

# Application of a Lightweight Enterprise Architecture Elicitation Technique Using a Case Study Approach

Nicholas Rosasco and Josh Dehlinger

*Department of Computer and Information Sciences, Towson University, Towson, MD, U.S.A.*

**Keywords:** Enterprise Architecture, Case Study, Grounded Theory Method, Experiential Software Engineering.

**Abstract:** Enterprise architecture (EA) has demonstrated utility for improving overall Information System (IS)/Information Technology (IT) outcomes for institutions, particularly those with large-scale or integration-related needs. To achieve the core goal of an EA – integration, alignment and governance between enterprise goals and the enterprise IS/IT portfolio – institutional vision, mission and objectives must be elicited, analysed, understood and documented by the enterprise architects. This paper proposes and evaluates a lightweight EA elicitation technique to gather the required information about enterprise mission and objectives as a lightweight entry point to developing an EA. Specifically, we investigate the evaluation results of our proposed technique in EA data elicitation and analysis stemming from a case study that was conducted on an institution with a significant IS/IT asset portfolio. Our proposed EA elicitation technique utilizes the VMOST elicitation question, a structured elicitation vehicle, and Grounded Theory Method as the qualitative analysis technique to analyse elicited responses. Application of this approach in a real case study garnered sufficient understanding the vision, mission and objectives of an enterprise to articulate objectives in a way suitable to use as institutional goal as a part of the Zachman EA framework.

## 1 INTRODUCTION

An enterprise architecture (EA) seeks to enable the creation of “organizational structure, business processes, information systems and infrastructure” from a “coherent whole of principles, methods, and models” (Lankhorst, 2005). To aid in integrating, aligning and governing an enterprise’s institutional goals and its information systems (IS), a number of EA frameworks (EAFs) have been created, including the Zachman Framework (Zachman, 1987), The Open Group’s Architecture Framework (TOGAF) (Open Group, 2009) and the European Space Agency Architectural Framework (ESA AF) (Gianni et al., 2013). To support these ends, EAFs have evolved to help align an enterprise’s vision, mission and goals with the contents of their IS asset portfolio. The effectiveness of this alignment is a determinant for the overall utility and benefit of the utilization of an EA and any misalignment is best caught early in the crafting of an EA (Minoli, 2008).

The concept of an IS portfolio reflects the reality faced by many enterprises which have, over time, accumulated a variety of IS solutions to support their business operations and architecture. By

encouraging a holistic, abstract view of both enterprise goals and motivations, EA approaches can provide critical context and scoping for IS needs and decision-making. The immediate issue that occurs for an institution when considering EA is the approach, tools and techniques to use, as this is left an open question by the various frameworks (Open Group, 2009); (Zachman, 1987).

The body of existing research literature available for the application of EA is largely focused on, and shaped by, considerations derived from the original enterprises that intended to use EA - namely very large and well-staffed enterprises, both in terms of IS and business staff (Zachman, 1987; Open Group, 2009); (Gianni et al., 2013). A lightweight approach would be a logical alternative but requires evaluation before such a path could be recommended. By lowering the entry barrier created by the need for expertise with suggested paths through the ecology of available tools and techniques, a significant opportunity for improved decision-making is placed within reach of entities with IS assets but without the substantial expertise available. To that end, this paper is a part of a larger investigation addressing the following two research questions:

- Can a general lightweight elicitation technique

	Why	How	What	Who	Where	When
Contextual	Goal List	Process List	Material List	Organizational Unit & Role List	Geographical Locations List	Event List
Conceptual	Goal Relationship	Process Model	Entity Relationship Model	Organizational Unit & Role Rel. Model	Locations Model	Event Model
Logical	Rules Diagram	Process Diagram	Data Model Diagram	Role Relationship Diagram	Locations Diagram	Event Diagram
Physical	Rules Specification	Process Function Specification	Data Entry Specification	Role Specification	Location Specification	Event Specification
Detailed	Rules Details	Process Details	Data Details	Role Details	Location Details	Event Details

Figure 1: Zachman Framework (as grid) (Zachman, 1987).

gather information suitable for conversion into enterprise vision, and mission?

- Does engaging in the elicitation provide data sufficient to begin populating an enterprise architecture framework?

To address these research questions, this paper presents the overall investigative structure and research methods employed to study of the application of a lightweight effort in EA data elicitation and analysis through a case study. Our lightweight approach for initial EA elicitation (Rosasco and Dehlinger, 2011a); (Rosasco and Dehlinger, 2011b) utilizes an interview vehicle from business strategy, VMOST (Sondhi, 1999), which has been employed and extended in this work to specifically enable the elicitation of the input to a simple EA framework, the Zachman Framework (Zachman, 1987). To achieve the necessary sensemaking (Weick et al., 2005) of qualitative data and assist in analysing elicited EA information, the Grounded Theory Method (GTM) has been used (Strauss and Corbin, 1989).

To apply and evaluate our proposed approach, this research utilizes a case study approach (Yin, 2003); (Eisenhardt 1989) as the research methodology. A case study approach affords the opportunity to increase the utility of EA methods and tools for smaller or less-resourced institutions by demonstrating the ease of use of this approach, as it is being tested and evaluated. This, in turn, reduces the need for costly changes, potential maintenance pitfalls and possible stakeholder frustration that will improve overall effectiveness and help avoid wastes of time and resources on inappropriate, unnecessary, or unworkable solutions. By encouraging internal

discussion on strategic planning, overall goals and objectives within an enterprise, a greater sense of mission is also likely to result from the employment of EA techniques (Sondhi, 1999; Minoli, 2008).

The contribution of this work is multipart. The case study will demonstrate and, primarily, evaluate our lightweight EA elicitation technique as a way to solicit the initial input for an EAF. This effort will also further work undertaken as part of a larger, ongoing study of guided and structured approaches for EA and investigating how qualitative techniques can be utilized in a software engineering context. Specifically, this paper describes the research methodology and evaluation of our proposed lightweight EA elicitation technique conducted with a real, representative enterprise.

The remainder of this paper is organized as follows. Section 2 reviews background and related work on the GTM, the VMOST strategy approach, and EA. Section 3 details our approach and evaluation within the case study approach. Section 4 provides evaluation results, discussion and caveats of our evaluation. Finally, Section 5 provides concluding remarks and future research directions.

## 2 RELATED WORK

The work for this case study combines techniques from several areas, including enterprise architecture (EA), business strategy studies, the VMOST elicitation vehicle (Sondhi, 1999; Bleistein et al., 2005) and the Grounded Theory Method (Strauss and Corbin, 1998).

- (1) What is the overall, ideal, end-state toward which the organization strives (vision)?
- (2) What is the primary activity that the organization performs to achieve the end-state (mission)?
- (3) How are the responses to Question 1 and 2 (vision and mission, respectively) appropriate and relevant to the environment?
- (4) Are the responses to Questions 1 and 2 (vision and mission, respectively) explicit or implied? How?
- (5) What are the basic activities and their rationale by which the organization competes with industry rivals?
- (6) What goals does the organization set to determine if it is competing successfully?
- (7) What activities does the organization perform to achieve the goals in Question 6?
- (8) How do the goals in question 6 support the response to question 1 (vision)?
- (9) What are the measurable objectives that indicate achievement of goals identified in Question 6, and what activities does the organization perform to achieve those objectives?
- (10) How do the objectives identified in Question 9 support the goals identified in Question 6?

Figure 2: VMOST questions, as adapted by Bleistein (Bleistein et al., 2005); (Bleistein et al., 2006).

## 2.1 Enterprise Architecture Frameworks

Developed in 1987 and later elaborated into a framework for EA, the Zachman Framework is used as a way to organize and analyse various presentations of an enterprise (Zachman, 1987). This EA framework (EAF) was employed to prepare the elicited EA data into a structure suitable for use in EA artefact creation. The Zachman Framework provides taxonomy, in the form of a simple grid, to document the “building blocks of enterprises” (Luftman, 1993). It is based on six questions (i.e., what, how, where, who, when, and why) and six general stakeholder-derived perspectives (i.e., planner, owner, designer, builder, implementer and worker) (Zachman, 1987). The resulting framework, typically depicted as a grid as shown in Figure 1, provides an overall view of the enterprise that is extremely flexible but provides little guidance on how to elicit the necessary information to populate the schema.

The lack of systematic procedures to guide enterprise architects in developing an EA is not unique to the Zachman Framework. For example, the 780 pages of The Open Group Architectural Framework (TOGAF) core document poses a similar problem for the user looking for answers about structured procedures for the enterprise architect to elicit and analyse an enterprise’s mission, goals and objectives (Open Group, 2009). This absence creates a significant barrier to the application of the processes and methods, forestalling the use of these powerful EA concepts outside arenas similar to the original adopting communities. This barrier, in turn, could deprive an institution of the insights that come from viewing IS/IT assets in the context of items in a portfolio.

## 2.2 The Vision-Mission-Objectives-Strategy-Tactics Approach

EA depends on having an enterprise’s vision, mission and business strategy in hand as the beginning of integrating, aligning and governing it’s IT infrastructure with its business architecture using an EAF (Minoli, 2008). The Vision-Mission-Objectives-Strategy-Tactics (VMOST) approach created by Sondhi (Sondhi, 1999) is used by the business community to understand and improve strategic comprehension within commercial enterprises. Sondhi’s work is built for the needs of the business community and enables those in management to assess institutional situations so as to rigorously define and explore options in complex situations. While providing a hierarchy of considerations – ranging from tactics, classed as day to day, to strategy, comprising major objectives – this tool is only a scaffold for understanding the layout of an enterprise (Sondhi, 1999).

The VMOST approach, created for strategic assessment, was adapted by Bleistein to a question-based format, and is shown in Figure 2. This adaptation was then combined with specific tools (Bleistein et al., 2005; Bleistein et al., 2006) for use within the information systems, technical management, and decision-making realms. While valuable, this work was done with static material, published by the entity being studied, and therefore is restricted to extant and available material. The study under discussion, however, interacts with a live enterprise, accepting the complications that come from study of a working institution and operational staffers.

The VMOST questions built for these needs are taken for this study as a foundation, a tested and workable basis for a series of closed interviews, rather than starting from the beginning and risking

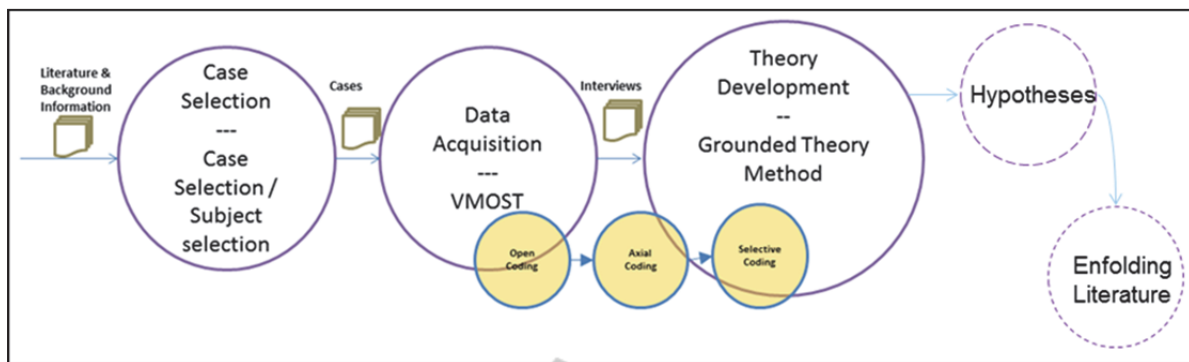


Figure 3: Elicitation and Analysis Methodology, set within the Case Study approach and employing GTM.

omission or oversight. In contrast to the earlier work the questions are employed as become a direct elicitation tool, rather than an organizational structure for existing textual materials.

### 2.3 Grounded Theory Method

The conduct of this study called for an analytic method that could provide sensemaking (Weick et al., 2005) utility of qualitative data. The Grounded Theory Method (GTM) is a technique created to allow creation and discovery of theory directly from qualitative data analysis (Strauss and Corbin, 1998). The method, authored as a joint effort by sociologists Glaser and Strauss, employs multiple stages of data coding to enable full comprehension of information (Strauss and Corbin, 1998). GTM provides a rigorous method for analysis of semi-structured, conversation-derived data, allowing for significant concepts to be discovered and theory to be developed and evolved from a variety of sources. This method is uniquely suited to working with the broad variety of data-types and inputs accumulated and solicited in the process of working across a broad spectrum of disciplines, objectives, and environments typical of a modern multiple role enterprise. By allowing for this data to be processed and analysed, a fuller and more comprehensive conception of the enterprise and conformance to its strategic goals is likely to result (Strauss and Corbin, 1998).

GTM has been employed previously in a variety of software engineering contexts. For example, GTM has been utilized to examine requirements as a means to develop UML class diagrams (Chakraborty and Dehlinger, 2009), to provide sensemaking utility in analysing non-functional requirements with the goal of developing non-functional goal trees (Chakraborty et al., 2012) and to understand the software maintenance practices of small software

development organizations (Hasan et al., 2011). The work presented here differs in that it utilizes GTM as a sensemaking (Weick et al., 2005) procedure specifically in the analysis of qualitative data resulting from the elicitation of EA mission, goals and objectives with the target being the initial EA artefacts needed in the Zachman Framework.

## 3 RESEARCH METHODOLOGY

This section elaborates on the configuration of the case study conducted for investigation of these concepts, beginning with the selection of the enterprise to be studied, as this was the primary driver for the research process. The case study documented here is informed by the work of Eisenhardt (Eisenhardt, 1989) on design and theory creation and Yin (Yin, 2003); (Yin, 2009) on the design and conduct of the study itself. Their foundational scholarship addresses a variety of concerns and considerations surrounding the specificity and reproducibility of case study acquired data, and allows for the application of these methods across a broad range of disciplines and areas of study, so long as known limitations are acknowledged.

The results of this approach have the benefit of providing actual usage feedback, based in concrete examples and become illustrative to other interested practitioners and scholars. Yin's work also posits that a case study can cope with a technically distinctive and intricate situation in which there will be more variables of interest than data points, and provide one result even while relying on multiple evidence sources. It also provides overall guidance on how to engage in and discuss a case study, including addressing research design, and planning, methodological questions, and overall rigor.

The approach used in this work, shown in Figure

3, to apply and evaluate our proposed lightweight EA elicitation technique utilizes Yin's case study approach (Yin, 2003); (Yin, 2009) and the GTM coding steps (Strauss and Corbin, 1998). Each of the steps of our research methodology is discussed in the following subsections.

### 3.1 Selecting the Case

The case study approach begins with a definition of the entities and population under consideration for the study, so that the appropriate controls, scoping and eventual limitations are apparent and identified. This selection defines the overall context and therefore, the generalizations from and applicability of the overall results and any theory based on the data.

Eisenhardt's synthesis of the various considerations in executing of a case study emphasizes the centrality of selecting an appropriate group for study. This definition is a central factor in reducing the opportunities for "extraneous variations" and allows for generalization of limits (Eisenhardt, 1989). Within that model, two rounds of population choice would be necessary. The first would be driven by the theoretical objectives, the second by statistical and coverage considerations.

#### 3.1.1 Selecting the Enterprise

After identification of the chief question(s) for the research and adoption of the case study approach, the next step, according to Yin (Yin, 2009), is the identification of and engagement with an enterprise. Concerns at this point in the sequence included willingness to participate, toleration of the presence of outsiders in the form of the research staff, and permissibility of using data. The latter, with commercial enterprises, sometimes limits the later publication of results with full examples.

In this instance, a representative of the staff of a U. S. public University's library, during an unrelated discussion, expressed an interest during the initial planning stages for this study. The use of an institution of this sort for this research afforded numerous advantages, chief among them the core of the staff, which numbered in excess of 50, are all generally accustomed to research and researchers. Local conditions also included a complex set of committees for internal management, a diverse set of roles and functions, responsibilities spanning everything from the curricular to legally mandated records retention, frequently including off-hours and off-site expectations.

The local information systems environment was also of significant complexity, involving multiple public and internal web presences and mechanisms, a complex set of standards for data interchange, local support mandates for multiple sets of systems, and stewardship responsibility for the licensing of a variety of digital and physical data sources. Investigating an enterprise with an IS asset portfolio but limited access to specialized staff, the research team was presented with a set of circumstances that is not unusual for an academic sector entity, including the absence of the profit/loss metric, which offered an opportunity to distinguish this work from various prior studies (Bleistein et al., 2005); (Bleistein et al., 2006).

The diversity of both the stakeholder population, including a primary user community of 23,000, and the varied objectives and needs they present, as well as relationship to external and parent entities, combined to make this a rich environment for application and evaluation of our approach. These connections included involvement in the collective university and library system created by the state government, plus interaction with the larger academic library community. The relative ease of scheduling and access, and willingness of the staff to participate, also proved a significant asset.

Overall, the library is comparable to a large number of peer institutions, and shares a profile generally similar to even more entities. It exists as an IS "heavy" institution, confronted with an evolving spectrum of social media systems and choices, and is constrained – compared with the original enterprises employing EA – by limited staffing and technology expertise. It also has an evolving mission and, like any enterprise, a need to budget both time and resources.

#### 3.1.2 Choosing Participants

With a subject enterprise for our case study evaluation identified and willing to participate, thenext consideration in the case study approach is to select which staff would be requested to participate. In order to cast as wide a net as possible, the second round of selection included consideration of the library as a system and the multiple roles and functions it and the staff performed.

This second stage established which staff within the enterprise under consideration would be interviewed as a part of the data collection process by starting with an existing organization chart and staff directory of the library. To maximize coverage and cast as wide a net as possible, participation by as broad swath of the staff was targeted; ultimately

Table 1: Example data subset, in Grounded Theory Method three-stage coding.

Ex.#	Interview Excerpt (Interview #) Quote	Generated Open code(s) underlined, with note(s)	Axial Code(s)
1	research center for students, faculty (I-1) ...where does the library want to end up? Oh, I think as being a research center for both students and faculty. Interviewee: The place where they turn for their research needs.	1. <u>research center</u> – idea that enterprise is key to investigations 2. <u>Students, Faculty</u> – differentiation between customer types	<ul style="list-style-type: none"> <li>• Larger goal</li> <li>• Stakeholders</li> </ul>
2	expectation that search be suitable easy straightforward as Google (I-5) but they've sort of come up with this expectation that everything that they search for ought to be as suitable or as easy...and straightforward as Google is, which we would like to see as well but it's a whole different model.	1. <u>User expectation</u> – what is desired 2. <u>Scoring</u> – as a target, this should be measured by surveys, etc.	<ul style="list-style-type: none"> <li>• Assessment/Metrics</li> </ul>
3	tailor to what is being taught (I-21) Or it's not just up to us. But we try to tailor our collection to what's being taught at Towson and it does have a curricular slant to it.	1. <u>Curriculum support</u> – course support often identified as key aspect of functions/goals	<ul style="list-style-type: none"> <li>• Provided service (specifically curricular)</li> </ul>

ultimately over 40% of the full-time/professional staff would become participants. Additionally, involvement by staffers representing the operating groups of the four major functional divisions was achieved, allowing consideration across multiple roles, viewpoints and sets of responsibilities.

### 3.2 Instruments and Protocols

To avoid unnecessary variables and to ensure consistent behaviours, the instruments and protocols for a case study must be defined. In this instance, that required a standardized set of questions as an elicitation instrument, and a well-specified interview strategy. These in turn, are fitted within the overall case study construction, as shown in Figure 3.

The Vision-Mission-Objectives-Strategy-Tactics (VMOST) method, adapted as questions in (Bleistein et al., 2005) from (Sondhi, 1999), was the initial instrument used for this study; this instrument was later extended as a result of the initial round of interviews based on the initial data. The original VMOST questions (shown in Figure 2), designed as a generic mechanism for developing an enterprise architecture (EA), are phrased in such a way as to make them meaningful outside the specialist realms of business strategy or software engineering. The VMOST questions are also not tailored to a specific industry and have been used previously in both business strategy (Sondhi, 1999) and information technology scenarios (Bleistein et al., 2005), giving a reasonable confidence to their reuse in this new application.

### 3.3 Fieldwork

After the institution, personnel and study instruments had been selected using the case study approach (Eisenhardt, 1989), the next step called for by the methodology is the fieldwork. This is the actual execution of the designed study upon the selected subjects and with the chosen instruments. In this work, this was the actual conduct of the interviews. This was followed by transcription of the collected recordings and some post processing of the transcripts. The processed transcripts were then united with the notes taken during the interviews.

It became apparent as the fieldwork application and evaluation continued that the one-on-one interview format exercised the questions in such a way as to capture nuanced reaction. The combination of notes and recordings provided the required mechanism, one that permitted interaction and feedback. This approach also appeared to reassure the participants on any concerns they may have had concerning the use of the resulting data and the objectives of the experiment, a critical consideration with human subjects. Multiple subjects were curious about both the goals and the ultimate outcomes of the experiment, and the in-person encounters allowed a much more fluid discussion. The interview format proved that it could provide for the need to acquire both the responses to and about the questions.

The interviews conducted using the VMOST questions generated a set of seven and a half hours of recordings from the 23 participants that form a broad base of responses to the VMOST questions, made broader still by allowing participants to



Figure 4: Sample of data presentation artefact, after GTM applied to data.

request clarification of the question and otherwise comment on the phrasing of and impression made by the question. These recordings, more than 100 pages once transcribed, are combined with the concurrent notes for each interview for asynchronous analysis of the responses by a second investigator, which the literature (Eisenhardt, 1989) posits as a step likely to increase complementary insight. Such additional insights lead to richer data and identification of several additional insights. The additional consideration of the information also, generally, leads to greater confidence in the analysis, as differing perception adds to the empirical grounding of the hypotheses derived. When this method was joined to a qualitative data collection form, and applied in a recorded close interview format with open-ended responses, a multi-format data collection strategy was created.

The resulting transcripts required some additional manual processing before further use. The transcripts were produced by an external, independent transcribing firm to ensure accuracy and clarity, and then are redacted to remove certain types of identifying information, including names, for protection of the identity of participants. Extraneous capture, including occasional anomalies and interruptions, acknowledgement of interview parameters, and some conversational pauses and digressions were also removed.

By going beyond a routine pigeonholing of answers-to-questions, it is possible to have a holistic interpretation of a full interview. This is in accordance with the Mintzberg synergy concept (Mintzberg, 1979), discussed in (Eisenhardt, 1989), that says that theory can be constructed from “rich

description”. It also led to greater notice of subtle shadings in phrasing and vocabulary and of differences arising from distinct specialties and responsibilities amongst interview participants. It also distinguished areas where “backtracking” to answer prior questions by respondents and other, conversational interaction “moments” occurred.

### 3.4 Data Analysis

Following the data collection and initial processing in the fieldwork stage, the case study sequence moves into the analysis portion of the investigation. This entails attempting to identify trends, repeated themes, and other constructs and concepts in order to understand the overall nature of and information contained in the data.

The interview sessions and subsequent processing and editing yielded a set of transcripts based on the primary interviews of staff. Grounded Theory Method (GTM) was used to analyse the qualitative data (Strauss and Corbin, 1998). This entailed using the three phase coding technique (open, axial and selective coding).

A set of sample intermediate data is shown in Table 1, with associated codes and demonstrates the stages of the GTM coding sequence used in this research as a part of the sensemaking process of analysing the data elicited from conducted interviews using VMOST questions. The “Interview excerpt” (shown in the second column of Table 1) cells contain key words or phrases, with fuller context beneath, that are used to inspire the initial, “open” codes that identify concepts, vocabulary and ideas for consideration

(Strauss and Corbin, 1998). The open codes (shown in the third column of Table 1) are words and phrases driving understanding and comprehension of the overall enterprise, generated from both the phrases and contextualization of the interviews (Strauss and Corbin, 1998). With the given examples, the open codes are annotated based on impression and initial reflection(s) of the coder. The open codes are then grouped and ordered with axial codes (shown in the fourth column of Table 1), which typically emerge as the set of open codes are considered and studied. Selective coding entails choosing one of the axial codes as the central or primary idea (not shown in figure), which is what is perceived to be the touchstone to which the others can be related for overall consideration of the situation (Strauss and Corbin, 1998).

### 3.5 Shaping Hypotheses

In both a theory development case study and an application of the GTM, one objective is to discover theories that are grounded in the data. In this research, the initial review of the coded data has led to several preliminary conclusions. The initial review of the data demonstrated remarkable coverage of the target EA framework (in our case the Zachman Framework (Zachman, 1987)), indicating a general validity to the initial concepts behind the study (Rosasco and Dehlinger, 2011a). Additionally, after the first set of interviews was conducted an opportunity for additional data collection presented itself. The organization under consideration had been conducting an internal strategy capture exercise in response to an institution-wide effort, and the concluding document was finished and made available. This allowed a comparison to be made between the library's internal efforts and the research results (Rosasco and Dehlinger, 2011b).

The results of this comparison indicated an improvement in areas of coverage for the VMOST methodology versus the more conventional exercise conducted by the library. This sequence of results also tracked with the overlap between collection and analysis, observed by Eisenhardt in several studies (Eisenhardt, 1989), and permitted some perspective on the overall responses and increased the awareness of the investigative staff to the additional contexts associated with a number of specialist terms and constructs.

After these two rounds of analysis with the initial data, a full application of the GTM was conducted once the complete data was available. The results of

the coding and review resulted in a number of artefacts and perceptions. A sample of one of these artefacts is shown in Figure 4, demonstrating the identification of groups and concepts. Code 2 ("students, faculty") from the first row in Table 1, referring to the different types of customer is, for example, reflected in the classifications being presented as part of the larger group "Stakeholders". Similarly, row 2's code 2, "scoring" finds a home – along with a wide variety of other metrics and tracking related concepts – under "Assessment/Metrics". Several of these artefacts were delivered to the institution's liaison to the project team, who responded positively to the overall understanding and modelling they represented.

As expected, several syntax and phrasing issues in the VMOST queries were identified, along with several general considerations for application of this process. Enhancements and modifications to the original VMOST questions are currently being considered for adaptation specifically in an EA context. The coverage of the Zachman framework, while generally good for the relatively low time and effort impact on the subjects, could be improved by relatively brief additions to the VMOST questions. These additional VMOST questions were drafted, and further interview sessions were conducted with a subset of the original members of the staff of the enterprise. This additional result set shows promise for even higher coverage levels of the framework and overall interest as a future departure point for deeper investigation.

### 3.6 Enfolding Literature

The Eisenhardt strategy for case study execution allows for consideration of "enfolding literature" – data text and artefacts that inform the understanding of the research team (Eisenhardt, 1989). In a commercial, governmental or other structured entity, these will often include various external and internal documents. This sort of input can include organizational charts, process diagrams and asset inventories, for example, as well as regulatory and oversight data.

The enterprise in this study participates in several larger institutional constructs and possesses a well-defined internal structure. Consideration of various governing, strategic and planning materials related to these larger and complex entities may yet prove relevant as feedstock for theory and context capture. This investigation and research, as a part of the longer-term project, is still underway. Successful



evaluation and identification of these items, if any, may prove useful for other entities, in terms of determining either inputs into an EA process or overall consideration of questions of operational control, scope, stakeholder expectations and general accountability.

## 4 DISCUSSION

The application of the VMOST questions (Sondhi, 1999) as a mechanism for EA elicitation and the utilization of the Grounded Theory Method (GTM) (Strauss and Corbin, 1998) for sensemaking of the qualitative data shows promise for enabling alignment of the IS/IT portfolio with strategic institutional goals. Specifically, the application of the lightweight EA elicitation mechanism proposed in this work has garnered a remarkable body of data at a cost to the institution that, so far, has proven to be an easily acceptable additional burden. The combination of tools employed (i.e., VMOST (Sondhi, 1999) and the GTM (Strauss and Corbin, 1998)) has been within acceptable scope of effort, and has created what appears to be a high level of overall comprehension regarding institutional objectives, context and goals. Similarly, the case study approach has proved an effective structure for handling numerous variables. This can be said with some confidence since, when using the Zachman Framework (Figure 1) as a measure, execution of the initial interview round alone produced inputs for all but one of the columns of the grid, when the responses to the two additional questions were used, the final column (“When”) had input data as well. While informal, the agreement by enterprise staff that the diagrammatic artefacts (Figure 4) derived from the GTM-coded data do correctly present a working understanding of the institution also affords an attestation of the validity of the results.

However, as with any experiential investigation, with a case study it is necessary to consider to the limitations of the data and process. As this particular study generated qualitative data, and in using the GTM applied a qualitative analytic method, there are potential risks of subjectivity present. There are also the customary challenges of results replication where working institutions are concerned. For example, having “been studied,” the researcher is unlikely to get the same response to the same question, if only because the subject has had an opportunity to consider their initial response. Additionally, as the institution was not static during the study routine evolutions and changes, including

changes to the roles of some of those interviewed, limits the chances of exact duplication later.

Given the origination of the project as a reaction to possible barriers to adoption of EA, it is worth noting that the particular analytic method applied could itself be a hurdle for an enterprise embracing the precise approach discussed in this work to date. While it is possible to the GTM could be applied by this specific enterprise without outside personnel, given the background and levels of education and expertise represented, it could prove impractical for some possible users. Further investigation and evaluation of other approaches and options to achieve similar ends are certainly merited.

The lightweight EA elicitation approach proposed and evaluated here, with these caveats, could be reused by another, similarly professionally-staffed institution. No limitations in this study have surfaced that would prohibit a comparable academic, non-profit, or governmental institution from successfully using as a guide the approach demonstrated by this case study. This study helps open the way for such an institution to apply EA and, thus, improve its IS/IT management. In providing a pattern, this work is a contribution to the IS artefacts available to practitioners.

## 5 CONCLUSIONS

The strategy of applying lightweight guidance for the initial data elicitation and analysis of the artefacts necessary for an enterprise architecture (EA) plan shows promise. With a locally-informed EA plan in hand, there appears to be a high likelihood of delivering the expected benefits of this area of practice including clear objectives and good requirements context information. The use of the case study method has provided useful results for the exercise of the approaches being examined and has successfully documented the use of EA outside of the large institution and technical-specialist contexts.

In terms of the overall project questions, lightweight elicitation techniques have exceeded the initial expectations for collecting data to populate an EAF, as exemplified by the easily identifiable information contained in the interview results even before processing. Additionally, the lightweight techniques have succeeded in fulfilling the need for vision and mission capture, as demonstrated by the richness of the resulting summary artefacts. The suitability of using this data in conjunction with other techniques, including the Business Motivation Model (BMM) (Object Management Group, 2010)

and Archimate (Open Group, 2012) should also be investigated as alternative mechanisms. Future work for this project will include soliciting additional feedback on those constructed artefacts and assembly of the various stages into a fuller presentation of the process, capabilities and operational considerations for the application of this lightweight methodology. Further investigation of the generalizations regarding scalability of the specific suite of techniques and the overall process will be undertaken as a part of the overall project.

## ACKNOWLEDGEMENTS

This work was partially supported by Towson University. The authors would like to thank the staff and administration of Towson University's Cook Library for their help and ongoing support and the reviewers for their comments and insights. This research was conducted under Towson University's Institutional Review Board for the Protection of Human Subjects exemption number 11-0X14.

## REFERENCES

- Bleistein, S. J., Cox, K. & Verner, J., 2005. Strategic alignment in requirements analysis for organizational IT. In *Proceedings of the 2005 ACM Symposium on Applied Computing - SAC '05*. New York, New York, USA: ACM Press, p. 1300.
- Bleistein, S., Cox, K. & Verner, J., 2006. Validating strategic alignment of organizational IT requirements using goal modeling and problem diagrams. *Journal of Systems and Software*, 79(3), pp.362–378.
- Chakraborty, S. and Dehlinger, J., 2009. Applying the Grounded Theory Method to Derive Enterprise System Requirements. *2009 10th ACIS International Conference on Software Engineering, Artificial Intelligences, Networking and Parallel/Distributed Computing*, pp.333–338.
- Chakraborty, S., Rosenkranz, C., and Dehlinger, J. 2012. "A Grounded Theoretical and Linguistic Analysis Approach for Non-Functional Requirements Analysis." *Proceedings of the International Conference on Information Systems ICIS 2012*.
- Eisenhardt, M., 1989. Building Theories from Case Study Research. *Academy of Management Review*, 14(4), pp.532–550.
- Gianni, D., Lindman, N., Fuchs, J., & Suzic, R. (2012). Introducing the European Space Agency architectural framework for space-based systems of systems engineering. In *Complex Systems Design & Management* (pp. 335-346). Springer: Berlin.
- Hasan, R., Chakraborty, S. & Dehlinger, J., 2011. Examining Software Maintenance Processes in Small Organizations: Findings from a Case Study. In R. Y. Lee, ed. *Software Engineering and Research (SERA)*, Springer, pp. 129–143.
- Jarvis, R. *Enterprise Architecture: Understanding the Bigger Picture – A Best Practice Guide for Decision Makers in IT*, The UK National Computing Centre, Manchester, UK.
- Lankhorst, M., 2005. *Enterprise Architecture at Work: Modeling Communications and Analysis*, Springer-Verlag, Berlin, Germany.
- Luftman, J., Lewis, P. R., and Oldach, S. H., 1993. "Transforming the Enterprise: The Alignment of Business and Information Technology Strategies", In *IBM Systems Journal*, 32(1):198-221.
- Minoli, D., 2008. *Enterprise Architecture A to Z* (1st ed.), Boca Raton, FL: Auerbach/CRC Press.
- Mintzberg, H., 1979. An emerging strategy of "direct" research. *Administrative Science Quarterly*, 24, pp. 580-589.
- Object Management Group, 2010. *Business Motivation Model (BMM) Version 1.1*. At: <http://www.omg.org/spec/BMM/1.1/>
- The Open Group, 2012. *Archimate 2.1 Specification*. At: <http://pubs.opengroup.org/architecture/archimate2-doc/toc.html>
- The Open Group Architecture Forum - Forde, C., 2009. *The Open Group Architecture Framework (TOGAF) 9th ed.*, Reading, Berkshire, UK.
- Rosasco, N. and Dehlinger, J., 2011. "Eliciting Business Architecture Information in Enterprise Architecture Frameworks Using VMOST." *1<sup>st</sup> ACIS International Conference on Computers, Networks, Systems and Industrial Engineering*, pp. 474–478.
- Rosasco, N. and Dehlinger, J., 2011. "Business Architecture Elicitation for Enterprise Architecture: VMOST versus Conventional Strategy Capture." *Ninth International Conference on Software Engineering Research, Management and Applications*, pp. 153-157.
- Sondhi, R.K., 1999. *Total Strategy*, Airworthy Publications International.
- Strauss A. and Corbin J., 1998. *Grounded Theory Methodology: An Overview*, Sage Publications, Thousand Oaks, CA.
- Weick, K. E., Sutcliffe, K. M. & Obstfeld, D., 2013. Organization Science and the Process of Sensemaking. *Organization Science*, 16(4), pp.409–421.
- Yin, R. K., 2003. *Applications of Case Study Research* (2nd ed., Vol. 34). Thousand Oaks, CA: SAGE Publications.
- Yin, R. K., 2009. *Case Study Research Design and Methods* (4th ed., Vol. 5). Thousand Oaks, CA: SAGE Publications.
- Zachman, J. A., 1987. "A framework for information systems architecture," In *IBM Systems Journal*, vol. 26, pp. 276-292.