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Measuring Acquisition Workforce Quality Through Dynamic Knowledge and Performance: An Exploratory Investigation to Interrelate Acquisition Knowledge With Process Maturity

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Panel 4. Improving Acquisition Workforce Quality and Effectiveness

Wednesday, May 14, 2014	
11:15 a.m. – 12:45 p.m.	**Chair: J. David Patterson,** Director, North American JDA Partnerships, N12 Technologies ***Measuring Acquisition Workforce Quality Through Dynamic Knowledge and Performance: An Exploratory Investigation to Interrelate Acquisition Knowledge With Process Maturity*** Mark Nissen, Naval Postgraduate School Rene Rendon, Naval Postgraduate School ***Highly Effective Acquisition Learning Organizations in the DoD: An Architectural Solution*** Robert Tremaine, Defense Acquisition University Donna Seligman, Defense Acquisition University ***A Comparison of Government and Industry Program Manager Competencies*** Roy Wood, Defense Acquisition University

Measuring Acquisition Workforce Quality Through Dynamic Knowledge and Performance: An Exploratory Investigation to Interrelate Acquisition Knowledge With Process Maturity

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Abstract

The efficacy of defense acquisition is highly dependent upon acquisition workforce quality, but assessing such quality remains a major challenge, particularly given the knowledge-intensive and dynamic nature of acquisition organizations and processes. Hence, it is difficult to gauge—much less predict—the impact of leadership interventions in terms of policy, process, regulation, organization, education, training, or like approaches. Building upon the development and application of Knowledge Flow Theory (KFT) over the past couple of decades, we have developed a state-of-the-art approach that enables us to analyze, visualize, and measure dynamic knowledge and performance. The main idea is to apply this approach inwardly to interrelate the knowledge and performance of acquisition processes (e.g., within contracting and project management organizations). In this exploratory study, we examine acquisition from the perspective of the procurement process, focusing in particular on organization knowledge and performance with respect to the processes used for the procurement of major systems and services. We begin with a summary of KFT and measurement and then introduce the Contract Management Maturity Model as an approach to acquisition performance measurement. We follow in turn by summarizing the research method guiding the study, after which we present preliminary results of our investigation. By interrelating knowledge to performance in terms of process maturity, this report presents the premier cause–effect relationship of its kind in the acquisition domain. This article concludes with key observations, limitations, and an agenda for continued research along these lines.

Introduction

Acquisition is big business. The U.S. Department of Defense (DoD) alone routinely executes 12-figure budgets for research, development, procurement, and support of weapon systems and other military products and services (Dillard & Nissen, 2005). Acquisition is also a knowledge-intensive business. In addition to myriad laws governing federal acquisition in the U.S., a plethora of rules and regulations specify—often in great detail—how to accomplish the planning, review, execution, and oversight of defense acquisition programs, large and small, sole-source and competitive, military and commercial (Dillard, 2003).

As a result in part—and due to high complexity, multiple stakeholders, goal incongruence, open process execution, and large pecuniary rewards for some participants—acquisition has been a problematic business, too. Seemingly every decade, acquisition problems must be addressed by another Blue Ribbon panel and reformed yet again. The Better Buying Power Initiatives (BBPI), as a recent instance, mandated efficiency and productivity improvements in five acquisition business areas: (1) affordability and cost growth, (2) productivity and innovation in industry, (3) competition, (4) tradecraft in services acquisition, and (5) non-productive processes and bureaucracy (Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics [OUSD(AT&L)], 2010). These initiatives focus principally on incentives for and interactions with contractors. The Defense Acquisition Workforce Improvement Act (DAWIA), as another instance, was signed into law in 1990 and emphasizes the education, training, and certification of people in the acquisition workforce (AWF). Of course, the two leadership interventions are related: People in the AWF need to know how to effect the kinds of efficiency and productivity improvements mandated via the BBPI.

These characteristics of acquisition emphasize the criticality of quality in the AWF itself: With so much at stake, and in such a knowledge-intensive environment, a high-quality workforce is essential to competent and professional acquisition performance.

These characteristics also elucidate the central role played by people and organizations in the AWF: People must be knowledgeable and work effectively—not only in terms of their own professional acquisition activities but also with many others in acquisition and customer organizations—in order to accomplish key objectives and ensure timely, affordable, and responsive delivery of products and services to fighting and support units, at home and abroad. Indeed, we understand well how the efficacy of defense acquisition is inextricably dependent upon workforce quality. Hence, leadership interventions along these lines appear to be highly appropriate and on target.

Assessing the impact of interventions such as these is a challenge, however (Assistant Secretary of the Navy for Research, Development, and Acquisition [ASN(RDA)], 2011a, 2011b). It's unclear whether the relatively recent BBPI, for instance, have had sufficient time to produce measurable impact. Even after two decades of the DAWIA, as another instance, efficacy remains challenging to assess, for many extant measures (e.g., number of Defense Acquisition University graduates, procurement lead-times, program cost growth) fail to account for critical aspects of the AWF and important impacts on acquisition performance. Indeed, it is difficult to gauge—much less predict—the impact of any leadership interventions along these lines (e.g., how much better the AWF has become, or even if it is improving over time). Hence, the impact of any particular leadership intervention is left largely to anecdote and optimism. To help trim acquisition budgets and guide leadership, an improvement in assessing leadership initiatives and interventions is needed.

Since acquisition is a knowledge-intensive endeavor (Snider & Nissen, 2003), the knowledge stocks of people comprising the AWF represent likely indicators of quality (e.g., education levels, training courses, years of experience, certification levels). However, such indicators are relatively static, pertaining to levels of knowledge that change comparatively slowly (Nissen, 2006a). In contrast, acquisition laws, rules, and regulations are revised frequently, and acquisition knowledge can change abruptly and render obsolete even huge stocks over time. Indeed, this dynamic acquisition environment requires members of the AWF to sustain career-long learning and knowledge development just to remain proficient as acquisition professionals. Thus, as indicators of AWF quality, static knowledge stocks appear to be out of phase with the highly dynamic nature of the acquisition environment.

Moreover, acquisition organizations experience persistent flux (Snider & Nissen, 2003). We understand well that no two acquisition projects, programs, organizations, customers, or requirements are completely alike. Hence, even well-educated and well-trained people, with appropriate certification levels and years or decades of acquisition experience, must continually learn afresh and expand their knowledge further with each new assignment. Likewise, it is clear that most acquisition organizations form and reform with new people (e.g., via personnel transfer, turnover, retirement, promotion) continuously and that end-customer needs shift perennially (especially at the tactical edges of warfare organizations). Due to such discontinuous membership (Ibrahim & Nissen, 2007), even these educated, trained, certified, and experienced people must learn repeatedly to trust and work effectively with many others—each time someone new joins or leaves a particular acquisition organization, and each time a novel product, service, or customer is involved. Thus, dynamic knowledge also appears to be an important AWF quality indicator.

The research discussed here recognizes these persistent—and seemingly immutable—attributes of the acquisition domain and workforce, and it seeks to overcome the limitations inherent in current approaches to assessing acquisition leadership initiatives and interventions. Specifically, this work augments extant, largely static measures of AWF quality through dynamic knowledge and performance metrics applied to the acquisition domain.

Building upon the development and application of Knowledge Flow Theory (KFT) over the past couple of decades (Nissen, 2006b), including very recent work to measure dynamic knowledge and performance at the tactical edges of military combat organizations (Nissen & Gallup, 2012), and applying such work to the acquisition domain (Nissen, 2012), we're able now to analyze, visualize, and measure dynamic knowledge flows, and we seek to leverage such ability to explain and predict corresponding organization performance levels. Two fundamental research questions follow accordingly:

- How can dynamic knowledge and performance metrics be applied to assess AWF quality?
- How can knowledge be linked to measure and predict performance levels of acquisition organizations?

In this exploratory study, we examine acquisition from the perspective of the procurement process, focusing in particular on organization knowledge and performance with respect to the processes used for the procurement of major systems and services, ranging from research and development to weapon system equipment and related maintenance. We begin with a summary of KFT and measurement and then introduce the Contract Management Maturity Model (CMMM; see Rendon, 2003) as an approach to acquisition performance measurement. We follow in turn by summarizing the research method guiding the study, after which we present preliminary results of our investigation. By interrelating knowledge to performance in terms of process maturity, this report presents the premier cause–effect relationship of its kind in the acquisition domain. This article concludes with key observations, limitations, and an agenda for continued research along these lines.

Knowledge Flow Theory and Contract Management Maturity

In this section, we begin with a summary of KFT and measurement and then introduce the CMMM, discussing the potential for linking and using these two frameworks to assess acquisition performance.

Knowledge Flow Theory and Measurement

The dynamic nature of knowledge indicates that both stocks and flows are important (Dierickx & Cool, 1989). Knowledge stocks have been comparatively straightforward to measure historically; metrics pertaining to education levels, training courses, years of experience, certifications, and like knowledge-oriented factors are employed broadly. Alternatively, knowledge flows have been comparatively much more difficult to assess; metrics pertaining to dynamic knowledge—particularly at the group and organization levels—are more elusive. The development and application of KFT (e.g., see Nissen, 2006b) over the past couple of decades has augmented the set of tools and techniques available to analyze, visualize, and measure dynamic knowledge and performance in the organization.

KFT is founded on a set of 30 principles that characterize dynamic knowledge. Such principles are actionable and empirical, and they support the diagnosis of workflow and knowledge-flow process pathologies, visualization of improvement interventions, and measurement of dynamic knowledge and performance gains (Nissen, 2006a). Dynamic knowledge is delineated via five-dimensional (5D) vector space. Knowledge-flow vectors carry measurements and elucidate diagnostic inferences pertaining to the people, processes, and organizations associated with knowledge work. Figure 1 illustrates the idea.

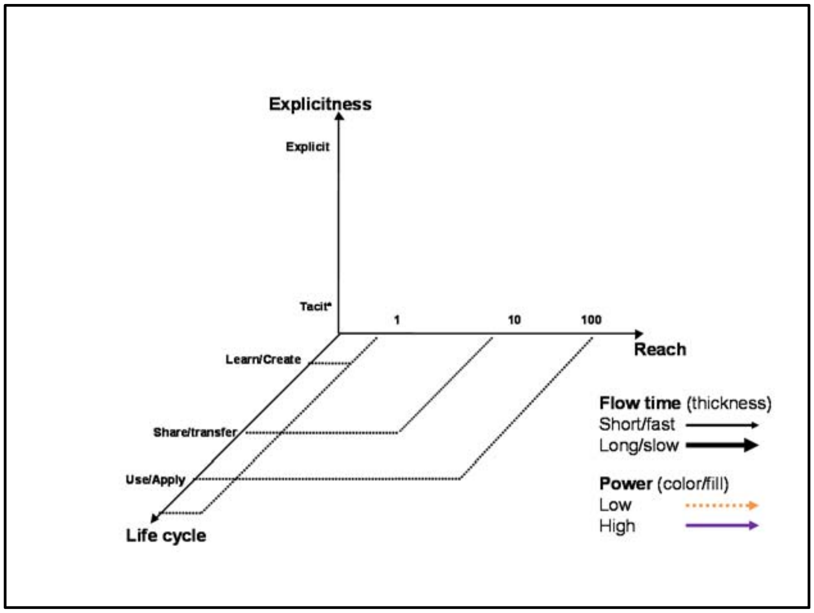

Figure 1. 5D Knowledge-Flow Diagram

Briefly, the vertical axis "Explicitness" characterizes the nature of knowledge along a tacit–explicit continuum. Tacit knowledge implies understanding and know-how/why, and it is associated most closely with the experiences of people (e.g., stemming from job assignments, mentoring, and teamwork) and routines of organizations (e.g., culture, process, ritual). Explicit knowledge implies awareness and know-who/what/where/when, and it is associated most closely with artifacts (e.g., documents, formulae, software). Generally, the more tacit the knowledge, the greater its appropriability and potential impact on positive performance becomes (Saviotti, 1998). One can measure knowledge explicitness using ordinal, interval, or ratio scales.

The horizontal axis "Reach" characterizes how broadly knowledge is known and shared in an organization. Here we operationalize reach in terms of the number of people in an organization who have access to and can employ any particular chunk of knowledge, but we could view reach in terms of organization levels instead (e.g., individual, group, organization, interorganization). Generally, the broader the reach of knowledge, the greater its amplification and potential impact on positive performance becomes (Nonaka, 1994). Measurements can be made using ordinal, interval, or ratio scales.

The axis "Life cycle" characterizes what is being done with a particular chunk of knowledge at some specific point in time. Here we include three activities: (1) some individual in the organization learns or creates new knowledge; (2) he or she shares existing knowledge with or transfers it to other people in the organization; and (3) one or more people in the organization use or apply existing knowledge to accomplish work. Generally, knowledge does not become useful until it is used or applied (Pfeffer & Sutton, 1999). Measurements can be made using categorical or ordinal scales.

Because visualization beyond three dimensions is difficult, we represent the dimension "Flow time" in terms of the thickness of lines used to delineate vectors. As shown in the key to the right of Figure 1, relatively thin lines are used to delineate short and fast knowledge flows, whereas comparatively thick lines represent knowledge that takes a long time and flows slowly. Generally, the more quickly that knowledge flows (e.g., across people, organizations, places, times), the greater its potential impact on positive performance becomes (Nissen, 2002). Measurements can be made using ordinal, interval, or ratio scales.

The dimension "Power" is represented similarly in terms of line style used to delineate knowledge-flow vectors. Knowledge that flows with relatively low power—this corresponds with relatively low performance levels of organization activities enabled by the knowledge—is delineated through orange dotted lines, whereas knowledge flows exhibiting high power—and hence enabling high performance—are delineated via purple solid lines. Measurements can be made using ordinal, interval, or ratio scales.

Integrating these five dimensions graphically and analytically generates a 5D vector space to examine dynamic knowledge. Such 5D space and examination schemes are completely general: They can be applied to any dynamic knowledge in any organization domain (e.g., acquisition, command and control, software engineering).

As an example of use and application, consider Figure 2, which illustrates an important knowledge flow desired by the organization. Point A represents one individual in the organization who learns something new (to that organization) or creates entirely new knowledge. In terms of the 5D space, this represents tacit knowledge that is created by an individual (i.e., one person), hence its position at the bottom-back corner of the diagram.

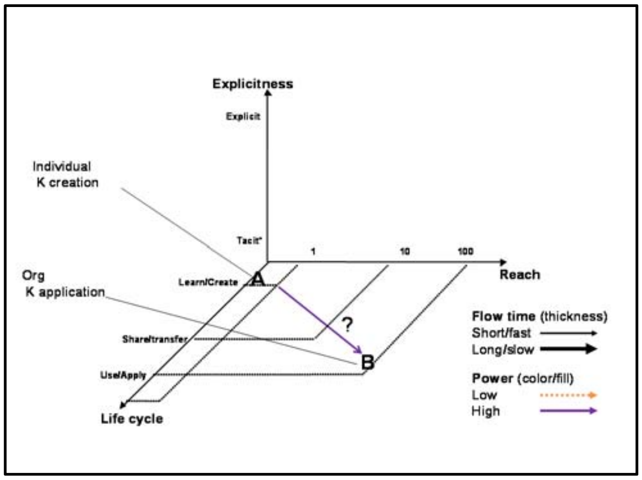

Figure 2. Knowledge Creation and Application Needs

In the acquisition domain, for instance, consider that such new knowledge could pertain to a technique for reducing the acquisition time for an important information system (IS) needed in the field. Because information technology (IT) advances so quickly—outpacing the ability of many acquisition organizations to develop and field systems responsively—the organization views this new knowledge created at Point A as important, and it would like to see such knowledge shared with and applied by all 100 people in that organization who work with IT.

Such application by 100 people in the organization is represented by Point B. The thin, purple, solid vector connecting Points A and B represents the desired knowledge flow: The organization wishes for such knowledge to flow quickly and with high power (e.g., enabling all 100 people at Point B to work, within one day, at the same performance level as the innovative individual at Point A). This represents a 5D knowledge-flow vector. A question mark in the figure next to the vector indicates that such a fast, powerful knowledge flow is desired by the organization, but it is unclear which, if any, organization process can enable it. Indeed, most organizations do lack such a process (Nissen, 2006b). Some other approach to sharing and applying the important IT acquisition knowledge is required.

Figure 3 delineates two alternate archetypical knowledge flows corresponding to processes that are within this organization's capabilities. (We say *archetypical*, because most organizations employ these classic processes routinely, and because they present a vivid contrast in terms of how dynamic knowledge flows.) One knowledge flow is depicted in terms of a relatively fast (i.e., thin lines) but low-power (i.e., orange, dotted lines) vector series; this first flow is associated with explicit knowledge and utilizes one or more ISs for knowledge articulation and distribution in explicit form. The other is delineated via a comparatively slow (i.e., thick lines) but high-power (i.e., purple, solid lines) vector; this second flow is associated with tacit knowledge and utilizes one or more human-centered approaches to knowledge sharing (e.g., group interaction, mentoring, personnel transfer).

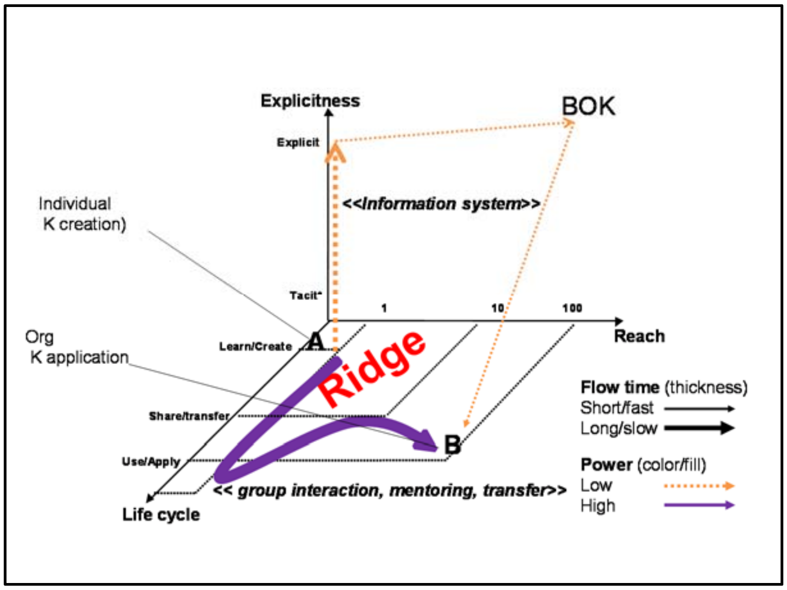

Figure 3. Alternate Archetypical Knowledge Flows

The key is that one can measure these five dimensions of knowledge—whether via explicit or tacit flows—and relate them to the corresponding knowledge-based process performance by people in the organization. Indeed, by correlating such dynamic knowledge measures with performance metrics, one can develop a model capable of analyzing, visualizing, and even predicting process performance based upon knowledge-flow patterns.

Of course, many diverse combinations of these archetypical knowledge flows are possible, too, yet most knowledge flows are likely to reflect some aspects of these two dynamic patterns (Nissen, 2006b). Through empirical analysis and calibration of specific knowledge flowing through any particular organization in the field, one can correlate 5D dynamic knowledge flows with work performance, resulting in a model capable of measurement and prediction. Through this technique, we are working to assess AWF quality in terms of dynamic knowledge flows.

Contract Management Maturity Model

Contract management is a notably challenging process, which can be viewed productively via six phases: (1) procurement planning, (2) solicitation planning, (3) solicitation, (4) source selection, (5) contract administration, and (6) contract closeout/termination (Rendon, 2008). Both individually and together as a set, these six phases of the contract management process form the basis for assessing contract management process capability and maturity, which offer in turn an approach to measuring performance (Garrett & Rendon, 2005; Rendon, 2008).

In a general process sense not specific to contract management, *process capability* is defined as "the inherent ability of a process to produce planned results" (Ahern, Clouse, & Turner, 2001, p. 4). As the capability of a process increases, it becomes predictable and measurable. As the organization steadily improves its process capability, organization competence increases, and organization processes become more mature (Ahern et al., 2001). *Competence*, in this case, is defined as "an underlying characteristic that is causally related to effective or superior performance, as determined by measurable, objective criteria, in a job or in a situation" (Curtis, Hefley, & Miller, 2001, p. 577). *Maturity* can be defined as "a measure of effectiveness in any specific process" (Dinsmore, 1998, p. 169). It is important to note that process maturity is not related to the passage of time. Different organizations mature at different rates, depending on the nature of the business and the emphasis placed on process improvement. Process maturity is more reflective of how far an organization has progressed toward continuously improving its process capability in any specific area.

Organization process capability can be assessed using a process maturity model. These maturity models are built on a series of maturity levels—each maturity level reflective of the level of competence for that process. As the organization gains process competence, it moves up the maturity scale. As maturity increases, so does capability and predictability, while risk decreases. Rendon (2003) was the first to apply the concept of process capability and maturity to organization contract management processes. The CMMM was developed as a method for assessing an organization's contract management process capability and using the assessment results to identify contract management process deficiencies and the need for process improvement. The CMMM has been applied at Air Force, Army, Navy, and defense contractor organizations (Rendon, 2008, 2009, 2010, 2011). The structure of the CMMM is based on the six contract management process phases previously discussed and on the five levels of contract management process capability maturity. Specifically, the five levels of contract management process maturity consist of Level 1 (Ad Hoc), Level 2 (Basic), Level 3 (Structured), Level 4 (Integrated), and Level 5 (Optimized).

From this discussion, it should become clearer how knowledge interrelates dynamically with process capability and maturity. Not only does knowledge exist, grow, and move within and between individual participants of the AWF, manifested through their professional performance of acquisition tasks, but we find it also at the organization level, manifested through the professional performance of processes, which are accomplished by many individual people, working together to accomplish many tasks toward a set of shared goals. Not only must individual people understand and be able to accomplish the key tasks comprising process work, but the organization as a whole must also understand and be able to accomplish the process itself. Organizations at higher maturity levels have arguably developed greater process-level understanding than their lower level counterparts; hence, they show potential to manifest correspondingly higher process performance levels. Knowledge—at the organization level as well as the individual level—drives such understanding and potential.

Research Method

Building upon recent case study research (Barnes & Williams, 2012; Nissen, 2012), in addition to our general acquisition experience and CMMM assessments (Rendon, 2011), we integrated data from previous studies to establish a basis for AWF quality assessment via KFT–CMMM linkage. In particular, we employed KFT and 5D modeling to identify key independent variables (e.g., kinds and levels of knowledge) and CMMM assessment results to identify corresponding dependent variables exhibiting good potential in our research context. We then explored the integration of these two parts (i.e., matching the independent variables with dependent variables) through a combination of qualitative and quantitative analysis.

Results

Results from this exploratory investigation center on delineating the procurement process via KFT, summarizing corresponding CMMM assessments, and linking the two to elucidate insight into AWF quality. We begin with an overview of the focal organizations.

Focal Organizations

The two focal organizations of this study include the contracting centers at two large, operational DoD organizations. Using pseudonyms, the Organization T contracting center provides acquisition and contracting support for the procurement of military equipment and hardware. This includes procuring research and development, systems, and repair parts and services. The Organization T contracting center does a relatively large amount of business (over $10 billion annually).

The Organization R contracting center provides innovative acquisition and contracting support for research and development acquisition. The Organization R contracting center also does a relatively large amount of business (almost $7 billion annually).

Although the Organization T and Organization R contracting centers acquire and procure different types of supplies and services, the contract management processes used are common to both organizations (Rendon & Snider, 2008). Additionally, the contract management processes used at these contracting centers are also common to other DoD and federal government agencies for the procurement of supplies and services. Thus, conclusions based on the analysis of the results from these contract management process assessments may be applicable to other DoD and federal government agencies. Indeed, given that many of the same process activities are required for all procurements, some aspects of our results should apply quite broadly and well beyond the government sector.

Analysis

In this section, we summarize some of the key knowledge data associated with our focal contracting organizations. In particular, we examine and compare three complementary knowledge proxies: procuring contracting officer (PCO) density, DAWIA level, and experience. The first measure characterizes the fraction of respondents surveyed in each organization that possess contracting warrants. The measure represents a sign of knowledge and experience in addition to education. It also, to some extent, represents organization contracting capacity. Since only warranted PCOs can sign contract documents, the greater the number of PCOs, the greater the organizations' capacity for performing the contracting mission. The measure varies from 0 (i.e., no one has a warrant) to 1 (i.e., everyone is warranted). The second measure characterizes respondents' certification levels. As noted in the previous section, there is an educational component (e.g., bachelor's degree and additional training) along with an experiential one (e.g., three years' experience). The third measure sums respondents' years of experience in the contracting domain. This measure is comparatively pure in terms of reflecting principally tacit knowledge.

There is likely to be some confounding and collinearity across these measures, as they all reflect some degree of experience (i.e., tacit knowledge), and the first two both reflect some degree of education (i.e., explicit knowledge) as well. Nonetheless, they do represent knowledge proxies that lend themselves to examination in our exploratory research context. Further, although each of these three measures is static in nature, all three are expected to have strong association with organization performance in terms of our process maturity measure. Follow-on research can build upon our results to refine these data, expand data collection, and investigate dynamic knowledge measures as well.

Table 1 summarizes numerical results for the Organization T suborganizations individually and as a whole. For Organization T, the CMMM survey resulted in 132 responses, reflecting a response rate of 56%. The first column identifies each individual suborganization by a two-letter code (e.g., "AB") and includes average values across all seven such individual suborganizations (i.e., "All"). The second column summarizes the relative density of warranted contracting officers surveyed in each suborganization. In the AB suborganization, for instance, roughly 40% of survey respondents were warranted as such. This exceeds the density of warranted contracting officers in the organization as a whole of course, but it reflects the relatively high-level pool of people surveyed. Such high-level people possess relatively good understanding of the organization's contracting processes and hence serve as appropriate respondents to evaluate its maturity. In similar fashion, the third column summarizes the relative certification level in each organization. In this same AB suborganization, for instance, the average certification level is 2.6. This reflects likewise appropriately a relatively highly certified pool of respondents with Level II and Level III DAWIA certifications. The fourth column summarizes the relative experience level in each organization, with suborganization AB shown at nearly 11 years' average experience among contracting personnel surveyed. Notice how the HD suborganization at the bottom of the table appears to be something of an outlier with a considerably higher experience level (i.e., 16.8 years).

Table 1. Organization T Knowledge Summary

Org	PCO	DAWIA	Years
AB	0.4	2.6	10.8
AD	0.2	2.6	11.4
AH	0.2	2.5	10.7
AI	0.6	2.8	12.8
AS	0.2	2.6	10.8
AT	0.3	2.4	11.6
HD	0.2	2.7	16.8
All	0.3	2.6	12.1

Note. n = 132

Table 2 summarizes knowledge data in the same manner for Organization R. Here the RT suborganization reflects that every respondent possesses Level III DAWIA certification. Notice how the overall comparison (i.e., "All" data) across these two organizations reflects slightly higher values for each knowledge proxy (i.e., PCO: 0.5 versus 0.3; DAWIA: 2.7 versus 2.6; years: 13.9 versus 12.1), whereas the individual organizations show comparative plusses and minuses across each proxy. For Organization R, the CMMM survey resulted in 96 responses, reflecting a response rate of 44%.

Table 2. Organization R Knowledge Summary

Org	PCO	DAWIA	Years
AD	0.5	2.5	14.9
AI	0.5	2.5	12.3
AP	0.5	2.8	13.1
ED	0.6	2.7	15.0
RT	0.4	3.0	14.1
All	0.5	2.7	13.9

Note. n = 96

Continuing the discussion, look now at the expanded Table 3, which incorporates two additional columns of information pertaining to Organization T. The fifth column summarizes the maturity score for each organization. This score represents the sum across all six categories, averaged for each individual suborganization. The AB suborganization, for instance, has a score of 221.6. This is the sum of six category scores for that suborganization (i.e., 38.8 for the procurement planning part, 40.8 for the solicitation planning part, 39.0 for the solicitation part, 36.4 for the source selection part, 39.8 for the contract administration part, 26.8 for the contract closeout part). The score for each category represents the average across all respondents in that organization. As noted in the previous section, higher scores correspond with higher maturity levels. The same scheme follows for the other suborganizations reported in this table. Table 4 follows the same format for Organization R.

Table 3. Organization T Maturity Summary

Org	PCO	DAWIA	Years	Score	Maturity
AB	0.4	2.6	10.8	221.6	2
AD	0.2	2.6	11.4	218.5	2
AH	0.2	2.5	10.7	202.5	2
AI	0.6	2.8	12.8	267.5	4
AS	0.2	2.6	10.8	240.6	3
AT	0.3	2.4	11.6	221.4	2
HD	0.2	2.7	16.8	241.7	3
All	0.3	2.6	12.1	230.6	2

It is important to note that we generally calculated, reported, and interpreted maturity scores for each of the six categories individually (Rendon, 2011). Continuing to use the AB suborganization as an example, we would normally use its score of 38.8 for the procurement planning part, for instance, for conversion to a maturity level of 3 (Structured). We would then likewise use its scores of 40.8 for the solicitation planning part and 39.0 for the solicitation part for similar conversion to Level 3. The scores of 36.4 for the source selection part, 39.8 for the contract administration part, and 26.8 for the contract closeout part convert to Level 2 (Basic). Summarizing up from this level of detail, the combined score of 221.6 would convert to an overall maturity level of 2, only just shy of Level 3. This level is reported in the sixth column for both the Organization T and Organization R suborganizations. The overall maturity levels of 2 for both organizations as wholes reflect weighted averages of these individual organization levels.

Table 4. Organization R Maturity Summary

Org	PCO	DAWIA	Years	Score	Maturity
AD	0.5	2.5	14.9	236.2	3
AI	0.5	2.5	12.3	189.6	2
AP	0.5	2.8	13.1	206.5	2
ED	0.6	2.7	15.0	222.2	2
RT	0.4	3.0	14.1	167.8	2
All	0.5	2.7	13.9	204.5	2

Now we seek to interconnect and interrelate the two kinds of data by exploring any relationships that may be apparent between our knowledge proxies and maturity scores. We can view these same data graphically. Figure 4 delineates the overall relationship between PCO and maturity score, for instance, across all organizations combined (i.e., Organization T and Organization R together). Overall, this does not appear to reflect a strong relationship, however. Indeed, the regression R^2 for this pair is 0 ($p = 0.87$). When combining the two organizations together, no pairwise relationship appears strong (e.g., $R^2 = 0.04$, $p = 0.56$ for Score-DAWIA; $R^2 = 0.01$, $p = 0.74$ for Score-Years). We do not plot these other views.

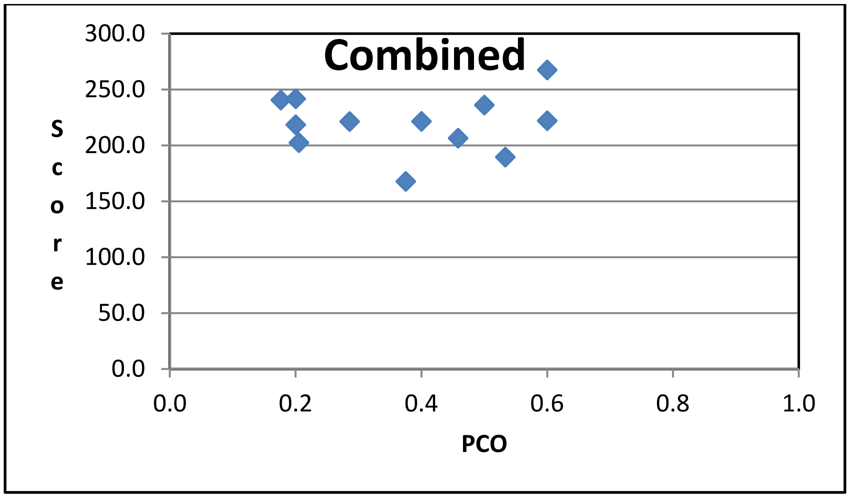

Figure 4. Combined Score-PCO Relationship

The relationship becomes somewhat more apparent when we separate the two organizations, however. Looking solely at Organization T in Figure 5 or Organization R in Figure 6, for instance, the interrelationship is more noticeable, both graphically and statistically (e.g., Organization T: $R^2 = 0.36$, $p = 0.15$; Organization R: $R^2 = 0.41$, $p = 0.25$).

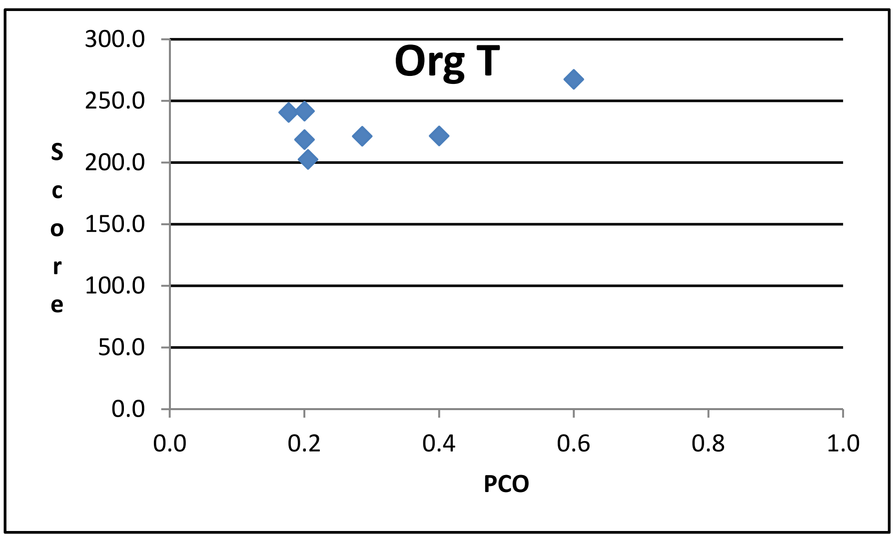

Figure 5. Organization T Score-PCO Relationship

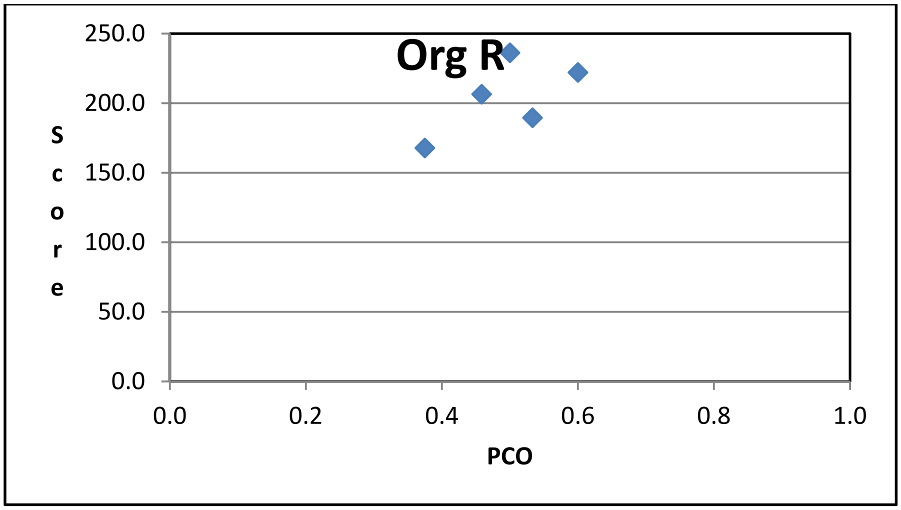

Figure 6. Organization R Score-PCO Relationship

Figures 7 and Figure 8 each delineates the respective relationship between DAWIA and maturity score, for instance, across the two organizations individually (i.e., Organization T and Organization R separately). Overall, this appears to reflect a stronger relationship (e.g., Organization T: $R^2 = 0.64$, $p = 0.03$; Organization R: $R^2 = 0.44$, $p = 0.22$) than those depicted previously in Figures 5 and 6 for PCO.

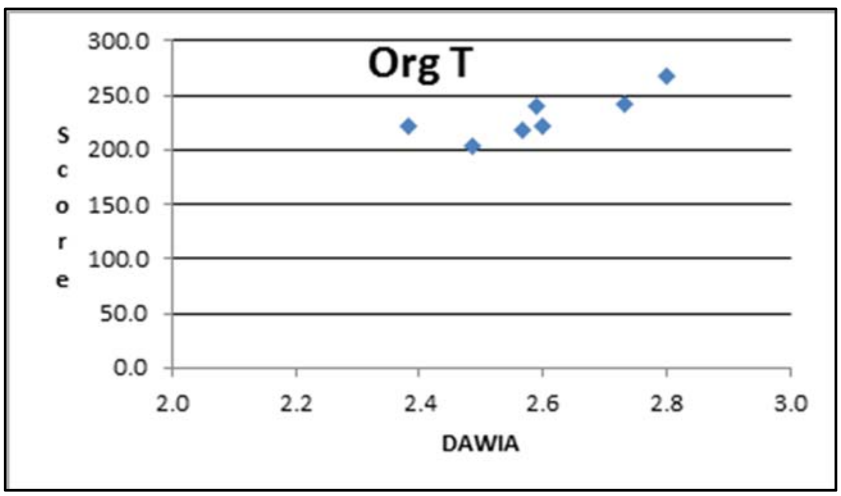

Figure 7. Organization T Score-DAWIA Relationship

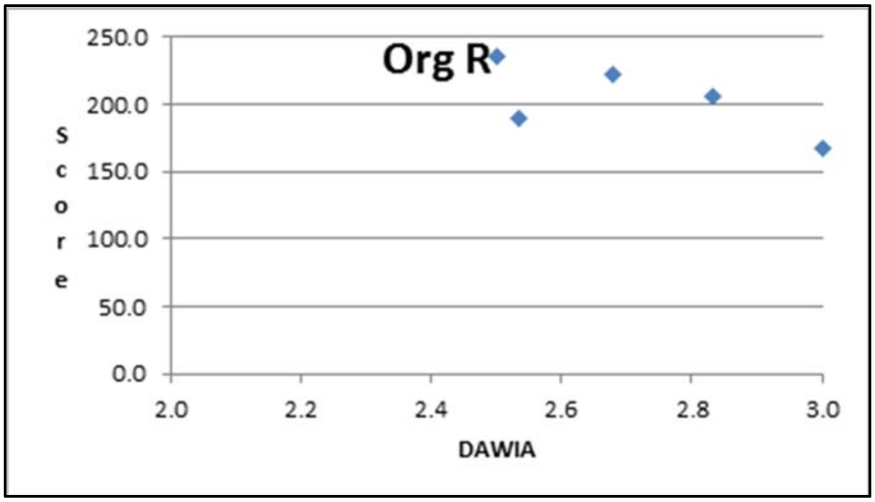

Figure 8. Organization R Score-DAWIA Relationship

Figure 9 delineates the relationship between years and maturity score, for instance, across Organization T individually. In this view, the one outlier (i.e., the HD suborganization) noted in the previous section appears quite prominently, and it affects the statistical fit (e.g., $R^2 = 0.22$, $p = 0.29$) accordingly.

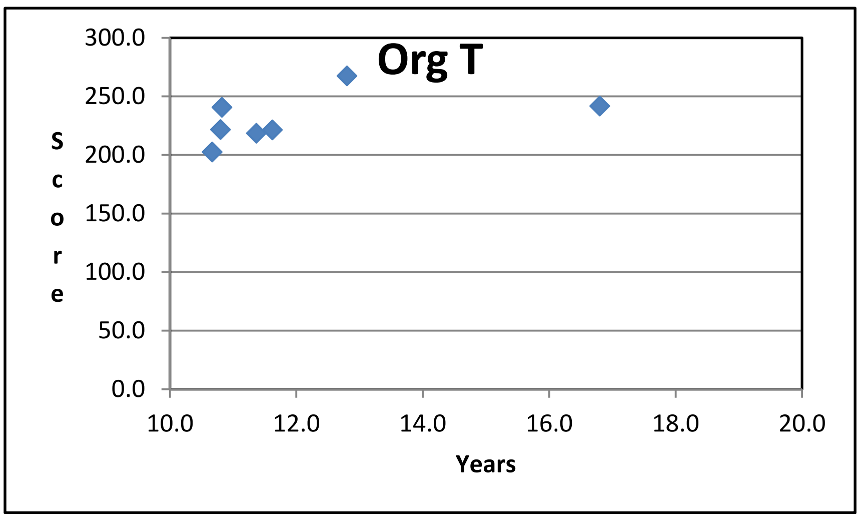

Figure 9. Organization T Score-Years Relationship

When we remove that outlier, however, as reflected in Figure 10, the relationship between years and maturity score becomes considerably more apparent graphically and stronger statistically (e.g., $R^2 = 0.59$, $p = 0.07$). The corresponding relationship is not as strong when viewing Organization R separately as in Figure 11 (e.g., $R^2 = 0.27$, $p = 0.37$).

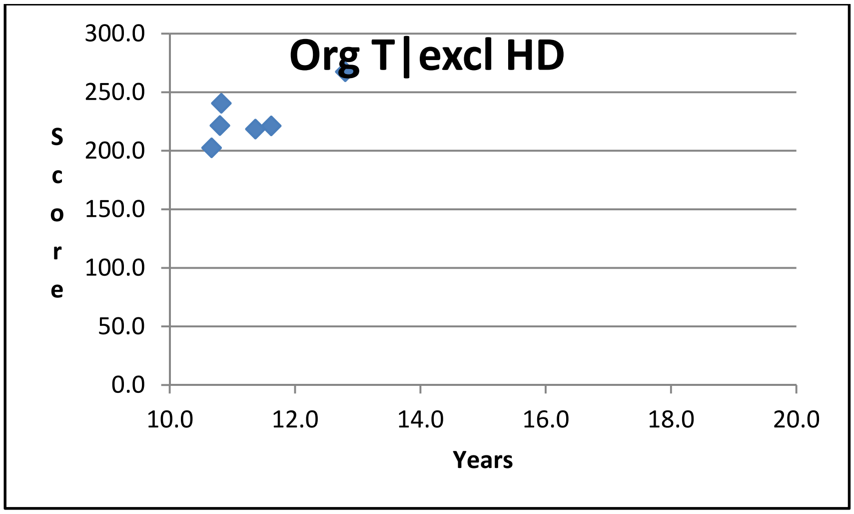

Figure 10. Organization T Score-Years Relationship (Sans Outlier)

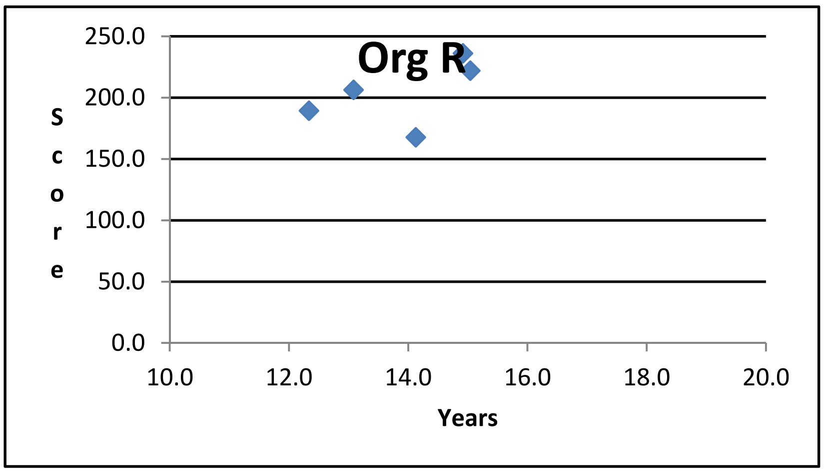

Figure 11. Organization R Score-Years Relationship

Our final look at these relationships involves multiple regression that includes all three knowledge proxies. We understand, of course, that results can be potentially highly spurious—and accordingly, the results can be potentially very tenuous—with so few observations, but it accommodates our exploratory interest, and it provides some new insight, nonetheless. Given the associated multidimensionality, we do not show graphics for this, but we note the statistical results for Organization T (e.g., $R^2 = 0.71$, $p = 0.24$) and Organization R (e.g., $R^2 = 0.72$, $p = 0.64$) individually. Noting the small number of observations again, these statistics suggest that knowledge as measured via our static proxies corresponds with performance in terms of process maturity. This represents a noteworthy discovery, and it begins to provide some empirical evidence to support our theoretical connection between knowledge flows and process maturity. We address several avenues for future research to build upon these exciting and new but exploratory and tenuous results.

Conclusion

In this exploratory study, we examined acquisition from the perspective of the procurement process, focusing in particular on organization knowledge and performance with respect to the processes used for the procurement of major systems and services. Building upon considerable field research involving two large, operational defense organizations, we collected data to summarize the absolute and relative knowledge levels across multiple organization units within both focal organizations. Specifically, we identified three knowledge proxies with good theoretical potential to correspond well with performance: PCO density, DAWIA level, and experience. We also collected data to summarize these organizations and units' corresponding process maturity levels as a performance measure, and we worked to interrelate knowledge and performance accordingly.

Examination of the organizations' data revealed considerable variation, both within and across them, in terms of all three knowledge proxies, and we also found ample variation in terms of process maturity. Because our unit of analysis is the organization unit, we do not have a large number of observations to support sophisticated statistical analysis. We do, nonetheless, provide both graphical and statistical summaries of the interrelationships between knowledge and performance, summaries that suggest a noteworthy empirical correspondence as predicted theoretically. Further, by interrelating knowledge to performance in terms of process maturity, this report presents the premier cause–effect relationship of its kind in the acquisition domain.

This article provides only an exploratory beginning to such promising research, however; hence, it illuminates a number of opportunities for productive follow-on work to build upon our results. For one, promising follow-on research could leverage the method developed here to expand the study across many other organizations and units. For another, future research to increase the number and sophistication of such proxies could lead to sharper, more discriminatory measures. For a third, considerable follow-on research to validate the survey instruments, calibrate the conversion tables, and understand how maturity interrelates with—and conceivably influences—other performance dimensions appears to be open-ended and highly promising at present. Finally, a desirable end result includes offering policy, leadership, and management guidance for the acquisition community. Given the importance of knowledge in terms of workforce quality, and given the dynamic nature of both the acquisition domain and its workforce, managers, leaders, and policy-makers need better guidance to develop organization innovations that offer good potential for positive impact. We continue making good metaphorical strides toward this result, which continued funding and research will facilitate and drive.

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