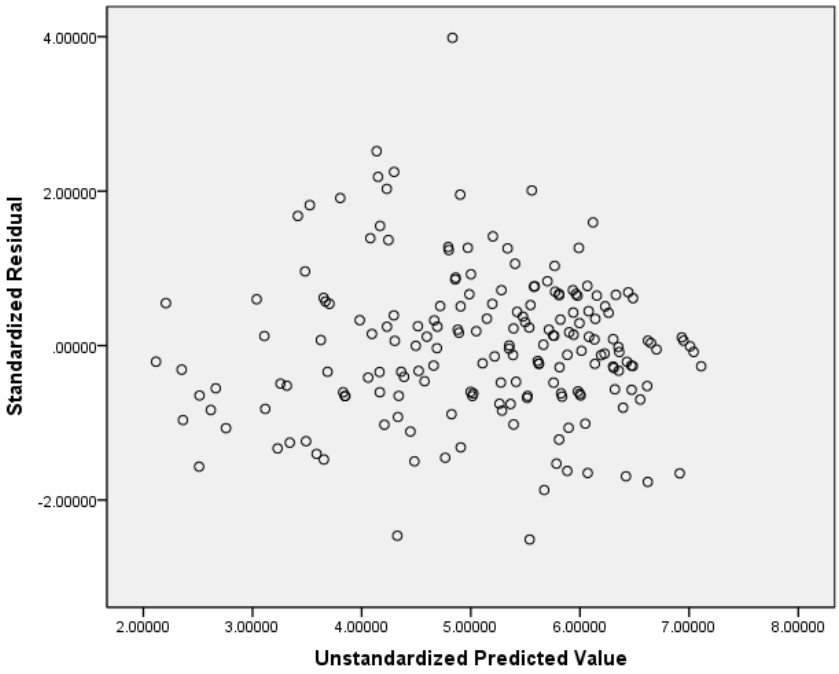

Standardized Residual
4.00000
2.00000
.00000
-2.00000
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Assimilation_Depth
Assimilation_Bredth
Assimilation_Diversity
0
1
2
3
4
5
Number of Employees
1
2
3
4
5
6
Gross Profits
Annual Sales



Homoscedasticity

As demonstrated in the plot of the residuals against the fitted values from the full model (Figure 8), the model appears to meet the constancy of error variance assumption. There appears to be no systematic pattern as the residuals center around zero (Kutner, et al., 2005). This finding is also corroborated by the plots of the residuals against the independent variables, as depicted in Figure 7. Thus, use of variance-stabilizing transformations for the dependent variable (square root or logarithmic functions) does not appear to be necessary.

Figure 8: Plot of Standardized Residuals against Fitted Values



Outliers

The plot of the residuals against the predicted values (Figure 8) also illustrates the presences of some outliers. Further examination of the data suggests that these outliers are not a function of a data entry error or any other mistaken value in the dataset. In addition, there is no theoretical reason why these cases may be outliers (i.e., nothing abnormal is noted in regard to demographics, etc.). Because there are not many outliers, the outliers are not extremely large (all are less than four standard deviations from the mean), there is no theoretical reason to remove these outliers, and the outliers are not a function of researcher error, it was determined that the outliers should be retained. Although inclusion of these outliers in the final model may slightly skew the results, these cases represent valid elements of the population; thus, deletion of these cases may

result in the loss of valuable information regarding the population of interest (Hair Jr, et al., 2010).

Results of Multiple Regression Analysis

This study employed multivariate regression for data analysis. After initial treatment of the data and assumption checks, data analysis was conducted via use of SPSS version19 software. Using a multivariate regression procedure, the independent variables were analyzed to determine which are statistically related to incorporation. The full model, which includes all study variables and controls, must be tested in order to garner adequate statistical results for hypothesis testing. However, once significant variables are identified, creating a more parsimonious, reduced model is desired in order to explain the greatest amount of variance in the dependent variable with the least amount of independent variables. This reduced model will be more valuable to those in both research and practice who are concerned with focusing on only the few, most critical variables. Thus, a backward elimination, stepwise regression approach was used.

To begin, the full model was run and results were obtained. The model is significant at the $p < .001$ level ($F_{189} = 39.305$; $R^2 = .831$; Adjusted $R^2 = .810$). The results of this analysis are illustrated in Table 18.

Table 18: Regression Results from Full Model

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.596	.243		2.448	.015		
	Number of Employees	.013	.033	.013	.398	.691	.914	1.094
	Gross Profits	.009	.041	.010	.207	.836	.438	2.283
	Annual Sales	-.025	.031	-.038	-.798	.426	.440	2.275
	Number of years since adoption	.026	.052	.017	.496	.621	.854	1.171
	Acceptance_Performance	-.081	.079	-.075	-1.014	.312	.185	5.402
	Acceptance_Effort	-.027	.061	-.028	-.442	.659	.255	3.918
	Acceptance_Social	.022	.075	.020	.292	.771	.209	4.783
	Acceptance_Facilitating	-.018	.075	-.018	-.235	.815	.178	5.605
	Routinization_ Equipment_Turnover	.162	.071	.167	2.282	.024	.189	5.293
	Routinization_ Supporting_Funds	.047	.059	.051	.795	.428	.244	4.105
	Routinization_Org_Status	.016	.073	.017	.214	.831	.168	5.959
	Routinization_Routine_ Maintenance	.024	.073	.025	.336	.737	.184	5.438
	Routinization_Certificatio n	.023	.073	.023	.311	.756	.181	5.523
	Routinization_Guidance	.199	.067	.220	2.961	.004	.182	5.494
	Routinization_Training	-.123	.055	-.140	-2.223	.028	.252	3.964
	Routinization_Promotion	.047	.072	.044	.647	.519	.216	4.622
	Routinization_Turnover	.035	.062	.034	.558	.578	.270	3.704
	Assimilation_Volume	.063	.066	.066	.950	.344	.212	4.727
	Assimilation_Depth	.143	.050	.175	2.844	.005	.266	3.753
	Assimilation_Bredth	.234	.052	.270	4.456	.000	.274	3.654
	Assimilation_Diversity	.154	.048	.189	3.205	.002	.291	3.440

The results of the full model yield some telling findings. To begin, none of the control variables are shown to be significantly related to the dependent variable. Next, only six of the 17 independent variables are shown to be significant. Finally, as shown by the variance inflation factors (VIF) in the far right column of Table 18, the regression model suffers from slight multicollinearity. However, the largest VIF value (5.959) is still well below the common cutoff threshold value of 10 (Hair Jr, et al., 2010). Thus, although notable, no remedial actions were deemed to be necessary.

Because only six variables were found to be significant, it was determined that a backward elimination, stepwise regression approach would be helpful in systematically removing insignificant variables. Not all insignificant variables are removed at once,

because the removal of each variable may change the nature and/or magnitude of the relationship between each of the other independent variables and the dependent variable (Hair Jr, et al., 2010). This is the rationale behind using a systematic, stepwise approach. Using the level of significance of each variable in the full model to determine the order of variable removal, a backward elimination stepwise regression was completed in SPSS version 19. Throughout this process, no other variables (aside from the six identified in the full model as significant) were found to be significant. The results of the reduced regression model (the model containing only the significant predictors) are illustrated in Table 19. The regression model is significant at the $p < .001$ level ($F_{189} = 139.701$; $R^2 = .821$; Adjusted $R^2 = .814$).

Table 19: Regression Results from Reduced Model

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.645	.170		3.797	.000		
	Routinization_ Equipment_Turnover	.198	.047	.203	4.214	.000	.420	2.378
	Routinization_Guidance	.243	.051	.269	4.734	.000	.303	3.299
	Routinization_Training	-.115	.049	-.132	-2.378	.018	.317	3.154
	Assimilation_Depth	.171	.044	.209	3.874	.000	.335	2.985
	Assimilation_Bredth	.235	.047	.272	4.952	.000	.325	3.073
	Assimilation_Diversity	.178	.042	.218	4.260	.000	.373	2.682

As shown in the results from the reduced model, three of the routinization variables and three of the assimilation variables are shown to be significant predictors of incorporation of EA. Notably, the nature of the relationship between training and incorporation, although significant, is negative. The nature of this relationship is opposite of that which was hypothesized, which leads to the rejection of this hypothesis, as discussed below. Also of note, the VIF values of each of the retained variables suggest no cause for concern regarding multicollinearity.

The percent of variance explained by the reduced model (R^2 value) is only slightly less than that of the full model. In fact, the adjusted R^2 value for the reduced model, which corrects the R^2 value in regard to the number of predictors in the model, is slightly higher than that of the full model. Table 20 illustrates the comparison of both models. Interestingly, the change in R^2 between the two models is not statistically significant. This suggests that, although much more parsimonious, the reduced model using only six predictor variables is just as useful in predicting incorporation of EA as the full model, which includes 17 predictor variables. More discussion regarding these findings can be found in Chapter 5, Discussion.

Table 20: Comparison of Full Model with Reduced Model

					Change Statistics				
Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	R^2 Change	F Change	df1	df2	Sig. F Change
1 Reduced	.906[a]	.821	.814	.53696	.821	119.398	7	182	
2 Full	.912[b]	.831	.810	.54333	.010	.697	14	168	.775

Results of Hypothesis Tests

The results of the multivariate linear regression, reported above, provide the basis for accepting or rejecting the study's hypotheses. For the purpose of hypothesis testing, the statistics generated from the full model are used. However, it should be emphasized that using the reduced model would lead to the same hypothesis conclusions regarding the significant relationships as using the full model.

Table 21: Results of Hypothesis Tests

Hypothesis No.	Acceptance Hypotheses	Support?	Sig	Beta
1	Higher levels of performance expectancy will correlate to higher levels of EA incorporation.	No	0.312	-0.075
2	Lower levels of effort expectancy will correlate to higher levels of EA incorporation.	No	0.659	-0.028
3	Higher levels of social influence will correlate to higher levels of EA incorporation.	No	0.771	0.020
4	Higher levels of facilitating conditions will correlate to higher levels of EA incorporation.	No	0.815	-0.018
	Routinization Hypotheses			
5	The presence of established equipment turnover procedures for equipment that facilitates EA will correlate to greater levels of EA incorporation.	Yes	0.024	0.167
6	The availability of local funds to support EA will correlate to higher levels of EA incorporation.	No	0.428	0.051
7	EA's status as a strategic-level asset will correlate to greater levels of EA incorporation.	No	0.831	0.017
8	Established, routine procedures for review and update of the EA will correlate to greater levels of EA incorporation.	No	0.737	0.025
9	Establishment of personnel classifications that account for the organization's use of an EA will correlate to greater levels of EA incorporation	No	0.756	0.023
10	An organization's use of governing regulations that address EA will correlate to greater levels of EA incorporation.	Yes	0.004	0.220
11	An organizational EA training program will correlate to greater levels of EA incorporation.	No*	0.028	-0.140
12	Promotion of individuals who support EA will correlate to greater levels of EA incorporation.	No	0.519	0.044
13	The greater the degree to which EA is unaffected by the turnover of those responsible for the organization's adoption of EA will correlate to a greater degree of EA incorporation.	No	0.578	0.034
	Assimilation Hypotheses			
14	Greater volume of EA use will correlate to EA incorporation.	No	0.344	0.066
15	Greater diversity of EA use will correlate to EA incorporation.	Yes	0.002	0.189
16	Greater breadth of EA use will correlate to EA incorporation.	Yes	0.000	0.270
17	Greater depth of EA use will correlate to EA incorporation.	Yes	0.005	0.175

* Although significant, the nature of the relationship is the opposite of what was hypothesized

Summary

This chapter presented the findings of this research effort. To begin, sample demographics, to include both individual-level participant demographics (i.e., gender, age, etc.) and organization-level demographics (i.e., annual profits, etc.) were reported. Adequate reliability of measures was then established via reporting Cronbach's alpha, mean, and standard deviations for each construct. After introducing control variables that, based on theory, may affect the results of the analysis, an in-depth analysis of the

statistical assumptions necessary for multivariate regression was conducted. This showed that the data and the proposed model displayed adequate levels of normality, constancy of error variance, independence, and linearity. In addition, it was explained why, although few outliers were present, none were removed. Finally, the results of the stepwise, multivariate linear regression were presented. These results served as the basis for accepting or rejecting each of the study's hypotheses, as reported at the end of this chapter.

Chapter 5: Discussion

The aforementioned data analysis yields interesting findings. This study proposed 17 hypotheses, of which, only five are supported. However, one other variable was found to be significantly related to incorporation of EA, but the nature of the relationship was not as hypothesized. The research model with significant relationships indicated is illustrated in Figure 9. In sum, the results suggest that the following are significant predictors of EA incorporation:

a) The presence of established equipment turnover procedures for equipment that facilitates EA

b) An organization's use of governing regulations that address EA

c) An established EA training program (negatively related)

d) Diversity of EA use

e) Breadth of EA use

f) Depth of EA use

In contrast, the results suggest that 11 of the independent variables investigated in this study are not significantly related to EA incorporation. These are:

a) Performance expectancy

b) Effort expectancy

c) Social influence

d) Facilitating conditions

e) The availability of local funds to support EA

f) EA's status as a strategic-level asset

g) Established, routine procedures for review and update of the EA (supply and maintenance)

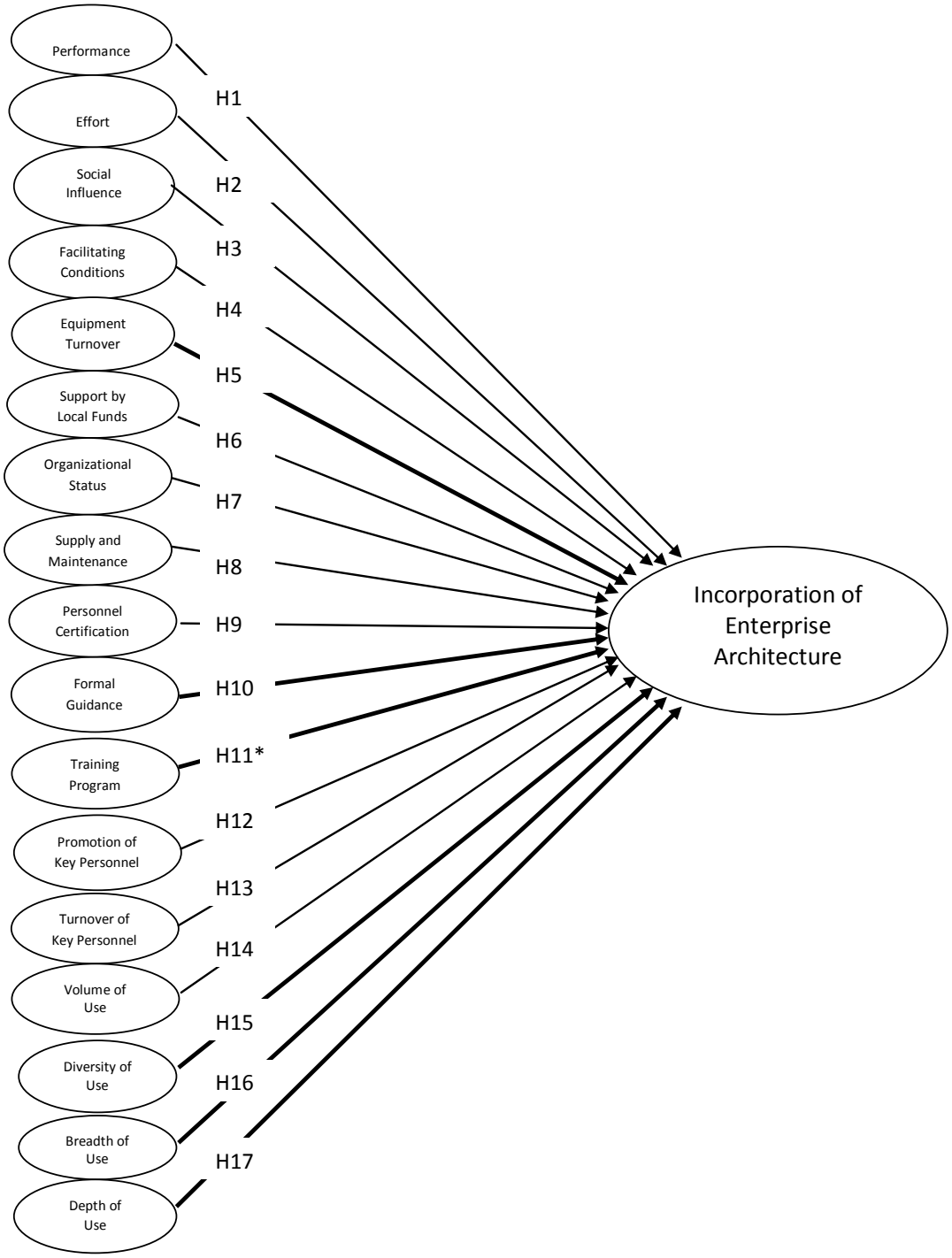
h) Establishment of personnel classifications that account for the organization's use of EA

i) Promotion of individuals who support EA

j) The degree to which EA is unaffected by the turnover of those responsible for the organization's adoption of EA

k) Volume of EA use

Figure 9: Research Model with Significant Paths Indicated



Note: Bold lines indicate significance at $p < .05$ level. Thin lines indicate non-significance
* Denotes significant, but negative relationship

In this chapter, the implications of these findings are discussed. To begin, the results of hypothesis testing are discussed, with an emphasis on the implications for advancing theory and research. Then, the results are discussed from a practitioner's perspective; given the results of this study, guidance is provided for those organizations that are working toward incorporating EA. The limitations of the study are then explained, which leads to a discussion of future research opportunities. This chapter closes with concluding remarks regarding this entire research effort.

Implications of Significant Factors

Equipment turnover procedures, governing regulations, an EA training program, and diversity, breadth, and depth of EA use were found to be significant predictors of EA incorporation in supply chain firms. Combined, these six variables account for over 82% of the variance in incorporation of EA in the supply chain. This section begins by describing the ramifications of these findings. The non-significant variables and implications thereof are then discussed.

Equipment Turnover Procedures

The first factor to be discussed that was found to be a significant predictor of incorporation of EA is *equipment turnover* ($\beta = .162$, $t = 2.282$, $p = .024$). In this dissertation, equipment turnover is defined as procedures for acquiring new generations of equipment needed to update the innovation. Yin et al. (1981) posit that continually updating all equipment associated with an innovation is important to facilitating routinization. Although EA is not comprised of actual hardware components, hardware

and software products are often utilized to operationalize the EA within an organization. ERP systems are often implemented in an effort to integrate internal and external information throughout an entire enterprise, to include supply chains (Davenport, 1998, 2000a, 2000b; Davenport & Brooks, 2004).

The findings of this study suggest that changes to the organizational governance system to account for routine acquisition of equipment needed to update components that operationalize EA are significantly related to incorporation of EA. This finding corroborates earlier routinization research that demonstrated how equipment turnover planning helps to routinize innovations into the adopting organization (Pluye, Potvin, Denis, Pelletier, & Mannoni, 2005; Yin, 1979, 1981; Yin, et al., 1978). Additional research has investigated the organizational benefits of equipment turnover, such as reduced energy consumption (Worrell & Biermans, 2005). Realizing such benefits may have a recursive, synergistic effect in that continued upgrades lead to continuous improvement and greater performance. This greater performance then reinforces the perceived efficacy of the innovation, and thus greater levels of incorporation of the innovation are realized.

Formal Guidance

The second factor to be discussed that was found to be a significant predictor of incorporation of EA in the supply chain is *formal guidance* ($\beta = .199$, $t = 2.961$, $p = .004$). In this dissertation, formal guidance is defined as the formal regulations and governing ordinance that address the innovation. Yin et al. (1978) found that innovations

were integrated into the organization, in part, by being included in its rules of governance and/or standard operating procedures.

Consistent with earlier routinization research, the findings of this dissertation suggest that the inclusion of the innovation in official instructions helps to solidify an organization's acceptance of the innovation as a standard practice and thus routinize the innovation. For instance, if it is directed by clear instruction that EA is to be referred to in making any decision that involves the use of IT in the organization, then it is more likely that EA will be used. This is analogous to the idea of "forced adoption" or "non-voluntariness" of an innovation, where management dictates that a specific innovation will be used by a certain constituency to complete a given task. Although it may seem obvious, research has provided evidence to suggest that such forced adoption is an effective means of getting constituents to utilize an innovation (Agarwal & Prasad, 1997; Lee, Kozar, & Larsen, 2003; Wu & Lederer, 2009). Indeed, although perceived voluntariness has been shown to make potential users feel more comfortable in using the innovation and may help to facilitate the initial stages of adoption from a change management perspective, complete voluntariness is thought to inhibit the later steps of diffusion (i.e., incorporation) (Vehring, Riemer, & Stefan, 2011). Thus, the presence of directives regarding an innovation, such as EA, in official organizational guidance (memos, directives, regulations, etc.) may instill a sense of forced adoption to those in the organization, which may explain why formal guidance is a significant predictor of the incorporation of EA.

Training Program

The third factor to be discussed that was found to be a significant predictor of incorporation of EA in the supply chain is *training program* (β = -.123, t = -2.223, p = .028). Although a significant predictor, the nature of the relationship is not as hypothesized. It was hypothesized that the degree to which a training program is established would be positively related to incorporation. However, the findings suggest that the relationship is negative; the greater the degree to which a training program is operationalized in an organization, the less incorporated EA is into the organization. Training program is defined in this dissertation as the establishment of an ongoing training program in support of the innovation. Notably, this does not include short-term training sessions that accompany adoption of the innovation, but rather routine training such that individuals new to the organization may learn about the innovation and existing employees can receive additional training.

From the perspective that training would precede incorporation of EA, it appears counterintuitive that an expansive training program would be negatively related to incorporation. However, the cross-sectional approach and statistical analysis conducted in this study cannot confirm causality – only correlation. As such, perhaps training is only important in the early post-adoption phases, and training tapers off once EA is incorporated. Under this explanation, training would still facilitate incorporation, as evidenced by the statistically significant relationship. An alternative explanation is that training efforts are only put into place when EA is not incorporated as expected. Perhaps the presence of more abundant training regimens is a lagging indicator that the innovation is not being well received and, thus, the organization's leadership is taking action to help

improve incorporation. In addition, this finding may be particular to the artifact of this investigation, EA, and not necessarily other innovations. It would follow that incorporating EA may not evoke much training for the organization as a whole; architects work with senior level management to draft EA and then only those charged with making IT decisions would have to understand how to use it. However, if something goes awry with this process, then training may potentially escalate.

Assimilation: Diversity, Breadth, and Depth of Use

Assimilation is defined as "the extent to which the use of the technology diffuses across the organizational projects or work processes" (Purvis, et al., 2001, p. 121). In sum, assimilation concerns the degree to which an innovation is actually used in the organization. To this end, four dimensions of assimilation are used in the literature: volume, diversity, breadth, and depth of use (e.g. Hart & Saunders, 1998; Massetti & Zmud, 1996). In this dissertation, three of these four factors were found to be significantly related to incorporation of EA. The results suggest that diversity of use, which is defined as the extent to which different organizational processes utilize the innovation, is significantly related to incorporation of EA ($\beta = .154$, $t = 3.205$, $p = .002$). The results also suggest that breadth of use, which is defined as the extent to which an organization collaborates within and between agencies regarding the innovation, is significantly related to EA incorporation ($\beta = .234$, $t = 4.456$, $p < .001$). Finally, the results suggest that depth of use, which is defined as the vertical impact of the innovation on the organization's business processes, is also significantly related to incorporation of EA ($\beta = .143$, $t = 2.844$, $p = .005$). Interestingly, volume, which is defined as the amount

of overall use of the innovation within the organization, was not found to be a significant predictor of EA incorporation ($\beta = .063$, $t = .950$, $p = .344$).

It follows that the actual degree of use of an innovation is a significant determinant of incorporation of the innovation. Because the purpose of EA is to streamline IT and business processes, diversity and depth of use appear to be logical predictors of EA incorporation: the more organizational processes encompassed by EA and the deeper embedded EA is into these processes, the greater the incorporation. The results also suggest that when firms use EA to collaborate with supply chain partners, then EA becomes more incorporated into the adopting organization. If incorporation is to be used as a proxy for implementation success (DeLone & McLean, 1992, 2003), then it follows that incorporation of EA and supply chain collaboration are significantly related. Unfortunately, empirical research regarding how EA is used by supply chain partners to realize shared benefits is markedly absent in the literature.

Although performance measures are not addressed in this study, the significance of the breadth of use factor implies that, at a minimum, EA supports supply chain collaboration. This is congruent with previous research that has investigated the relationships between EA and agility and collaboration (Chae, et al., 2007; Choi, et al., 2008). However, more research is needed to investigate additional benefits that may be derived from EA; some benefits that are often assumed but lack a wide body of empirical support include increased responsiveness, improved decision-making, improved communication and collaboration, reduced costs, and greater business-IT alignment (Tamm, et al., 2011). Future research regarding benefits to the supply chain could use

EA incorporation (as measured in this study) as an independent variable when examining these potential benefits.

Implications of Non-significant Factors

The above variables were found to be significant predictors of EA incorporation. Curiously, however, many variables addressed in this study were found to be non-significant predictors of incorporation. These findings are quite interesting, as these non-significant findings seemingly defy both theory and logic. However, in retrospect, close examination of these variables, the research setting (supply chain), and research artifact (EA) reveals several possible explanations for why the hypotheses regarding these variables were not supported. Discussion now turns to the variables that were hypothesized to be significant predictors of incorporation, but were found to be non-significant.

Technology Acceptance Factors

None of the factors that consider how well an organization's constituency accepts an innovation were significantly related to how well EA is incorporated in a supply chain organization. Indeed, neither performance expectancy ($\beta = -.081$, $t = -1.014$, $p = .312$), effort expectancy ($\beta = -.027$, $t = -.442$, $p = .659$), social influence ($\beta = .022$, $t = .292$, $p = .771$), nor facilitating conditions ($\beta = -.018$, $t = -.235$, $p = .815$) were found to be significant predictors of EA incorporation. This finding has telling implications for theory and research; the results imply that just because an innovation is accepted by those in the organization does not mean that it is deeply embedded. Acceptance, then, is just an

early step in the post-adoption diffusion process and does not necessarily imply that the innovation will become incorporated. Future research could examine potential mediating factors of the relationship between technology acceptance and incorporation. For instance, referring to past stage models of the organizational diffusion process (Cooper & Zmud, 1990; Rogers, 2003), it may be that the effect of technology acceptance on incorporation is fully mediated by routinization and/or assimilation factors.

Routinization Factors

Only three of the nine factors regarding routinization were found to be significant predictors of EA incorporation in a supply chain organization. Local funds ($\beta = .047$, $t = .795$, $p = .428$), organizational status ($\beta = .016$, $t = .214$, $p = .831$), procedures for review and update of EA (i.e., supply and maintenance) ($\beta = .024$, $t = .336$, $p = .737$), personnel certification ($\beta = -.123$, $t = -2.223$, $p = .028$), promotion of key personnel ($\beta = .047$, $t = .647$, $p = .519$), and turnover of key personnel ($\beta = .035$, $t = .558$, $p = .578$) were all found to be non-significant predictors of EA incorporation in the supply chain. More research is required in order to determine if these factors are not significant because of the research artifact (EA) or setting (the supply chain) – or if these factors are simply not predictors of incorporation. In addition, as with the acceptance factors, there may be additional moderators or mediators of the relationship between some routinization factors and incorporation that have yet to be discovered. However, because little work on routinization has been completed since Yin (1979, 1981) and Yin and colleagues' (1978) research, it is difficult to ascertain what these factors may be. Routinization is an

important step in organizational innovation diffusion, and it is hoped that more attention will be given in future research.

Volume of Use

Finally, in regard to non-significant predictors of incorporation, it is interesting to note that volume of use ($\beta = .063$, $t = .950$, $p = .344$) was found to be the only non-significant assimilation variable. Volume of use is defined as the amount of overall use of the innovation within the organization. The result of the volume of use factor may differ from other assimilation factors addressed in this study because of the artifact and research setting of this particular study. EA is used most often by IT professionals and senior management. Thus, the volume of use throughout the entire organization may not necessarily be required for EA to be incorporated. In contrast, because EA is supposed to comprehensively integrate many business processes that span the organization, diversity and depth of use may be more applicable. In addition, the significance of breadth of use may be attributed to the fact that the sample frame consists of supply chain firms, which inherently rely heavily on inter-firm collaboration (Mason, Lalwani, & Boughton, 2007; Matopoulos, Vlachopoulou, Manthou, & Manos, 2007; Whipple & Russell, 2007). Future research should examine whether or not the findings of this study generalize to additional technological innovations or research settings. It is suspected that the assimilation factors that are found to be significant indicators of incorporation will vary with both the innovation and research setting. Nonetheless, theoretically applicable dimensions of use will likely always remain to be significant predictors.

Implications for Practice

By identifying and aggregating the myriad factors that are proposed to comprise the incorporation of a technological innovation into one framework, this dissertation provides insight for those in industry who seek to not just adopt, but fully embed a newly acquired innovation into their organization. To begin, managers who are looking specifically to incorporate EA into the supply chain can use the findings of this study to determine where to commit resources. To this end, it appears that establishing clear guidance regarding EA may be a logical first step toward incorporation. Within this guidance, procedures for equipment turnover should be explained and programs to facilitate such turnover should be initiated. In addition, use policies and expectations could be outlined in such guidance. Finally, management should promote and monitor use of EA throughout the organization. The findings of this dissertation suggest that establishing such guidance and ensuring that constituents adhere to such policies will have the greatest impact on EA incorporation. Conversely, working to gain constituency buy-in and acceptance may not be the best use of resources, in the case of incorporating EA in supply chain organizations.

Caution should be used if one wishes to generalize the findings of this study to organizations outside the supply chain environment or to innovations aside from EA. For instance, because of the inherent inter- and intra-organizational interdependencies in the supply chain that are required for the effective transportation and storage of goods and services, the adoption of innovations in this context likely differs from other organizational contexts. In addition, the nature of EA makes it different from many other technological innovations; EA is strategic in nature, affects multiple business processes,

and, although it directs IT usage, EA is not itself an IT. However, business leaders can use this dissertation's UFTII as a reference regarding the actions that management should consider when looking to fully incorporate any innovation into any organization.

Although only six of the 17 variables in the UFTII were found to be significant predictors of EA incorporation in a supply chain organization, these 17 variables may provide a theoretically sound, research-based starting point regarding factors that should be considered by senior management when looking to incorporate technological innovation. It is likely that the significance of these 17 factors varies depending on the innovation artifact and industry. In checklist-like fashion, managers can use the factors identified herein to begin a number of organizational initiatives aimed toward embedding any recently-adopted innovation. For instance, an effort can be initiated to begin a series of internal announcements from top managers, which will help to facilitate social influence. Another effort can advocate for changes to existing budgets or budgeting procedures, which would help to facilitate support by local funds. Additional initiatives may be instituted to account for all factors that are relevant to the adopting organization and specific innovation.

Limitations

Although thorough, this dissertation suffers from some limitations. Some of these limitations are inherent to any research effort that uses one research artifact and/or a specific research setting in order to make inferences about the target population, thus limiting generalizability. Other limitations include those that pertain to survey method research.

The findings and implications of this research effort are limited by the sample frame and research artifact used. To begin, EA differs from many other technological innovations; it is a guiding document rather than an information technology. Thus, another explanation for the non-significant effect of the acceptance factors found in this study may be attributed to the fact that EA was used as the research artifact. Perhaps the majority of the constituency in an organization is not necessarily concerned with EA, because only those in senior leadership positions or IT jobs routinely deal with EA. This would mean that an employee's opinion regarding EA may be rather irrelevant to the actual incorporation of the innovation. Or, perhaps EA is a type of innovation that is more top-down driven than other innovations. If an organization's leadership dictates that EA is to be used, there may not be much that anyone else in the organization can really say or do. Similar rationalizations could be made to attribute to the non-significant findings regarding the routinization variables to the research artifact. In sum, the findings of this study may not transcend to other technological innovations. However, only future research can confirm this assertion. Nonetheless, this study still provides a listing of potentially significant predictors (and measures thereof) that may be used as the basis to examine additional technological innovations.

The sample used in this study also represents a potential limitation to the findings. IT professionals, which constitute the majority of the sample, may have a biased opinion of EA and the factors that may or may not affect its incorporation. However, it is assumed that any bias that participants would inject into the study would be uniform throughout all study variables, and thus would not adversely affect the data analysis and subsequent findings. This is because this study is concerned most with analyzing

relationships between variables. Again, future research can be useful in examining additional sample frames.

The survey method chosen for this study also provides potential limitations. For instance, this method often introduces various sources of bias into a research effort. These include single key-informant bias, common method bias, and non-response bias. Although these biases were addressed and controlled for, it is likely that some bias still exists. Future research in this area that employs different methods can help to corroborate or countermand the findings of this study.

Future Research

This dissertation assimilated potential predictors of innovation incorporation and tested their significance to incorporating EA into supply chain organizations. However, there may be different ways to view the concept of incorporation. Using the UFTII proposed in this dissertation as a starting point, additional research and analyses may be useful in further examining the relationships between UFTII constructs and how they relate to additional technological innovations. In this section, propositions for future research are offered.

If incorporation is the culmination of acceptance, routinization, and assimilation, then the factors identified in extant literature that are thought to facilitate acceptance, routinization, and assimilation should correlate to some degree. In other words, degree of incorporation may account for shared variance in each of these factors. This shared variance has been demonstrated across factors in research regarding acceptance (Venkatesh, et al. 2003); however, research has not examined shared variance across

these stages of the organizational diffusion process. The correlation matrix (Table 17) reported in this dissertations provides evidence of significant correlations between factors. Inasmuch, it is proposed that future research should investigate whether or not incorporation may be a higher-order factor comprised of acceptance, routinization, and assimilation factors – or if it is a completely independent construct.

Proposition 1: The factors that comprise the dimensions of incorporation (acceptance, routinization, and assimilation) are interdependent; a higher-order factor accounts for this shared variance.

Next, if a higher-order factor is shown to explain shared variance between acceptance, routinization, and assimilation variables, then future research is encouraged to develop a valid and reliable scale to measure such a phenomenon. In its entirety, the UFTII suggests up to 17 factors that should be measured in any given study. Provided that three or four items are used for each factor, this results in a rather long scale that may be difficult to employ in practical research settings. Such long measures are not only cumbersome for participants, but have been shown to be less reliable because of participant fatigue, a greater instance of nonresponse, and other factors (Hinkin, 2005; Rogelberg & Stanton, 2007; Schmitt & Stults, 1985; Schriesheim & Eisenbach, 1990). However, because of the above noted interdependencies, some of these factors may be consolidated. Future scale development research employing factor analysis and other techniques could result in a valid and reliable measure.

Proposition 2: Careful scale development should result in a measure that, while remaining multi-dimensional, may also be parsimonious, valid, and reliable.

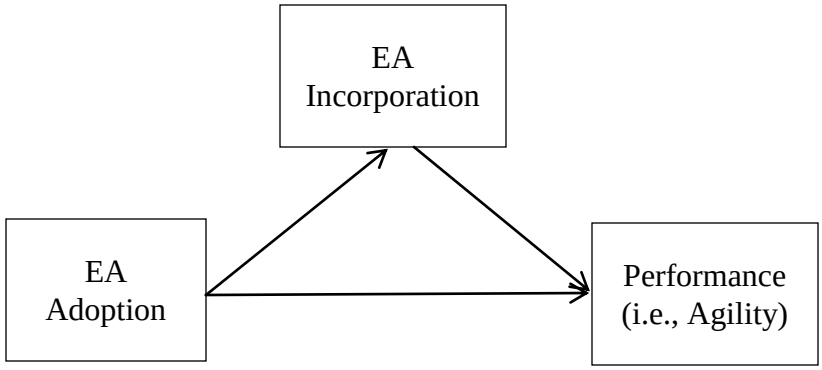
The UFTII accounts for the potential predictors of incorporation, as developed in the literature. Existing measures or theoretical definitions in which to base new artifact-specific measures of these factors can be found in this dissertation and other extant literature (e.g. Liang, et al. 2007; Massetti & Zmud 1996; Venkatesh, et al. 2003; Yin 1979). However, as demonstrated in past innovation studies and in this dissertation, researchers should investigate only those factors that are deemed appropriate for their particular research setting. For example, when Liang et al. (2007) measured assimilation of ERP specifically in a back office automation setting, "breadth" was omitted because it did not apply. Similar, theoretically justified omissions from the UFTII will be appropriate in future research. However, appropriate acceptance, routinization, and assimilation factors should be assessed in future studies that wish to examine incorporation of different research artifacts in different research settings in order to account for all potential predictor variables.

Proposition 3: Not all factors accounted for in the UFTII apply to every research setting; however, all theoretically applicable factors of acceptance, routinization, and assimilation should be considered and measured in future studies in order to assure that all potential factors are accounted for in future studies.

This study used an organizational level of analysis. Although this unit of analysis is certainly appropriate for this particular research effort, some scholars suggest that it may be beneficial to integrate EA throughout all firms in a given supply chain, thus considering the entire chain as an enterprise (Liu, Zhang, & Hu, 2005). Undoubtedly, the EA for each organization within a supply chain must account for all external linkages; however, the idea of supply chain as enterprise remains intriguing and may offer a fruitful area for future research. Unfortunately, use of EA in this capacity is rare. Nonetheless, perhaps a case study research approach may be used to investigate such occurrences and examine whether this idea is not only tenable, but if the factors identified in this research are also applicable to the supply chain level of analysis.

Finally, this dissertation is focused solely on incorporation of EA and has not addressed any outcomes of such incorporation. The literature espouses many positive outcomes of EA adoption (Tamm et al., 2011), one of which is agility (Chae, Choi, & Kim, 2007; Choi et al., 2008; Lankhorst, 2009). Using theories such as the resource based view and strategy-structure-performance, empirically investigating outcomes of EA may be a promising area for future research. As an example, Figure 10 illustrates a model that can be used as the basis for such research, which considers EA as a strategic resource and incorporation of EA as a proxy for the changes to organizational structure to accommodate strategy.

Figure 10: Proposed Future Research Model



Conclusion

Extant diffusion of innovation and related literatures propose a myriad of factors that may help or hinder the complete incorporation of a technological innovation into an organization. However, until now, these factors have not been assimilated into a single, cogent framework. In addition, many of these factors have not been empirically tested to determine whether or not they indeed significantly relate to the incorporation of a technological innovation. The purpose of this dissertation was to discover the factors that affect the incorporation of EA into an adopting organization. To accomplish this purpose, this dissertation asked, (1) what factors are suggested in the literature to facilitate the organizational incorporation of any technological innovation? And (2) what factors are shown to be significantly related to the organizational incorporation of EA in the supply chain environment?

In response to these questions and in order to provide a comprehensive response, this dissertation was organized into five distinct chapters. The introduction chapter provided the background and motivation for this study's topic. The second chapter

provided the literature and theoretical background in which the remainder of the study was based. The third chapter developed the 17 hypotheses that were tested in this study and outlined the method used to test them. The fourth chapter presented the findings of this research effort. The results suggest that equipment turnover procedures for equipment intended to facilitate EA, an organization's use of governing regulations that address EA, an organizational EA training program (negatively related), and diversity, breadth, and depth of EA use are all significant predictors of EA incorporation in supply chain organizations. However, contrary to the hypothesized relationship, the training program factor was found to be negatively related to EA incorporation. In summary, only five of the 17 hypotheses were supported. In chapter five, the implications of these findings for theory and practice were discussed.

Diffusing technological innovation into an organization is a process that is not complete until the innovation is thoroughly embedded into the organization, such that the innovation is no longer considered to be "new." Extant research and conceptualizations of the organizational innovation diffusion process often truncates the process at technology acceptance or focuses entirely on assimilation, which only accounts for the degree of use of an innovation. Unfortunately, changes to the organization's governance structure are often overlooked. Furthermore, the many factors that have been previously shown to affect organizational diffusion are often not accounted for in studies. This study provides a unified look at the many organizational factors that may affect the incorporation of any technological innovation. Specific guidance is offered in regard to the particular factors that seemingly affect incorporation of EA in supply chain organizations. It is hoped that this research effort begins the discussion on precisely what

steps are required to move the diffusion status of an innovation from newly adopted to deeply incorporated, thus fulfilling the perceived gap in the literature regarding science's understanding of post-adoption innovation diffusion.

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Appendix 1: Survey Instrument

Thank you very much for taking the time to help with our research. You have been identified as someone who is familiar with an organization that uses (or is attempting to implement) an Enterprise Architecture (EA). In this study, we are interested in determining which organizational factors are most important to incorporating an EA into an organization. This survey will ask you a variety of questions regarding both the organization that has adopted EA and its members.

In this study, **we define EA as a comprehensive framework which defines the business, the information necessary to operate the business, the technologies necessary to support the business operations, and the transitional process necessary for implementing new technologies in response to changing business needs.**

When answering the questions in this survey, please consider an organization that you are familiar with that uses an EA. If you have experience with multiple organizations, please answer the following questions based on the organization that you have the most experience with. Please answer all questions to the best of your ability. If you are uncomfortable with any question, please feel free to leave the response blank. Again, thank you for your time. Your input is invaluable to this research effort.

To begin, please tell us a little about yourself

Gender

- ○ Male
- ○ Female

Age

- ○ 18-25
- ○ 26-35
- ○ 36-45
- ○ 46-55
- ○ 56-65
- ○ 66-75
- ○ 76+

Years of experience with EA (please round to nearest year)

Affiliation with Target Organization (the organization that will be the basis of your responses regarding EA)

- ○ IT Professional in the Organization (architect, network administrator, etc.)
- ○ Other Position in Organization
- ○ Consultant
- ○ Other

Years of experience with Target Organization (please round to nearest year)

Next, please tell us a little about the organization that will be the focus of your responses

Note: Please answer the following questions based on the organization unit/level that adopted the EA

Organization Name (Optional)

Organization's Country of Origin

Number of Employees

Ownership

- ○ Publicly traded
- ○ Private
- ○ Government
- ○ Joint venture
- ○ Non-Profit
- ○ Other

Organization Type

- ○ Manufacturing
- ○ Service
- ○ Defense
- ○ Other

Below is a listing of business processes that are related to supply chain management. Please indicate which processes your organization executes. You may indicate multiple processes, if applicable. Not all organizations participate in these activities, so please check "None of these" if your organization is not involved in these activities.

- ☐ Plan - Processes that balance aggregate demand and supply to develop a course of action which best meets sourcing, production, and delivery requirements.
- ☐ Source - Processes that procure goods and services to meet planned or actual demand.
- ☐ Make - Processes that transform product to a finished state to meet planned or actual demand.
- ☐ Deliver - Processes that facilitate the transport of finished goods and services to meet planned or actual demand, typically including order management, transportation management, and distribution management.
- ☐ Return - Processes associated with returning or receiving returned products for any reason. These processes extend into post-delivery customer support.
- ☐ None of these.

Gross Profits

- Less than $100,000
- $100,000 - $1 Million
- $1-10 Million
- Greater than $10 Million, less than $100 Million
- Greater than $100 Million
- Unknown/unsure/does not apply

Annual Sales

- Less than $100,000
- $100,000 - $1 Million
- $1-10 Million
- Greater than $10 Million, less than $100 Million
- Greater than $100 Million, less than $1 Billion
- Greater than $1 Billion
- Unknown/unsure/does not apply

Number of years since Target Organization first adopted/decided to implement EA (please round to nearest year)

The following questions address how well members of the organization accept EA. Please indicate to what degree you agree with the following statements. If the question does not apply to your situation, please feel free to skip that question.

As a reminder, **we define EA as a comprehensive framework which defines the business, the information necessary to operate the business, the technologies necessary to support the business operations, and the transitional process necessary for implementing new technologies in response to changing business needs.**

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Members of the organization find EA to be useful in their job	○	○	○	○	○	○	○
Using EA enables members of the organization to accomplish tasks more quickly	○	○	○	○	○	○	○
Using EA increases productivity in this organization	○	○	○	○	○	○	○
Members of the organization who embrace EA are more likely to be promoted or given a raise	○	○	○	○	○	○	○
How one is to interact with and employ the EA is clear and understandable	○	○	○	○	○	○	○
Members of the organization find it easy to become skillful in employing EA	○	○	○	○	○	○	○
Members of the organization find EA easy to understand and use	○	○	○	○	○	○	○
Learning to work within the guidelines of EA is easy	○	○	○	○	○	○	○

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Influential people in this organization believe that EA should be used	○	○	○	○	○	○	○
Those who I believe to be important believe that EA should be used	○	○	○	○	○	○	○
The senior management of the organization has been helpful regarding use of EA	○	○	○	○	○	○	○
In general, the organization has supported use of the EA	○	○	○	○	○	○	○
The organization has the resources necessary to use EA	○	○	○	○	○	○	○

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
The organization has the knowledge necessary to use EA	○	○	○	○	○	○	○
EA is compatible with other organizational systems	○	○	○	○	○	○	○
A specific person or group is available to provide assistance with difficulties related to EA	○	○	○	○	○	○	○

The following questions address how the organization's governance structure has adapted to accommodate EA. Please indicate to what degree you agree with the following statements. If the question does not apply to your situation, please feel free to skip that question.

As a reminder, **we define EA as a comprehensive framework which defines the business, the information necessary to operate the business, the technologies necessary to support the business operations, and the transitional process necessary for implementing new technologies in response to changing business needs.**

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
The organization has established routine procedures to update the systems required to support the EA (i.e. enterprise systems, etc.)	○	○	○	○	○	○	○
Updating the EA or its facilitating systems is not a problem	○	○	○	○	○	○	○
Procedures for purchasing new generations of equipment needed to update EA or its facilitating system are in place	○	○	○	○	○	○	○
The organization has plans in place to facilitate equipment turnover for EA and its associated systems	○	○	○	○	○	○	○
EA and its facilitating systems are completely supported by routine funding	○	○	○	○	○	○	○
Funds to support EA initiatives are readily available in the organization	○	○	○	○	○	○	○
EA and its facilitating systems are supported by internal, budgeted funds	○	○	○	○	○	○	○
Requests for additional funding are not required to support EA	○	○	○	○	○	○	○

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
EA is driven by our organization's strategy	○	○	○	○	○	○	○
EA is positioned as a strategic asset in the organization	○	○	○	○	○	○	○
The highest level of management is responsible, in general, for all facets of the EA	○	○	○	○	○	○	○
In my opinion, the strategic plan for our organization is encompassed by the EA	○	○	○	○	○	○	○
The organization has routine procedures to review and update the EA, as needed	○	○	○	○	○	○	○
There are specific individuals in the organization that are responsible	○	○	○	○	○	○	○

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
The organization has a "help desk" or similar function to support EA	○	○	○	○	○	○	○
Supplies to support EA and its facilitating systems are easy to come by	○	○	○	○	○	○	○
The appropriate personnel classifications/job descriptions account for skills required to administer EA	○	○	○	○	○	○	○
There are positions in the organization that require expertise with EA	○	○	○	○	○	○	○
Experience with EA is required of new hires who seek to fill certain positions in the organization	○	○	○	○	○	○	○
There is an adequate number of manpower positions to support EA	○	○	○	○	○	○	○
The organization's governing regulations address use of EA	○	○	○	○	○	○	○
There exists formal guidance that describes how EA is to be used	○	○	○	○	○	○	○
Applicable organizational policies account for use of EA	○	○	○	○	○	○	○
Referring to EA when making decisions regarding IT is mandatory in the organization	○	○	○	○	○	○	○

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
The organization has established a program for educating employees about EA	○	○	○	○	○	○	○
The organization has established a training program for EA	○	○	○	○	○	○	○
New personnel are provided training regarding EA	○	○	○	○	○	○	○
Members of the organization can readily obtain training and/or education regarding EA from the organization	○	○	○	○	○	○	○
Personnel associated with EA have been promoted to higher levels in the organization	○	○	○	○	○	○	○
It is desirable to be associated with EA	○	○	○	○	○	○	○
If individuals associated with EA are promoted, they continue to champion EA	○	○	○	○	○	○	○

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
There are senior managers who are experienced with EA	○	○	○	○	○	○	○
EA has survived a turnover in key personnel	○	○	○	○	○	○	○
Even after the initial champions of EA have left the organization, EA continues to endure	○	○	○	○	○	○	○
The survival of EA is not dependent on just a few key personnel	○	○	○	○	○	○	○
Those originally associated with bringing EA to the organization were in their positions long enough to bring EA on-line	○	○	○	○	○	○	○

The following questions address how the degree to which EA is used in the organization. Please indicate to what degree you agree with the following statements. If the question does not apply to your situation, please feel free to skip that question.

As a reminder, **we define EA as a comprehensive framework which defines the business, the information necessary to operate the business, the technologies necessary to support the business operations, and the transitional process necessary for implementing new technologies in response to changing business needs.**

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
EA is always considered when discussing IT	○	○	○	○	○	○	○
EA is referred to often	○	○	○	○	○	○	○
The organization uses EA extensively	○	○	○	○	○	○	○
All functional areas of the organization are integrated within EA	○	○	○	○	○	○	○
EA is considered when modifying any business process within the organization	○	○	○	○	○	○	○
EA guides usage of all of the information technologies used in the organization	○	○	○	○	○	○	○
EA is used to guide collaboration with outside organizations	○	○	○	○	○	○	○
EA is used to foster inter-organizational relationships	○	○	○	○	○	○	○
EA ties together different organizational units	○	○	○	○	○	○	○
Employees at all levels consult EA for appropriate guidance	○	○	○	○	○	○	○
Everyone in the organization knows about EA	○	○	○	○	○	○	○
The lowest organizational levels (e.g. operational) employ tenets of EA	○	○	○	○	○	○	○

These final questions address how well EA is incorporated into the organization. Please indicate to what degree you agree with the following statements. If the question does not apply to your situation, please feel free to skip that question.

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
This organization provides the benchmark for how EA should be employed	○	○	○	○	○	○	○
This organization uses its EA to make strategic-level decisions that involve IT	○	○	○	○	○	○	○
EA is deeply embedded into the organization	○	○	○	○	○	○	○
EA is fully institutionalized by the organization	○	○	○	○	○	○	○
This organizations uses its EA to make decisions regarding the integration of IT and business objectives	○	○	○	○	○	○	○
The tenets of EA use are embodied by this organization	○	○	○	○	○	○	○

Finally, what are the most important issue(s) that you believe affect how well EA is incorporated into an organization?

We thank you for your time spent taking this survey.
Your response has been recorded

Appendix 2: Information Letter

Auburn University
Department of Management

(NOTE: DO NOT AGREE TO PARTICIPATE UNLESS IRB APPROVAL INFORMATION WITH CURRENT DATES HAS BEEN ADDED TO THIS DOCUMENT.)

INFORMATION LETTER
for a Research Study entitled
"Incorporating Enterprise Architecture in Supply Chain Organizations"

You are invited to participate in a research study designed to investigate how an organization may better incorporate enterprise architecture (EA) to effectively align information technology (IT) with its business strategy. As such, we are looking to measure your perception of both how well an organization that you are familiar with has embraced and utilized EA, and of various organizational characteristics that we believe may influence how well an organization embodies the use of EA. This study is being conducted by Ben Hazen, a doctoral candidate at Auburn University under the direction of Dr. Joe Hanna from the Auburn University Department of Aviation and Supply Chain Management. You were selected as a possible participant because we believe that your experience with the implementation and execution of EA is invaluable in helping us to determine what organizational factors are important to consider when trying to successfully implement an EA, and you are of legal age in the state in which you reside.

What will be involved if you participate? Your participation is completely VOLUNTARY. If you decide to participate in this research study, you will be asked to complete a web-based survey consisting of 50 questions. Your total time commitment will be less than 15 minutes.

Are there any risks or discomforts? No risks or discomforts are anticipated.

Are there any benefits to yourself or others? Benefits to others may include a better understanding within the IT and business communities regarding how to effectively employ an enterprise architecture.

Will you receive compensation for participating? We are not offering compensation for your participation.

If you change your mind about participating, you can withdraw at any time by closing your browser window or not clicking the submit button on the survey. If you choose to withdraw, your data can be withdrawn as long as it is identifiable. Once you've submitted anonymous data, it cannot be withdrawn since it will be unidentifiable. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with Auburn University or the Department of Management.

Any data obtained in connection with this study will remain anonymous. We will protect your privacy and the data you provide by ensuring that your information and participation is completely ANONYMOUS. The survey will not collect your IP address or e-mail address and is hosted on the secure Qualtrics server. Information collected through your participation may be used to help fulfill my dissertation research requirement and may be published in a professional supply chain management journal.
If you have questions about this study, please contact Ben Hazen at benjamin.hazen@auburn.edu / 334-246-1791 or Dr. Hanna at jhanna@business.auburn.edu / 334-844-6848.

If you have questions about your rights as a research participant, you may contact the Auburn University Office of Human Subjects Research or the Institutional Review Board by phone (334) 844-5966 or e-mail at hsubjec@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION ABOVE, YOU MUST DECIDE IF YOU WANT TO PARTICIPATE IN THIS RESEARCH PROJECT. IF YOU DECIDE TO PARTICIPATE, PLEASE CLICK ON THE "NEXT" BUTTON BELOW.
YOU MAY PRINT A COPY OF THIS LETTER TO KEEP.

//Signed//

_____

Ben Hazen, Investigator 5/18/2011

//Signed//

_____

Dr. Joe Hanna, Co-Investigator 5/18/2011

The Auburn University Institutional Review Board has approved this document for use from 30 May 2011 to 29 May 2012. Protocol # 11-184 EX 1105

Appendix 3: Introduction Message

Greetings,

I am a doctoral candidate in the Department of Management at Auburn University. I would like to invite you to participate in my dissertation research by completing a short survey. I am trying to determine what steps an organization should take to better incorporate EA with its business practices. I am looking to tap the knowledge of anyone who is familiar with EA and who has experience with an organization that has implemented EA. Whether you are a business leader, architect, IT professional, consultant or anyone else with an interest in EA, I would sincerely appreciate your input.

As a participant, you will be asked to complete a 50 question survey, which should take less than 15 minutes to complete. The survey is completely anonymous; we will not ask any identifying information or capture your IP address. Although we are not offering compensation, your assistance is greatly appreciated.

If you are interested in participating and would like more information about the study, please click the link below, which will take you to an information letter and the survey.

If you have any questions or would like additional information about my study, please e-mail me at benjamin.hazen@auburn.edu. You may also contact my advisor, Dr. Joe Hanna, for more details at jhanna@business.auburn.edu.

Thank you in advance for your assistance.

Respectfully,

Benjamin Hazen, Doctoral Candidate
Department of Management, College of Business
Auburn University, Alabama

Survey Link:

http://auburncla.qualtrics.com/SE/?SID=SV_4NGBdERxisjRYVe

Appendix 4: Content Validity Questionnaire for Incorporation Measure

Incorporation content validity

You have been identified as someone who is familiar with diffusion of innovations and/or enterprise architectures (EA). I am soliciting your expert opinion regarding how well these following ten questionnaire items capture "incorporation of enterprise architecture." Incorporation is defined as the implementation activities directed towards embedding an adopted innovation within an organization. EA is a comprehensive framework that defines the business, the information necessary to operate the business, the technologies necessary to support the business operations, and the transitional process necessary for implementing new technologies in response to changing business needs. I am creating a measure of how well EA is incorporated into an organization. Please rate the following items to determine how well they define the incorporation of EA. Please use the following scale to rate each item: 1: Does not capture the definition 2: Captures some of the definition 3: Captures most of the definition

This organization provides the benchmark for how EA should be employed

1 2 3

This organization uses its EA to make strategic-level decisions that involve IT

1 2 3

EA is deeply embedded into the organization

1 2 3

EA is fully institutionalized by the organization

1 2 3

This organization uses its EA to make decisions regarding the integration of IT and business objectives

1 2 3

The tenets of EA use are embodied by this organization

1 2 3

This organization uses EA well

1 2 3

○	○	○

This organization knows how to utilize EA

1	2	3
○	○	○

Other firms consult this organization regarding how to employ EA

1	2	3
○	○	○

EA is the cornerstone for IT and strategy in this organization

1	2	3
○	○	○

Submit