Facilitating Decision-making, Re-use and Collaboration: A Knowledge Management Approach to Acquisition Program Self-awareness

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FACILITATING DECISION-MAKING, RE-USE AND COLLABORATION: A KNOWLEDGE MANAGEMENT APPROACH TO ACQUISITION PROGRAM SELF-AWARENESS

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Facilitating Decision-making, Re-use and Collaboration: A Knowledge Management Approach to Acquisition Program Self-awareness

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Abstract

Decades of reform have been largely ineffective at improving the efficiency of the DoD Acquisition System, due in part to the complex processes and stovepipe activities that result in duplication of effort, lack of re-use and limited collaboration on related development efforts. This research applies Knowledge Management (KM) concepts and methodologies to the DoD acquisition enterprise to increase “Program Self-awareness” (Gallup & MacKinnon, 2008, p. 2). This research supports the implementation of reform initiatives such as Capability Portfolio Management and Open Systems Architecture, which share the common objectives of reducing duplication of effort, promoting collaboration and re-use of components. The DoD Maritime Domain Awareness (MDA) Program will be used as a test case to develop prototype data schemas and apply text and data mining tools to identify duplication and/or gaps in the features of select MDA technologies. This paper will also provide the foundation for future development of the Program Self-awareness concept and KM tools to support decision-making and improve the effectiveness of the DoD Acquisition System.

I. Introduction

A. Background

The Department of Defense (DoD) fiscal year 2009 budget for Research, Development, Test and Evaluation (RDT&E) and procurement exceeds $180 billion (Gates, 2009, p. 37). Given such huge budget outlays and the increasing pressures of shrinking discretionary budgets and fragile economy, the DoD Acquisition System is the subject of intense scrutiny from government oversight activities, industry, and the general public. This scrutiny has been amplified by highly publicized acquisition program failures, continued cost and schedule overruns and lengthy development cycles.

DoD acquisition has endured an environment of seemingly perpetual reform to arrest this chronically poor performance, resulting in complex acquisition process models, increased executive oversight, and incremental policy changes. The effectiveness of acquisition reforms has yet to be evidenced in the overall performance of the DoD Acquisition System. Independent and government-chartered studies and reports have repeatedly highlighted the need for improved systems engineering and business processes to incorporate best practices from the commercial sector.

The DoD has embraced several recommendations from these critical reports and moved to adopt several commercial best practices and process initiatives. Two such policy initiatives relevant to this research are the adoption of Capability Portfolio Management (CPM) and Open Architecture (OA) approaches, discussed at length in later sections of this paper. CPM and OA are relatively early in their implementation and address different levels of the acquisition process, but reflect the overarching DoD goals of improving decision-making regarding systems-of-systems (SoS) acquisitions to avoid duplication, identify gaps, and decrease costs and development times.

The tools and processes used by acquisition decision-makers to support implementation of CPM and OA are not well defined. A fundamental requirement of both CPM and OA approaches is that acquisition managers develop an awareness of related efforts and activities across an enterprise and/or community of interest (COI) to identify duplication of effort, capability gaps, re-use and collaboration opportunities. It is the premise of this paper that development of improved “Program Self-awareness” is fundamental to the success of the CPM and OA reform initiatives. This paper applies commercial and government best practices to develop Program Self-awareness through Knowledge Management (KM) methods and tools.

The DoD Maritime Domain Awareness (MDA) Program will be used as a test case for application of KM decision support tools to provide normalized “views” of program elements and attributes, termed “features”, to support informed program decision-making. The premise of this research is that application of KM tools will improve Program Self-awareness and support the informed decision-making required to realize the full potential of the CPM and OA initiatives.

B. Problem Statement and Research Question

DoD acquisition is an extremely complex system comprised of numerous stakeholders and organizations that navigate an array of procurement processes in an uncertain environment to deliver useful military capability to the warfighter at the best possible value to the government. Acquisition reforms have been largely ineffective at improving the efficiency of the system, due in part to stovepipe activities that often result in duplication of effort, lack of re-use and

collaboration on related development efforts. This research applies KM concepts, methodologies, and tools to DoD acquisition programs to increase its self-awareness. It is the goal of this research to demonstrate the Program Self-awareness concept through application of prototype decisions support tools to the DoD MDA Program to answer the following research question.

- How can KM methodologies and decision support tools be used to improve Program Self-awareness and decision-making to reduce duplication and enable collaboration and re-use in complex DoD acquisition programs?

C. Methodology

This paper provides an overview of ongoing thesis research which will explore the problem of duplication, lack of re-use and collaboration in DoD Acquisition and follow the intuition that increased "Program Self-awareness," enabled by KM decision support tools, will improve acquisition process efficiencies in these areas. The research will be grounded in Systems Theory and Congruence Model to develop an understanding of the DoD Acquisition System and identify root causes of the stated problem. This research will apply KM tools to the DoD MDA Program as a test case and evaluate the potential for improved Program Self-awareness based on feedback from the office of the DoD Executive Agent (EA) for MDA. This work will provide the foundation for future research on the Program Self-awareness concept and development of KM tools with the goal of improving decision-making and enabling re-use and collaboration in DoD acquisition programs

D. Scope

The impact of implementation of the concepts and tools suggested in this research on other organizational components within the DoD Acquisition System (structure, processes, people) are not addressed in depth in this research. It is recognized that further research will be required to study organizational congruence and cultural issues to realize the full benefits of the Program Self-awareness concept.

II. Systems Theory and Organizations

This research explores the potential for change in the DoD Acquisition System through application of KM tools to improve Program Self-awareness. The Congruence Model, depicted in Figure 1, is grounded in Systems Theory and provides a framework to understand the complexity of the DoD Acquisition System.

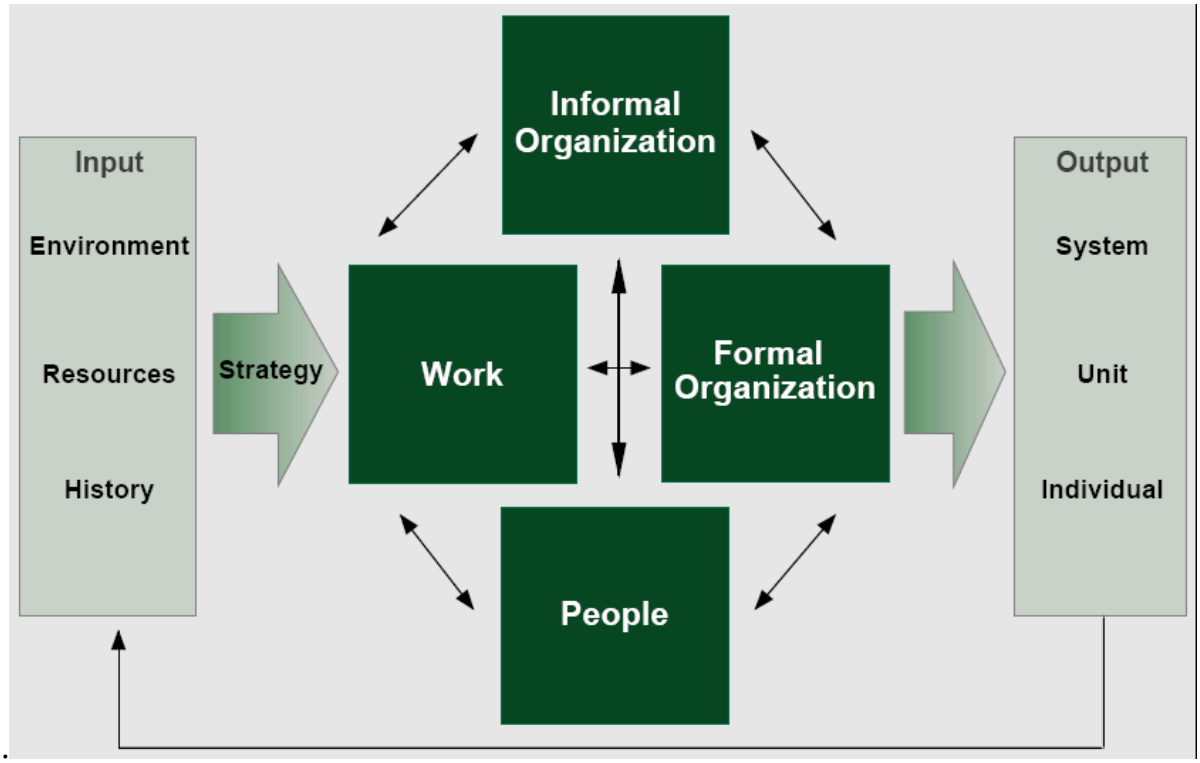

Figure 1. The Congruence Model
(Mercer Delta, 1998, p. 14)

This research focuses on the potential benefit of technology, namely KM tools, to improve "fit" among acquisition system components to achieve improved output efficiency and facilitate implementation of policy objectives such as CPM and OA. The Congruence Model is useful in this context as it highlights the interdependency among system components, which must be considered when introducing such tools into a complex system (Mercer Delta, 1998, pp. 1-15). This research suggests that application of KM tools may form a sort of "glue" to improve the fit among components, and that subsequent change(s) to other system components, namely organizations and processes (work), will likely be necessary due to implementation of these technologies

This research seeks to demonstrate the potential increase in MDA Program Self-awareness, which could facilitate improved decision-making, increased collaboration, object re-use, and reduced development timelines. Figure 2 applies the Congruence Model to the DoD Acquisition System and highlights the opportunity area for application of KM tools and collaboration to improve fit among components and overall efficiency of the system.

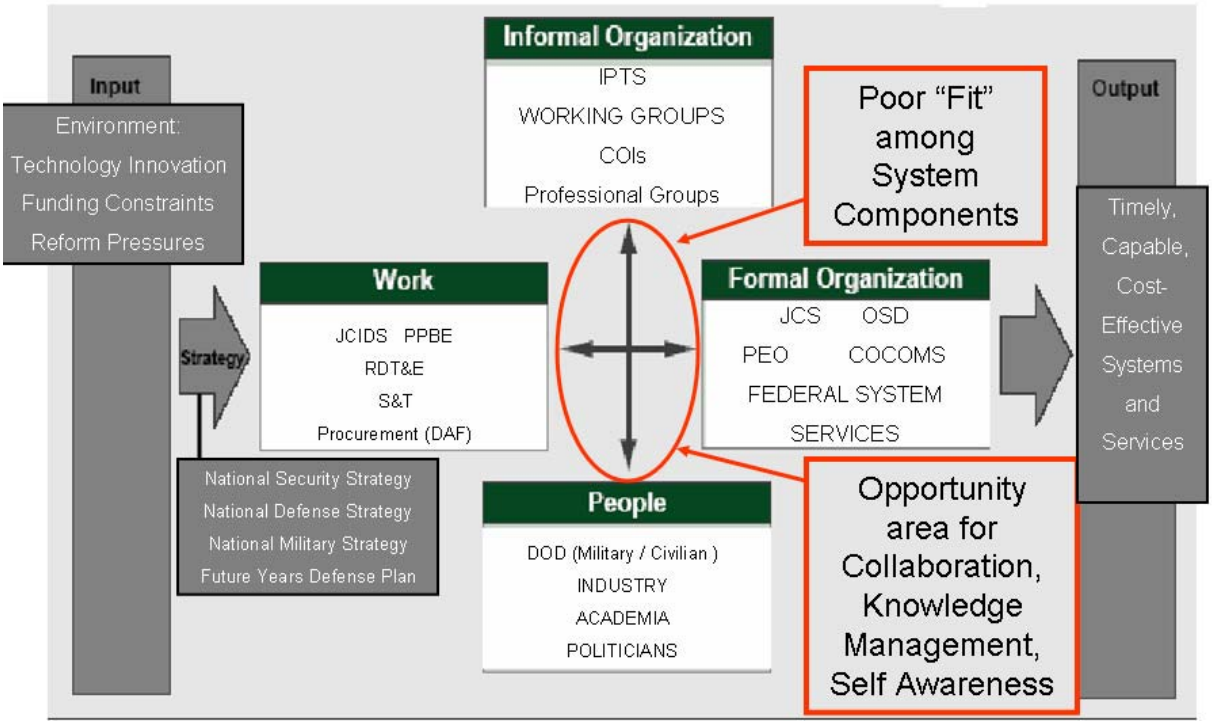

Figure 2. The Congruence Model Applied to the DoD Acquisition System
(Mercer Delta, 1998, p. 14)

III. Program Self-awareness

This research defines Program Self-awareness as the collective and integrated understanding of program attributes (system technology features, R&D activities, etc.) and surrounding environment by program decision-makers (program managers, system engineers, sponsors). Program Self-awareness allows decision-makers to recognize relationships among program attributes and seize collaboration and re-use opportunities to support cost effective acquisitions.

Achieving Program Self-awareness in complex acquisition programs such as the DoD MDA program is a lofty goal considering the myriad of stakeholders, processes, people, activities, and organizational structures involved. This research will highlight the potential of KM tools to provide an incremental improvement in Program Self-awareness. The figure below represents what Program Self-awareness embodies in the MDA Community of Interest, supported by collaboration and use of KM tools to enable improved decision-making (Gallup & MacKinnon, 2008, p. 2).

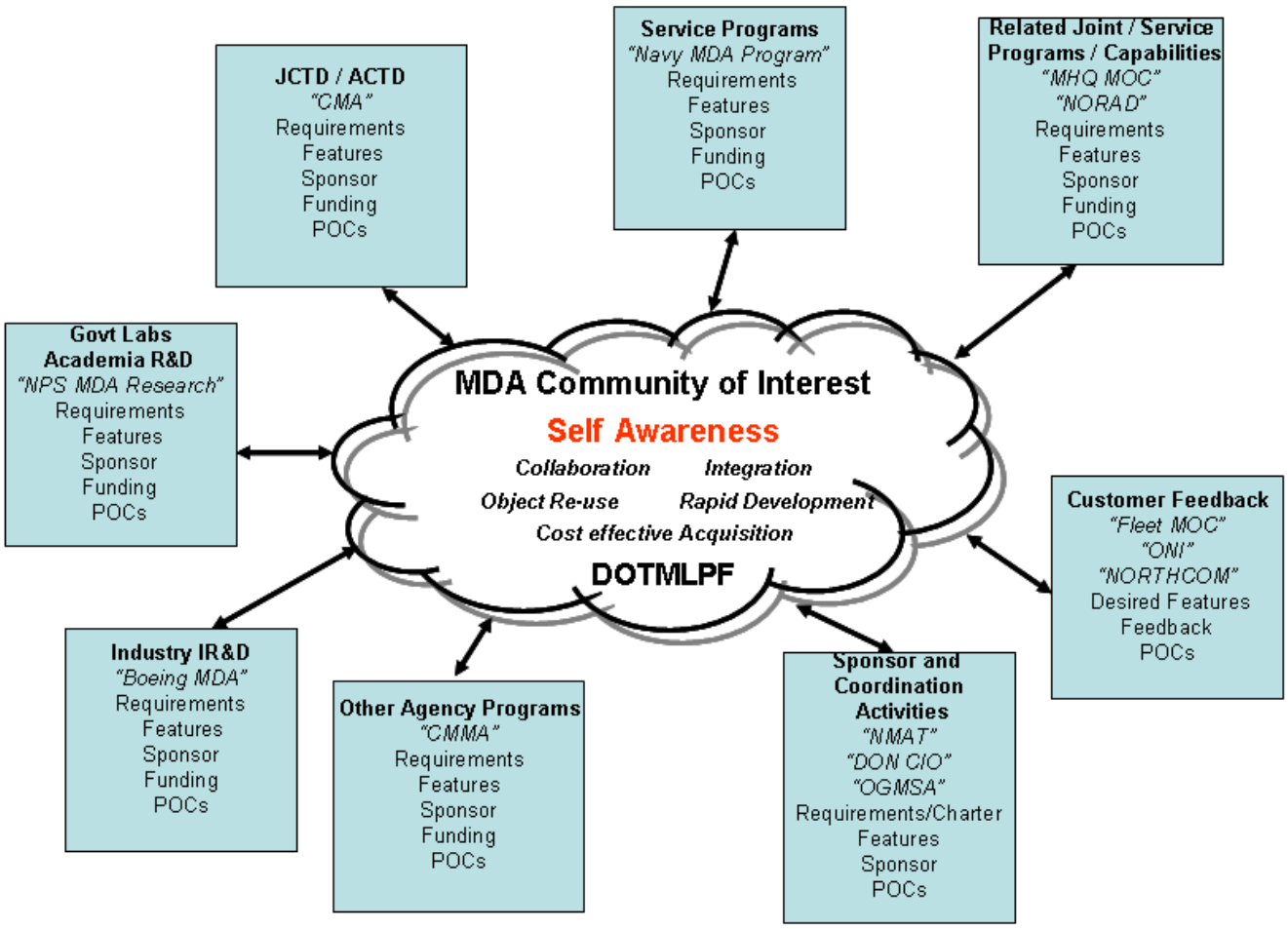

Figure 3. MDA Program Self-awareness
(Gallup & MacKinnon, 2008)

IV. Knowledge Management

The information age continues to shape the organizational environment and produce varying effects on all system components of the Congruence Model. The power of personal computing, global networking, and collaborative technologies are now fundamental to many organizational processes—enabling increased speed, availability, and volume of data to support decision-making. These technology changes have challenged organizational norms and forced organizations to perform varying degrees of self-analysis to assess the impact of these changes to the fit among organizational components (Mercer Delta, 1998, p. 15).

The challenges posed to organizations in the information age are many, to include the task of turning massive amounts of data into pertinent knowledge and leveraging the potential of the network enabled "informal organizations" to improve decision-making. The study of the dynamics and potential of technology, process, and structure to improve organizational knowledge and decision-making has fueled academic study and technology research and development under the umbrella term of Knowledge Management (KM). The formal definitions of KM vary widely among theorists and practitioners in the field, but generally address the common goal of improving the ways organizations transform data into knowledge to support

decision-making. This research will focus on how KM methodologies and tools which can be applied to organizations to improve process, structure, and decision-making.

The application of KM principles to DoD acquisition was the subject of research by military fellows at the Defense Systems Management College (DSMC) in January 2000, titled "Program Management 2000: Know the Way. How Knowledge Management Can Improve DoD Acquisition" (Cho, Hans & Landay, 2000). The DSMC fellows draw the following conclusions relevant to this research:

- the commercial sector is successfully adopting KM strategies to achieve competitive advantage;
- Implementation of KM technologies in an organization must consider impacts on its people, processes, and structure to be successful;
- KM initiatives require culture change and must have the full support of the leadership to be successful;
- Mangers who effectively use their company's knowledge were able to overcome knowledge-based barriers and institutional stovepipes to improve collaboration and customer relationships;
- KM is a source of organizational and economic value;
- Communities of Practice or Interest (COP/COI) are forums of networked people with similar interests and issues which come together to address problems, provide solutions, share ideas, and build communication links. COI development provides the foundation for KM implementation;
- KM implementation should be an incremental process built upon small successes. (Cho et al., 2000)

Cho et al. make a compelling case for adoption of a KM concepts, tools and strategy in the DoD Acquisition System. This research will apply specific KM tools to a specific acquisition problem in hopes it will lead to the "small success" the DSMC researchers suggest is vital to foster widespread KM adoption in DoD acquisition.

A. KM Tools

KM tools and methodologies support the transformation of data into information and knowledge. The KM tools relevant to this research include data and text mining, data warehousing, data analysis and visualization.

1. Data and Text Mining

DoD acquisition programs generate massive amounts of documentation during all phases of development process, to include text documents, spreadsheets, and structured relational databases, etc. The amount of data and text contained in these documents is staggering and holds great potential for application of data and text mining techniques to derive and discover useful information that can be used to generate knowledge and improve decision-making from a sea of seemingly unrelated data.

Data mining is a "class of information analysis based on databases that looks for hidden patterns in a collection of data which can be used to predict future behavior. True data mining

software does not just change the presentation, but actually discovers previously unknown relationships among the data" (Turban, Shardra, Aronson & King, 2008, p. 13).

Text mining is "the application of data mining to non-structured or less structured text files, which entails the generation of meaningful numeric indices from the unstructured text and then processing those indices using various data mining algorithms" (Turban et al., 2008, p. 224).

This research will apply certain data and text mining techniques to the DoD MDA Program to demonstrate the potential for increased Program Self-awareness of the portfolio of MDA system features to support improved programmatic decision-making.

2. Data Warehouses and Data Marts

Data mining techniques require a set of data be defined from which the various data mining algorithms can be applied and subsequent analysis be performed. This set of data is termed a data warehouse or data mart. A data warehouse is a "physical repository where relational data are specifically organized to provide enterprise-wide, cleansed data in a standardized format." (Turban et al., 2008, p. 223). A data mart can be considered a subset of a data warehouse which can be used to support a functional area, department, or community of interest. These terms will be used interchangeably for the purposes of this research (Turban et al., 2008, p. 222).

The development of data warehouses into the structured form required to support data mining is not a trivial process. The data warehouse will need to be developed to support the functional area being supported and have the following fundamental characteristics: subject-oriented, integrated, time-variant, and nonvolatile. The data warehouse may also be developed to include the following capabilities: web-based, relational/multi-dimensional, client/server, and include metadata (data about data. (Turban et al., 2008, pp. 39-40).

Text mining, on the other hand, is focused on developing new meanings and relationships from unstructured data in the form of documents (memos, e-mails, instructions, policies, etc.) to support decision-making. The set of documents required to support text mining can vary in type and structure, providing much more flexibility in formulation compared to data warehouse development. The additional benefit of text mining is the amount of information available in a form ready for processing, which includes upwards of 80% of the data a typical organization collects. Text mining algorithms are also complex and typically involve the following steps.

1. Eliminate commonly used words (the, and, other);

2. Replace words with their stems or roots (e.g., eliminate plurals, and various conjugations and declarations);

3. Consider synonyms or phrases (e.g., student and pupil may be grouped together);

4. Calculate the weight of the remaining terms (e.g., based on frequency of occurrence in a document or set of documents). (Turban et al., 2008, pp. 159-160)

3. Analytics and Visualization

The development of data described above supports its transformation to information and knowledge through the process of analytics and visualization. Analytics can be defined as a "category of applications and techniques for gathering, storing, analyzing, and providing access to data to help enterprise users make better business and strategic decisions" (Turban et al., 2008, p. 86). This research will apply several analytical applications, to include data mining, text mining and visualization techniques to discover new information and knowledge. These KM tools have the potential to highlight relationships among program "features" to support decision-making regarding duplication of effort, gaps, re-use and collaboration opportunities in the DoD MDA program. For the purposes of this research, a "feature" is a marketable behavior or property of a system, ideally documented in a design, such as the "power window" feature on modern automobiles.

B. Collaboration

This research has repeatedly identified the importance of collaboration to support KM implementation. The DSMC study heavily emphasized the linkage between KM success and the organization's culture of information sharing and collaboration. The DSMC researchers also concluded that a typical DoD acquisition program performs very little collaboration across different programs other than informal networks of functional area experts formed at the same physical location. When development teams were asked how often they go outside their program organization to seek knowledge to problems they faced, the most frequent response was "rarely if ever." The researches found it wasn't that the teams didn't recognize the potential power of collaboration, they just "don't know who else is working on similar issues or don't see any connection between their project and another one in a different area" (Cho et al., 2000, pp. 1-4).

The size of the DoD Acquisition enterprise, lack of enterprise collaboration and KM tools and stovepipe organizational structures do not support a culture of information sharing. The continued explosion and proliferation of networking technologies has penetrated the DoD acquisition environment and spawned several collaboration and knowledge-sharing initiatives germane to this research, which may represent the early stages of a move towards greater collaboration in DoD acquisition:

In recognition of the imperative and potential power of collaboration to support the complex DoD Acquisition System, KM and acquisition experts at NPS (Thomas, Hocevar & Jansen, 2006) studied collaboration in the most complex DoD and Interagency acquisitions to develop a "collaborative capacity" assessment tool. Figure 3 depicts the "Collaborative Capacity" model developed by Thomas et al (2006) to guide their research. The notion that collective self-awareness is integral to the success of solving a common problem can be derived from this model. It can also be inferred from the model that collaboration is the "glue" used to bond "stovepipe" organizations together to solve a common problem such as an inter-agency acquisition.

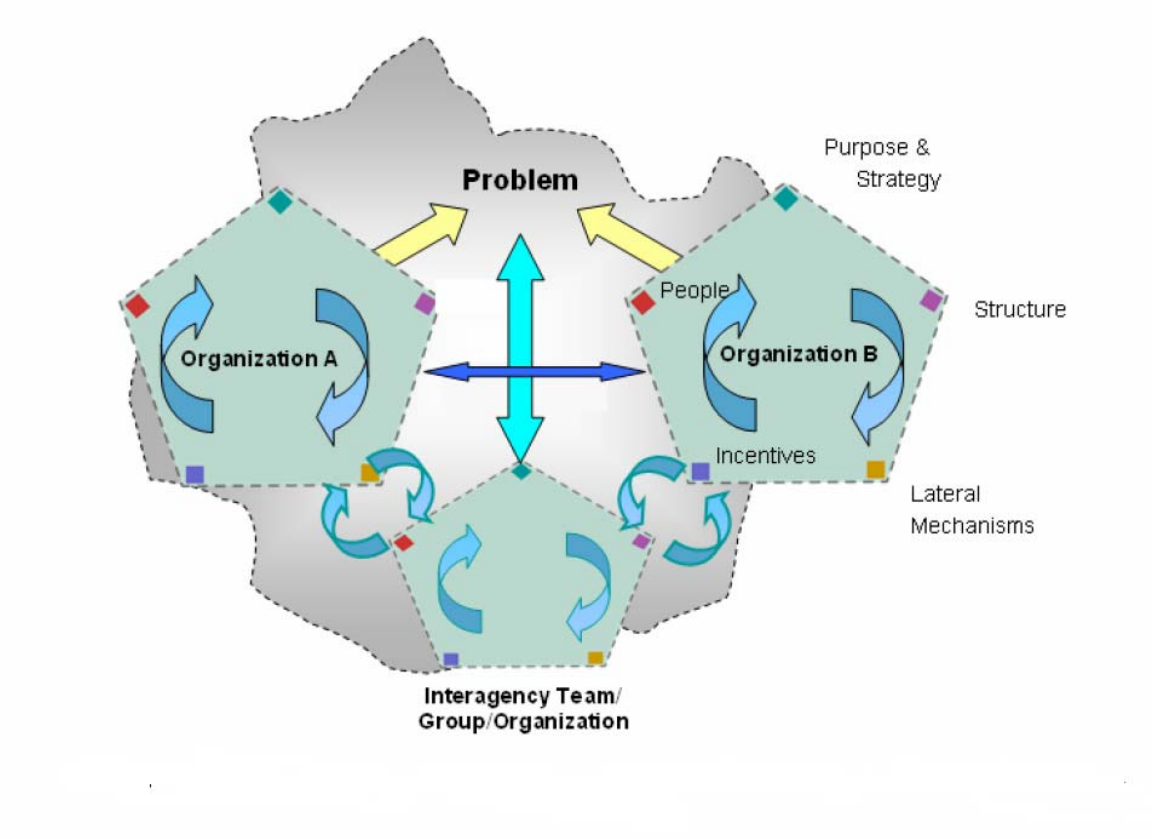

Figure 4. Collaborative Capacity Model
(Thomas et al., 2006, p. 7)

V. DoD Acquisition Initiatives

Two DoD acquisition policy initiatives relevant to this research are the adoption of Capability Portfolio Management (CPM) and Open Architecture (OA) approaches. Both CPM and OA are relatively early in their implementation and address different levels of the acquisition process, but share the common goal of improving DoD decision-making regarding systems-of-systems (SoS) acquisitions to avoid duplication, reduce costs, and decrease development times.

A. Open Architecture (OA)

The emphasis on open systems architecture (OA) has increased over the past decade with OA now recognized as an integral part of DoD systems engineering and acquisition processes. OA is not a new concept, however, and draws from engineering design principles that have shaped mature industries for many decades. The modern automobile is one such example of OA design principles, as it supports integration of thousands of its components through what can be viewed as a system-of-systems design. This OA design allows most components to be built by numerous manufactures to a standard interface specification, which allows tires built by numerous manufactures to fit onto the wheels of a wide range of vehicles. The OA approach is very attractive in the context of DoD acquisition as it offers potential for decreased development timelines and reduced costs largely through re-use of components in system-of-systems acquisitions. OA designs also support quick upgrades and modifications, removing the requirement to redesign other components or entire system as would be

necessary due to change propagation in closed or non-modular system designs. The application of OA to the design of software-intensive systems has been the focus of early OA initiatives, to include the Navy PEO-IWS Software Hardware Asset Reuse Enterprise (SHARE) Repository, which serves as a searchable library of ship combat systems software and related assets available for re-use by eligible contractors.(Johnson & Blais, 2008, p. 1).

The increased emphasis on OA has resulted in several initiatives to establish common technical and architectural standards to promote increased re-use and interoperability for OA systems, to include the SHARE repository described above. These efforts are critical to the success of DoD OA implementation and require continued development of common vocabularies and collaboration tools to facilitate discovery of related efforts and potential re-use opportunities.

A fundamental requirement of OA is that acquisition managers develop an awareness of related efforts and activities across an enterprise and/or COI to support decision-making regarding re-use and collaboration opportunities. It is the premise of this paper that development of Program Self-awareness is fundamental to the success of OA policy initiatives.

B. Capability Portfolio Management (CPM)

In 2006, the Deputy Secretary of Defense released a memorandum to introduce the Capability Portfolio Management (CPM) approach to DoD Acquisition. The intent of exploring the CPM approach was:

> to manage groups of like capabilities across the (DoD) enterprise to improve interoperability, minimize capability redundancies and gaps, and maximize capabilities effectiveness. Joint capability portfolios will allow the Department to shift to an output-focused model that enables progress to be measured from strategy to outcomes. Delivering needed capabilities to the joint warfighter more rapidly and efficiently is the ultimate criterion for the success of this effort. (Deputy Secretary of Defense, 2006, p. 1)

The initial implementation of CPM included establishment of four capability area test cases (Joint Command and Control, Joint Net Centric Operations, Battlespace Awareness, Joint Logistics) to evaluate the CPM approach with the long-term goal of achieving broader implementation in the 2009-2013 timeframe. CPM goals, objectives, and guidance emphasized the importance of system-of-systems engineering approaches and “data transparency”:

> test case managers–in conjunction with existing data management stewards and the Institutional Reform and Governance effort–should work together to establish an approach (business rules, data structure changes, knowledge management tools) that will strengthen the linkage of authoritative information to capabilities without compromising information flexibility. (Deputy Secretary of Defense, 2006, Attachment A, p. 4)

CPM implementation was further directed across the DoD acquisition enterprise in 2008 and linked to all nine Tier 1 Joint Capability Areas (JCA). The new policy detailed CPM integration and alignment with existing DoD acquisition structures and processes to achieve widespread implementation. (Deputy Secretary of Defense, 2008, p. 1) The definition of CPM was also refined to “the process of integrating, synchronizing, and coordinating Department of Defense capabilities needs with current and planned DOTMLPF investments within a capability

portfolio to better inform decision-making and optimize defense resources" (Deputy Secretary of Defense, 2008, Glossary, p. 8).

The CPM approach is relevant to this research in that it is grounded in improved acquisition decision-making to reduce duplication of effort and identify capability gaps in the DoD portfolio of systems. The emphasis on development supporting data structures, KM tools, and implied expectation of expanded collaboration provide a clear linkage between DoD policy and this area of research. KM tools directly support CPM decision-making at multiple levels of acquisition as will be demonstrated with the DoD MDA Program to identify relationships among a portfolio of system features.

VI. MDA Program

The National Plan to Achieve Maritime Domain Awareness (MDA) from October 2005 defines the Maritime Domain as "all areas and things of, on, under, relating to, adjacent to, or bordering on a sea, ocean, or other navigable waterway, including all maritime-related activities, infrastructure, people, cargo, and vessels and other conveyances." Additionally, it defines MDA as "the effective understanding of anything associated with the maritime domain that could impact the security, safety, economy, or environment of the United States." The stakeholders in this enterprise make up the Global Maritime Community of Interest (GMCOI), which includes "federal, state, and local departments and agencies with responsibilities in the maritime domain. Because certain risks and interests are common to government, business, and citizen alike, community membership also includes public, private and commercial stakeholders, as well as foreign governments and international stakeholders" (DHS, 2005, p. 1).

The problem set that faces the Navy, a key member of the GMCOI, is that:

> commanders lack access to, and the ability to process and disseminate, the broad spectrum of information and intelligence that enables cooperative analysis necessary to understand maritime activity in their area of responsibility, and requisite to early threat identification and effective response against these threats; and when appropriate, to enable partners to respond (Chief of Naval Operations, 2009).

Navy MDA is key to addressing this problem set because it will "enable the warfighter to sustain decision superiority to successfully execute its missions. MDA is fundamental to decision making superiority at all levels of command" (Chief of Naval Operations, 2009). The Navy plans to improve the following capabilities to achieve MDA; "focused data collection; technological enhancements; greater cooperative information sharing; supporting enduring and emerging maritime security partnerships; and the professional development of navy personnel within the maritime operations centers at naval components and numbered fleets" (Chief of Naval Operations, 2009).

VII. MDA Program Self-awareness Test Case

The MDA Program is indicative of complex system-of-systems acquisition efforts being undertaken by the DoD. The MDA program includes additional complexity caused by the extensive international and interagency involvement, which exhibit the complexities shown in the Collaborative Capacity Model shown in Figure 3.

This research will develop and examine a representative data mart of structured and unstructured program and policy documents from members of the GMCOI. This task is especially challenging in that there is not one consolidated repository for MDA-related programmatic documentation. This data will be collected from various members in the GMCOI closely involved in MDA systems development and acquisition. Data and text mining tools will be applied to the MDA Data Mart using the methodology depicted in Figure 5 (Turban et al., 2008, p. 156).

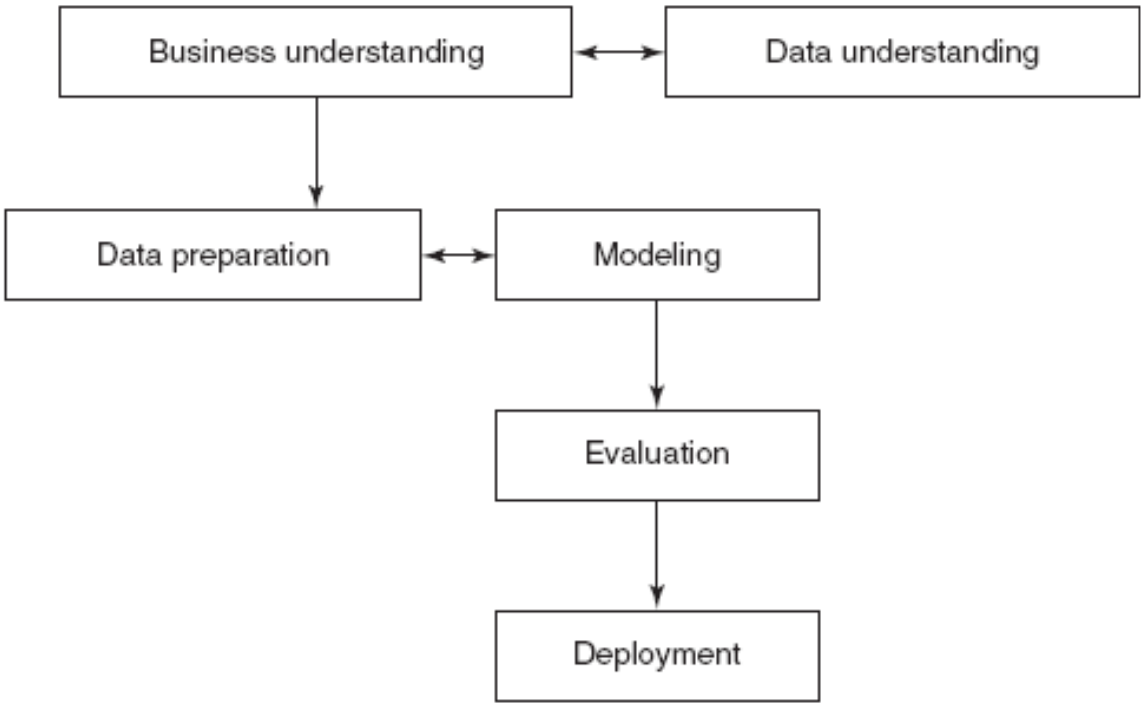

Figure 5. Data-mining Process Recommended by CRISP-DM
(Turban et al., 2008, p. 156)

To date, this research has gathered program documentation related to three prototype MDA systems, to include Predictive Analysis for Naval Deployment Activities (PANDA), a Defense Advanced Research Projects Agency (DARPA) project, Track Assessment and ANomoly Detection–Maritime (TAANDEM) software subsystem, and Comprehensive Maritime Awareness System being developed through the Navy Research Lab (NRL). These documents have been placed into the MDA data mart for use in our modeling and analysis.

The next step in our research will be to further our data understanding and prepare the data for application of the various mining algorithms. This phase of the research is underway as this paper is being prepared. NPS KM research expertise and cutting-edge data and text mining applications will be leveraged during this phase of the research. After the initial data cleansing and preparation, the mining tools will be applied to the data mart for subsequent evaluation and analysis using visualization products to identify common features, capability gaps, and relationships between MDA system features. We expect several iterations of this process to extract useful data from the models.

Using preliminary data and the Quantum Intelligence (QI) data and text tools developed by Dr. Ying Zhao, the visualization products depicted in Figures 6 and 7 were developed to demonstrate representative products of this research to highlight relationships among system feature data.

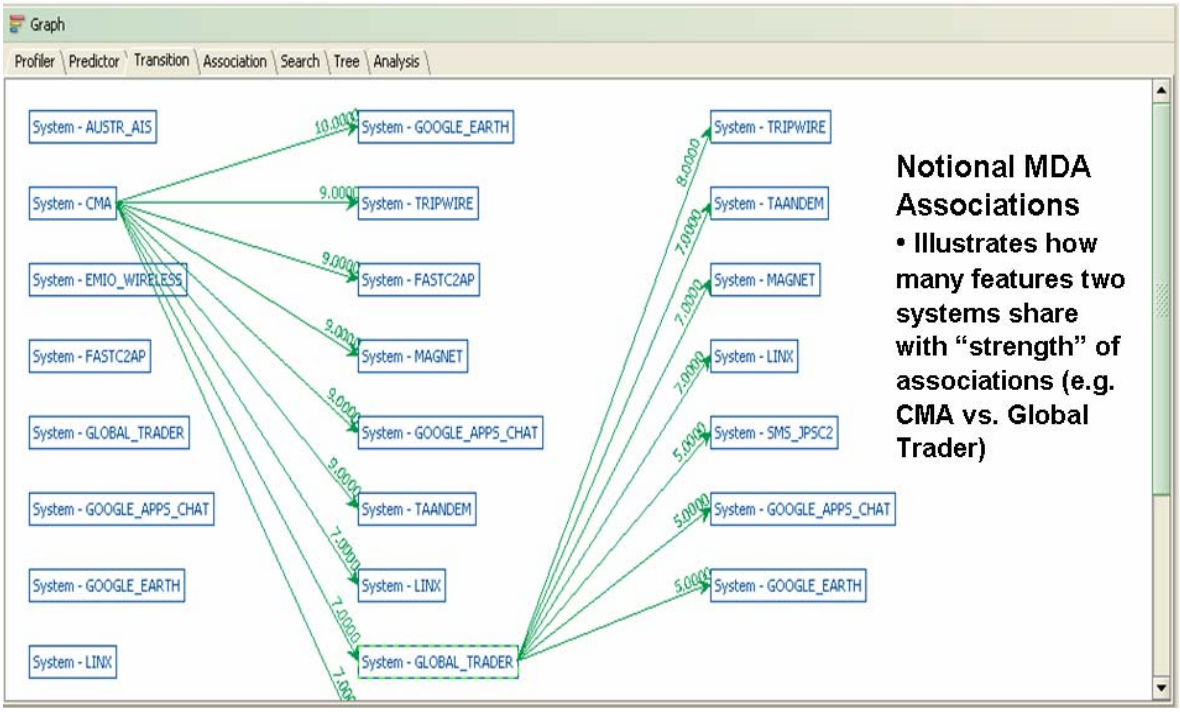

Figure 6. Sample MDA System Cluster Visualization
(Zhao, 2009)

"Fan out" with "Fan in" Illustration

- **The more "arrows out" indicate more features shared with another technology**
- **Reveals overlapping or missing common features (e.g. EMIO)**
- **Works like a "social network"**

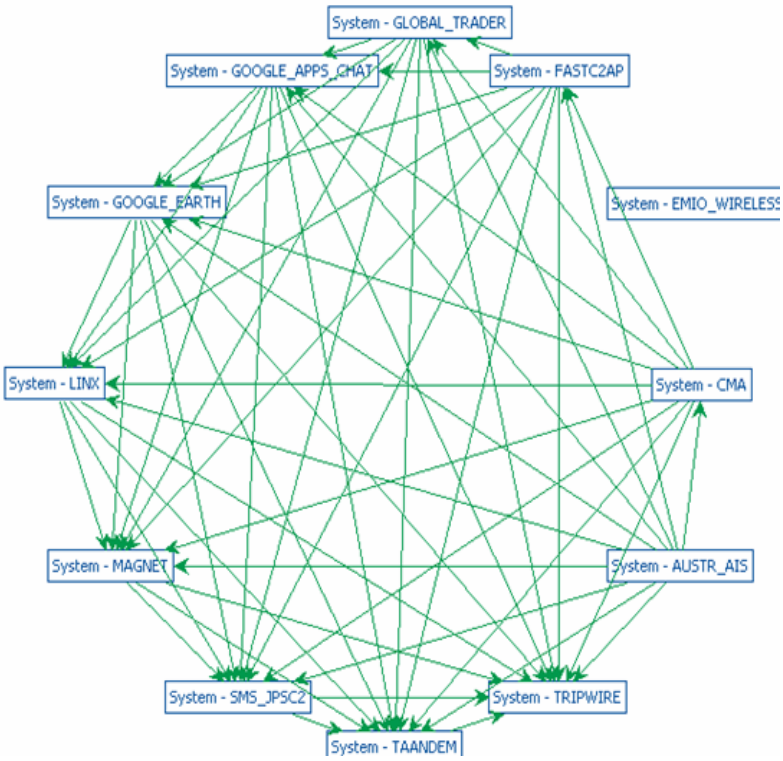

Figure 7. Sample MDA System Cluster Visualization
(Zhao, 2009)

The final step in the data mining process is deployment. As this is only a demonstration of KM tool utility for Program Self-awareness, we do not plan to deploy the algorithms developed during this process. This work will for the foundation for a larger effort by the DoD EA for MDA that will hopefully be applied to a much larger data mart developed from the entire GMCOI.

VIII. Predicted Findings

The MDA Program is representative of complex DoD Acquisition Programs. KM concepts and tools demonstrate utility for improving Program Self-awareness to help identify portfolio gaps and duplication which can lead to improved resource allocation decision-making, collaboration among acquisition activities, and re-use of SoS components. Figure 8 provides an overview of the research methodology described above.

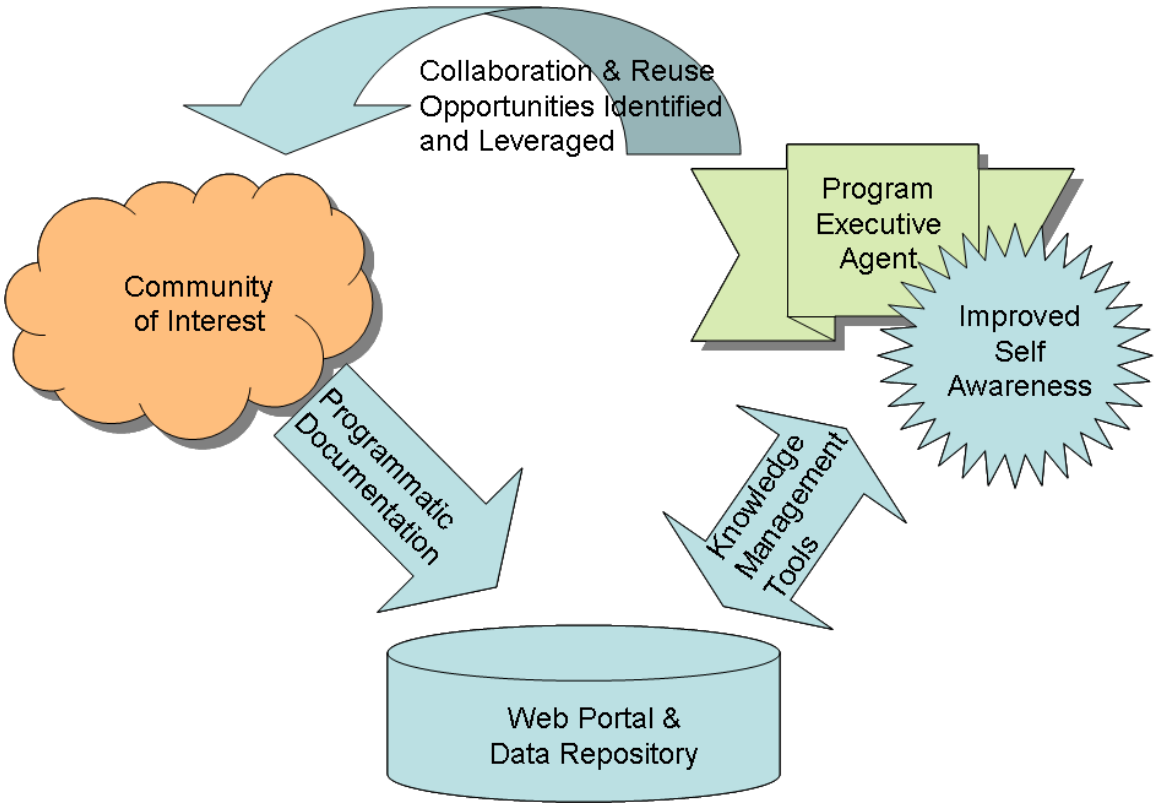

Figure 8. Program Self-awareness KM Process

As mentioned above, a central repository for MDA programmatic documentation does not currently exist. This research will recommend development of a GMCOI MDA web portal for use as a data warehouse to support future KM implementation and to promote collaboration and re-use. We hope this work will provide foundation for future work to refine Program Self-awareness concept and KM implementation in DoD Acquisition.

List of References

Chief of Naval Operations. (2009*). Establishment of the Navy Maritime Domain Awareness Office* (Administrative Message 181837Z MAR 09). Washington, DC: Author.

Cho, G., Hans, J., & Landay, W. (2000). *Program management 2000: Know the way. How knowledge management can improve DoD Acquisition*. Fort Belvoir, VA: Defense Systems Management College Press.

Department of Homeland Security (DHS). (2005). *National plan to achieve maritime domain awareness for the national strategy for maritime security*. Washington, DC: Author.

Deputy Secretary of Defense. (2006, September 14). *Capability portfolio management test case roles, responsibilities, authorities, and approaches*. Memorandum. Washington, DC: Author.

Deputy Secretary of Defense. (2008, September 25). *Capability portfolio management*. Directive. Washington, DC: Author.

Gates, R. (2009, January/February). A balanced U.S. military strategy. *Foreign Affairs*, *88*(1).

Gallup, S., & MacKinnon, D. (2008). *Status assessment of maritime domain awareness capability development.* Monterey, CA: Naval Postgraduate School.

Johnson, J., & Blais, C. (2008). *Software hardware asset reuse enterprise (SHARE) repository framework final report: Component specification and ontology.* Monterey, CA: Naval Postgraduate School.

Mercer Delta. (1998). *The congruence model: A roadmap for understanding organizational change*. Boston, MA: Author.

Thomas, F., Hocevar, S., & Jansen, E. (2006/2008). *A diagnostic approach to building collaborative capacity in an interagency context.* Monterey, CA: Naval Postgraduate School.

Turban, E., Shardra R., Aronson, J.E., & King, D. (2008). Business intelligence: A managerial approach. Upper Saddle River, NJ: Pearson Education.

Zhao, Y. (2009, March 2). *Clusters/associations/search of MDA/C2/ISR features*. Unpublished PowerPoint presentation. Monterey, CA: Naval Postgraduate School.

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