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**Selecting an Enterprise Architecture
Model to Support Alignment of
Information Technology Efforts with
Strategic Business Goals**

CAPSTONE REPORT

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Abstract

for

***Selecting an Enterprise Architecture Model to Support Alignment
of Information Technology Efforts with Strategic Business Goals***

Waddington (2004) and Bloomberg (2005) believe that organizational characteristics should help determine the choice of an enterprise architecture model. This paper examines key existing models and aligns these with variations in organizational maturity level, including business process definition, system development life cycle and enterprise data warehouse (Phillips, 2004). Outcomes are provided for enterprise architects and systems analysts who seek to model both technical and business components to support strategic planning efforts (Baker and Janiszewski, 2005).

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CHAPTER 1 – Purpose of Study

Brief Purpose

An enterprise architecture depicts the relationships between processes and systems that an organization uses to succeed in its business (Buchanan and Soley, 2002, pg. 3; Bernus and Nemes, 1993, para. 8) and is used by organizations to strategically align their business processes with their IT resources (Buchanan and Soley, 2002, pg. 3). Whyte (2004) notes that “enterprise architecture provides the means for the business and information systems to truly function as partners to deliver the benefits of information systems investment” (para. 15).

In general, an enterprise architecture captures and defines every piece of information and process in dozens of enterprise architecture models (Zachman, 1997, para. 3 & 5). There is no universal agreement however among enterprise architecture practitioners concerning which potential models and related artifacts might best be selected to describe an enterprise architecture, nor are models totally understood by businesses and information systems managers (Whyte, 2004, para. 1; Zachman, 1997, para. 1; Baker and Janiszewski, 2005, para. 2; Goikoetxea, 2004, para. 3). Just as there are multiple methods for strategic planning, change management, and return-on-investment calculations, there are many forms of business and technical models which might be used to depict an enterprise architecture (Buchanan and Soley, 2002, pg. 3; Locke, 2003, para. 9). A comprehensive set of enterprise architecture models should, when combined, express the business and technology aspects of the company as a cohesive framework, and serve as a blueprint of the enterprise (Buchanan and Soley, 2002, pg. 3; Finkelstein, 1997, para. 13-14).

Developing an enterprise architecture is costly and time consuming and requires a continued commitment by upper management (Whyte, 2004, para. 13). And as Whyte (2004) notes, an architecture "is never finished. It must grow and develop with the corporation" (para. 12). As an organization matures and changes, its need for architecture models also changes (Buchanan and Soley, 2002, pg. 8). In order for management to provide ongoing support, a positive return on investment associated with the models used to create and update the enterprise blueprint is imperative (Haddad, 2005, para. 2). Therefore, it is critical to select the "best" model for the circumstances at hand (Baker and Janiszewski, 2005, para. 4).

Waddington (2004) and Bloomberg (2005) believe that characteristics of an organization may play a role in determining the better choices for enterprise architecture models to meet certain requirements (Waddington, 2004, para. 5; Bloomberg, 2005, para. 6). The purpose of this study is to determine how variations in three organization characteristics – the degree of documented business processes (Jackson 2005, para. 14), the extent of a well defined system development life cycle (Aaby, 2001; Chapman, 2004, para. 14) and the existence of an enterprise data warehouse, or database of record (Barry, 2002, pg. 12) - influence selection when evaluating various enterprise architecture models to satisfy the business requirement of aligning information technology efforts with the strategic goals of the company (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1).

This study is designed as an integrative review of the literature (Russell, 2005, para. 1). Documented case studies (Leedy and Ormrod, 2001, pg. 149-150; Creswell, 2003, pg. 15) and literature addressing the context, purpose, goals and processes of enterprise architecture

modeling (SearchVB.com, 2005) published between 1987 and 2005 are amassed based on a set of collection criteria (see Figure 1: Criteria for Data Collection and Analysis). A content analysis strategy, proposed by Krippendorff (2004, pp 93-96) is used to design and implement the data analysis, using criteria presented in Figure 1: Criteria for Data Collection and Analysis. The content analysis is executed in two steps:

Step 1: Selected architectural models, as reported in case studies, are examined in relation to how they satisfy the business requirement of aligning information technology efforts with the strategic goals of the company (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1). *Step 2:* These models are then associated with three organization characteristics listed above, indicating levels of organizational maturity. Results of the content analysis are presented in the form of a clustering dendrogram (Krippendorff, pg. 208-210) and cross-tabulations (Krippendorff, pg. 194-197).

The intended audience for the study is enterprise architects (Bloomberg, 2003, para. 6; Baker and Janiszewski, 2005, para. 15-16) and systems analysts (Princeton Review, 2005) in information technology roles who are tasked with modeling the organization to support management's strategic planning and project efforts (Baker and Janiszewski, 2005, para. 17-18). The outcomes of the study, designed for this audience, include:

- a description of enterprise architecture models which are reported to be effective in real use to meet the specified business requirement;
- a matrix mapping variations in three selected organization characteristics to these enterprise architecture models, as derived from the clustering dendrogram created in the analysis; and

- a brief explanation on how enterprise architects (Bloomberg, 2003, para. 6; Baker and Janiszewski, 2005, para. 15-16) and systems analysts (Princeton Review, 2005) can use the matrix in the decision-making process.

Full Purpose

The concept of enterprise architecture first appeared in the 1980s with the initial work of John Zachman in modeling information systems using his Zachman Framework (Zachman, 1997, para. 1). Zachman's work has evolved to include the entire enterprise and has been supplemented by the efforts many other practitioners of enterprise architecture, as the complexities of software development and the information needs of organizations have grown (Buchanan and Soley, 2002, para. 1; Borenstein and Brooks, 2005, para. 1).

According to Zachman (1997), in order to effectively communicate the complexities of the organization to various audiences, a set of inter-related models is needed rather than one extremely complex model (para. 8). In non-profit and governmental agencies, models must provide ways for agencies to share information in order to work together with limited resources (Borenstein and Brooks, 2005, para. 6-10). In corporate organizations, communication between business and information systems staff, including the CEO and CIO, is paramount to building an accurate and usable architecture (Baker and Janiszewski, 2005, para. 9-13). Management committees and boards of directors all need to understand an enterprise architecture through models in order to make suitable strategic decisions (Buchanan and Soley, 2002, para. 5; Borenstein and Brooks, 2005, para. 12-13).

Operationally, enterprise architecture models (Ambler, 2002, para. 5) are used by information technology (IT) managers to meet four business requirements:

- align information technology efforts with the strategic goals of the company (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1);
- streamline development of integrated processes and systems (Thompson, 2005, para. 16-17; Zachman, 1997, para. 6);
- remove ineffective or redundant processes (Zachman, 1997, para. 7); and
- manage change and growth by identifying where change is needed and focusing efforts on the correct areas of the enterprise (Whyte, 2004, para. 11).

This study focuses on an examination of how various enterprise architecture models realize the first operational business requirement listed above, i.e., how to align information technology efforts with strategic goals.

Alignment of IT efforts with the strategic goals of the company is an important area for improvement by organizations (Buchanan and Soley, 2002, para. 2; Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 28-30). Less than twelve percent of IT projects executed between 1998 and 1999 in Fortune 500 firms had any correlation to the strategic goals of the respective organization, according to a study covering over 145,000 projects (Buchanan and Soley, para. 2). An enterprise architecture guides information technology project planning to align projects with the strategic goals of the enterprise (Cottey and Chang, 1996, para. 1).

Enterprise architecture can be implemented by companies of any structure or size (Barry, 2002, pg. 9; Swoyer, 2005, para. 2). Waddington (2004) and Bloomberg (2005) believe that characteristics of an organization may play a role in determining the better choices for enterprise architecture models in a given situation (Waddington, 2004, para. 5; Bloomberg,

2005, para. 6). The purpose of this study is to determine how three pre-selected organization characteristics influence selection when evaluating various enterprise architecture models to satisfy the business requirement of aligning information technology efforts with the strategic goals of the company (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1). The three organization characteristics included in this study are:

- Degree of documented business processes (Jackson 2005, para. 14);
- Extent of a well defined system development life cycle (Aaby, 2001; Chapman, 2004, para. 14); and
- Existence of an enterprise data warehouse, or database of record (Barry, 2002, pg. 12).

These three characteristics are used as gauges of organizational maturity (Phillips, 2004, pg 56), described by Jackson (2005, para. 11) as the measurement of an organization's effective internal management systems and practices.

An integrative research review (Russell, 2005, para. 1) is performed to identify which enterprise architecture models are most useful for an organization, depending on its maturity level with respect to three organization characteristics: degree of documented business processes (Jackson 2005, para. 14), extent of a well defined system development life cycle (Aaby, 2001; Chapman, 2004, para. 14), and existence of an enterprise data warehouse, or database of record (Barry, 2002, pg. 12). The integrative review allows the researcher to examine the existing knowledge base, evaluate its quality relative to validity and reliability of the literature, and derive conclusions from the literature while noting where additional research is needed (Russell, 2005, para. 2-4).

Literature collection is limited to materials published between 1987, when the Zachman Framework was introduced (Thompson, 2005, para. 15), and 2005. Because the Zachman Framework is considered the foundation of enterprise architectural thinking (Schekkerman, 2004, pg. 7), no attempt is made to gather literature prior to its introduction. Literature collection targets both case studies of enterprise architecture modeling efforts and broad-based discussions about enterprise architecture modeling. Detailed criteria for the data collection process, and the related focus on each of the two stages of the data analysis process, are noted in Figure 1: Criteria for Data Collection and Analysis. Collected literature must satisfy at least one of the criteria for use in one of the first two stages of content analysis, although ideally articles will be used in both stages one and two of content analysis.

Data Collection Criteria	Data Analysis Plan
<p>Literature for initial collection describes examples of models applied to enterprise architecture depiction as they are used to satisfy various forms of a pre-selected general business requirement. This literature is used as the foundation for proposing associations between a set of enterprise architecture models and variations in the business requirement. It is also used to create an interactive set of coding phrases for the second stage of</p>	<p>This literature is read twice – first in order to identify possible models for use in depicting a portion of an enterprise architecture, and second in order to determine which models appear to meet the general business requirement of alignment of information technology with the strategic goals of the business. Phrases which are indicative of the business requirement are noted in step two of this stage as well. These two steps form stage</p>

analysis.	one of the content analysis plan.
Literature describes one or more of three pre-selected organization characteristics in addition to noting some manifestation of the business requirement to align business and information technology. This section of literature provides the foundation for proposing variations in the form of a business requirement relative to organization characteristics.	<p>This literature is also read twice.</p> <p>Variations in the selected business requirement, as identified in the literature and noted in step two of stage one, are coded (step one of stage two of the content analysis plan). Secondly, these are associated to the variations in three organization characteristics identified in the literature in order to frame the final outcome of study.</p> <p>Validity checks are strongly enforced in this analysis to avoid incorrect inferences and insufficient basis for proposed alignments (Russell, 2005, para. 19).</p>

Figure 1: Criteria for Data Collection and Analysis

Content analysis (Krippendorff, 2004, pg. 30) in support of an integrative literature review (Russell, 2005, para. 1) is used as the data analysis methodology. Analysis of literature from primary and secondary channels (Russell, 2005, para. 11) is conducted using the criteria noted in Figure 2 to support the “comparison of similar phenomenon inferred from different bodies of text” (Krippendorff, 2004, pp. 93-94). Russell (2005) describes primary channels as including technical and business professional journals as well as research into references

discovered in those materials, and secondary channels as including research bibliographies and reference databases (para 11).

The data are coded (Krippendorff, 2004, pp. 84-85) in a two-staged multi-step process onto a shared coding form spreadsheet (see Appendix A: Coding Form & Code Book: Stages One and Two Content Analysis) (Neuendorf, 2005). Each entry on the coding form represents a literature source. While some literature is expected to be coded in both stages one and two, other articles will be used in only one of the two stages, depending on content.

In step one of stage one of the content analysis process, a set of enterprise architecture models is identified in the literature by searching for words such as ‘model’, ‘depiction’, ‘diagram’, or ‘chart’. In step two of stage one of the content analysis process, words or phrases within the same literature indicative of the general business requirement of aligning information technology efforts with the strategic goals of the company (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1) are identified. The researcher uses a strong level of implication as the basis for deriving these words or phrases (Colorado State University, 2005). Results of this first stage of coding are entered in the coding form as a list of enterprise architecture models’ names and descriptions, and the associated words or phrases indicating variations of the general business requirement.

In step one of stage two of the content analysis process, coding is designed to identify three pre-selected characteristics of the organizations, including (1) documented business processes (Jackson 2005, para. 14), (2) well defined system development life cycle (Aaby, 2001; Chapman, 2004, para. 14), and (3) enterprise data warehouse, or database of record

(Barry, 2002, pg. 12). Identification involves noting occurrences of these and related words. In step two of stage two, the words and phrases recorded in step two of stage one are used as interactive categories for coding (Colorado State University, 2005). Results of stage two coding are entered into the coding form as a list of phrases indicating variations in the three organization characteristics and the associated words or phrases indicative of the selected general business requirement. Entries whose sources match with the entries from stage one are combined as a single entry in the spreadsheet.

Results of the coding steps in each stage of the content analysis are realigned to produce a secondary set of results:

1. The coding information recorded in a raw state on the recording form is grouped based on a strong level of implication (Colorado State University, 2005) related to concerns of frequency and variation. Three lists are produced:
 - Enterprise architecture models and the frequency of their occurrence in the literature (see Figure 9: Selected Enterprise Architecture Models);
 - Variations in the language from the literature associated with the general business requirement of alignment of IT and business strategy, and their frequencies of occurrence in the literature (see Figure 11: Variations in Phrasing for a Business Requirement); and
 - Variations in the three organization characteristics, and their frequencies in the literature (see Figure 10: Variations in Three Organization Characteristics).
 - Next, a cross-tabulation is created mapping the grouped models to the grouped variations of the business requirement, based on the existence of

both elements within a common source in the literature (Krippendorff, 2004, pp. 194-196).

2. The grouped variations of the organization characteristics are graded on three scales (Krippendorff, 2004, pp. 136-137) as noted in Figure 2: Organizational Characteristics Recording Template.
3. Clustering of business requirement variations around the organization characteristic variations is depicted as a dendogram (Krippendorff, 2004, pp. 208-210).

Business Processes Definition							
key words: process, use case, task, job, workflow							
< No documented processes							Fully documented processes >
System Development Life Cycle							
key words: methodology, RUP, SDLC, software development, CASE							
< No system development methodology							Well defined SDLC methodology >
Enterprise Data Warehouse							
key words: data warehouse, database of record, taxonomy, business intelligence, data							
< Operational database only							Enterprise data warehouse >

Figure 2: Organizational Characteristics Recording Template

Outcomes of the study, derived from the results of the two-stage content analysis process and secondary results, are presented in the following three formats:

1. Discussion of the various enterprise architecture models and their relative frequency within the literature.

2. A matrix mapping an organization's characteristics relative to organization maturity, as depicted on the three scales displayed in Figure 3, to various enterprise architecture models which are seen in the literature to be effective as applied to the business requirement of alignment of information technology with the strategic goals of the business (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1). Interpretation is based on the dendrogram and cross-tabulation results.
3. A brief explanation on the use of the matrix in the enterprise architecture model decision making process.

The study is intended to provide information to enterprise architects (Bloomberg, 2003, para. 6; Baker and Janiszewski, 2005, para. 15-16) and systems analysts (Princeton Review, 2005), who are often hired into an organization under the domain of information technology. While the primary audience is information technology staff who are examining and undertaking enterprise architecture development within their organizations, the findings will also be of value to involved business analysts (PCMag.com, 2005). Modeling the enterprise includes modeling both the technical and the business components to support management's strategic planning and project efforts (Baker and Janiszewski, 2005, para. 17-18) and thus includes staff from both parts of the organization.

The goal is to provide useful information to aid in bringing as much value as possible to an organization through the selection of the most appropriate enterprise architecture models based on an organization's relative maturity (Comport and Rosser, 2005, para. 6).

Significance of the Study

Many organizations are working harder to maintain their industry positions or break into new markets (Waddington, 2004, para. 1; Cottey and Chang, 1996, para. 1; Zachman, 1997, para. 1). As Waddington (2004) notes, “Today’s business environment is characterized by the challenges of increased globalization, the need to sustain growth in mature markets, and the sudden explosion of legislative and regulatory compliance demands” (para. 1).

In preparation, businesses need to increase the effectiveness of their processes and systems and learn how to integrate business and technical assets (Cottey and Chang, 1996, para. 1-2; Buchanan and Soley, 2002, para. 7). With this information, an enterprise should be better able to analyze assets, support changes and manage risks (Jensen, 2001, para. 11-12; Cottey and Chang, 1996, para. 3). These goals provide the impetus for enterprise architecture as a discipline. Enterprise architecture strives to manage the information comprising an organization, including its business processes, its systems and its resources, through documentation and governance (Baker and Janiszewski, 2005, para. 21-24). Zachman (1997) notes that “the key to accommodating change in the knowledge-based, Information Age enterprise lies in the ‘engineering’ discipline for building and managing the enterprise models coupled with the cultural discipline to employ the resultant models in the on-going operation of the enterprise” (para. 8).

Enterprise architecture is most effective at providing benefits to the organization when there are well-defined business and technical architectures established (Institute for Enterprise Architecture Developments, 2005, para. 14-17). As illustrated in Figure 3, adding enterprise

architecture to a well-defined business architecture increases the usefulness of information in the enterprise, while adding enterprise architecture to a well-defined technology architecture decreases the cost and complexity of organization systems.

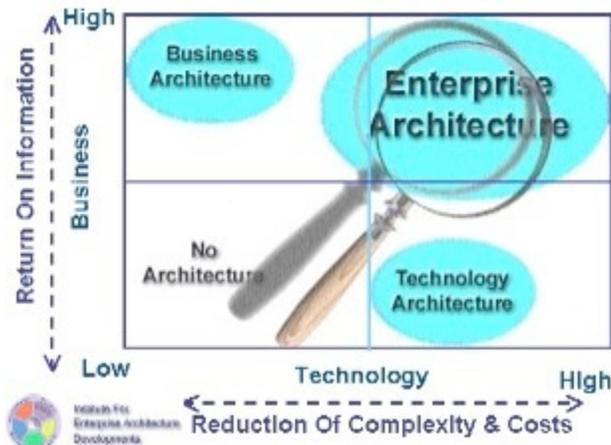


Figure 3: Benefits of Enterprise Architecture (reprinted from The Institute for Enterprise Architecture Developments, 2005)

Organizations differ greatly in the degree to which they have implemented business and technology architecture, but even immature organizations can still benefit from a pragmatic implementation of enterprise architecture (Buchanan and Soley, pg. 5). Pragmatism in this context is classified as the realization of useful information, as derived from The Columbia Encyclopedia's (2005) definition "theories are ultimately justified by their instrumentality, or the extent to which they enable people to attain their aims."

Unfortunately the management of information is a young science which has yet to produce common standards and tools (Baker and Janiszewski, 2005, para. 2). In addition, models and documentation need to be useful as communication tools in order to be usable to an enterprise, so they must present views which are understandable to varied audiences (Zachman, 1997, para. 6).

Enterprise architecture frameworks are sets of models which are used to depict an enterprise architecture (Schekkerman, 2004, pg. 5). There are numerous enterprise architecture frameworks and models. Since 1987, when Zachman introduced the Zachman Framework (Zachman, 1997, para. 1), there have been over two dozen frameworks presented as proposed standards to the industry (Schekkerman, 2004, pg. 7). In addition, a CapGemini survey from 2003 noted that over 30% of organizations with enterprise architecture in place have implemented their own enterprise architecture modeling framework (Schekkerman, 2004, pg. 5). Each model has its own purpose and intended audience (Schekkerman, 2004, pp. 9-15). This study attempts to provide some insight into the selection process of one or more models for the implementation of an enterprise architecture.

Limitations to the Research

The time frame covered by the literature collected for this study spans from 1987, recognized as the birth date of enterprise architecture modeling, to 2005. Literature prior to this date has no bearing on enterprise architecture as defined within this study.

Collection of articles is executed through primary and secondary channels (Russell, 2005, para. 12). Primary channels include review of technical journals such as *Enterprise Architect*, *Application Data Trends*, and *Enterprise Systems Journal*. In addition, references noted in these articles are used as a source for obtaining other articles. Secondary channels include the use of reference databases, such as *Academic Search Premier*, *FirstSearch*, and *EBSCO*, to locate material.

Web-based resources are used extensively in order to obtain a wide variety of material from international sources. Reliability and validity are an issue with web-sourced information so an effort is made to restrict literature to professional periodicals and institutional web sites. However, some of the articles obtained are editorial in nature. A notation to this effect is included, when necessary.

This study performs an integrative literature review to compile information on the use of enterprise architecture models in different types of organizations. The purpose of an integrative literature review is to summarize the literature by analyzing previously conducted research and assessing the reliability and validity of this research to determine the current knowledge base (Russell, 2005, para. 4). Literature is reviewed using coding methods

outlined in Krippendorff (2004, pp 132-149). Coding is based on the occurrence of words and phrases, which systematizes the handling of large quantities of material.

Three characteristics of organizations are used as indicators of the relative maturity of enterprises, although there are many organizational traits which can be monitored for change as an organization matures (NASCIO, 2003, para. 14-18). These three characteristics – degree of documented business processes (Jackson 2005, para. 14), extent of a well defined system development life cycle (Aaby, 2001; Chapman, 2004, para. 14) and existence of an enterprise data warehouse, or database of record (Barry, 2002, pg. 12) – are readily noted by the researcher in the literature associated with enterprise architecture. The literature and subsequent analysis focuses on these three organization traits as general indicators. Other organization traits indicative of maturity, such as development of a Project Management Office (McHale and Wall, 2005, pg. 34) or existence of disaster recovery and contingency plans (The Contingency Planning Guide, 2002, para. 4-5), are not addressed.

Similarly, there are many business requirements associated with enterprise architecture modeling (Borenstein and Brooks, 2005, para. 6-10; Baker and Janiszewski, 2005, para. 9-13). This study focuses on one business operational requirement – alignment of information technology project work with the enterprise strategic goals (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1). This requirement is selected as the focus of this study because it centers on information technology managers as the audience of the models. Since information technology analysts and architects are the targeted audience for this study, the focus on this requirement seems appropriate. Other requirements,

though equally important in the field of enterprise architecture, are not addressed in this study.

Krippendorff (2004) notes that the researcher should avoid doing their own content coding, but rather should delegate that task to one or more well-trained coders. With a researcher coding their own data, he writes, “it is not possible to distinguish whether the data generated under these conditions are the products of the written instructions or the analysts’ conceptual expertise, especially when the analysts have certain conclusions in mind.” (pg. 131) In this study, the researcher performs the coding analysis of the literature due to time restraints.

Varied forms of presentation are included to provide information in formats easily usable by people with different learning styles (University of Minnesota Duluth, 2005). A textual format discussion of various enterprise architecture models presents basic information on the models reviewed. A matrix mapping two enterprise architecture modeling requirements to variations in three characteristics of the enterprise provides a visual representation of clustering information. A brief summary describing usage of the matrix can assist information technology staff on making concrete decisions on the choice of model.

Because there are so many enterprise architecture frameworks and models, not every one is included in the review of models. Since the literature review is based to a large degree on case studies, the number and type of models reviewed is limited to those in the studies. Many models are very similar and may differ only by their inclusion in various frameworks, or the language associated with their presentation. In these cases, the model which figures most predominately in the literature is reviewed, and the associated models are referenced.

Other models may be components of popular frameworks but do not receive any mention in the literature; these are not included. A maximum of six models are included in the study because of time constraints on content analysis.

Definitions

Business analyst – A member of an organization's business area who analyzes the operations of a functional unit and provides information to information technology staff (PCMag.com, 2005).

Business process – A set of practices performed to achieve a given purpose and satisfy a business need (Phillips, 2004, pg. 4).

Business requirement – A perceived need by the business staff in order to perform the processes associated with conducting the business (Rational, Inc, 2001, pg. 2; Smith, 2005, para. 1 and 10).

Data warehouse - A relational or hierarchical database which provides access to enterprise business data. A data warehouse is used primarily as the source for business intelligence analytical analysis, but also can support some operational activities (Swoyer, 2005, para. 4; Ohlson, 2005, para 1; Waddington, 2004, para. 35).

Enterprise architect – A person within an organization who assembles and maintains an enterprise architecture with the assistance of other staff, communicates the architecture to management, and provides governance to ensure the architecture is referenced when making change decisions. (Bloomberg, 2005, para. 4-5; Baker and Janiszewski, 2005, para. 25-29)

Enterprise architecture framework – A classification system for components of a business, or a set of models which collectively can be used to represent an enterprise. Enterprise architecture frameworks have been developed to meet very specific needs of various industries, such as government agencies and telecommunications. (Schekkerman, 2004, pg. 5)

Enterprise architecture model – An illustration of some facet of an enterprise architecture, such as a Business Logical Model or System Interface Description. It describes a portion of the business. (Gottlieb, 2004, pg. 591)

Organization characteristic – For purposes of this study, an organization characteristic is a system or practice regularly used by an organization to meet a requirement of doing business (Kent, 2005, para. 20).

Organizational maturity -- The degree to which an organization has developed effective internal management systems and practices (Jackson, 2005, para. 11).

System development lifecycle, or SDLC -- A set of documented processes and models which are used in software development projects to ensure that development occurs in a consistent repeatable fashion, making the end product much easier to maintain and enhance, and that a quality product is produced (Aaby, 2001, para 1; Rational, Inc, 1998, pg. 1)

Systems analyst --A person within an organization, usually within information technology, who models systems and their components based on business requirements and technical limitations. (Princeton Review, 2005)

Problem Area

The quest to bring information technology and business users into alignment within companies is a widespread goal (Smith and Fingar, 2002, para. 3-4; Whyte, 2004, para. 15; Hoffman, 2004, para. 3). When IT and business teams partner to reach strategic goals, the enterprise can function more efficiently and adapt to change more readily (Institute for Enterprise Architecture Developments, 2005, para. 14). Enterprise architecture acts as an enabler to align the business and the technical components of the organization by documenting business rules, information requirements, application systems, relationships between applications and data, and the technology infrastructure of the organization (Finkelstein, 1997, para. 1).

Since the 1950's with the advent of the computer age, organizations have attempted to automate processes, using their information technology staff to provide technical solutions (Zachman, 1997, para. 7). As businesses grow, their information technology teams spend more time building support structures, each of which is only viewable by a small portion of the business users (Malykhina, 2005, para. 3). Many businesses find that as they grow, their business processes and data also grow but are not as accessible (Borenstein and Brooks, 2005, para. 1). As a business becomes more complex, it becomes increasingly difficult to see the whole enterprise, the set of business processes and data that keep the business moving (Gottlieb, 2004, para. 1; Chabrow, 2002, para. 5). Improvement efforts focus on components of the enterprise in an effort to move the entire business forward (Whyte, 2004, para. 6; Jensen, 2001, para. 7, Thompson, 2005, para. 5). Redundant processes and stand-alone data stores are built inadvertently (Borenstein and Brooks, 2005, para. 1-2; Chabrow, 2002, para.

5; Waddington, 2004, para. 2; Zhong, 2003, para. 1). The resulting inventory of systems and applications becomes a heavy burden for the enterprise to bear, a set of legacy systems which Zachman (1997) calls “a kind of albatross” (para. 5) (Goikoetxea, 2004, para. 1).

As a science, enterprise architecture started in the late 1980’s with the introduction of John Zachman’s framework of information systems models (Zachman, 1997, para. 1). Zachman’s approach to modeling is to answer six key questions – what, how, where, who, when and why – that are asked by a variety of staff within an organization (Zachman, 1997, para. 5). The selection of the models themselves varies from organization to organization – it is the purpose of the models that is consistent across various usages of his framework (Zachman, 1997, para. 10).

Waddington (2004) notes that the structure of a company shapes the form of its architecture (para. 5). The more diverse its processes and data, the more difficult it is to cohesively model the business (Waddington, 2004, para. 5 & 19-20). An enterprise architecture must be modeled in such a way that the information technology and business staff within that organization’s culture can understand and make use of the models (Bloomberg, 2005, para. 6).

Selection of appropriate enterprise architecture models is key to their usability by a varied audience within the enterprise (Locke, 2003, para. 2-4). The maturity of an organization, the degree to which it effectively manages internal systems and practices (Jackson, 2005, para. 11; Phillips, 2004, pg 56), can be measured and used as a guide for the selection of enterprise architecture models.

While many enterprise architecture models might be coupled with variations in organization maturity, this study examines selected models which have assisted in aligning information technology efforts with the strategic goals of the company (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1), as noted in the literature.

The EA models which have proven useful in case studies are associated to variations in three organization characteristics that are indicative of organization maturity:

1. Degree of documented business processes (Jackson 2005, para. 14);
2. Extent of a well defined system development life cycle (Aaby, 2001; Chapman, 2004, para. 14); and
3. Existence of an enterprise data warehouse, or database of record (Barry, 2002, pg. 12).

Additional explanation about each of these organization characteristics follows.

Organization characteristic #1: Documented business processes, the core of a business architecture, are often modeled using a process maturity model, the BPM (business process maturity) model (Jackson, 2005, para. 1-5). Business processes are also a component of the Capability Maturity Model – Integration (CMMI), a standard benchmarking system affording certification for various levels of organization maturity (Chapman, 2004, para. 14). Phillips (2004) notes that organization effectiveness requires having a motivated work force, “but even our finest people can’t perform at their best when the process is not understood” (pg. 3). Business complexity is reduced as process documentation is developed and used for training staff to execute processes consistently (Jackson, 2005, para. 16).

Organization characteristic #2: A system development lifecycle, or SDLC, is a set of documented processes and models which are used in software development projects to ensure that development occurs in a consistent repeatable fashion so the end result is much easier to maintain and enhance, and that a quality product is produced (Aaby, 2001, para 1; Rational, Inc, 1998, pg. 1). An SDLC is a component of a technical architecture of an organization as well as a component of the CMMI (Chapman, 2004, para. 14).

Organizational characteristic #3: Organizations that keep operational and analytical data in disconnected data stores make it difficult to view the information of the enterprise (Waddington, 2004, para. 14; Dineley, 2005, para. 13-14). A data warehouse provides access to enterprise business data which is the source for business intelligence, analysis tools providing insights into how an organization is operating (Swoyer, 2005, para. 4; Ohlson, 2005, para 1; Waddington, 2004, para. 35). A database of record further defines a data warehouse to provide operational and analytical information from a single source for all business users (Barry, 2002, para. 17). The enterprise data store is another component of the technical architecture of the enterprise (Dineley, 2005, para. 1).

By providing information technology staff, such as enterprise architects and systems analysts, with information on the relationship of a selection of enterprise architecture models which help satisfy a specific business requirement to variations of characteristics of the organization, this study gives them a thoughtful approach for evaluation of other EA models to satisfy additional business requirements. IT staff can narrow the search for appropriate enterprise architecture models to those that fit the needs of their business based on its maturity level (Waddington, 2004, para. 23-24).

CHAPTER 2 – Review of References

The review of references provides a detailed summary of the key literature used in this research project. References for content analysis process and enterprise architecture modeling are both included in the key literature, which is defined as literature fundamental to the development of this research. Literature reviewed in this section is presented alphabetically by citation. Each listing includes the citation, a summary of the content, its relevance to the research, and criteria for its acceptance in the research.

Baker, David C. and Janiszewski, Michael (2005, June). Seven Essential Elements of EA. Enterprise Architect. [Online serial]. Retrieved September 15, 2005 from <http://www.ftponline.com/ea/magazine/summer2005/features/dbaker/>.

Baker and Janiszewski are practicing enterprise architects with Diamond Cluster International, a consulting firm that has made significant contributions to promoting the science and implementation of enterprise architecture. This article provides an overview of the general lifecycle of enterprise architecture implementation and processes within businesses. Some details about common pitfalls are also included. Both the general information and the common pitfalls are used as references within the Brief and Full Purpose sections of the study, particularly in discussions of the relationship of enterprise architecture models to business requirements.

The article is found in the online version of Enterprise Architect, a professional journal providing enterprise architects and systems analysts with practical information and resources. Enterprise Architect is used by the researcher at least weekly in support of her professional role as a reliable source of information.

Buchanan, Richard D. and Soley, Richard Mark (2002). Aligning Enterprise Architecture and IT Investments with Corporate Goals. Object Management Group.[Online}. Retrieved September 15, 2005 from <http://www.omg.org/registration/META-OMG-WP-Public.pdf>.

This article is a thorough discussion of the processes associated with implementation of enterprise architecture and its use in the strategic planning and software project management aspects of business. It progresses through the history of EA development and proposes strategies for implementation based on case studies and best practices. The authors represent senior management from two highly respected information technology organizations – META Group and Object Management Group.

Object Management Group (OMG) is a consortium for international standards in software specifications. Its members include systems vendors, software developers and end users. It has been providing specifications for inter-operability of software since 1989, including the Common Object Request Broker Architecture (CORBA), Interface Definition Language (IDL) and Unified Modeling Language (UML). The OMG, in conjunction with META Group, a leading research and consulting company, is currently working on developing and

promoting Model Driven Architecture (MDA), an enterprise architecture that focuses on information technology components.

The article is referenced within several other pieces of literature used in the study. It is available direct from the Object Management Group's website.

Krippendorff, Klaus (2004). Content Analysis: An Introduction to its Methodology. Sage Publications: Thousand Oaks, CA.

This text provides basic knowledge about content analysis as well as detailed information on methods and strategies. Determination of the structures used for content analysis and coding recording is based on Krippendorff's book and is used extensively in the writing of the Full Purpose and Methods sections of the study. In addition, his text provides references to other source material used for background and, to a lesser extent, basic content analysis knowledge.

Based on the recommendations of the Applied Information Management program's staff, this text was selected and obtained for general use throughout the research process. It has proven invaluable in deciphering the many aspects of content analysis and supplying additional references for deeper research.

Morganwalp, Jill and Sage, Andrew P. (2003). A System of Systems Focused Enterprise Architecture Framework and an Associated Architecture Development Process. Information, Knowledge and Systems Management, 3, 87-105.

Morganwalp and Sage present a process for developing an enterprise architecture as well as concrete examples of the development process. Focus is on building an architecture based on a system of systems. A system of systems, as defined by the authors, is “a collection of independently useful systems that have been integrated together to achieve additional properties not associated necessarily with any of the individual systems” (pg. 89).

The authors are both associated with George Mason University’s Department of Systems Engineering and Operations Research. The information they provide, specifically the examples they walk through on how to implement their suggested processes, was useful in understanding the relationship between enterprise architecture models and the purposes the models serve. Although the article is not referenced directly in this paper, it was used for fundamental understanding of the enterprise architecture development process.

This article is printed in the Information, Knowledge and Systems Management journal, a professional journal for systems engineering published in The Netherlands.

Richardson, Gary L., Jackson, Brad M. and Dickson, Gary W. (1990, December). A Principles-Based Enterprise Architecture: Lessons Learned From Texaco and Star Enterprise. MIS Quarterly, pp. 385-403.

A detailed description of an enterprise architecture implementation, this article provides very good examples of modeling techniques that were used and those that succeeded in meeting business requirements through their use. The article is utilized in the data analysis section of the study.

This is a case study of the architecture that emerged through integration of two companies into one. It is presented by two members of management from the information technology staff of the two companies in conjunction with an associate of the University of Minnesota's Carlson School of Management. A summary section in the article alludes to the lessons learned in the growth of the enterprise architecture, which is referenced in the Conclusions section of this study.

The article is printed in the MIS Quarterly, a juried professional journal for systems analysts and management staff in information technology.

Russell, Cynthia L (2005, March). An Overview of the Integrative Research Review. Progress in Transplantation [Online serial]. Retrieved September 24, 2005 from http://www.findarticles.com/p/articles/mi_qa4117/is_200503/ai_n13476203/print.

Russell's text provides a concise and usable synopsis of the integrative literature review process and purpose. It is used in the Brief and Full Purpose sections of the study as well as the Methods chapter to provide detail on the content analysis stages and how the data is

selected. This article also provides detail on how to apply validity tests at each stage of the process, which are noted in the Methods chapter.

The article was discovered through a search of literature using the EBSCO research bibliography. References for the article were also found in several other integrative literature review studies in the medical field. None of these are used as references within this study, however.

Zhong, Jian (2003, March). From Stove-Piped Projects to Unified Enterprise Architecture. JavaWorld [Online serial]. Retrieved September 15, 2005 from <http://www.javaworld.com/javaworld/jw-03-2003/jw-0321-ssop.html>.

Zhong uses an example of implementation of a security service as the basis for a presentation on enterprise architecture and its benefits to the organization. His case study of an e-authentication service developed for the U.S. Department of Energy is used as one of the case studies in the data analysis section of this paper. In addition, his discussion of enterprise architecture development and usage is referenced in the Problem Area section of Chapter 1.

This article was obtained from JavaWorld magazine online. JavaWorld is recognized by practicing software developers as an essential resource for documentation on new techniques, best practices, and case studies. Zhong has published three additional enterprise architecture articles in JavaWorld, although this article is the only one used for this study. He is a senior

enterprise architect for a large consulting firm handling many U.S. government projects, and is certified by Sun and IBM in java, architecture and XML technologies.

CHAPTER 3 - Method

Larger Method of Study

The intent of this study is to provide insights into the relationship of organizational maturity, as demonstrated through three organization characteristics, to the selection of the most appropriate enterprise architecture model to meet one specific business requirement. An integrative literature review is used as the primary research method (Russell, 2005, para. 1). An integrative literature review is selected because it employs analysis of a body of literature to aid in identifying issues and proposing theoretical frameworks (Russell, 2005, para. 1). The integrative literature review, according to Russell (2005, para. 4), answers four research questions:

What is known from existing research?

Is the known information valid and reliable?

What else should be known about this topic?

What is the next step or research that should be performed?

The technique of content analysis is employed as a way to conduct data analysis in this study, because it provides the researcher the opportunity to make inferences from selected text (Krippendorff, 2004, pg. 18). Analysis includes a process of coding selected material (Krippendorff, 2004, pp. 125-127) along three dimensions:

- discovery of enterprise architecture models which have been used effectively;

- discovery of variations in three characteristics of organizational maturity (Phillips, 2004, pg 56), and applying the values to ratio scales (Krippendorff, 2004, pg. 162); and
- discovery of one selected business requirement (Rational, Inc, 2001, pg. 2; Smith, 2005, para. 1 and 10) as it is interpreted in organizations with different levels of maturity.

Cross-tabulations (Krippendorff, 2004, pg. 195) and a clustering dendogram (Krippendorff, 2004, pp. 208-210) of the resulting data are used as the basis for inferring relationships between organizational maturity and effective enterprise architecture models, presented in the outcomes of the study. Specifically, abductive inference (Krippendorff, 2004, pg. 85) provides the basis for extrapolation of the data results (Krippendorff, 2004, pg. 180) to produce the outcomes of the study, presented in the form of:

- a discussion of models identified from the literature,
- a matrix mapping an organization's characteristics relative to organization maturity to various enterprise architecture models which are seen in the literature to be effective as applied to the business requirement of alignment of information technology with the strategic goals of the business (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1); and
- an explanation on how to use the matrix in the process of selecting an enterprise architecture model.

Data Collection Strategy

The approach to collection of the literature is based on sampling (Weber, 1990, pg. 42) from published reports on the topic of enterprise architecture. Because the final report is targeted at information technology professionals, emphasis is placed on gathering material from information technology professional journals, white papers from information technology consulting firms and presentations from information technology conferences.

Literature on enterprise architecture is collected, and specific attention is given to gathering information on business requirements for enterprise architecture, including case studies where enterprise architecture is employed. Because the end result of the study correlates the following three dimensions – business requirements, organization maturity and enterprise models – articles are gathered in which at least two of the three elements are identified.

Web-based resources are used extensively in order to obtain a wide variety of material from international sources. Final literature selection is performed a posteriori (Russell, 2005, para. 16), weighting each article's reliability based on an evaluation of its scientific rigor (Allende, 2004, para. 14), significant deviations from findings in the majority of articles (Krippendorff, 2004, pg. 77), and possibly any errors in the recording of its data (Russell, 2005, para. 16).

Material obtained through primary channels (Russell, 2005, para. 12) includes articles from technical journals such as *Enterprise Architect*, *Application Data Trends*, *Intelligent Enterprise*, *IBM Systems Journal* and *Enterprise Systems Journal*. In addition, references

noted in these articles are used as a source for obtaining other articles. Many articles are obtained from publications for a more general audience, such as Info World and PC Week.

Secondary channels provide access to material from reference databases, such as Computer Source, Academic Search Premier, FirstSearch, and EBSCO. In addition, the Google search engine is employed to obtain a wider range of web information. Search phrases such as 'enterprise architecture', 'enterprise architecture model', 'EA', 'ontology', 'data warehouse', 'capability maturity model', 'Zachman framework', and 'IT alignment' are used for the search engines and reference databases.

The Computer Source database provided access to over 300 periodicals, many of which were technical and professional journals. The majority of the material obtained from database searches was found on this database. The Academic Search Premier and First Search databases were used to supplement the literature for the study. EBSCO was used as the tool for accessing all the databases through the University of Oregon library system.

Google searches provide the widest variety of material, but have limited results providing material from educational or professional sources. White papers from various architecture tool or service vendors are obtained from Google more often than from other sources. These are useful as case study literature.

Data Analysis Strategy

Content analysis (Krippendorff, 2004, pg. 30) in support of an integrative literature review (Russell, 2005, para. 1) is used as the data analysis methodology. A two-stage multi-step process is used to record data for analysis and present the recorded data in various formats.

Stage One of Content Analysis

Stage one of the content analysis process proceeds in two steps. In step one of stage one of the content analysis process, a set of enterprise architecture models is derived from the literature through the use of phrase coding (Krippendorff, 2004, pp. 84-85). Phrases include words such as ‘model’, ‘depiction’, ‘diagram’, or ‘chart’.

In step two of stage one of the content analysis process, words or phrases within the same literature indicative of the general business requirement of aligning information technology efforts with the strategic goals of the company (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1) are identified. The researcher uses a strong level of implication as the basis for deriving these words or phrases (Colorado State University, 2005).

Results of this first stage of coding are entered in the coding form (see Appendix A - Coding Form & Code Book: Stages One and Two Content Analysis) as a list of enterprise architecture models’ names and descriptions, and the associated words or phrases indicating variations of the general business requirement. The associations may be indicative of a

strong relationship between the two concepts (Colorado State University, 2005), so validity checks are performed and noted on the coding form by checking for words such as ‘unless’, ‘maybe’ or ‘sometimes’ in describing the relationship of both concepts in the literature (Russell, 2005, para. 20).

Results of stage one are presented in Appendix B - Completed Coding Form.

The results of stage one are then generalized (Colorado State University, 2005) and grouped into a set of enterprise architecture models, displaying frequency of occurrence in the literature, and the variations of the selected business rule with which they are associated in the literature. These groups are presented as a cross-tabulation showing a set of architecture models, identified in the literature, and the specific forms of the business requirement which they have been shown to satisfy (see Figure 9: Association of Selected EA Models to Variations in a Business Requirement) (Krippendorff, 2004, pp. 194-196). A template for this cross-tabulation is provided in Figure 4: Template for Model-Requirement Matrix.

	Business Requirement Phrase 1	Business Requirement Phrase 2	Business Requirement Phrase 3	Business Requirement Phrase 4	Business Requirement Phrase 5	Business Requirement Phrase 6
Model Name 1	freq	freq	freq	freq	freq	freq
Model Name 2	freq	freq	freq	freq	freq	freq
Model Name 3	freq	freq	freq	freq	freq	freq
Model Name 4	freq	freq	freq	freq	freq	freq
Model Name 5	freq	freq	freq	freq	freq	freq
Model Name 6	freq	freq	freq	freq	freq	freq

Figure 4: Template for Model-Requirement Matrix

Stage Two of Content Analysis

In the first step of coding in stage two of the content analysis, three pre-selected characteristics of the organizations, including (1) documented business processes (Jackson 2005, para. 14), (2) well defined system development life cycle (Aaby, 2001; Chapman, 2004, para. 14), and (3) enterprise data warehouse, or database of record (Barry, 2002, pg. 12) are identified through occurrence of related words, as noted in Figure 2: Organizational Characteristics Recording Template.

In step two of stage two, the words and phrases recorded in step two of stage one are used as interactive categories for phrase coding the stage two literature (Colorado State University, 2005).

Steps one and two of stage two record variations in organization characteristics associated with variations in the selected business requirement. Validity checks are performed and noted on the coding form by checking for words such as ‘unless’, ‘maybe’ or ‘sometimes’ in describing the relationship of both concepts in the literature (Russell, 2005, para. 20).

Results of stage two coding are entered into the coding form as a list of phrases indicating variations in the three organization characteristics and the associated words or phrases indicative of the selected general business requirement. Entries with sources that are a match with the entries from stage one are combined on a single row in the spreadsheet. Results of stage two are presented in Appendix B - Completed Coding Form.

The results of stage two are then generalized (Colorado State University, 2005) and grouped into a set of variations in the selected business rule and variations in three organization characteristics. The grouped variations of the organization characteristics are graded on three ratio scales as noted in Figure 2: Organizational Characteristics Recording Template. (Krippendorff, 2004, pg. 162).

Ratio scales are used because there is an intrinsic linear order to the variations in the three selected organization characteristics, which imply that the first point is lower in value than the second point, which is less than the third point, etc. (Krippendorff, 2004, pg.162) along a continuum, from “none” to “greatest”. The first variable that is plotted on this scale addresses the *degree of documented business processes* (Jackson 2005, para. 14). Relevant organization characteristics are plotted on a scale anchored by ‘No documented processes’ at one end of the scale, and ‘Fully documented processes’ at the other (see Figure 13: Ratio Scales of Three Selected Organization Characteristics).

Results of this coding step related to the organization characteristic *system development life cycle* (Aaby, 2001; Chapman, 2004, para. 14) are plotted on a scale anchored by ‘No system development methodology’ and ‘Well defined SDLC methodology’ (see Figure X: Ratio Scales of Three Selected Organization Characteristics).

Results of this coding step related to *an enterprise data warehouse or database of record* (Barry, 2002, pg. 12) are also plotted on a scale between end points of ‘Operational database only’ and ‘Enterprise data warehouse’ (see Figure 13: Ratio Scales of Three Selected Organization Characteristics).

An example of a populated ratio scale is provided in Figure 5: Example Ratio Scale, Documented Business Processes.

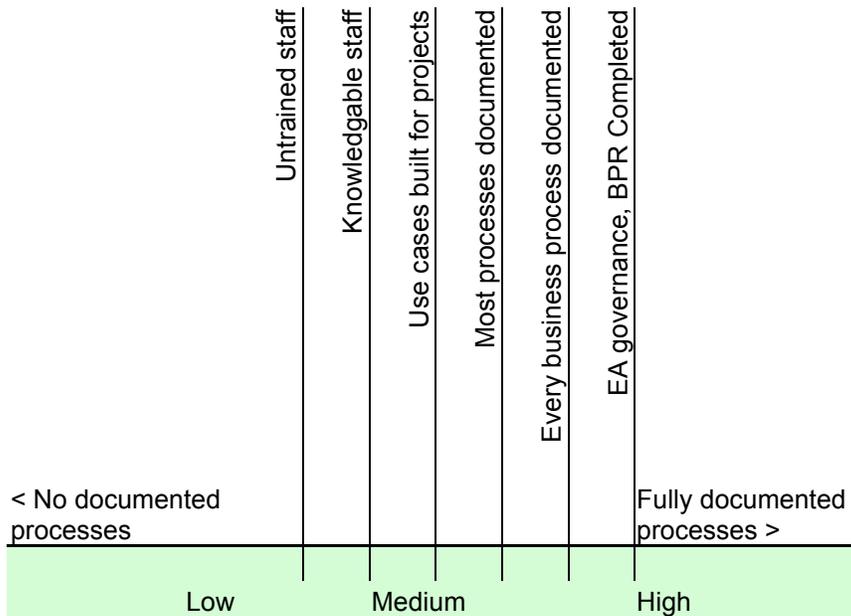


Figure 5: Example Ratio Scale, Documented Business Processes

A dendrogram illustrating clustering of business requirement variations around the organization characteristic variations is also used to present the results of stage two in Figure 14: Clustering Variations in a Business Requirement (Krippendorff, 2004, pp. 208-210).

Figure 6: Clustering of Business Requirements Template depicts the template for the dendrogram.

Business Requirement Phrase 1	
Business Requirement Phrase 2	High Rated Organization Characteristic
Business Requirement Phrase 3	
Business Requirement Phrase 4	Medium Rated Organization Characteristic
Business Requirement Phrase 5	
Business Requirement Phrase 6	Low Rated Organization Characteristic

Figure 6: Clustering of Business Requirements Template

Data Presentation Strategy

Strategies for presenting the results of the content analysis are presented above, in relation to each step and stage. The first final outcome of the study, derived from these results, is presented as a discussion of models identified in the literature that meet different forms of the selected business requirement of aligning information technology efforts with the strategic goals of the company (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1) (see Figure 10: Association of Selected EA Models to Variations in a Business Requirement). The discussion frames the Conclusions chapter of this study.

In addition, a cross-tabulation matrix is presented, mapping an organization's characteristics relative to organization maturity, as depicted on the three scales displayed in Figure 13: Ratio Scales of Three Selected Organization Characteristics, to various enterprise architecture models which are seen in the literature to be effective as applied to the business requirement of alignment of information technology with the strategic goals of the business (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1. This matrix (see Figure 21: Associations of Organization Maturity Characteristics to EA Models) is based on the cross-tabulation results from stage one and the dendogram results from stage two. A pictorial representation of the same data is provided in Figure 22: Associations of Organization Maturity Levels to EA Models, Graphic View.

The Conclusions Chapter ends with a brief discussion of methods in which to use the matrix in the decision-making process. The goal is to assist information technology staff, including

enterprise architects and systems analysts, by providing useful information to aid in selecting the most appropriate enterprise architecture models to satisfy a specified business requirement based on an organization's relative maturity (Comport and Rosser, 2005, para. 6).

CHAPTER 4 – Analysis of Data

This chapter presents the process and results of the content analysis stages of the research. Two stages are included. Stage one involves analysis of selected references in two steps, in order to identify (1) various approaches to modeling enterprise architecture and (2) ways that each model incorporates the general business requirement of aligning information technology efforts with the strategic goals of the company (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1). Stage two involves analysis of the same selected references, in order to gather information on variations in three organization characteristics associated with enterprise maturity: documented business processes (Jackson 2005, para. 14), well defined system development life cycle (Aaby, 2001; Chapman, 2004, para. 14), and enterprise data warehouse, or database of record (Barry, 2002, pg. 12). Associations between these variations in enterprise maturity and the variations found in the general business rule in stage one analysis are documented and presented as the final outcome of the study.

Report of Stage One Content Analysis

As noted in the Data Analysis Strategy section of Chapter 3, there are two steps to stage one content analysis. Step one focuses on recording and tallying the presence of enterprise architecture models in a set of selected literature, through the use of phrase coding (Krippendorff, 2004, pp. 84-85). Step two discovers words or phrases within the same set of literature which are indicative of the general business requirement of aligning information technology efforts with the strategic goals of the company (Zachman, 1997, para. 10; Baker

and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1). Data from 25 sources (see Appendix B - Literature Selected for Data Analysis) is analyzed in these two steps.

Step one is approached by looking in the literature for the occurrence of any key words, as itemized in Figure 7: Phrase Coding for Step One of Stage One Content Analysis. Three passes are made through the literature to obtain a larger sampling of data. In the first pass, the occurrences of the key words are recorded. The second pass coding phrases are discovered through a thorough review of the literature in which no occurrences of the first pass coding phrases are found. In order to maintain consistency, a third pass through the entire literature set is coded again using the phrases from pass two. In this way, all pieces of literature are coded from the entire set of coding phrases.

First Pass	Second Pass
Model	Assessment
Depiction	Specification
Diagram	Rule
Chart	Standard
Graph	Ontology
Matrix	Dictionary
View	Use case

Figure 7: Phrase Coding for Step One of Stage One Content Analysis

These coding phrases are used to discover enterprise architecture models referenced in the literature. The names and a brief description surrounding the use of the model are entered into the coding form (see Appendix A – Coding Form & Code Book: Stages One and Two Content Analysis).

The same set of literature is then used as the source for step two of stage one content analysis. The discovery of variations in the general business requirement of aligning information technology efforts with the strategic goals of the company (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1) is approached through phrase coding using the phrases noted in Figure 8: Phrase Coding for Step Two of Stage One Content Analysis. These phrases were derived first from the wording of the business requirement (align, business, business strategy, strategic, goal, technology) and secondarily from synonyms (align: partner, goal: value, objective, mission, purpose).

Align
Business
Business strategy
Strategic
Technology
Value
Objective
Partner
Mission
Goal
Purpose

Figure 8: Phrase Coding for Step Two of Stage One Content Analysis

The coding phrases are used to discern variations in the specified general business requirement. These are recorded on the coding form (see Appendix A – Coding Form & Code Book: Stages One and Two Content Analysis) in line with the models discovered in step one above.

An additional pass through the literature is made to check for the existence of negative association phrases between the models and the business requirement. This check is

performed using phrase coding of the phrases ‘unless’, ‘maybe’ and ‘sometimes’. Negative or positive association between the model and business requirement is noted in the coding form as described in the codebook.

Coding results for stage one content analysis can be seen in Appendix C – Completed Coding Form: Stages One and Two Content Analysis.

The completed coding form from stage one content analysis is used to group similar models together and come up with a set of enterprise architecture models referenced in the literature. Seven models have multiple occurrences within the literature; of these, the top six are selected for further analysis (see Figure 9: Selected Enterprise Architecture Models).

Enterprise Architecture Model	Frequency in the Literature
Data model	16
Process model	11
Unified Modeling Language (UML) Class diagram	3
UML Activity diagram	2
UML Sequence diagram	2
Data flow diagram	2

Figure 9: Selected Enterprise Architecture Models

Similarly, the variations of the selected business requirement are also analyzed for redundancies and grouped into comparable categories. Because the business requirements vary widely in their form, generalization relies upon a strong level of implication (Colorado State University, 2005). Many of the variations of the business requirement are oriented toward differing time periods. These are separated into long term focus, short term focus, and stability (or current) focus. In addition, some instances of the business requirement focus

instead on the strategic partnership of information technology and the business. As a result, four categories of the generalized business requirement are determined, varying by focus. These are labeled ‘align with strategic business direction (long term goals)’, ‘align with business goals and priorities (short term goals)’, ‘assist the business in being successful by adding value (stabilization)’ and ‘partnership of the business and IT (sharing resource)’. The variations of the business requirement, as evidenced in the literature, are listed in Figure 10: Variations in Phrasing for a Business Requirement.

Generalized Variations of the Business Requirement	Frequency in the Literature
assist the business in being successful by adding value (stabilization)	18
align with business goals and priorities (short term goals)	12
align with strategic business direction (long term goals)	8
partnership of the business and IT (sharing resource)	7

Figure 10: Variations in Phrasing for a Business Requirement

The grouped models are then mapped with the frequency of occurrence to the grouped categories of the selected business requirement from the completed coding form. The resulting cross-tabulation can be viewed in Figure 11: Association of Selected EA Models to Variations in a Business Requirement.

	align with strategic business direction (long term goals)	align with business goals and priorities (short term goals)	assist the business in being successful by adding value (stabilization)	partnership of the business and IT (sharing resource)
data model	3	7	8	2
process model	2	1	7	1
UML class diagram	2	2	1	1
UML activity diagram	2	1	1	1
UML sequence diagram	2	1	1	1
data flow diagram	0	0	2	0

Figure 11: Association of Selected EA Models to Variations in a Business Requirement

Report of Stage Two Content Analysis

The purpose of stage two content analysis is to identify the various forms of three pre-selected characteristics of organizations, including (1) documented business processes (Jackson 2005, para. 14), (2) well defined system development life cycle (Aaby, 2001; Chapman, 2004, para. 14), and (3) enterprise data warehouse, or database of record (Barry, 2002, pg. 12) as they are represented in the literature, and associate them with variations of

the general business requirement of aligning information technology efforts with the strategic goals of the company (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1). This is accomplished in two steps.

In step one of stage two content analysis, phrase coding (Krippendorff, 2004, pp.84-85) is employed using the phrases identified in Figure 2: Organization Characteristics Recording Template. Information from twenty eight sources of literature (see Appendix B – Literature Selected for Data Analysis) is recorded on the coding form (see Appendix A – Coding Form & Code Book: Stages One and Two Content Analysis).

In step two of stage two content analysis, phrase coding (Krippendorff, 2004, pp. 84-85) is used to identify the variations of the selected business requirement in the literature. The phrases resulting from step two of stage one are used for the coding process. The variations of the selected business requirement are recorded in the coding form (see Appendix A – Coding Form & Code Book: Stages One and Two Content Analysis).

An additional pass through the literature is made to check for the existence of negative association phrases between the business requirement and the organization characteristics. This check is performed using phrase coding of the phrases ‘unless’, ‘maybe’ and ‘sometimes’. Negative or positive association between the business requirement and the organization characteristic is noted in the coding form as described in the codebook.

There is some overlap between the literature sources used for stage one content analysis and those used in this stage, although the two sets are not identical because instances of the

coding phrases for both stages of content analysis are not found in all literature. All of the articles in the set of literature included reference to the general business requirement of aligning information technology efforts with the strategic goals of the company (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1), but not all included both enterprise architecture models as well as variations of the three organization characteristics. When references to all three variables exist in a single literature source, entries into the coding form are combined on one line regardless of the content analysis stage.

The resulting completed coding form from stage two content analysis can be seen in Appendix C – Completed Coding Form: Stages One and Two Content Analysis.

The results from stage two content analysis are then generalized (Colorado Statue University, 2005). The variations of the selected business requirement, analyzed in stage one content analysis, are analyzed again with the additional entries. These variations are then grouped into comparable categories. Because the business requirements vary widely in their form, generalization relies upon a strong level of implication (Colorado State University, 2005). The same four categories of the generalized business requirement are determined from this larger sampling, varying by focus. A listing of these variations and their frequency of occurrence in the literature can be found in Figure 10: Variations in Phrasing for a Business Requirement. Note that the frequency figures are indicative of results from the sum of stage one and stage two content analysis.

The variations in the organization characteristics are analyzed for any redundancies and grouped accordingly. The resulting sets of variations in the organization characteristics are listed in Figure 12: Variations in Three Organization Characteristics, Ordered by Maturity Level. These variations are then mapped to ratio scales (Krippendorff, 2004, pg.162) in the progression from least to most mature stage of the characteristic (see Figure 13: Ratio Scales of Three Selected Organization Characteristics).

Organization maturity is described by Jackson (2005, para. 11) as the measurement of an organization's effective internal management systems and practices. The variations of the organization characteristics indicate distinctions between the development of systems and practices.

Business Process Definition	Frequency	Software Methodology	Frequency	Data Warehouse	Frequency
List processes	4	Develop methodology	5	Operational data	2
Document processes	4	Integrate methodology	6	Enterprise access	3
Standardize processes	5	Manage projects	4	Domain model	4
Manage processes	2			Data warehouse	6

Figure 12: Variations in Three Organization Characteristics, Ordered by Maturity Level

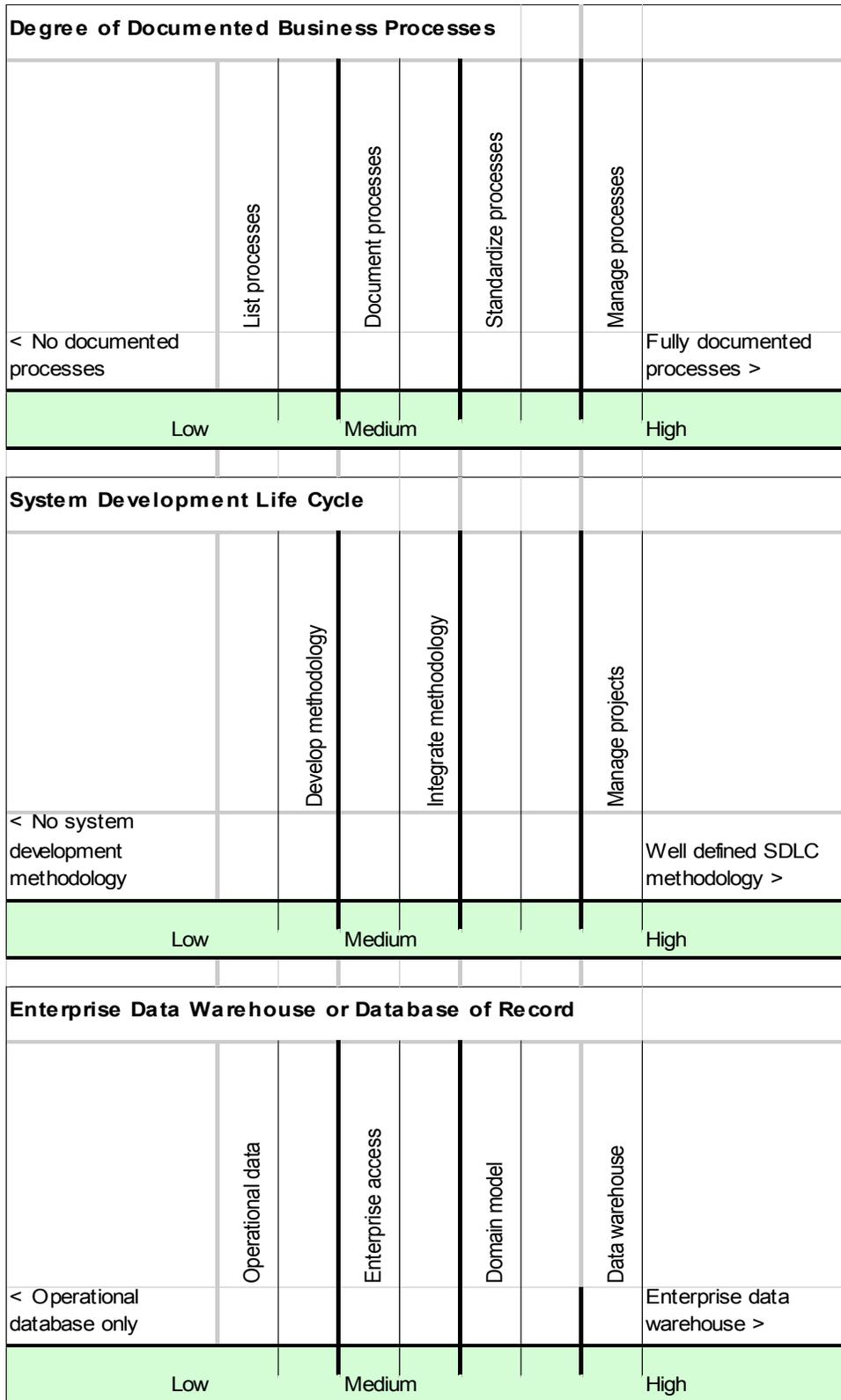


Figure 13: Ratio Scales of Three Selected Organization Characteristics

The categories of organization characteristics are analyzed and associated to the categories of the selected business requirement. A dendogram is presented (see Figure 14: Dendogram -- Clustering Variations in a Business Requirement) as a means to illustrate clustering of variations in the selected business requirement around variations in the three pre-selected organization characteristics (Krippendorff, 2004, pp. 208-210).

Business Process Definition			
Assist the business in being successful by adding value	stabilization		
Partnership of the business and IT	sharing resource	Manage processes	
Align with business goals and priorities	short term goals		
Assist the business in being successful by adding value	stabilization	Standardize processes	
Partnership of the business and IT	sharing resource		
Align with strategic business direction	long term goals		
Assist the business in being successful by adding value	stabilization	Document processes	
Align with strategic business direction	long term goals		
Assist the business in being successful by adding value	stabilization	List processes	
Partnership of the business and IT	sharing resource		
Software Methodology			
Align with business goals and priorities	short term goals		
Assist the business in being successful by adding value	stabilization	Manage projects	
Align with strategic business direction	long term goals		
Align with business goals and priorities	short term goals		
Assist the business in being successful by adding value	stabilization	Integrate methodology	
Partnership of the business and IT	sharing resource		
Align with strategic business direction	long term goals		
Align with business goals and priorities	short term goals	Develop methodology	
Partnership of the business and IT	sharing resource		
Data Warehouse			
Align with business goals and priorities	short term goals		
Assist the business in being successful by adding value	stabilization	Data warehouse	
Partnership of the business and IT	sharing resource		
Align with business goals and priorities	short term goals		
Assist the business in being successful by adding value	stabilization	Domain model	
Partnership of the business and IT	sharing resource		
Align with strategic business direction	long term goals		
Align with business goals and priorities	short term goals		
Assist the business in being successful by adding value	stabilization	Enterprise access	
Partnership of the business and IT	sharing resource		
Align with strategic business direction	long term goals		
Align with business goals and priorities	short term goals	Operational data	
Assist the business in being successful by adding value	stabilization		

Figure 14: Dendogram -- Clustering Variations in a Business Requirement

CHAPTER 5 – Conclusions

Widely Used Enterprise Architecture Models

This study performs an integrative literature review to compile information on the use of enterprise architecture models in different types of organizations. Content analysis of selected literature results in a collection of six enterprise architecture models which consistently are associated with the business requirement of aligning information technology efforts with the strategic goals of the company (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1) as found in the literature. Several of these models can vary in format based on their intended audience and purpose. In these cases, focus is on the forms of these models which are used as communication devices between IT and the business.

Each of the six models is examined below, presented in order of decreasing frequency of appearance in the literature.

#1 - Data Model

Ambler (2005) identifies three types of data models which build upon one another as the audience and purpose evolves (para. 8). These include:

- Conceptual (also referred to as domain). These are models that allow high level views of business data, often valuable for communication between IT and business users (Ambler, 2005, para. 9).
- Logical. These are models that extend the conceptual model with additional information on the relationship between data entities and the data attributes each entity possesses. Logical models are also used for communication between IT and the business users to further define a view of the data (Ambler, 2005, para. 9).
- Physical. These are models that, when used as the design for implementation of a database, extend the logical with detail on the data attributes and the relationships between entities, including such detail as data typing and data constraints. Attributes and entities are named according to the organization naming standards. This model provides the detail to enable a database administrator (DBA) to construct the database, acting as a database blueprint. It is not designed as a tool for communication with the business. (Ambler, 2005, para. 10)

The conceptual and logical data models are valuable enterprise architecture tools for communication with business staff (Ambler, 2005, para. 9). At the conceptual level, an enterprise wide domain model becomes the objective (Maciag, 2005, pp. 207-212). This model depicts the pertinent business data across the entire business. Its goal is to minimize redundancies and gain consensus on the name and nature of business data objects (Haddad, 2005, para. 14).

The logical enterprise architecture data model extends the base domain model by including attribute information and the relationship between the data entities. Although enterprise naming standards are usually associated with the physical data model, many feel that correct naming standards should be enforced in the logical model in order to identify redundancies and the semantics of relationships between data entities (Haddad, 2005, para. 14; Barry, 2002, pg. 16).

An example of a logical data model is shown in Figure 15: Logical Data Model Example (reprinted from AgileData.org).

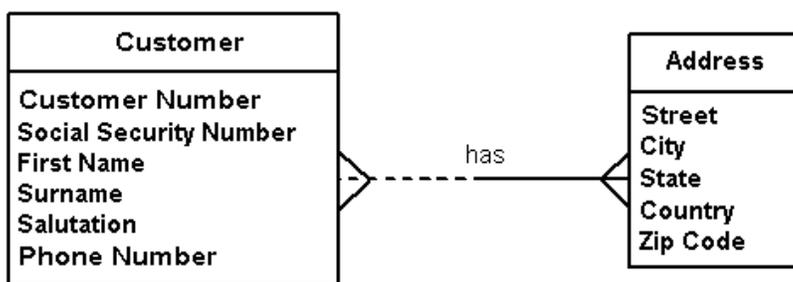


Figure 15: Logical Data Model Example (reprinted from AgileData.org)

#2 - Process Model

A business process model describes the flow of a set of actions to reach a specific goal, and the influences upon those actions by people or things (Thompson, 2005, para. 7; Sparks, 2005, para. 3). There are many designs for process models including:

- Black box diagrams. The process itself is depicted as a black box, and focus in the diagram is on the input and output to the process – the users, actors, data, reports, etc;
- Fishbone diagrams. These diagrams model the relationships between the influencers of a process more than the process itself;
- Flow diagrams. These diagrams include the data flow diagram (described below), the Unified Modeling Language (UML) activity diagram (described below) and the UML business process diagram (National Institute of Standards and Technology, 2005, sec. 3.3.2; Sparks, 2005, para. 1).

The black box and fishbone diagrams are limited in their usefulness because they attempt to address a portion of the process at a time, and are not used as communication tools (National Institute of Standards and Technology, 2005, sec. 3.3.2). The UML business process diagram is designed to be a communication tool (Sparks, 2005, para. 4), and is proposed here as the process model of choice. A UML process model example depicting the process of modeling a business process, is shown in Figure 16: UML Business Process Model example (reprinted from Sparx Systems, 2005).

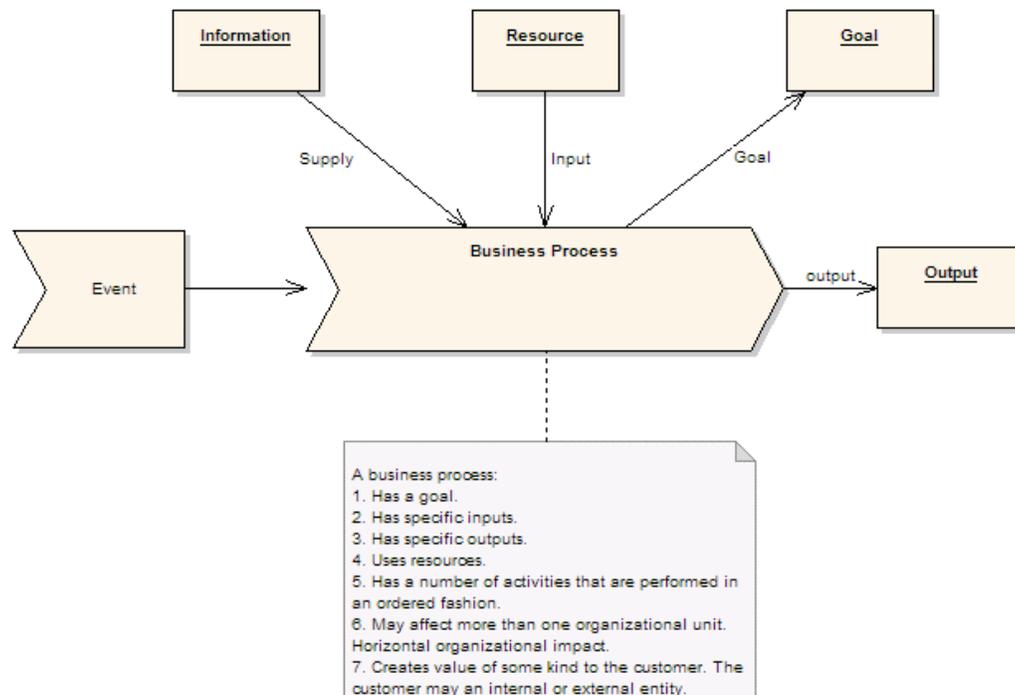


Figure 16: UML Business Process Model example (reprinted from Sparx Systems, 2005)

#3 - UML Class Diagram

There are many similarities between a Unified Modeling Language (UML) class diagram and a data model, but there is a fundamental difference in their development and focus. While a data model exposes a data entity and its relationship to other data entities, a class diagram focuses on both the data and its behavior (Ambler, 2005, para. 6). A class diagram is also referred to as an object model.

Similar to data models, object models are used to communicate with the business and develop a common domain model for an enterprise. The enterprise domain model can be used for communication between IT and the business to establish, at the least, an enterprise

set of standard objects and relationships. Building a common object model of components which can be identified by the business as pertinent to its functioning can serve to reduce the existence of redundant objects, clarify the relationship between objects, and promote the use of a common vocabulary of object names and their hierarchical relationships (Maciag, 2005, pp. 105-111).

There is a preference to build such a model to be industry-specific rather than enterprise specific. Oldfield (2002) notes “the Domain Model for one Enterprise should be the same as that for any other Enterprise conducting business in the same domain” (pg. 3). Building an industry-standard model, however, can be daunting, if not impossible, in businesses that have not yet had industry standards developed. A more reasonable approach is to limit the domain model to the enterprise.

An example of a UML class diagram is shown in Figure 17: UML Class Diagram Example (reprinted from Gooch, 2000).

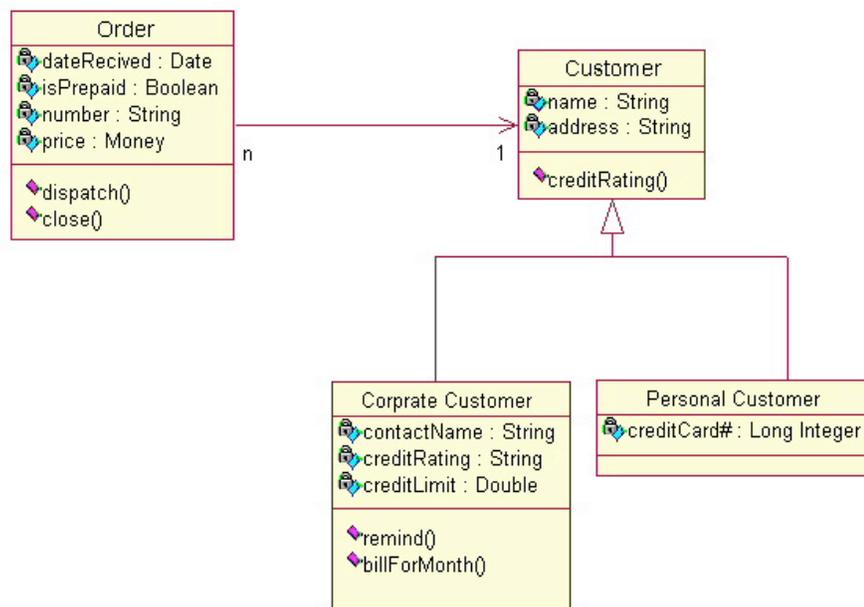


Figure 17: UML Class Diagram Example (reprinted from Gooch, 2000)

#4 - UML Sequence Diagram

The UML sequence diagram relies on an existing definition of classes or objects and displays the sequence of messages between objects in a business process (Martin, 1998, para. 2). Because they depict each message rather than larger relationships between objects, they have limited usefulness as communication tools with business users (Martin, 1998, para. 20). They are more valuable as a supporting document for other UML diagrams, or as a design tool for software developers (Martin, 1998, para. 20). As a supporting tool for communication with the business, presented in conjunction with a UML activity diagram and class diagram, they can show the order of use of the various objects which may be helpful in understanding their relative importance.

An example of a sequence diagram is depicted in Figure 18: UML Sequence Diagram

Example (reprinted from AgileData.org).

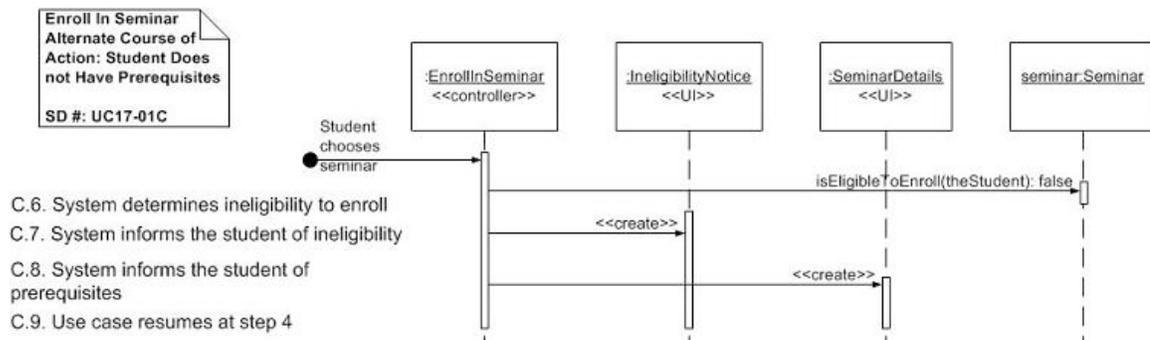


Figure 18: UML Sequence Diagram Example (reprinted from AgileData.org)

#5 - UML Activity Diagram

UML activity diagrams are very similar to sequence diagrams, but have the added advantage of illustrating the relationship between objects more clearly (Martin, 1998, para. 1). Like sequence diagrams, they are used in conjunction with UML class diagrams as a means to communicate with business staff (Gooch, 2002, para. 2). Activity diagrams are useful for describing the actions included in a business process and when they should occur (Gooch, 2002, para. 2). They are a form of a process model.

An example of a UML activity diagram is illustrated in Figure 19: UML Activity Diagram

Example (reprinted from Gooch, 2002).

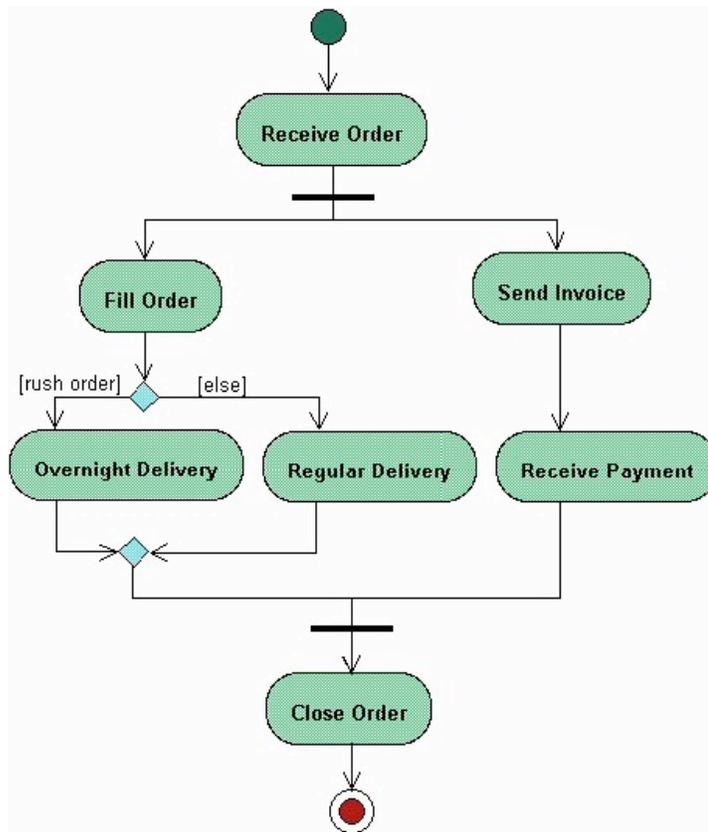


Figure 19: UML Activity Diagram Example (reprinted from Gooch, 2002)

6 - Data Flow Diagram

Data flow diagrams depict the flow of data as it enters a systems and moves between activities (Ambler, 2005, para. 3). The diagrams also show the data storage, both logical and physical. Data flow diagrams are a specific form of a process model that has been in use since the late 1970's (Ambler, 2005, para. 3). Several variations in the formats of data flow diagrams have been introduced over the years, but the general layout remains the same.

As a communication tool, data flow diagrams are useful for tracking information through the business process (Ambler, 2005, para. 10). While they can be useful as a communication

tool, they must be kept small to be easily readable – implying that many of these diagrams might be needed to model a complete system. (Ambler, 2005, para. 10).

An example of a data flow diagram is presented in Figure 20: Data Flow Diagram Example (reprinted from SmartDraw.com).

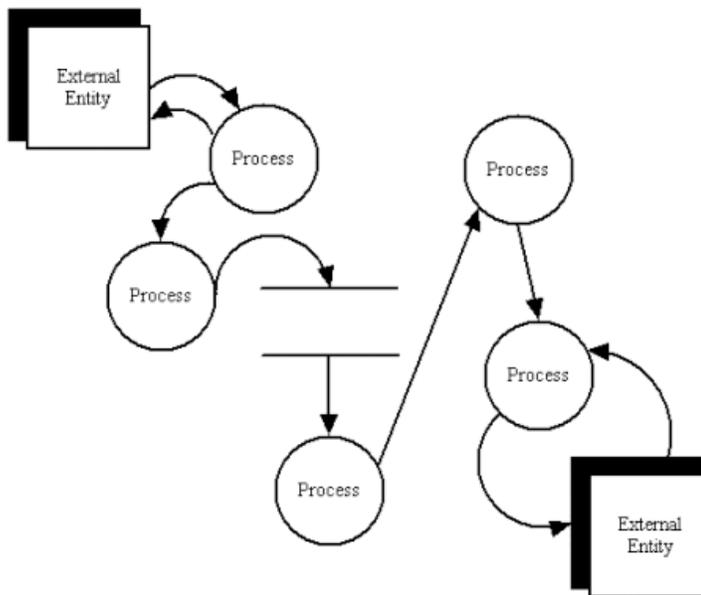


Figure 20: Data Flow Diagram Example (reprinted from SmartDraw.com)

Use of EA Models Relative to Organization Maturity

The six enterprise architecture models discussed above are plotted against the various levels of organization maturity, as identified through analysis of three organization characteristics in stage two content analysis. When the results from stage one content analysis are combined with the dendrogram results from stage two content analysis (see Figure 14: Dendrogram -- Clustering Variations in a Business Requirement), the result is a matrix that depicts the

various data models relative to organizational maturity. This final matrix is presented in Figure 21: Associations of Organization Maturity Characteristics to EA Models.

A pictorial view of this information is provided in Figure 22: Associations of Organization Maturity Levels to EA Models, Graphic View.

	Business Process Definition	Software Methodology	Data Warehouse	Business Process Definition	Software Methodology	Data Warehouse	Business Process Definition	Software Methodology	Data Warehouse
	High			Medium			Low		
data model	10	15	17	7.5	20	20	13	12	18
process model	8	8	9	4	11	11	10	4	10
UML class diagram	2	3	4	1.5	6	6	4	5	5
UML activity diagram	2	2	3	1	5	5	4	4	4
UML sequence diagram	2	2	3	1	5	5	4	4	4
data flow diagram	2	2	2	1	2	2	2	0	2

Figure 21: Associations of Organization Maturity Characteristics to EA Models

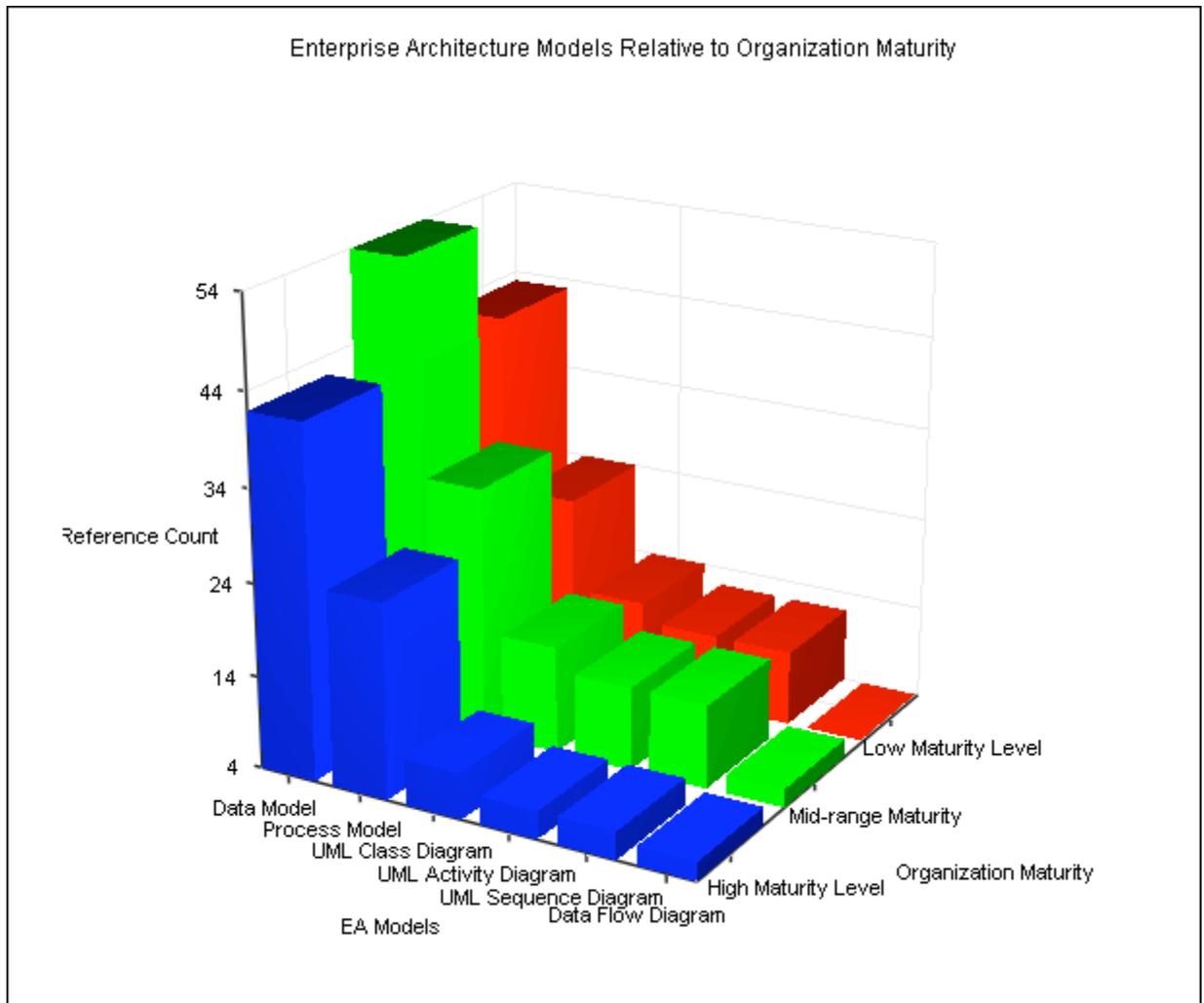


Figure 22: Associations of Organization Maturity Levels to EA Models, Graphic View

The results of the analysis indicate that data and process models are the most prevalent form of enterprise architecture model used for satisfying the general business requirement of aligning information technology efforts with the strategic goals of the company (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1). This may in part be explained by the multitude of variations in the form of these two models. The other models listed – UML class diagram, UML activity diagram, UML sequence diagram and data flow diagram – are all fairly specific in their format.

As revealed in this study, data models appear to be valuable regardless of the level of organizational maturity. Models of operational data in sub-systems are needed for every enterprise. For the more mature organizations, advanced data models are used to build and maintain domain models. As Barry (2002) notes, “In industry organizations, work has begun on standardizing some data elements and the semantics of those elements for exchanging data among multiple industries” (pg. 16).

Process models are slightly more valuable in low to medium maturity organizations. It is at these maturity levels that standardization of processes is a significant issue (Jackson, 2005, para. 14-16). The process of building an enterprise architecture includes documenting existing business practices as needed, implying a requirement to include a process model or models of some form (Buchanan and Soley para. 26).

The set of three UML diagrams, each described above, is most useful when presented as a communication tool together. Each of the models has its own focus, and both the activity and sequence diagrams reference the class diagram. The similarity in occurrences of these models in the literature reflects this inter-dependency. These models appear to be most useful in low to medium maturity organizations.

Data flow diagrams appear in all levels of maturity. These are a specific form of a process model which is widely accepted as a technique due to the model’s longevity and omnipresence in the IT world. Of the six models analyzed, data flow diagrams have a relatively low frequency. This may be due to their size limitation, requiring a multitude of models to convey what might be presented in one process model of a different format.

Using the Analysis Results

The relative maturity of an organization can be judged roughly from within the information technology community without the use of complex tools or lengthy checklists. Organizations in an environment where processes are reactive and day-to-day activities focus on immediate concerns are fairly low in maturity. Those with proactive processes, well established guidelines and standards, and both short and long term goals are much more mature.

When faced with the choice of an enterprise model to use for satisfying the general business requirement of aligning information technology efforts with the strategic goals of the company (Zachman, 1997, para. 10; Baker and Janiszewski, 2005, para. 30; Finkelstein, 1997, para. 1), an IT staff person might use the matrix provided in Figure 21 to narrow the scope of possible models.

In addition, the matrix provides a different way to approach the research on the use of a model to satisfy any other business requirement. Several steps are needed to find an appropriate model:

Step 1. Identify the business requirement. Make sure the business needs are identified.

Models are used as communication tools. The business is the audience. Often the business has difficulty identifying the value of an enterprise architecture effort, so choosing a model they feel is valuable is a good first step (Richardson, Jackson and Dickson, 2001, pg. 399).

Step 2. List the possible enterprise architecture models to meet the business requirement.

Research what others have done or follow established best practices. Select models which would be of value to the organization.

Step 3. Estimate the relative maturity of the organization. Have processes been well documented? Are data stores limited to transactional data only?

Step 4. Filter the list of models down to those most appropriate for the maturity of the organization. Select models where the information to complete them is available.

Additional steps, such as validating the appropriateness of a given model by prototyping its use, or using models which can be consolidated with existing models, or using standard notation, are all additional concerns which can be addressed.

APPENDIX A –

Coding Form & Code Book: Stages One and Two Content Analysis

Code Form for Enterprise Architecture Model, Business Requirement and Organization Characteristics

Code Form Enterprise Architecture Models Useful in Alignment of IT and Business Strategy								
#	Source (APA Citation)	Model Name	Model Description	<--> Validated?	Business Requirement Phrase(s)	<--> Validated?	Characteristic Code	Organization Characteristic Phrase(s)

Code Book for Enterprise Architecture Model, Business Requirement and Organization Characteristics

The Coding Form is used to record two coded sets of information from the selected literature:

1. Each article containing both a reference to an enterprise architecture model and a reference to the general business requirement of aligning IT with the strategic goals of the business are coded.
2. Each article containing both a reference to one of three organization characteristics and a reference to the general business requirement of aligning IT with the strategic goals of the business are coded.

For articles which contain all three components, a single line entry is made.

#

A unique numeric value used to reference the row in the form when performing subsequent analysis and groupings. The number value should begin with one and increment by one for each entry.

Example: 1

Source (APA Citation)

The bibliographic citation for the source of the coded entry.

Example: Waddington, David (2004, November). An Architected Approach to Integrated Information. Kalido [Online]. Retrieved September 2, 2005 from <http://datawarehouse.ittoolbox.com/browse.asp?c=DWPeerPublishing&r=http://hosteddocs.ittoolbox.com%2FDW041505.pdf>

Model Name

The word or phrase by which the model is identified in the literature.

Example: Entity Relationship Model

Model Description

A summary of the benefits and format of the model being coded, as noted in the literature.

Example: A pictorial representation of the relationship between logical data entities, including specification of the cardinality of the relationships.

↔ Validated?

A notation on whether the association between the model and the business requirement phrase is validated in the article. A positive association can be either an explicit association pattern in the text (x is used for y, if x then y), an implicit association pattern in the text (x in close proximity to y) or a lack of negative association patterns (x and not y, either x or y)

Possible values for this field include:

- Y, there is a positive association between these two elements
- N, there is a negative association between these two elements
- Blank – the association has not been validated

Example: Y

Business Requirement Phrase(s)

Words or phrases (one per line) from the article which imply an association to the business requirement of aligning IT with the strategic goals of the business.

Example: 'IT investments...assessed on a timely...basis'

↔ Validated?

A notation on whether the association between the business requirement phrase and the organization characteristic phrase is validated in the article. A positive association can be either an explicit association pattern in the text (x is used for y, if x then y), an implicit association pattern in the text (x in close proximity to y) or a lack of negative association patterns (x and not y, either x or y)

Possible values for this field include:

- Y, there is a positive association between these two elements
- N, there is a negative association between these two elements
- Blank – the association has not been validated

Example: Y

Characteristic Code

A numeric code indicating which organization characteristic the following word or phrase applies to. The possible values are:

1. documented business processes
2. well defined system development life cycle
3. enterprise data warehouse, or database of record

Example: 1

Organization Characteristic Phrase(s)

Words or phrases (one per line) from the article which describe a variation in the degree of implementation of the organization characteristic.

Example: 'User manuals for automated systems'

APPENDIX B –

Literature Selected for Data Analysis

Set of Literature for Stage One Content Analysis

1	A New Service-Oriented Architecture (SOA) Maturity Model (2005). Retrieved November 2, 2005 from: http://www.ebizq.net/views/download_raw?metadata_id=6446&what=feature
2	Ambler, Scott (2005). Architecture and Architecture Modeling Techniques. AgileData.org [Online]. Retrieved November 4, 2005 from: http://www.agiledata.org/essays/enterpriseArchitectureTechniques.html
3	Barry, Douglas (2002). Getting Ready for a Services Oriented Enterprise Architecture. Distributed Enterprise Architecture, 5,8. Retrieved October 4, 2005 from http://tp.bia-bg.com/Work/Serv-Orient%20Architecture.pdf .
4	Bernus, Peter and Nemes, Laszlo (1993). A Framework to Define a Generic Enterprise Reference Architecture and Methodology. Griffith University [Online]. Retrieved September 12, 2005 from: http://www.cit.gu.edu.au/~bernus/taskforce/geram/report.v1/report/subsectionstar4_2.html
5	Borenstein, Joram and Brooks, Rex (2005, June). Ontology Management for Federal Agencies. DMReview [Online serial]. Retrieved September 12, 2005 from: http://www.dmreview.com/editorial/dmreview/print_action.cfm?articleId=1030240 .
6	Buchanan, Richard D. and Soley, Richard Mark (2002). Aligning Enterprise Architecture and IT Investments with Corporate Goals. Object Management Group [Online}. Retrieved September 15, 2005 from http://www.omg.org/registration/META-OMG-WP-Public.pdf
7	Burke, Jason (2005, June). Are Life Sciences Ready for an Industry Architecture? Microsoft.com [Online]. Retrieved October 4, 2005 from http://download.microsoft.com/download/7/D/D/7DD45493-8958-4377-8C79-ADB8489B4937/LifeSciencesIndustryArchitecture.doc
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12	Gottlieb, B. Iyer (2004). The Four-Domain Architecture: An Approach to Support Enterprise Architecture Design. IBM Systems Journal, 43, 587-597.
13	Haddad, Chris (2005, March). Where's the ROI? WebLogicPro. [Online serial]. Retrieved September 15, 2005 from http://www.ftponline.com/weblogicpro/2005_03/magazine/columns/soapbox/default_pf.aspx
14	Handler, Robert and Bryan Maizlish (2005). Power PMO. Projects@Work [Online].

	Retrieved October 31, 2005 from: http://www.projectsatwork.com/content/articles/226311.cfm
15	Margulius, David L. (2005, March 14). Process-Driven Architectures. InfoWorld, 27, 40-42.
16	Morgenthal, J.P. (2005, September). Enterprise Architecture: The Holistic View: Reuse Versus Performance in SOA. DMReview Online [Online serial]. Retrieved September 27, 2005 from http://www.dmreview.com/editorial/dmreview/print_action.cfm?articleId=1037865
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18	NASCIO (2003, December). NASCIO Enterprise Architecture Maturity Model. [Online]. Retrieved October 2, 2005 from http://www.nascio.org/hotIssues/EA/EAMM.pdf
19	Raden, Neil (2005, October). Start Making Sense: Get from Data to Semantic Integration. Intelligent Enterprise, 8, 24-31
20	Richardson, Gary L., Jackson, Brad M. and Dickson, Gary W. (1990, December). A Principles-Based Enterprise Architecture: Lessons Learned From Texaco and Star Enterprise. MIS Quarterly, pp. 385-403.
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25	Zhong, Jian (2003, March). From Stove-Piped Projects to Unified Enterprise Architecture. JavaWorld [Online serial]. Retrieved September 15, 2005 from http://www.javaworld.com/javaworld/jw-03-2003/jw-0321-ss0_p.html .

Set of Literature for Stage Two Content Analysis

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21	Richardson, Gary L., Jackson, Brad M. and Dickson, Gary W. (1990, December). A Principles-Based Enterprise Architecture: Lessons Learned From Texaco and Star Enterprise. MIS Quarterly, pp. 385-403.
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23	Smith, Aaron (2005). Partners in Time. Projects@Work [Online]. Retrieved October 31, 2005 from: http://www.projectsatwork.com/content/articles/222669.cfm
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27	Whyte, Michael J.P. (2004, May 13). "Enterprise Architecture – the Key to Benefits Realization." DM Review. [Online serial]. Retrieved September 2, 2005 from http://www.dmreview.com/whitepaper/WID1003503.pdf
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**APPENDIX C –
Completed Coding Form:
Stages One and Two Content Analysis**

#	Source (APA Citation)	Model Name	Model Description	<--> Validated?	Business Requirement Phrase(s)	<-> Validated?	Characteristic Code	Organization Characteristic Phrase(s)
1	Handler, Robert and Bryan Maizlish (2005). Power PMO. Projects@Work [Online]. Retrieved October 31, 2005 from: http://www.projectsatwork.com/content/articles/226311.cfm	bubble charts	The data is focused on quantifying the business value (the Y axis) and the technology innovation introduced by the project (the X axis). The estimated cost of the project is used to determine the size of the "dot" plotted on the graph.	y	key value drivers for the organization	y	2	a program management office (PMO) to manage delivery of projects

		detailed architectural viability assessment	determining the alignment to the technology architecture blueprint and extensively evaluating technology risks	y	enterprise-wide technology strategy	y	2	Project plans, contracts, required resources, risks, processes, architectural blueprints, integration requirements, integration approaches, and highly detailed cost/benefit or EVA analysis
				y	maintain alignment with evolving business goals and priorities	y	1	strategic initiatives to consolidate and standardize processes and programs
				y	Achieving and maintaining close alignment with business units on PMO goals and processes	y		
				y	Does the idea align tightly with corporate priorities	y		
				y	value proposition for the company	y		
				y	significantly improved alignment of IT requests with business priorities and a sharp decrease in discretionary	y		

					or non-value-add requests			
2	Retna, San (2005). Loop Dreams. Projects@Work [Online]. Retrieved October 31, 2005 from: http://www.projectsatwork.com/content/articles/222896.cfm			y	ensure that critical business objectives are supported with sufficient internal funding and program execution	y	2	track individual projects on how well they were progressing towards an on-schedule and on-budget completion
				y	the organization is making sufficient investments to reach critical objectives	y		
3	Smith, Aaron (2005). Partners in Time. Projects@Work [Online]. Retrieved October 31, 2005 from: http://www.projectsatwork.com/content/articles/222669.cfm			y	decisions ... as to what the most important projects are	y	2	development of a project management methodology

4	A New Service-Oriented Architecture (SOA) Maturity Model (2005). Retrieved November 2, 2005 from: http://www.ebizq.net/views/download_raw?metadata_id=6446&what=feature .	Service Level Agreement	contract between the business and IT, it specifies the boundaries of acceptable system behavior	y	partnership between technology and business organizations	y	1	Business Services, focused on the improvement of internal business processes, and Collaborative Services, focused on the improvement of collaborative processes with external partners,
				y		y	1	modeling, execution, and management of complex, stateful business processes across the extended enterprise
				y		y	2	Integrate SOA into project development methodology.
5	Murphy, Jerald (2005, August). Building an Agile IT Infrastructure. EBizQ.net [Online]. Retrieved November 2, 2005 from: http://www.ebizq.net/views/download_raw?metadata_id=6296&what=feature	Objective Systems Interconnect (OSI) Model	eight-layer network interface model. At layer two, almost everyone has moved away from Token Ring/Fiber Distributed Data Interface (FDDI), and embraced Ethernet as the accepted layer-two protocol. Standards work continues up the application protocol stack, with service-oriented architectures (SOAs) beginning	y	Neither business nor IT can look at any new technology in isolation. The entire business value chain should be explored.	y		

			to gain acceptance.					
6	Ulfelder, Steve (2005). Enterprise Leadership: Simply, Aligned. BMC Software [Online]. Retrieved November 2, 2005 from: http://www.bmc.com/BMC/BSM/CDA/hou_BSMPage_Detail/0,,11459313_23341658_23110114,00.html			y	to facilitate IT-business alignment	y	2	standardize its system management practices
				y	IT-business alignment in the form of Business Service Management (BSM)	y		

7	Zhong, Jian (2003, March). From Stove-Piped Projects to Unified Enterprise Architecture. JavaWorld [Online serial]. Retrieved September 15, 2005 from http://www.javaworld.com/javaworld/jw-03-2003/jw-0321-sso_p.html .	UML Class Model	OMG UML specification model of objects and their hierarchical structure	y	The goal is to build a service that offers value	y	1	List of business processes; List of information systems that support those business processes
		UML Activity Model	OMG UML specification model of a business process	y	business strategic-driven process	y	2	An MDA development process
		UML Sequence Diagram	OMG UML specification model of a business process	y	share information in support of a common mission	y	3	databases will be centrally hosted and made accessible enterprisewide
8	Ohlson, Kathleen (2005, June). Business Processes Key to Business Intelligence. ADTMag.com [Online serial]. Retrieved September 16, 2005 from http://www.adtmag.com/print.asp?id=11299			y	There needs to be communications between businesses and IT	y	3	The company is currently connecting key wholesale systems and services by building enterprise intelligence models, including data warehouse, ETL and reporting and analytics plans
				y		y	1	redesigning business process and rules

9	NASCIO (2003, December). NASCIO Enterprise Architecture Maturity Model. [Online]. Retrieved October 2, 2005 from http://www.nascio.org/hotIssues/EA/EAMM.pdf	process model	Process models have been prepared	y	Documentation of business drivers, and strategic information is consistent	y	2	description of the architecture development lifecycle processes,
				y	Program is integrated with strategic planning and budgeting processes	y	1	processes have been defined and documented
10	Morgenthal, J.P. (2005, September). Enterprise Architecture: The Holistic View: Reuse Versus Performance in SOA. DMReview Online [Online serial]. Retrieved September 27, 2005 from http://www.dmreview.com/editorial/dmreview/print_action.cfm?articleId=1037865	data model	Isolate services that introduce tight coupling with the underlying architecture or data models until they can be replaced by high performing loosely coupled components	y	the ability to deliver long-term missions	y	3	we leverage powerful relational database engines

11	<p>Haddad, Chris (2005, March). Where's the ROI? WebLogicPro. [Online serial]. Retrieved September 15, 2005 from http://www.ftponline.com/weblogicpro/2005_03/magazine/columns/soapbox/default_pf.aspx</p>	data model	<p>Ability to identify redundant business processes and data is dependent on establishing a common process and data model. Establishing semantic relationships is a prerequisite to normalizing the various application portfolio assets</p>	y	describes its objectives in support of corporate goals	y	3	<p>Ability to identify redundant business processes and data is dependent on establishing a common process and data model</p>
		process model	<p>Ability to identify redundant business processes and data is dependent on establishing a common process and data model. Establishing semantic relationships is a prerequisite to normalizing the various application portfolio assets</p>	y		y		

12	Chapman, James R. (2004). Software Development Methodology: a.k.a. System Development Life Cycle. Principle Based Project Management, Washington D.C. Retrieved October 2, 2005 from http://www.hyperthot.com/pm_sdm.htm .	Software requirements specifications	Software quality, reliability, and maintainability are enhanced by having good documentation for requirements	y	Definition of the business process and business requirements	y	2	Every step along the system development life cycle has its own risks and a number of available techniques to improve process discipline
13	Burke, Jason (2005, June). Are Life Sciences Ready for an Industry Architecture? Microsoft.com [Online]. Retrieved October 4, 2005 from http://download.microsoft.com/download/7/D/D/7DD45493-8958-4377-8C79-ADB8489B4937/LifeSciencesIndustryArchitecture.doc	CDISC Operational Data Model (ODM)	The CDISC Operational Data Model (ODM), for example, can be used to exchange information between systems or organizations today	y	...enable [various staff] to work toward the same goal	y		
		process model	Data models such as those developed by CDISC are typical components of an industry architecture and are usually coupled with other	y		y		

			technology standards, process models, business rules, and shared functionality.					
		business rules	Data models such as those developed by CDISC are typical components of an industry architecture and are usually coupled with other technology standards, process models, business rules, and shared functionality.	y		y		
14	Buchanan, Richard D. and Soley, Richard Mark (2002). Aligning Enterprise Architecture and IT Investments with Corporate Goals. Object Management Group [Online}. Retrieved September 15, 2005 from http://www.omg.org/registration/META-OMG-WP-Public.pdf	Porter's five forces model	Most corporate strategy groups still rely on models, like Porter's five forces model, that were introduced in <u>Competitive Strategy</u> to help define corporate environmental threats and opportunities.	y	IT investments are made according to objective measures of business strategic value	y		

		UML System Diagram	begins by creating a UML model that describes the applications and components the company supports and defines how they should be integrated	y	Those that succeed will figure out how to align IT organizations, priorities and development processes with company strategies in a systematic way in order to assure that IT efforts support company goals.	y	2	monitors the existing IT development processes
		UML Class Model	OMG UML specification model of objects and their hierarchical structure	y		y	2	model-based approach to application development
		UML Activity Diagram	OMG UML specification model of a business process	y		y	3	allow customers to access a variety of corporate databases and applications, developers must find a way to link all of these databases and applications together in a way that can provide Web users with almost instantaneous responses.
		UML Sequence Diagram	OMG UML specification model of a business process	y		y		

15	<p>Borenstein, Joram and Brooks, Rex (2005, June). Ontology Management for Federal Agencies. DMReview [Online serial]. Retrieved September 12, 2005 from http://www.dmreview.com/editorial/dmreview/print_action.cfm?articleId=1030240.</p>	FEA Business Reference Model (BRM)	<p>The primary set of tools which the FEAF provides are the five reference models that define terminology and associated data types for the broad areas of IT which are common across the government and comprise the major components of the Federal Enterprise Architecture Management System (FEAMS):</p>	y	[new federal legislation does] enable the various departments and agencies of the Federal Government to more effectively focus on the particular scopes and purposes of their more narrowly defined domains of activity and knowledge	y	3	[an ontology] is most important to stress the relationships that hold among the entities because it is through those relationships that resources are quickly found and utilized within specific domains, and which allow inference and rules engines to allow abstract knowledge resources to be supplied with operational data and perform useful tasks
		FEA Service Component Reference Model (SRM)	<p>The primary set of tools which the FEAF provides are the five reference models that define terminology and associated data types for the broad areas of IT which are common across the government and comprise the major components of the Federal Enterprise Architecture</p>	y		y		

			Management System (FEAMS):					
		FEA Performance Reference Model (FRM)	The primary set of tools which the FEAF provides are the five reference models that define terminology and associated data types for the broad areas of IT which are common across the government and comprise the major components of the Federal Enterprise Architecture Management System (FEAMS):	y		y		

		FEA Technical Reference Model (TRM)	The primary set of tools which the FEAF provides are the five reference models that define terminology and associated data types for the broad areas of IT which are common across the government and comprise the major components of the Federal Enterprise Architecture Management System (FEAMS):	y		y		
		FEA Data Reference Model (DRM)	The primary set of tools which the FEAF provides are the five reference models that define terminology and associated data types for the broad areas of IT which are common across the government and comprise the major components of the Federal Enterprise Architecture Management System (FEAMS):	y		y		

16	<p>Bernus, Peter and Nemes, Laszlo (1993). A Framework to Define a Generic Enterprise Reference Architecture and Methodology. Griffith University [Online]. Retrieved September 12, 2005 from http://www.cit.gu.edu.au/~bernus/taskforce/geram/report.v1/report/sectionstar4_2.html</p>	process model	Thus the architecture should be based on the modelling of the enterprise engineering process	y	the architecture should tie and relate enterprise integration and enterprise engineering to the rest of activities in the enterprise	y	2	the life-cycle of the Enterprise Engineering / Integration Processes... consist of the concept, identification, requirements definition, design, implementation (detailed design) etc. of enterprise engineering projects
		Product Life-Cycle Matrix	The matrix, first of all, is a specification of the Generic Architecture of an Entity. Which entity's life-cycle is implemented by the enterprise? The obvious answer is that it is the products (services) produced by the enterprise	y		y		

17	Barry, Douglas (2002). Getting Ready for a Services Oriented Enterprise Architecture. Distributed Enterprise Architecture, 5,8. Retrieved October 4, 2005 from http://tp.bia-bg.com/Work/Serv-Orient%20Architecture.pdf .	data model	In industry organizations, work has begun on standardizing some data elements and the semantics of those elements for exchanging data among multiple industries.	y	help organizations leverage IT for competitive advantage and business success.	y	3	decouple your organizational data from your operational systems and to store this data in a database of record
18	Ambler, Scott (2005). Architecture and Architecture Modeling Techniques. AgileData.org [Online]. Retrieved November 4, 2005 from: http://www.agiledata.org/essays/enterpriseArchitectureTechniques.html	Computation Independent Business Model (CIBM)	The CIBMs represent the business requirements and processes that the system or component supports. A CIBM could include a collection of business rule definitions and a UML activity diagram used to describe the overall business process supported by the system/component	y	represent the business requirements and processes that the system or component supports	y	1	a collection of business rule definitions and a UML activity diagram used to describe the overall business process supported by the system/component

		Platform Independent Component Model (PICM)	PICMs are used to model the logical business components, also called domain components. A PICM could be described via a UML component model and a collection of interface definitions	y		y		
		Platform Specific Model (PSM)	PSMs bring technology issues into account and reflect platform-specific considerations. A PSM could be comprised of a UML class diagram, several UML sequence diagrams, several UML state chart diagrams, and a physical data model	y		y		

19	Richardson, Gary L., Jackson, Brad M. and Dickson, Gary W. (1990, December). A Principles-Based Enterprise Architecture: Lessons Learned From Texaco and Star Enterprise. <u>MIS Quarterly</u> , pp. 385-403.	data plans	Each business unit will be responsible for developing data plans that reflect their unique characteristics within the unit's business environment	y	support business functions and management decision making	y	3	maintains a corporate data repository
		data definitions, data-related conventions and standards	A set of data-related conventions and standards... developed and adhered to for the storage and sharing of data	y	the application of technology to business solutions demands a thorough knowledge of the business and its directions	y	1	Figure 2 shows the business functions... and gives some indication of the information processing systems supporting these functions.
		technology gap model	Partnerships with strategic suppliers will need to be used to engineer future models (ie "technology gaps")	y	it is vital that the information systems planning function be fully integrated with the business strategic planning process	y	2	information systems will need to be developed using formal planning and software engineering methodologies
		network architecture model	The enterprise network model is the blueprint that describes the planned	y	implement... quality information systems that are closely	y	3	A set of data-related conventions and standards will need to be developed and adhered to for the storage and sharing of data

			connectivity of workstations and servers throughout the organization		aligned with business objectives			
				y	the real value of architectural design... became recognized...as an activity that is necessary to achieve strategic company goals	y		
20	Waddington, David (2004, November). An Architected Approach to Integrated Information. Kalido [Online]. Retrieved September 2, 2005 from http://datawarehouse.ittoolbox.com/browse.asp?c=DWPeerPublishing&r=http://hosteddocs.ittoolbox.com%2FDW041505.pdf	data model	The most important criteria... is the degree to which the various business data models are (or need to be) different.	y	must be based upon the requirements of the business organization and process	y	3	implementation of an enterprise data warehouse
21	SAP AG (2004). <u>Enterprise Services Architecture – An Introduction</u> . Walldorf, Germany. Author	business scenario model (use case)	description of a business process from start to finish	y	IT organizations must enable these new business initiatives	y	2	provides a unified application development platform that contains the tools, methodologies, rules, user interface patterns, and services

22	Raden, Neil (2005, October). Start Making Sense: Get from Data to Semantic Integration. <u>Intelligent Enterprise</u> , 8, 24-31	database schema model	physical data model	y	Physical implementation decisions always belong with the technologists. However, those most familiar with business objectives... will ultimately control information resources.	y	3	establish one place for all the data needed for managerial reporting, thereby alleviating the need to query hard-pressed operational systems directly. The SVT (single version of truth) ideal is to have a data warehouse that contains the one true, inviolate set of enterprise data.
		UML object model (domain model)	canonical entity model of a business	y		y		
		ontological graph or map	Ontological graphs or maps depict the relationships between things, not just their definitions	y		y		
23	Gottlieb, B. Iyer (2004). The Four-Domain Architecture: An Approach to Support Enterprise Architecture Design. <u>IBM Systems Journal</u> , 43, 587-597.	process flow diagram	Models the business processes and dependencies	y	help enterprises synchronize their business needs and IT capability	y	1	the processes, procedures, business tools, tasks that encode business rules, and dependencies required to support the various functions within a business

		data flow diagram	models the business rules and data, their usage and interrelationships	y		y	3	business rules and business data and information of all types, their usage, interrelationships and demographics, as well as their definitions, ownership, distribution and composition
		entity relationship model	description of the business entities and their relationships	y		y		
24	Thompson, Jess (2005, August 30). <u>Architects Should Integrate Their Model-Based Assets</u> . Gartner Research. Stamford, CT: Author	process model	A process model casts business requirements into a network of activities and is interconnected by flows. The main purpose of a process model is to explicitly show the interrelationships between people and systems in a flow of the tasks that are needed to perform work	y	refactoring IT organizations and assets so that they provide the services required to contribute to business growth and efficiency	y	1	provide governance of a business's process environment, with the goal of improving agility and operational performance, eliminating redundant or unnecessary steps (cost savings) and supporting parallelism in the execution of process (improved efficiency)
		event flow and control specifications (state model)	they provide a specification of how input events are transformed into the required behavior and output events	y		y	3	maximize the value, usefulness and security of information assets across all boundaries

		data model	A data model identifies business entities and relationships among the entities	y		y		
		ontology	establishing a metadata ontology that establishes a single metadata concept... and relates the concept to the model artifacts used in the separate perspectives	y		y		
25	Finkelstein, Clive (1997). <u>A Visible Solution: Enterprise Information Architecture</u> . White Paper, Visible Systems Corporation	logical data model	The logical model should include operational data entities as well as strategic information data entities that will tell executives how their enterprise is performing	y	linking strategic requirements to systems that support them, and by linking the business model to application designs	y	2	it must be engineered. This requires a method and approach that is rigorous and repeatable
		physical data model	There should be a model for each application/database /data store that includes the tables, columns and table relationships derived from its data dictionary	y		y	3	facilitated through the implementation of a strategic information warehouse
		data	meta-data about	y		y		

		dictionary	physical data structures					
26	Margulius, David L. (2005, March 14). Process-Driven Architectures. <u>InfoWorld</u> , 27, 40-42.	process model	IT must be able to model and implement a process-driven architecture at an abstracted level	y	focus everybody in the IT organization on what their contribution to business value is	y	1	the business side must first formally define its processes
27	Chabrow, Eric (2002, November 11). One Nation, Under I.T. <u>Information Week</u> , pp. 47-52.			y	how to create IT systems that let agencies... share information deemed critical	y	1	map what processes technology supports and the systems and software that are used
28	Cotter, Paul T. and Chang, Richard A. (1996, June 24). Plan Your Enterprise Architecture. <u>Information Week</u> , pp. 75-79.	use case	User requirements are expressed thorough "use cases" and the service characteristics expected for the application blueprint to be useful	y	ensures that an enterprise's technology investments are aligned with its strategy	y	1	a business blueprint to gain a thorough, explainable high-level view of key business processes
29	Goikoetxea, Ambrose (2004). A Mathematical Framework for Enterprise Architecture Representation and Design. <u>International Journal of Information Technology & Decision Making</u> , 3, 5-32	business process view	As the general enterprise information architecture evolves... there will be a recognition of various types of business process that will be considered basic...	y	business processes and business systems that drive these architecture design efforts	y	1	agencies must identify the [business processes] performed to support its mission, vision and performance goals

			that we will call the Business Process Architectural View					
		business systems hierarchy	The creation of a hierarchy of business systems for an enterprise information architecture... can finally turn into a rewarding design activity	y		y		
		data flow diagram	Information flows from one business system to another business system, and some of the information content is stored in the form of data elements in databases... data flows... should map to those data elements	y		y		

		data model	Information flows from one business system to another business system, and some of the information content is stored in the form of data elements in databases	y		y		
		applications view	Applications are software implementations of the services... provided by the various business systems. They are modeled with the lower functionality at the bottom, progressing to the top of the stack where thin interfaces to the underlying services provide specific functionality	y		y		

		technology view	The technology architectural view consists of the physical products... that will house the applications, the database, the data warehouse, and service directories, enable transaction processing, direct messages from one platform to another, enable the flow of information... and in general enable the day-to-day conduct of businesses	y		y		
30	Whyte, Michael J.P. (2004, May 13). "Enterprise Architecture – the Key to Benefits Realization." DM Review. [Online serial]. Retrieved September 2, 2005 from http://www.dmreview.com/whitepaper/WID1003503.pdf	process diagram	During the discovery phase of the project, certain architecture-like artefacts are usually produced. These form the basis for the new project.	y	Enterprise Architecture provides the definition of the corporation's needs. Then each [IT] purchase can be carefully measured to see how it will fit into the overall scheme.	y	3	enterprise data architecture

		entity relationship model	During the discovery phase of the project, certain architecture-like artefacts are usually produced. These form the basis for the new project.	y		y	1	partially documented process architecture
		infrastructure diagram	During the discovery phase of the project, certain architecture-like artefacts are usually produced. These form the basis for the new project.	y		y		

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