A Cognitively-Based Competency Model for Small Unit Counter-IED Performance

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Competency modeling is the process by which skills and areas of knowledge to perform a task are identified and associated with that job, task, or mission. This technique is useful to uncover which particular knowledge and skill areas are required for successful completion of a specific job or task. This paper describes a cognitively-based competency model developed to understand the types of tasks performed at the small unit level for counter-IED operations for the purpose of developing assessment items. We conducted data collection using a simulation interview protocol with Warfighters, and multiple raters coded each interview to develop the competency model. The model consists of six competencies, some of which have multiple sub-competencies, and the underlying KSAs. This process is particularly useful in applied settings, and the pairing of this type of data collection method and the competency model process can be used in various domains, particularly cognitively challenging ones.

INTRODUCTION

There is a long-standing problem in the military of how to measure performance. Not only do different levels of performance and aptitude need to be captured, there are numerous domains in which measurement needs to be standardized. At the core of the issue is understanding the competencies to be measured because once these are understood and fully articulated, measurement more easily becomes an extension of those competencies.

Competencies can be loosely defined as those skills and areas of knowledge necessary to perform a task, but it is agreed that an important part of the definition is context (Koeppen, Hartig, Klieme, & Leutner, 2008; Shippmann et al., 2000). Cognitive competencies differ from other types of similar constructs, such as cognitive dispositions, in that, unlike the latter, cognitive competencies are meant to reveal a person's ability to perform a specific cognitive challenge rather than simply respond a range of general cognitive challenges. Another important facet of cognitive competencies is that they are acquired by learning which takes place in a very specific environment; thus, competencies can be trained (Koeppen et al., 2008). For our purposes, we specifically talk about cognitive competencies, which we refer to as those areas which one must understand and satisfactorily be able to perform to complete a job.

Competency modeling is the process of identifying a set of central competencies necessary for successfully performing a job, task, or mission (Koeppen et al., 2008; Lievens & Sanchez, 2007; Shippmann et al., 2000). The strong focus on task requirements found in various competency modeling definitions and uses makes it very similar to what many people refer to as a job analysis; that is, identifying the major requirements to successfully perform a job (Shippmann et al., 2000). However, one of the major distinctions made between the two is that competency modeling tends to be more applied and more functionally tied to specific job and tasks, and it tends to put more emphasis on daily behavior than do job analyses (Sanchez & Levine 2009).

Cognitive competency models focus on the relationships between performance and underlying cognitive knowledge, skills, and other areas. While the specific design of the model depends on the questions and decisions addressed, typically they all include knowledge, skills, and abilities/aptitudes (KSAs), and some also include other characteristics of the competencies, such as behavioral indicators (Koeppen et al., 2008; Lievens & Sanchez, 2007). The frequent criticism that competency modeling lacks psychological and scientific rigor is not without merit; however, studies do show that when raters are trained and experienced in what to look for, competency modeling can be effective and accurate (Lievens & Sanchez, 2007).

Though there are many ways in which competency models can be applied, a common use is the development of assessment items (Lievens & Sanchez, 2007; Shippmann et al., 2000). Though the validity of competency models dictates the quality of the assessment items, when working from an accurate model, assessment items can be generated that are relevant to the content of and address the underlying concepts associated with the task(s) (Koeppen et al., 2008; Lievens, Sanchez, & De Corte, 2004; Lievens & Sanchez, 2007).

Our work focuses on areas of performance that require difficult judgments and decision making under stress and performance that is not easily routinized into procedures. Therefore, we have developed a methodology based a cognitive foundation for our unique approach to competency modeling. In a JIEDDO-funded project for the US Marines and US Army, we developed a cognitively-based competency model to address small unit performance in counter improvised explosive devices (C-IED) operations. Our process and final model are described in the following sections.

PRACTICE INNOVATION

Our project focused on understanding the C-IED operations currently being conducted in the small unit to address the Attack the Network (AtN) and Defeat the Device (DtD) areas of performance. We began this process by reviewing data from previous cognitive task analyses (CTAs)

performed as part of a predecessor project (Phillips, Moon, Baxter, & Cooper, 2008). From this data we identified eight areas of interest to C-IED operations that we used as the basis for interviewing in a limited domain analysis. We then visited several Marine and Army sites to determine what operations are being conducted at the small unit level to address these areas. We determined that the primary tasks performed by small units were observing and assessing the environment, collecting information, and reporting. From this data we pulled concepts related to C-IED and used a card sort technique to group related concepts. Based on the data, we developed a set of six competencies. We defined each competency, and some competencies were broken down into two or three sub-competencies when there were multiple underlying facets of the same construct. We also developed a preliminary competency model outlining KSAs that were known from our previous work and that fell into each of the competencies.

Our next step was to obtain data to support, explain, and specify these preliminary competencies. We were also aware that as data collection progressed, one or more of these areas might drop from the analysis, as they were obtained from interviewing and observing a limited number of people.

Our data collection consisted of going to both Marine and Army sites and interviewing Warfighters with varied backgrounds, time in service, and personal experience with C-IED. We interviewed a total of 16 participants using a simulation interview protocol (Militello & Hutton, 1998) . This protocol consists of a "day in the life" simulation in which participants were walked through numerous segments of a continuous scenario and asked pointed questions at specific points during the interview. This type of interview was chosen over other methods of CTA because of its ease of building in specific cues, events, and situations and the ability to obtain a consistent set of responses across participants that varied only in individual proficiency. The scenarios were designed such that they addressed one or more of the six competencies; thus, we had competencies and KSAs that were "built in" to the segments that we could look for in the participants' responses. We developed the simulation interview with an in-house subject matter expert (SME) to ensure our cues and situations were relevant and that there was nothing in the course of the interview that would take participants "out" of the scenario, i.e., interrupt their cognitive flow with factors and cues that were not realistic. The interview consisted of ten segments, and all participants completed the entire interview.

The first step we took in the analysis process was to have the analysis team independently reviewed each transcript and assign each participant a proficiency rating of Novice, Low Intermediate, High Intermediate, or Expert. We then met to gain agreement on each participant rating. The proficiency levels were based on the participant's amount of personal experience, the level of detail of his or her descriptions, and the number of concepts the participant was able to produce for each particular question. Any discrepancies between raters were resolved through discussion to ensure consensus on the ratings. The results of these analysis sessions were used to develop descriptions of each proficiency level.

We then began creating the competency model from the data. The first step we took was to have each of the interview transcripts independently reviewed by multiple raters to identify the competencies the participant used. We created a coding form listing the competencies that were "built in" to each segment. The team coded each transcript by segment to identify not only the competencies expressed in each segment, but the underlying KSAs and associated behavioral indicators as well. If an expected competency was not found in the response to the segment, that was noted as well. We then met to gain agreement on the competencies found in each segment for each participant. Next, we revised the competency model, detailing the KSAs and behavioral indicators found for each competency. We also revised the competency definitions based on the data.

Our next step was to code each segment of the transcripts for the use of the competency. That is, sometimes participants used a competency, but the way it was used was in what we judged to be an ineffective manner. We made a second sweep through the data to determine if the participant used the competency correctly or incorrectly. This determination was based on the competency definitions and how well the participant applied the competency. The team again met to gain agreement on the ratings of competency use. We subsequently revised the competency model to reflect the data.

FINDINGS

The competency model we developed has six competencies, three of which have sub-competencies, and can be seen in Table 1. The competencies are as follows: *perspective taking, anticipatory thinking, problem detection, sensemaking, communicating, and gathering information.* For representation purposes and due to the large size of the original model, the model presented here is an abbreviated version with a limit of five or less KSAs per competency/sub-competency.

Perspective taking is broken down into two sub-competencies—adversary perspective taking and host nation perspective taking. Adversary perspective taking is defined as considering how the enemy as a whole, or individual adversaries, perceives a situation and using that information to inform one's own behavior. Host nation perspective taking is defined as considering how the local population thinks and behaves and using that information to inform one's own behavior.

Anticipatory thinking is defined as visualizing possible consequences or outcomes that could occur in the future in order to solve problems and inform actions.

Problem detection is defined as identifying an immediate and/or discrete threat or issue that is off the normal baseline or expected flow of events and must be resolved.

Sensemaking is broken down into three sub-competencies—assessing people, assessing the situation, and assessing risk. Assessing people is defined as using an individual's or group's verbal communications, body language, or behaviors to judge their intentions, motivations, or current activities prior to taking action. Assessing the

situation is defined as using background knowledge and what is perceived or sensed from the surroundings to judge the situation prior to taking action. Assessing risk is defined as making a determination about a threat associated with the immediate situation and the necessary resources available to inform actions prior to taking action.

Communicating is defined as communicating to or exchanging knowledge with one or more persons, i.e., understanding what is important to communicate, when and how.

Gathering information is broken down into two sub-competencies--gathering information from people and gathering information from the environment. Gathering information from people is defined as taking action to extract information from a person or group of persons. Gathering information from the environment is defined as taking action to obtain information from what can be sensed from one's surroundings.

Table 1. Cognitively-Based Competency Model of C-IED Operations.

Competency 1 – Perspective Taking – Adversary Perspective Taking

Knowledge

- Insurgent strategies for transporting materials.
- Awareness of optimal emplacement techniques and locations
- Terrain features that are typical of the AO
- History of past experience with foreign units.
- Who is an outsider and who lives in the village.

Skills

- Creative thinking
- Tactical patience, which involves observing instead of immediately taking action.
- Adapt behavior based on information acquired about adversary.

Abilities

- Observation of behavior and changes to behavior
- Spatial abilities to recognize angles of observation

Competency 1 – Perspective Taking – Host Nation Perspective Taking

Knowledge

- Normal activity for the village, route, or AO pattern of life in the AO
- Culturally-based behaviors and norms
- Local language
- Items that are deemed valuable to the local populace
- Economic state of the village.

Skills

- Interpersonal skills such as building rapport
- Working as a team with local nationals

Abilities

- Observation of behavior and changes to behavior

Competency 2 – Anticipatory Thinking

Knowledge

- Awareness of recent BLUFOR civil works projects.
- Recent insurgent activity such as an ambush and/or IED hot spots.
- Past experiences of BLUFOR and foreign units in that AO.

Skills

- Critical thinking (using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions, or approaches to problems)

Abilities

- Spatial abilities to recognize angles of observation
- Perform mental simulations of the possible events that may occur
- Ability to foresee consequences of possible actions

Competency 3 – Problem Detection

Knowledge

- Awareness of geographics - the identification of habitual areas where people from the community gather for routine activities.
- Components of an IED
- Types of IED components
- Awareness of how terrain can complicate CIED tasks
- Types of IEDs

Skills

- Combat profiling
- Combat tracking
- Attention to detail
- Effectively uses mechanical devices to detect and measure biological activity.

Abilities

- Observant of details of human behavior
- Visual acuity
- Ability to detect subtle changes in the environment
- Distinguish between the phases of IED emplacement

Competency 4 – Sensemaking – Assessing People

Knowledge

- Cultural norms
- Local customs
- BLUFOR TTP
- Clothing and hairstyles that distinguish different tribes/villages.
- Awareness of proxemics - the distance people maintain as they interact

Skills

- Use of common interest to build rapport
- Communication skills
- Demonstrate cultural awareness and sensitivity
- Combat profiling

Abilities

- Social perceptiveness – being aware of other's reactions and understanding why they react as they do
- Recognition of patterns suggesting threat

Competency 4 – Sensemaking – Assessing the Situation

Knowledge

- Terrain features that are typical of that AO.
- Daily routine of the local AO

- How time of the month affects local activity
- Meaningful days that disrupt the daily routine of the local AO

Skills

- Self-Monitoring: monitoring ones performance to make improvements or take corrective actions (S)
- Tactical patience – observing instead of immediately taking action
- Observation skills

Abilities

- Recognition of patterns suggesting threats

Competency 4 – Sensemaking – Assessing Risk

Knowledge

- Devices or terrain that could be advantageous for insurgent
- Properties and vulnerabilities of chokepoints
- BLUFOR TTPs
- Mission requirements

Skills

- Manage time appropriately
- Manage resource appropriately

Abilities

- Assess how terrain could be used for IEDs
- Recognition of when priorities need to shift

Competency 3 – Problem Detection

Knowledge

- Key individuals that need the information
- What information Higher HQ can provide
- Awareness of what information is important to report to HQ
- Importance of tracking information over time.
- Communication procedures and report formats.

Skills

- Clear and concise verbal and written communication
- Intra-squad communication
- Provide information to other patrols
- Inter-squad communication

Abilities

None found in the data

Competency 6 – Gathering Information – Gathering Information From People

Knowledge

- Local customs
- Local regulations
- Recent IED and insurgent activity in the area
- Cultural norms such as behaviors that can be considered insulting
- Tribal hierarchy and/or authority

Skills

- Tactical questioning techniques
- Active listening
- Interpersonal skills such as building rapport.
- Collaborating with outside groups
- Clearly communicating ones intentions

Abilities

- Deal with uncooperative or confrontational villager

Competency 6 – Gathering Information – Gathering Information From the Environment

Knowledge

- TTPs for searching homes and/or vehicles
- TTPs for investigating an IED
- Knowledge of readily available resources
- Indicators of insurgent activity
- Types of IED making materials

Skills

None found in the data

Abilities

- Visual ability such as depth perception and far vision.
- Manage large amounts of information about people and surroundings
- Multitasking - simultaneous performance of two or more tasks
- Distinguish between common household items and suspicious materials.

The competency analysis included deriving behavioral indicators for each competency and sub-competency to provide data for the assessment items. A rich set of behavioral indicators emerged from the data, but are documented separately from the base model shown here due to the sheer number of findings in order to preserve a clear, easy to read set of competencies in the representation.

As part of the competency analysis, we also compared proficiency levels across competencies to see how Warfighters at different proficiency levels understand and use the competencies. We counted how many times a competency was used positively, meaning the participant understood and used the competency correctly, and negatively, meaning the participant did not use the competency correctly. This measure of determining overall knowledge and use of competencies and the underlying KSAs has been used in other military research (McCloskey, Behymer, Papautsy, & Ross, 2010).

We found that novices tended to have less overall understanding of the competencies than the other proficiency levels. Their overall positive use of the competencies was less frequent than other participants, and their overall negative use of the competencies was more frequent than other participants. This was expected, given that novices tend to have a much more shallow understanding of concepts. Conversely, experts were found to have an overall greater understanding of the competencies than the other proficiency levels. They exhibited more positive use and less negative use, which was also expected due to their deeper and broader understanding of concepts.

Interestingly, those individuals rated as low intermediates tended to have greater positive use of nearly all the competencies than high intermediates. However, they also had more negative use of the competencies. This suggests that perhaps high intermediates are more selective about when and

how they use a competency than low intermediates who may be taking a lot of "shots in the dark" to see what works as they begin to understand the range of strategies available.

While there is some crossover among the KSAs for the competencies, this was minimized, as a competency model should remain as orthogonal as possible. However, there is not a one-to-one relationship between the KSAs. That is, there is not one area of knowledge that corresponds to one skill that corresponds to one ability. The model is designed so that all the KSAs combine to form the competency. Additionally, some competencies were more complex and had more KSAs than other competencies.

It should be noted that some competencies do not have any data in a category. Problem detection has no abilities listed, and gathering information from the environment, under the competency gathering information, does not have any skills listed. This does not indicate that there are no abilities and skills, respectively, required for these competencies. Rather, this is due to the fact that, for the purposes of this project, the protocol used did not pull out any abilities and skills in those areas. Future research should address these gaps and attempt to gather more data for the areas in which there was very little information obtained during 0 this project.

DISCUSSION

The approach used in this paper is unique for a military measurement application. Our method of data collection has been used in more traditional CTA capacities, but has not traditionally been used to develop competency models. However, it was effective in this context. We were able to tailor a standard interview process to gather specific data to help in the creation of a cognitively-based competency model. While this process was designed for C-IED operations in small units, it can be modified for other domains that contain a high degree of cognitive complexity, in which it would be helpful to identify competencies and their underlying components, such as intelligence analysis, aviation, and healthcare.

Additionally, our purpose for creating the competency model was to have data applicable and relevant to C-IED operations in small units around which we could create assessment items to measure performance on these tasks. However, competency models developed from this process could have a number of applications, ranging from theoretical to practical. A cognitively-based model could be used to inform and guide the design and development of training and support systems.

Our resulting model is not only useful for C-IED operations, but it would be extremely helpful in irregular warfare and stability operations because of the cognitive competencies we have identified, such as host nation perspective taking. Using the underlying KSAs could be very helpful in determining what types of performance areas Warfighters need to be trained in when working in these areas of operation, and training content could be created from these cognitive competencies.

The model itself can also be applied to human social and cultural behaviors. This is a focus in warfighting today, and while more culturally-based competency models can certainly be developed using this process, this model has components that could be useful in these contexts while maintaining a tactically and cognitively-based center.

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REFERENCES

Koeppen, K., Hartig, J., Klieme, E., & Leutner, D. (2008). Current issues in competence modeling and assessment. *Journal of Psychology, 216(2),* 61-73.

Lievens, F., Sanchez, J.I., & De Corte, W. (2004). Easing the inferential leap in competency modelling: The effects of task-related information and subject matter expertise. *Personnel Psychology, 57(4),* 881-904.

Lievens, F., & Sanchez, J.I. (2007). Can training improve the quality of inferences made by raters in competency modeling? A quasi-experiment. *Journal of Applied Psychology, 92(3),* 812-819.

McCloskey, M. J., Behymer, K. J., Papautsy, E. L., & Ross, K. G. (2010). *A developmental model of cross-cultural competence at the tactical level* (Technical Report 1278 prepared under Contract W91WAW-09-C-0037 for the US Army Research Institute for the Behavioral and Social Sciences). Arlington, VA: 361 Interactive, LLC.

Militello, L. G., & Hutton, R. J. B. (1998). Applied Cognitive Task Analysis (ACTA): A Practitioner's Toolkit for Understanding Cognitive Task Demands. *Ergonomics, 41(11),* 1618-1641.

Phillips, J. K., Moon, B. M., Baxter, H. C., and Cooper, J. C. (2008a). Cognitive task analysis for improvised explosive device defeat: Cognitive task analysis final technical report. Technical Report prepared under Contract M67854-07-C-8068 for the USMC Program Manager for Training Systems. Westlake, OH: Cognitive Training Solutions.

Sanchez, J.I., & Levine, E.L. (2009). What is (or should be) the difference between competency modeling and traditional job analysis. *Human Resource Management Review, 19(2),* 53-63.

Shippmann, J.S., Ash, R.A., Battista, M., Carr, L., Eyde, L.D., Hesketh, B., … Sanchez, J.I. (2000). The practice of competency modeling. *Personnel Psychology, 53,* 703-740.