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Communications of the Association for Information Systems

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A Competency Model for the Information Technology Workforce: Implications for Training and Selection

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Abstract:

With a new wave of demand for information technology (IT) staff, it is time for the IT community to discover what competencies are needed for IT workers in the new millennium. Most organizations have outsourced their IT projects to low-cost centers in developing countries, and this has changed expectations about local workers—organizations need, and expect, to employ highly skilled IT professionals. This article draws on the competency model to explore what competencies are needed to successfully equip the IT workforce. This research uses the example of IT architects to illustrate how to use the competency model to identify important sets of competencies. We interview professional architects, analyze the content of the discussions and derive a list of fourteen competency attributes important to IT architects. Some competencies are easy to develop, others are difficult to change, and this has implications for university education and industry hiring. This article also discusses the general use of competency models for IT workforce training and selection.

Keywords: IT workforce, IT architects, competency models, the Iceberg Model of Competencies, skills, knowledge, self-concept, traits, motive

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I. INTRODUCTION

Information systems (IS) researchers have always been interested in the issues and problems faced by the information technology (IT) workforce. What are the pressing IT workforce issues in 2010? We believe that a global resurgence in demand for IT workers makes it crucial for the IT community to discover what competencies are needed for IT workers in the new millennium. Indeed, this question is important at any time because IT competencies are vital to be able to transform IT investment into business opportunity [Lee and Lee, 2006]. Industries and government bodies have started to respond to the demand for the next wave of IT workers by analyzing job characteristics and generating lists of important IT skills. For instance, the Skills Framework for the Information Age Foundation¹ (the Foundation) in the UK is a collaborative effort between e-skills UK, the British Computer Society and the Institute for the Management of Information Systems. The Foundation offers workshops to employers of IT professionals and helps them to establish frameworks for assessing their employees' professional skills. The Australian Computer Society² has also recently prepared a framework for the core body of knowledge and skills for IT professionals.

In the U.S., the dominant framework is the Occupational Information Network (O*Net). O*Net is a comprehensive database for organizing and describing job characteristics and worker attributes. It provides broad (but shallow) information for 974 occupations. O*Net uses four types of descriptors: worker characteristics (e.g., work styles), worker requirements (e.g., skills and education), experience requirements (e.g., licensing and training) and occupational requirements (e.g., organizational context). Organizations and human resources (HR) professionals use O*Net to develop job descriptions, and individuals can use O*Net to identify jobs fitting their skills and interests.

O*Net is an example of a job analysis framework. Job analysis frameworks primarily look at "what" is accomplished and they tend to be work- and task-oriented [Shippmann et al., 2000]. They emphasize IT *knowledge* and *skills* to achieve work objectives. However, management and HR researchers also believe that *traits* and *motivations* are just as influential in competently and successfully performing in a position [Boyatzis, 1982; Fulmer and Conger, 2004; Gangani et al., 2004]. Collectively, these characteristics are called *competencies*. Because job analysis frameworks fail to give a complete picture of competencies, *competency models* are generally applied. Competency models are worker-focused, and they look at "how" work objectives are met. This article applies competency theories to the IT workforce. Our work will help the IT community equip students and IT workers with relevant competencies, and provide HR professionals with guidelines for recruiting, training, selecting and placing their IT staff.

The article is organized as follows: Section II reviews the literature and describes the Iceberg Model of Competencies, on which our analysis is based. Sections III and IV use the example of the IT architect to illustrate how competency models can guide the analysis of IT workforce competencies. Section V analyzes issues related to endowing the future IT workforce with relevant skills and the implications on IT training and selection. The last section concludes the article.

II. WORKFORCE COMPETENCIES AND COMPETENCY MODELS

Competencies are "underlying characteristic[s] of an individual that [are] causally related to criterion-referenced effective and/or superior performance in a job or situation" [Spencer and Spencer, 1993, p. 9]. Management researchers originated this concept [e.g., Cardya and Selvarajanb, 2006; Mansfield, 1996]. Mirabile [1997] defined competencies as knowledge, skills, abilities or characteristics associated with high performance. Rothwell [2002] similarly defined core competencies as an individual's knowledge, skills and abilities to accomplish critical work tasks. Fulmer and Conger [2004] and Gangani et al. [2004] revealed that individuals' motivations and work perceptions also influence their ability to competently and successfully perform in a position. Recent work by Sheehan et al. [2009] highlighted the significance of emotional competencies. Competencies have also been found to be context-specific, which implies that some competencies are more important for certain jobs than others [Boyatzis, 1982; Delamare Le Deist and Winterton, 2005].

¹ See: <http://www.sfia.org.uk/>

² See: <http://www.acs.org.au/index.cfm?action=show&conID=cbok>

Competency models identify the functional or behavioral competencies that are required to operate in a job [Fogg, 1999]. They are derived from analyses that differentiate high-performers from average- and low-performers [Mirabile, 1997]. In the models, competencies are often organized into a hierarchy or grouped into clusters with descriptors. The actual number and groups of competencies in a model depends upon the nature and complexity of jobs and the culture and values of the organization in which the work takes place. Generally, the competency model for a single role would be likely to have eight to sixteen competencies [Shippman et al., 2000]. Competency models provide a holistic approach for examining the competencies individuals need to perform a given job [Rodriguez et al., 2002]. Contrary to traditional job analysis, competency modeling ties the derivation of job specifications to the organization's strategy and to other non-strategic job requirements. These are then used to generate a "common language" in the form of a set of human attributes or individual competencies. This information can then be used in workforce hiring, training and assessment. It may even serve as a blueprint for outstanding performance. In the extant HR research, competency models are considered more reliable predictors of performance than academic aptitude and knowledge tests [McClelland, 1973].

Many professional sectors, such as health care [Garman et al., 2006], develop their own competency models. Obviously, these models are not easily applied to IT. However, there are several generic models relevant to the IT workforce, including the *Hudson 5+1 Competence Model*, *Boyatzis' General Model of Competencies* and the *Iceberg Model of Competencies*.

A European consulting firm, Hudson, developed the Hudson 5+1 Competency Model. The model has five competency clusters: information management, task management, people management, interpersonal management and personal management. There is a sixth cluster for technical or organization-specific knowledge and competencies. The Boyatzis model has six clusters: goal and action management, leadership, human resource management, directing subordinates, focusing on others and specialized knowledge. Boyatzis [1982] conducted a series of studies to examine the significance of social roles, knowledge and skills in each cluster. The Hudson and Boyatzis models do not refer to any particular job role, but they do emphasize management and social interaction skills. In essence, the clusters in their models, and the sets of skills they discovered, are generally used to prepare a person to be a competent manager.

In contrast, the Iceberg Model of Competencies is not oriented towards management level jobs. Spencer and Spencer [1993] adapted Boyatzis' set of characteristics [1982]³ to derive five types of competency characteristics: motives, traits, self-concept, knowledge and skills. *Motives* are psychological features that arouse a person to action toward a desired goal. These internal drives lead to the need to seek achievement, power and affiliation. *Traits* are an individual's dispositional characteristics, which lead to consistent responses to situations or information. *Self-concept* is how an individual positions him/herself. It is related to his/her values and self-concept. *Knowledge* is the body of facts, principles, practices and theories that form the basis for a given discipline. It is the acquired information in specific work domains. Lastly, *skills* are the application of knowledge and know-how to perform a certain physical or mental task. Knowledge and skills are fundamentally different. For instance, IS graduates from an enterprise architecture course would demonstrate that they possessed analysis skills by conceptualizing a system infrastructure. This requires an underlying knowledge of computer networks and an ability to apply system design principles.

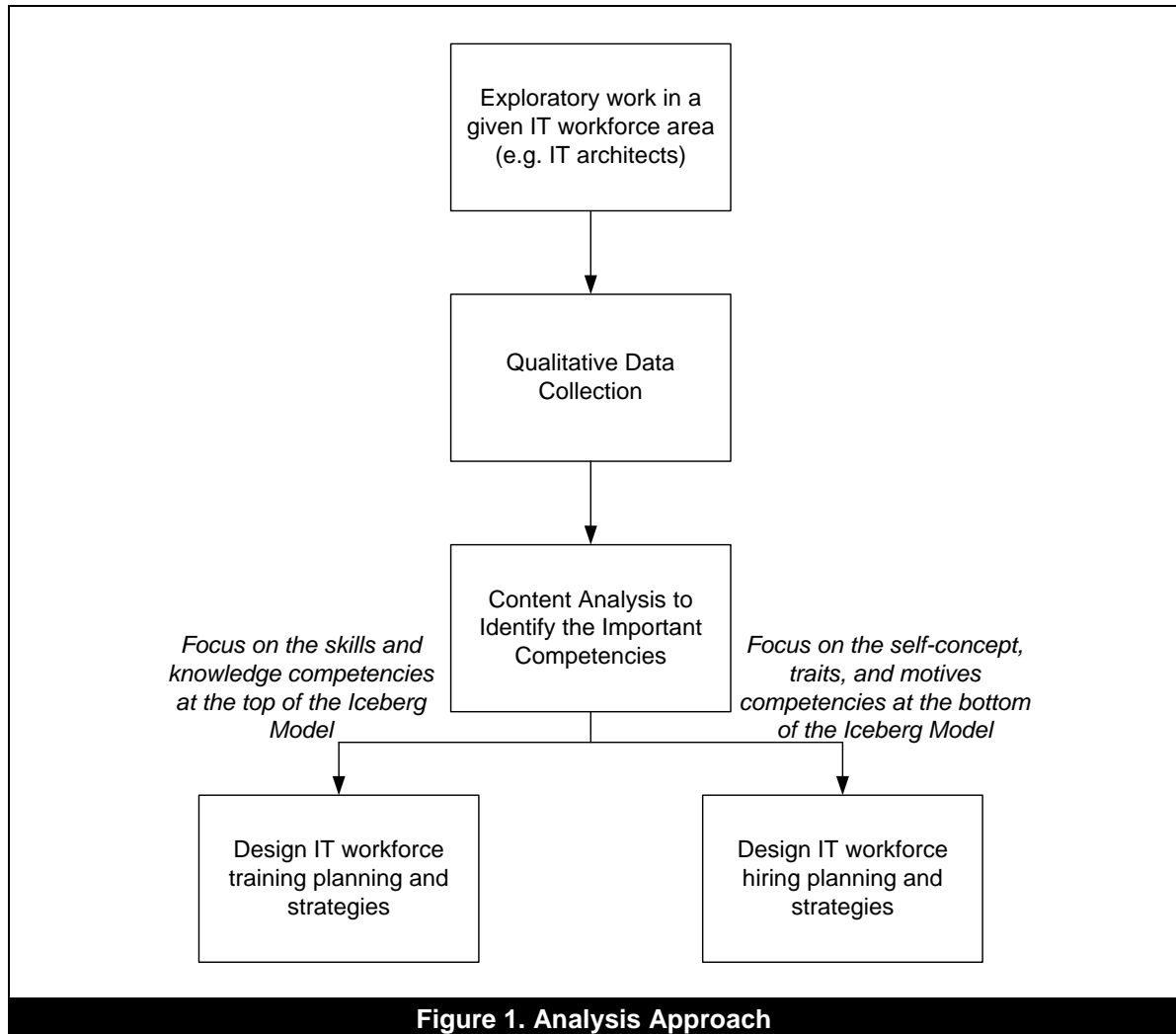
Spencer and Spencer's [1993] Iceberg Model provides us with a better understanding of various competency categories. The authors emphasized that it is often difficult for an organization to know whether an individual possesses these five competencies, and that some characteristics are difficult to acquire by training. Hence, they used the analogy of the iceberg. The characteristics at the bottom of the iceberg are more hidden and more difficult to develop. According to the Iceberg Model, knowledge and skills tend to be visible and relatively surface characteristics of individuals, whereas traits and motives are deeper and more central to personality. Self-concept characteristics fall somewhere in between. Hidden and visible competencies play different roles in the job. Hidden competencies are the behavioral competencies that drive an individual's performance in a job, whereas visible competencies tend to be the technical competencies required by employers [Spencer and Spencer, 1993].

The most common HR practice relating to competency modeling is that employers identify sets of behaviors that distinguish outstanding from adequate performers [Cockerill et al., 1995]. This approach is limited to employers' observations of how their staff accomplishes the work. Yet, employers barely familiar with the job are sometimes employed in competency modeling [Shippmann et al., 2000]. Hence, Lievens et al. [2004, p. 882] questioned the "lack of task information inherent in competency modeling." It is also why Vakola et al. [2007, p. 261] noted that

³ Spencer and Spencer [1993] used self-concept to replace social roles in Boyatzis' model [Boyatzis, 1982]. Self-concept attends to their inner world of ideas, whereas social roles relate to the interactions with the outer world of people.

"[c]ompetency models tend to focus on what managers currently do rather than what is needed to perform effectively in the future." Thus, Vakola et al. [2007] called for competency modeling with a proactive approach.

Using a proactive approach to understand what IT workers currently do, this research adopts the method depicted in Figure 1 for competency analysis. We use IT architects as an example to illustrate how this approach can be applied to provide directions for training and selection. We conduct interviews with high-performers in the domain of IT architecture, and perform a content analysis to arrive at a list of competencies. The Iceberg Model guides us to develop plans for training and selection. Training focuses on the development of competencies at the top of the iceberg, whereas HR selection identifies and evaluates a worker's competencies at the bottom of the iceberg. Section III will outline the methodology, and Section IV will present the list of competencies.



III. METHODOLOGY

Context of Research Problems

This research uses the example of the IT architect to illustrate how the Iceberg Model can guide training and selection. Broadly speaking, the duties of an IT architect are to organize logic for business processes and infrastructure, and integrate and standardize organizational operating models [Boh and Yellin, 2006]. We chose the IT architect for three reasons:

First, organizations have been outsourcing their IT projects to low-cost centers in developing countries since the early 1990s, reducing the demand for lower-level skills in developed countries. With the resurgence in the IT industry, we expect there to be increasing demand for a highly skilled IT workforce in developed economies. IT architects are highly skilled IT workers.

Second, IT architects work across many different areas. Figure 2 is a conceptualization of architecture within the domain of IT. IT architecture provides a general skill set of the architects' discipline, and specialization areas include enterprise architecture, software architecture and security architecture. The complexity of the job matches the expectations of the IT workforce in general. As Niederman et al. [1991, p. 480] have noted, the trend in IT is to handle projects "covering an increasing breadth of technologies [that call] for greater and more specialized skills." Hence, we believe that we will derive richer findings by analyzing the competencies of IT architects, rather than other IT jobs, such as database administrators and computer programmers.

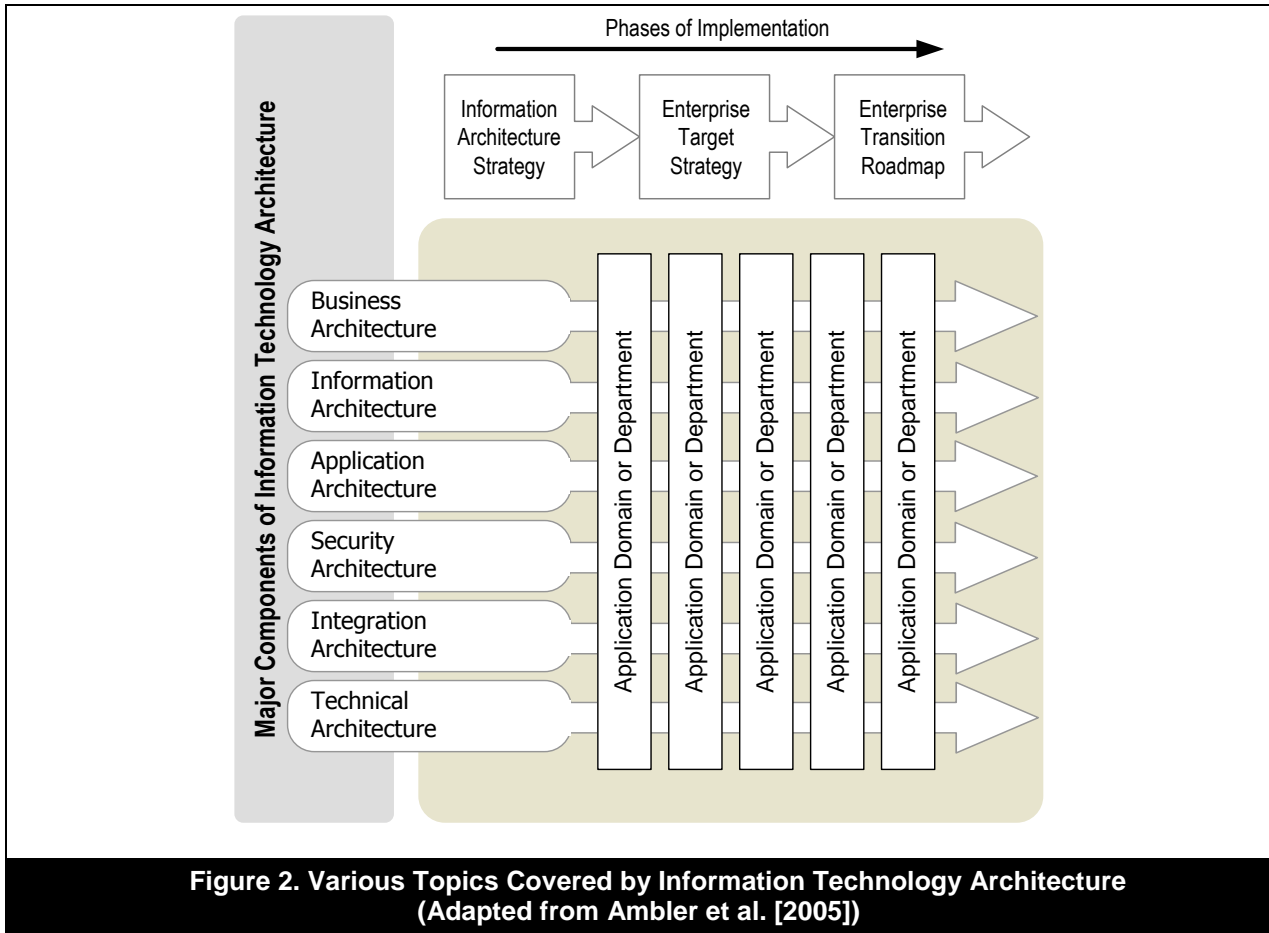


Figure 2. Various Topics Covered by Information Technology Architecture (Adapted from Ambler et al. [2005])

Third, IT architects play a significant role in organizations [McKeen and Smith, 2008]. In 1996, the U.S. Federal Government's Enterprise Architecture created the Clinger-Cohen Act. The Act encourages firms to adopt an integrated technology framework to improve organizational performance by aligning their IT investment and their technology architecture. Smith and McKeen [2006] have predicted that IT management style in the U.S. will shift from anticipatory to architectural (i.e., creating the appropriate enterprise, process and IT frameworks). Other countries, such as Australia, the UK, Canada, the Netherlands and India, are also active in the IT architecture domain [Schekkerman, 2005].

Procedures

The IT architect's job is very specific, so we used qualitative measures to reveal rich and deep details. We used the content analysis method previously described in Insch et al. [1997] and Strauss and Corbin [1990] to guide our data collection and analysis.

Step 1: Prepare and Pre-test a Coding Scheme

The researchers first reviewed the literature on workforce competency theories to define research questions and constructs. The IS literature revealed several broad categories, such as skills, technical knowledge, organization-specific knowledge, abilities, social roles, self-concept, traits and motivation. Our research identified and analyzed the texts related to these categories. We developed a coding scheme to categorize words or phrases, as our unit of analysis. For instance, the phrases "ability to communicate," "ability to describe," "ability to present," and "good communication on all levels" would be placed into the category "communication ability." Two researchers crosschecked the face validity between the definitions of concepts and coding rules. After we generated a coding



scheme, we conducted pre-tests with an academic colleague, two postgraduate students who had knowledge of or work experience in IT architecture, and an IT architect currently working in industry. Two researchers used the coding scheme to analyze the interviews. Any disagreements in the independent ratings were resolved through discussion. The pre-test provided information to purify the coding scheme and to merge overlapping constructs. For example, “communication skills” and “communication ability” were regarded as the same category, and “ability to communicate” was coded as “communication skills.” Semantic validity was ensured by two researchers confirming that terms with similar meanings were categorized in a similar fashion [Weber, 1999].

Step 2: Gather Narratives

A judgment sampling was used in the main data collection. This approach is frequently adopted in qualitative studies [e.g., Armstrong et al., 2007]. The data collection process continued until one additional interview could not bring any further information. By the end, we had interviewed fourteen highly skilled IT architects.

Each interviewee was currently working as an IT architect and had a minimum of five years’ experience in the role. Each had been the lead architect for more than five projects, each project with a budget of over AUD250,000. All had received written commendations from their clients and, in many cases, this praise was backed up with financial bonuses. We carefully selected the interviewees to maximize the range of industries and personal backgrounds included in the sample group. They worked in a variety of organizations ranging from a single-person boutique consultancy to a multi-national international financial organization with over 20,000 employees. Five industries were represented: government, IT services and outsourcing, software product development, distribution, and financial services. The IT architects were aged from thirty-four to sixty-six years, and there were two females. All the interviewees had worked as IT architects in Australia and abroad.

The interviews were semi-structured, held in the interviewees’ usual workplaces, and lasted between forty and ninety-five minutes. The interviewer had a good knowledge of IT architecture and postgraduate qualifications in research methodology. The interviews were all audio-recorded (with interviewee consent) and field notes were made. Care was taken to protect the interviewees’ anonymity. The interviewees discussed open-ended questions, for example, “Thinking of a person you regard as a good IT architect, what makes them good at their job?” Appendix 1 shows the interview protocol.

Step 3: Assess Reliability and Construct Validity

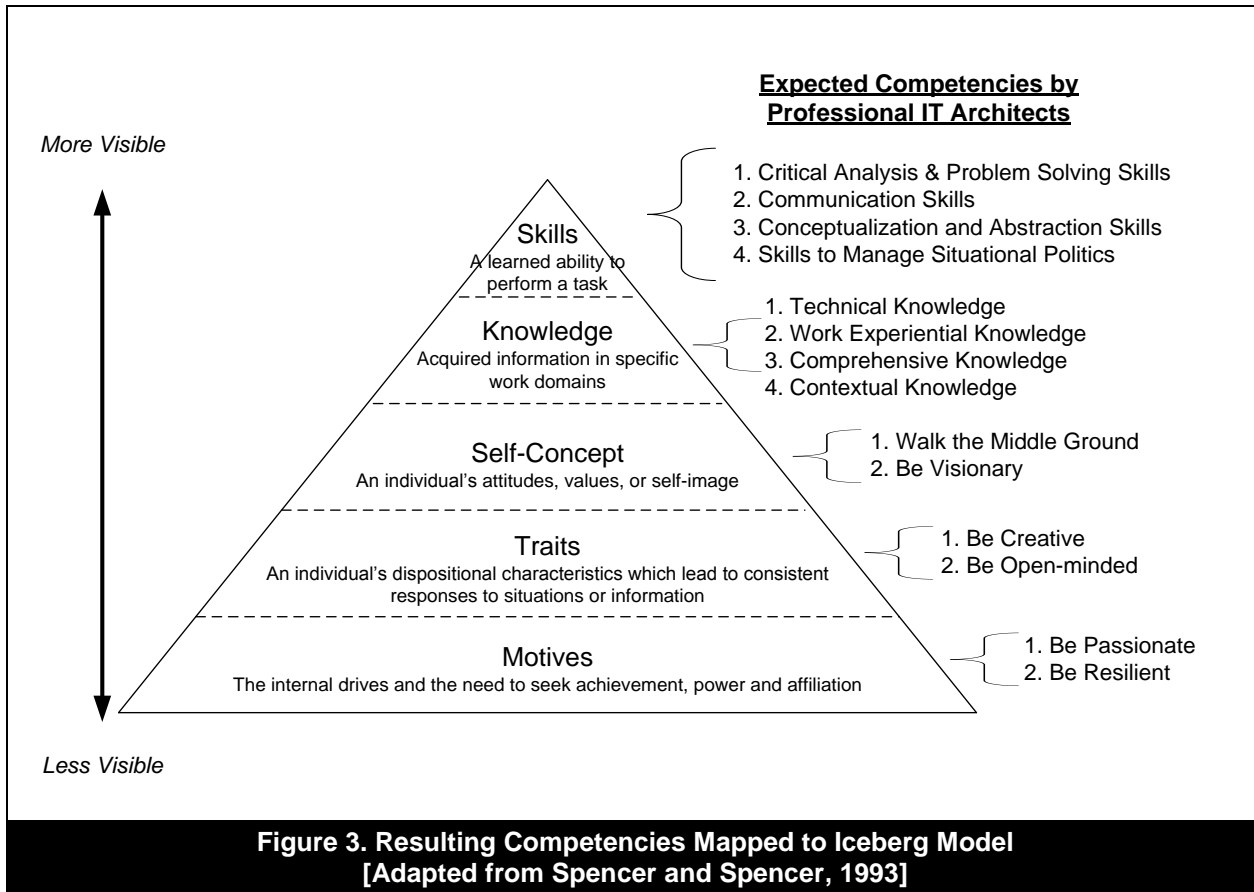
Two researchers independently coded the interview transcripts using NVivo software. We used inter-rater reliability to assess the consistency of classification [Insch et al., 1997]. In the initial coding, the researchers classified some concepts into different constructs. For instance, one researcher considered “manage subordinates’ conflicts” to be an interpersonal skill, whereas the other considered it to be “ability to manage situational politics.” Hence, the coding scheme was refined. This process was reiterated three times until the inter-rater reliability reached 0.90. To ensure instrument stability, the researchers twice re-coded three interview transcripts against the finalized coding scheme [Insch et al., 1997]. The stability score was 0.92.

A third researcher independently analyzed the data to offer a different perspective, to reduce possible researcher bias and to check that no important attributes had been missed. The third researcher brought “a different and possibly more objective eye to the evidence” [Eisenhardt, 1989, p. 538]. This researcher was not given the coding scheme and went through the interview transcripts several times, moving back and forth among the data, the IS literature and the emerging concepts. The three researchers examined the extent to which the categories actually measure what they are intended to measure (convergent validity) and the extent to which the categories are uncorrelated with measures in other categories (discriminant validity). Disagreements were fully discussed until we had a consensus on the coding scheme and data analysis results.

IV. FINDINGS

Interview Results

In this section, we report fourteen competencies as the final set of important IT architects' competencies. Figure 3 presents a summary.



Skills

The following four competencies are key skills that reflect the “know-how” required to work as an IT architect.

(a) Critical Analysis and Problem Solving Skills

To architect a system, IT architects must first be able to break the problem down into its component parts and see inter-relationships and hierarchies of ideas. They have to be able to critically assess issues by drawing on relevant concepts and values. Then, IT architects must be able to come up with appropriate solutions to tackle the problem. These solutions cover both managerial and technical [Perks and Beveridge, 2003].

Critical analysis and problem solving skills refer to the creative application of rules, procedures, techniques or principles to solve a complex problem where there is no single correct answer. All interviewees considered this skill to be important. Two of them pointed out the reasons why this skill was important. For example, one interviewee said, “it’s the relationship between different objects that is very complex,” while another stated that it was crucial for an architect to have “that kind of analytical skill, that ability to identify various alternatives, alternative approaches and analyze the implications of going down one path against another.”

Eight interviewees emphasized that being able to consider alternative solutions was important: “the role demands an ability to identify the potential solutions,” and “when you set your mind to a problem in the abstract, you can often come up with multiple ways of solving it, and, generally speaking, you can look at those alternatives and you can work out pros and cons to all of them.” Similar comments emerged when we asked interviewees what they looked for when hiring an IT architect: they considered the capability of “working out, you know how you get there from the steps,” and whether candidates can “solve a problem instead of doing a task.” This aligns with the fact that many organizations considered problem-solving capabilities to be an important IT skill [Schulz et al., 2008]. This skill set is common within the IT workforce [Chilton and Hardgrave, 2004].



(b) Communication Skills

IT architects act as bridges between various departments in organizations. They must be able to talk in the language of business managers and then switch to the language of technical developers [Bredemeyer, 2006]. Therefore, it was not surprising that all of the fourteen interviewees identified communication as an essential skill for IT architects. Indeed, communication skills were always ranked as one of the top-3 important skills by IT managers [D'agostino, 2004]. This embraced oral, visual and written communication skills as well as the ability to present material to clients and colleagues. As one interviewee said, "if they can't communicate, nothing else matters." Related comments from three distinct interviewees included, "communication is a really strong skill that you need to have," "the ability to describe concepts at the right level of detail, in the right way, to the different stakeholders," and "communicate on many levels." Similar opinions were expressed when we asked interviewees to describe what they looked for when hiring IT architects: for example, one interviewee stated that they "look for the ability to be able to communicate," and two interviewees stated that "being able to communicate effectively" was essential.

(c) Conceptualization and Abstraction Skills

One of IT architects' tasks is to establish architecture frameworks of standards, methods, practices and tools aligned with industry best practices [Spewak and Hill, 1993]. Conceptualization and abstraction skills are essential to complete these tasks. These skills are to invent or contrive an idea and formulate the idea mentally. All interviewees mentioned these skills in the interview. One interviewee explained it as, "even when I'm thinking of a problem which is completely abstract, completely semantic or philosophical, it's pictured in color in my mind and looked at from all angles." Another stated that a key differentiator for highly skilled IT architects was "the ability to visualize complex structures in their mind." Three other interviewees identified the "capacity to imagine, visualize a solution," "the ability to conceptualize things," and "conceptualization, or concept-building, seeing concepts, working with concepts". Another interviewee said that a critical capability "would be conceptualization or conceptual skills or those imagining skills that allow you to think in terms of models or concepts, and allow you to form relationships between those concepts and even think about and build abstract machines in your mind's eye."

(d) Skills to Manage Situational Politics

As IT architects' role is to ensure that the technology objectives of an organization are aligned to its business goals, they look at various cross-functional systems and business processes across various units [Bredemeyer, 2006]. Thus, it is inevitable that IT architects interact with managers from different units. Because these managers have different needs and expectations, effective IT architects' management styles should vary with the situation [Perks and Beveridge, 2003, p. 22]. One important skill is managing situational politics; that is, understanding the politics of the organization and the work environment, and how that influences IT architectures. Managing situational politics also involves interpersonal skills, as illustrated by this comment, "you can actually judge the likelihood of it working, given the context it has to work in." Another interviewee stated, "I think architecture is about politics as much as it's about anything else." While another described the capability by identifying it as a weakness: "I probably haven't always seen or read correctly the politics of a particular situation, so I tend to go in with perhaps a slightly naïve view at times."

Overall, IT architects define, analyze, and review system architecture and requirements for organizational IT platforms [Boh and Yellin, 2006]. They integrate and test software to confirm compliance with specifications. The above attributes match the expectations of IT architects. They also echo the remark by Bredemeyer [2006] that "[t]he good architects, then, are good technologists and command respect in the technical community, but also are good strategists, organizational politicians, consultants and leaders."

Knowledge

The following four competencies emerged as the key knowledge requirements of the IT architect, reflecting facts, principles, practices and theories.

(a) Technical Knowledge

Ten of the fourteen interviewees pointed out that an IT architect requires good technical knowledge, emphasizing that IT architects are individuals with "very, very strong, deep, technical skills, and architectural skills." Six interviewees specified the particular technical knowledge required. For instance, one interviewee mentioned that "knowledge of system analysis and design is essential." The other interviewee stated that "in my opinion web services again are a means to an end. Service orientated architectures are a means to an end as well." Three interviewees highlighted the importance of web services. According to Demirkan and Goul [2006], the continued increase of service-oriented architecture (SOA) deployments solidifies the need for the IT architects and their knowledge on SOA is essential to ensure efficient software reuse. Our findings aligned with Demirkan and Goul's views.

Nine interviewees emphasized the importance of high-level technical knowledge. One said, “I don’t think architects have to be original coders or programmers.” Another commented, “they don’t have to write in C, or they don’t have to write in Visual Basic, they just have to understand how those systems interact with one other and what are the key factors within those systems that will help to drive change, or will impinge on the ability for flexibility or connectivity between systems and processes so it doesn’t.” Another interviewee pointed out that outsourcing was always a possibility: “I can always employ people who know detail about technology ... I can outsource a whole range of things and I know that the deliveries for those [modules using low-level technical knowledge] are quite clear and I know what I can get. At the higher end of things it’s much harder to do.”

(b) Work Experiential Knowledge

Relevant work experience is essential for a successful IT architect. All the interviewees stated that an IT architect needs to have experience in project management and in all facets of the software development life cycle. Two interviewees mentioned that it was not easy for IT architects to acquire this knowledge simply by having a university education. In addition, IT architects require credibility, in particular technical credibility, and this is gained through experience over time or specific prior technical achievement. One interviewee said, “IT people had difficulty believing my credibility because ... I hadn’t got as much depth in programming as they had, so, therefore, they thought that I couldn’t really conceive of all the issues.” Interestingly, none of the interviewees thought current technical credibility was essential; instead, an IT architect could rest on their laurels if they had previously been regarded as an expert. Another interviewee said, “they will be known through the company as being good, because they have been” (emphasis added).

(c) Comprehensive Knowledge

Because IT architects interact with managers from different units, it is important for them to have comprehensive knowledge. Twelve of the fourteen interviewees said that having comprehensive knowledge was far more important than being an expert in a few forms of technology or problem domains. One interviewee emphasized balance: “I think when people are overly specialist, it doesn’t make you good for this sort of work.” An IT architect has to be able to “do everything from business development work through to proposing and designing and architecting solutions and building solutions.” One interviewee commented, “so staying within the one business unit, within the one style of solution, sticking with your own solutions and extending it just a little bit all the time. It’s eventually not a recipe for a successful architect.” As another interviewee stated, “hiring an IT architect, experience, in terms of being through and seeing a number of different issues and problems within different organizations and so forth” was crucial.

(d) Contextual Knowledge

All but one interviewee acknowledged the complexity of IT architecture and emphasized that highly skilled IT architects had to understand the objectives and strategies of business clients. Three interviewees emphasized that different architecture approaches should be adopted under different circumstances. Different interviewees expressed this capability in different ways. One interviewee said, “they need to understand what the business problem is”; another stated that IT architects needed “the business acumen.” Others said, “without thinking of global business model implications ... is a bit naïve,” “need to understand ... what is the business model that I’m trying to work within,” and “the good architects are the ones who come from a business perspective as well.” Another interviewee said that “I’d put more value, in terms of the business acumen” when hiring. Our findings aligned with Briody’s [2007] opinions.

Self-Concept

The following two competencies were related to self-concept, which is how a person perceives his/her role in the job.

(a) Walk the Middle Ground

IT architects serve as the link between IT and the rest of the business. When there are sharply contrasting views between two organizational units, IT architects are always required to accommodate both units to some extent [Lankhorst, 2009]. Eleven interviewees mentioned this importance role of IT architects in the interviews. One interviewee described this as, “architects really link the business and the developers.” Another stated, “I can interpret between technical speakers and business users, and I think that’s the greatest strength an architect has.” To perform well in this aspect of their job, IT architects need to have good communication skills and be able to negotiate, translate and accommodate the views of others: “You also have to be able to translate those sorts of business terminology,” “bringing those two views together,” and “the IT architect is connecting business to information technology.” One interviewee described how this capability differs from facilitation, in that it involves judgment, “to work out what makes a quality outcome you have to be able to balance the needs of a wide range of people and the ability to see through other people’s eyes.”

(b) Be Visionary

A visionary individual believes that he/she plays an important role in the future of an organization, system or industry and is able to plan accordingly. Being a senior IT person in an organization, the IT architect should be able to take a macro view of the entire area, not just the minutiae of the problem or domain at hand. This idea was reflected from the interviews. Ten interviewees described the importance of this competency with statements such as “it’s getting people to look at the big picture” and “can see things broadly and strategically and has this vision about going ahead and doing things that I think is really good.” Another interviewee said that it was important that an IT architect had “the vision of what we were trying to achieve.” One interviewee noted that vision is associated with influence: “to influence things you need to have the longer vision.”

Traits

The following two competencies were regarded as traits because they reflect an individual’s personality, which leads to consistent patterns of thinking, feeling and acting.

(a) Be Creative

Many organizations look for IT workers with higher levels of creativity [Schulz et al., 2008]. IT architects, being senior IT workers, are also expected to be creative. Seven interviewees mentioned the importance of being creative. They described “creative” as being able to think outside the box, having unusual ideas and innovative thoughts, and being able to put things together in new and imaginative ways. One interviewee stated that “just about every solution they must provide is always going to be unique, regardless of whether you can take some previously known solution, you still have to modify it and make it suit what it is the client is asking for.” Two other interviewees were very succinct, simply stating, “I don’t want textbook answers,” and “Absolutely, definitely, they have to be creative.”

(b) Be Open-minded

Eleven of the fourteen interviewees stated that open-mindedness was important and described it as being ready and able to entertain and generate new ideas. To illustrate, one interviewee who has managed many IT architects stated, “you’ve got to be really, really open, as an architect, you’ve got to be really up for someone else having a better idea.” Another said that s/he would not hire candidates “if they weren’t open to new ideas and possibilities.” Our findings align with the fact that when tackling a contextual problem, open-minded IT architects work more effectively because they are willing to accept the possibility that suggestions by managers in that context might be better than their ideas. In addition, open-minded IT architects are more enthusiastic to learn new technologies.

Motives

The following two competencies are motives, which drive individuals to keep performing.

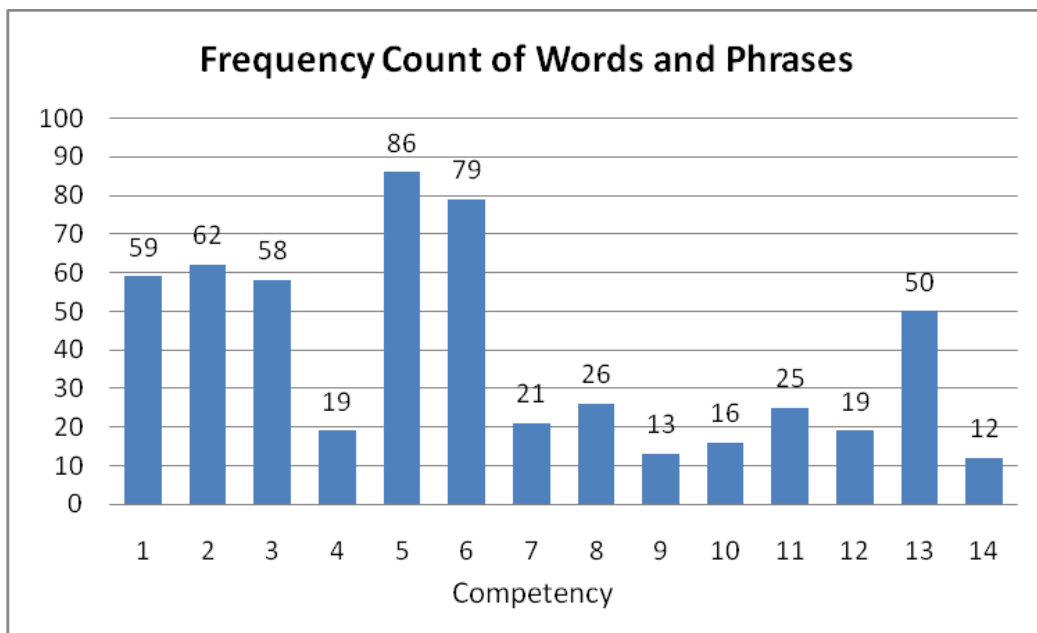
(a) Be Passionate

Technology is always evolving. Because IT architects design and analyze complex systems, they have to learn new technologies in order to take advantage of technological change. Their passion gives them motivation to tackle challenges at work. This idea was reflected in thirteen interviews. Thirteen interviewees said that it was important to be “passionate” and described this in terms of feeling, desire and vehemence. Here are some indicative quotes: “you’ve got to actually have a passion for understanding and getting excited about things,” “you have to have a passion for architecture to do it,” and “you have to be passionate.” One interviewee told us why an IT architect needed to be passionate: “you have to be passionate about it because you will face resistance.”

(b) Be Resilient

IT architects work with many different stakeholders, including leadership and subject-matter experts, to build a holistic view of the organization’s strategy, processes, information, and information technology assets. Disagreement between different stakeholders may lead to conflicts and slow down the progress of the architecture project. This results in frustration and anger [Brahm, 2008]. To our interviewees, resilience is the ability to readily recover from adversity, depression or the like. IT architecture is usually a long-term proposition; there are inevitable setbacks and the IT architect needs to be able to rebound. For example, one interviewee said, “I’m looking for somebody who’s picked themselves up from a bang,” while another said “a key psychological thing that you need is that sort of resilience that you can bounce back from ... minor setbacks or whatever.” Another interviewee looked for “psychological resilience” when hiring into IT roles.

Figure 4 provides a frequency count of how often the concepts had been emphasized by the interviewees. However, the frequency count might not accurately reflect the importance of the concept, because interviewees might use body language or tone of voice to emphasize the importance of a competence.



Key for x-axis (Competencies)

1. Critical Analysis and Problem Solving Skills	8. Contextual Knowledge
2. Communication Skills	9. Walk the Middle Ground
3. Conceptualization and Abstraction Skills	10. Be Visionary
4. Skills to Manage Situational Politics	11. Be Creative
5. Technical Knowledge	12. Be Open-minded
6. Work Experiential Knowledge	13. Be Passionate
7. Comprehensive Knowledge	14. Be Resilient

Figure 4. Content Analysis Results

Implications from the Competency Model Analysis for IT Architects

Comparison of Job Analysis and Competency Modeling

Our results from the competency modeling align with the descriptions in O*Net. For example, companies like Microsoft and IBM already know the gargantuan architecture tasks awaiting them in 2010 and thereafter and are hiring IT architects. Their job requirements are extracted from the descriptions in O*Net which focus on communication and technical skills [Collett, 2006]. These skills are also identified in our competency analysis. Indeed, our approach gives richer results in two aspects.

First, job analysis describes job responsibilities and neglects intangible factors important to the role. However, competency analysis accounts for these factors, which are represented by hidden competencies (i.e., traits and motives) in the model. Hidden competencies indicate to employers whether an individual will use his/her visible competencies in an effective way to complete the task. In the example of IT architects, if a person has strong communication skills but is not open-minded, then it is uncertain whether this person will utilize his/her communication skills effectively. Moreover, understanding what hidden competencies are important helps an organization find the right person to work within the organizational culture. As remarked by Nelson [1997], competency analysis goes far beyond person-job fit, and competencies cater to the person-organization fit.

Second, job analysis only helps employees to understand some job requirements whereas competency analysis allows an understanding of how an individual's underlying characteristics lead to superior performance [Yeung, 1996]. To be a high performer, an individual has to integrate knowledge, skills, attitudes, motives and behavior in meeting work expectations [Nolan, 1998]. The findings of job analysis help organizations and individuals understand job requirements, but not the paths to achieve high performance. On the contrary, competency analysis provides a means to discuss strengths, areas for improvement, training, and developmental opportunities between an individual and his/her supervisor [McLagan, 1996].

University Education

The competency analysis with the Iceberg Model sheds light on university education. A strength of the Iceberg Model is to present a hierarchy of competencies. As mentioned in Section II, the competencies at the top of the iceberg are easier to develop, whereas the competencies at the bottom of the iceberg are more difficult to develop. As the first step of training, university education can focus on easy-to-develop competencies (i.e., those at the top of the hierarchy).

We undertook a review of university curricula of architecture courses in thirty-seven public universities in Australia and eight public universities in New Zealand. Five universities offered degrees related to architecture (Table 1).

Table 1: Architecture Degrees in Australian and New Zealand Universities

University	Degree	Main topics
Edith Cowan University	Graduate Certificate of Business (enterprise integration track)	Business processes, supply chain, integration with enterprise systems, and e-business
Griffith University	Master of Enterprise Architecture	Business management, architecture standards, software architecture (started in 2008)
Monash University	Master of Business Information Systems (enterprise systems track)	Business issues, design, development, strategic thinking, management, communication, and overseeing implementation
RMIT University	Master of Technology (enterprise architecture track)	Business strategy, enterprise architecture concepts and frameworks, communication and marketing of architectures, strategic development and maintenance, governance
University of New South Wales	Master of Science (enterprise architecture track)	Business, policy, strategy, integrating enterprise systems and information systems, the web, or a variety of electives

Fourteen universities offered architecture-related courses.⁴ Generally speaking, these programs tend to place an emphasis on technical courses (e.g., software architecture and system architecture) while skills such as managing politics are overlooked. Situational politics play an important role for IT architects, more so than for any other IT professionals. IT architects are the bridges and the coordinators between various departments. They bridge the divide between company directors and IT professionals, and manage IT investment and infrastructure construction within the companies. Conflicts among departments or between senior and junior management are unavoidable. Unfortunately, situational politics apparently receive little attention in the classroom.

The competency analysis results inform university curriculum designers about core skills and knowledge. This helps the designers to confirm which courses should be included in the curriculum to match industry expectations. Table 2 provides a list of architecture-related courses in the master programs shown in Table 1. We reviewed course outlines available on the web. The learning objectives on course outlines indicated how these courses would enhance students' skills and knowledge. Certainly, the success of content delivery depends on the teaching methods and assessment. A range of teaching methods, including lectures, guest lectures, group problem-solving exercises, and group presentations, is appropriate for architecture-related courses. The courses may have different forms of assessments, whatever is most appropriate to the course objectives and content, for example, individual assignments, group assignments, presentations, demonstrations of working code, written reports and examinations.

⁴ We considered the course to be relevant for our research based on two criteria: First, course description and/or learning objectives of the course included IT architecture or other types of architecture. Second, the course had been offered already, or was being offered for the first time in 2008.

Table 2: How University Education Meets the Industrial Expectation

Industrial Expectation	Skills / Knowledge							
	1	2	3	4	5	6	7	8
General Business-Oriented Courses								
• Information Systems Management							√	
• IT Strategy	√						√	
• IT Project Management	√					√	√	√
• IT Governance	√	√		√		√	√	√
• Organizational Change Management	√	√		√		√	√	√
General Technical-Oriented Courses								
• Programming Languages	√	√	√		√		√	
• System Analysis and Design	√	√	√		√	√	√	
• Software Engineering	√	√	√		√	√	√	
• Usability Analysis	√	√	√		√		√	
• Web Services and Applications					√		√	
Architecture-Related Courses								
• Systems Architecture	√	√	√			√	√	√
• Information Architecture	√	√	√			√	√	√
• Enterprise Architecture	√	√				√	√	√
• Architecture Case Studies	√	√		√		√	√	√

Keys for Skills / Knowledge

- 1 = Critical Analysis and Problem Solving Skills
- 2 = Communication Skills
- 3 = Conceptualization and Abstraction Skills
- 4 = Skills to Manage Situational Politics

- 5 = Technical Knowledge
- 6 = Work Experiential Knowledge
- 7 = Comprehensive Knowledge
- 8 = Contextual Knowledge

Corporate Training

The Iceberg Model of competency analysis sheds light on corporate training. Corporate training programs specialize in developing competencies built on extensive job-related experience. These competencies are generally located in the middle part of the iceberg, because they are relatively less visible. In the context of IT architects, developing knowledge to be a generalist is a potential topic to be included in a corporate training program. University students typically have limited work experience, and, therefore, it is difficult to “teach” students how to apply the skills gleaned from different courses to a work environment. Thus, providing training to staff to develop such competencies becomes the responsibility of employers, not universities.

Several companies offer corporate training programs for IT architects. For instance, consulting and training companies, such as Business Systems Architects LLC and Bredemeyer Consulting, arrange on-site architecture training for corporate employees. Also, IBM offers laboratory sessions with hands-on exercises to train IT architects how to do business modeling with advanced visual tools. It also provides instructor-led lectures for advanced IT architecture topics, such as building proficiency in managing IT architecture projects, leading IT architecture teams in the public and private sectors. These topics build upon one’s work experience, and therefore, they are too advanced for university students.

Hiring and Selection

The competency analysis also provides HR managers with selection guidelines. Based on our findings, HR managers should make a list of desirable competencies. In the HR literature, various hiring techniques are available to assess different competencies. For example, since competencies at the higher level of the iceberg are more visible, these competencies can be easily assessed with personal interviews [Randall and Randall, 2001]. There are two styles of personal interviews, behavioral and situational. Situational interviews concentrate on how the applicants will react when confronted with a hypothetical situation, whereas behavioral interviews focus on past experiences and behavior of the applicants. Situational interviews are generally applied to assess competencies which do not refer to extensive job-related experience. They provide insight into an applicant's competencies, such as communication skills, problem-solving skills and reasoning abilities [Zedeck et al., 1983]. An example of situational questions on the competency, *communication skills*, is: "How do you establish a working relationship with new clients?" Behavioral interviews help to assess an applicant's contextualized skills and knowledge. Thus, they are useful in assessing competencies, including *work experiential knowledge* and *capability to be a generalist*. An example of behavioral questions on the competency, *work experiential knowledge*, is: "Describe a decision you made that was unpopular and how you handled implementing it." Competencies at the lower level of the iceberg, such as *being passionate* and *being resilient*, are less visible. Personality tests can be used to help HR managers to assess these competencies [Aiken, 2004]. Examples of personality tests include the California Psychological Inventory and the Myers-Briggs Personality Types. Prior HR research has also suggested that the chances of hiring a desirable applicant can be improved by using networking to identify perspective employees [Feiertag, 1994]. This is particularly important if the company plans to hire for a senior IT position.

V. DISCUSSION

Training is a top issue for IT executives [Luftman and Kempaiah, 2008]. The aim of this article is to understand how the Iceberg Model of competency analysis can be used to scrutinize the competencies required for the IT workforce and to set out the implications this has for IT training and selection.

Theoretical Implications

This research brings competency models to the IT workforce literature. Industry and government bodies use job analysis frameworks to describe job requirements, but these frameworks are task-oriented and focus only on skills and knowledge. For example, O*Net is a database that uses 275 descriptors for each of the 974 occupations. These frameworks are useful for helping HR personnel prepare a job description, but they fail to confirm the importance of people's hidden characteristics for effectively delivering organizational capabilities. To bridge this gap, we inform our investigation with competency models. We choose the Iceberg Model from several alternatives because we consider it to be more applicable to IT job contexts. The Iceberg Model categorizes competencies based on their visibility and resilience, whereas other competency models (e.g., Boyatzis' General Model of Competencies) have well-defined competency clusters. With a spectrum of visibility and resilience, the Iceberg Model identifies those competencies that can be developed in the classroom and those that can be revealed only in the selection process. The identification process used in this research can also be the foundation for further detailed research into the role of project managers or other IT professionals.

Competency models give IT and HR researchers a common language for discussing workforce issues. However, it is worthwhile to note that competency models are not the sole solution for every hiring and selection decision [Cockerill et al., 1995], nor should they be the only tool used in education and training [Dalton, 1997]. Framing competencies as an outcome may overlook the personal and mental processes that underpin skills and knowledge [Ashworth and Saxton, 1990]. Some idiosyncratic competencies that can help a person to be successful in their job, or contribute to the competitiveness of an organization, may be ignored if the competency model is solely used to strategically select only staff that fit the model. Organizations should not overlook the importance of developmental resources to help employees acquire competencies where a gap exists [Lado and Wilson, 1994].

Practical Contributions

In the past thirty years, many non-IT organizations have used competency models to strategically address management practices and organizational culture [Vakola et al., 2007]. Many Fortune 500 organizations use role-specific competencies to help manage and develop their staff [Boyatzis et al., 1996]. The first practical contribution of this article is to use the competency model to address a contemporary IT workforce question—*what competencies are important to equip the new millennium workers?* The IT industry in developed countries has been transformed by the outsourcing of software implementation projects to low-cost centers in developing countries and the commensurate decline in demand for low-level IT skills at home. This trend shows no sign of abating, and it has fundamentally changed the nature of the IT workforce. As today's IT workers climb their career ladders, they are expected to have many non-IT competencies (e.g., communication skills, political acumen). Thus, IT training and education institutions may need to update their programs to match industry expectations. Technical courses, such

as database management and systems analysis and design, remain an important part of any IT curriculum, but there must also be some managerial components.

Second, the interviews help us understand the specialized capabilities of the IT architect and offer insights into how organizations train and select for these roles. On one hand, some competencies are important, visible and easy to develop. University curricula or organization training programs should focus on developing these competencies. When universities design curricula, it is vital to recognize that some skills or knowledge (e.g., conceptualization skills) are general and useful to other IT roles (e.g., system engineers and software engineers), but some skills or knowledge (e.g., contextualized knowledge) are more specialized for IT architects only. The curriculum design should indicate a clear path for IT workers who plan to become licensed architects. On the other hand, some competences are difficult to develop in classroom teaching, although nonetheless important. These competencies reflect personal disposition, and an effective selection process is expected to filter incompetent workers.

Limitations

Our study has some limitations. First, we examined only one IT role (i.e., IT architects). Yet, even though IT architect is a specialization, some general skill sets of the architects' discipline are applicable to IT workforce. Second, we had relatively few interviewees (fourteen); however, their responses were remarkably similar. In addition, many of the interviewees worked for international organizations and had significant overseas experience so they represent mainstream views. They also had valuable insights on the IT architect's career path. Third, the sample was exclusively resident in Australia. IT firms in different countries have different working culture and practices, and this limits the generalizability of our findings. For example, in countries with mature architecture practices there may be increased focus on the less visible competencies as the foundational competencies are already appreciated and developed. While in countries with less developed architecture practices, the visible competencies may be seen as more important as the means to establish a solid foundation for architectures. Future studies should be conducted in the U.S. and other major IT countries to increase our research generalizability.

VI. CONCLUSION

The resurgence in global demand for IT workers leads to an important question: What competencies are important to transform the new millennium workers? This research addresses this question by borrowing a management theory: the Iceberg Model of Competencies. Our work uses the example of the IT architect to illustrate how the Iceberg Model can be used to identify workforce competencies. Our findings provide industry and academia with valuable knowledge. For industry, we clearly describe the characteristics and distinguishing capabilities of highly skilled IT workers so that organizations can more effectively select and develop IT workers. We give universities an improved understanding of the characteristics of IT workers and a set of visible and easy-to-develop competencies that can be used to structure IT training programs.

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Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that:

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APPENDIX 1: INTERVIEW QUESTIONS

- (1) Interviewee background.
 - 1a. What is your education and work background?
 - 1b. What is your age and qualifications?
 - 1c. What is your current role and what are the upsides and downsides of that role?
- (2) What capabilities do you think makes you good at your job?
 - 2a. What makes you good at your job as an IT architect?
 - 2b. What are your strengths and weaknesses as an IT architect?
 - 2c. Thinking of a person you regard as a good IT architect, what makes them good at their job?
- (3) What capabilities do you look for when choosing to train and hire other IT architects?
 - 3a. Which of these are the most important?
 - 3b. Which of these are the least important?
 - 3c. What capabilities would be the reasons for you to hire a person to be an IT architect?

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