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**Aligning Net-Centric Practice with Net-Centric Technology:  
A Way Forward**

**Architecture, Policy, Net-Centric Metrics, Social Domain Issues**

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**Aligning Net-Centric Practice with Net-Centric Technology:  
A Way Forward  
(Abstract)**

Implementing the Net-Centric Operations (NCO) vision in support of enhanced command and control presents technical, operational, and cultural challenges. The technical challenges are being addressed by both industry and the Department of Defense pushing the state of the art further ahead. However, in many cases the technology “art” is too far ahead of the DoD policy and management “practice”. In fact, technology vendors offering products to help in the management aspects of network enabled systems and services often find their solutions are in search of clearly defined problems. This misalignment exists because a DOD enterprise level NCO “operating model” has not been clearly articulated to demonstrate how consumers and providers of net-centric services will interact. More than a Concept of Operations (CONOPS), which tends to describe an optimal end state, an operating model should be a framework to allow emergent behavior to first grow and then sustain a net-centric environment.

Consequently, an NCO operating model must address architectural, policy, governance, performance monitoring, and cultural issues and practices. However, as noted above the operating model is itself a transformational model. It cannot prescribe a “to-be” world to any degree of specificity. Instead, the operating model establishes the tenets of policy and governance that can help align emerging technology to fulfill the vision of NCO. Once defined and set in motion, the operating model presents a way forward to defining emerging NCO capability requirements; selecting and implementing the enabling technologies; and extending the NCO environment to further Defense component and agency domains.

# **Aligning Net-Centric Practice with Net-Centric Technology: A Way Forward**

## **Introduction**

The purpose of this paper is to present a conceptual approach and practical recommendations for conceiving and implementing a Net-Centric “Operating Model” in the Command and Control (C2) environment. The scope of this paper is meant to focus attention on the growing gap between current and emerging technological capabilities and an operating construct to best leverage this technology.

It is generally recognized that the introduction of new, transformational technology in any context, combat operations or combat support and business activities requires a concomitant socialization and training on how best to “use” the new capabilities. However, the Net-Centric Operations and Warfare (NCOW) vision will require new doctrine and practices on how best to optimize the technology for more effective warfighting and combat support beyond a users guide. For example, the invention and introduction of the mechanized tank in World War I was by itself relatively easy to operate, but the full potential of the technology was not achieved until Tank Warfare Doctrine was developed and honed before and during World War II.

This paper is based on the premise that in many cases the technology “art” is too far ahead of the DoD policy and management “practice”. Net-centric technology vendors offering products to help in the management aspects of network enabled systems and services often find their solutions are in search of clearly defined problems. This misalignment exists because a DOD enterprise level NCO Operating Model has not been clearly articulated to demonstrate how consumers and providers of net-centric services will interact. In addition, an underlying assumption used in this paper is that net-centric technology and operating principles apply equally to both to the C2 and combat support (business) environments. This will provide a broader range of concepts to demonstrate how to better align the state of the art with the state of the practice in the C2 arena.

Consequently, this paper seeks to focus attention on how best to develop the doctrine or Operating Model that can tie the strategic vision of NCOW to the tactical functionality of net-centric technology.

## **What's Different About This Transformation?**

Transformation as an organizational improvement initiative has come to mean many things to different people and, in fact, be overused as a term to describe organizational direction. This occurrence tends to water down the perception of the true impact of any specific initiative over time. Many past transformation initiatives have been undertaken within the existing context of how operations are conducted. The introduction of new technology and/or procedures to improve the enterprise's critical activities is done within the existing operating environment. For instance, the implementation of an Enterprise Resource Planning (ERP) application to improve an organization's financial or supply chain processes presumes many of the processes embedded in the software will be adopted and adapted by that organization. In effect, the organization will change some of its processes to optimize the technology, but in the main will continue to operate as before, but hopefully, marginally more efficiently. Consequently, enterprise architecture, policy and governance, performance measurement standards, and social domain issues are not affected. Organizational doctrine remains unchanged.

From an architectural point of view, especially within the Department of Defense (DoD) Architecture Framework (DoDAF), this allows for a relatively straightforward articulation of the "To-be" world. The transformation to the desired end state can be represented as a migration from a portfolio of known activities, systems, and capabilities ("As-is") to the To-be architecture and portfolio. The marketplace over the last decade has responded to this paradigm by offering well-defined technology packages that solve easy to conceive (albeit not necessarily execute) process improvement initiatives. The ERP paradigm is a commoditized market. However, the success of these packages requires that the operating doctrine does not change otherwise the commodity will not achieve economies of scale.

Organizational policy, governance, and performance metrics models remain relatively constant in this paradigm as well. Improving a process through better technology will allow better policy goals' achievement, enhance oversight, and increase performance. Other than ensuring expertise in operating the new tools, socialization issues are very manageable. Transformation is achieved, therefore, when the new status quo is achieved.

This is why many past transformational efforts have not achieved truly revolutionary gains in effectiveness or productivity. In some cases, a promising and revolutionary new technology was sub-optimized because it was fit into the status quo and no one knew how to increase productivity or military effectiveness. Recalling the tank example above, lacking any better doctrine, the tank was used as infantry support. While dramatically effective, the technology was not yet optimized. In other cases, failure was the result of a transformational initiative reaching too far. An end state was envisioned that could not be supported by either the technology or the operating model. The promise of an ERP revolutionizing the way business is conducted is inherently beyond the design of a commoditized application that was designed to improve but maintain the status quo. In sum, most recent transformational initiatives have really been incremental improvements whether in the arena of combat or combat support operations.

This is also why the Net-Centric transformation is different from the past. First, the emerging technology is not commoditized. The design concept of Service Oriented Architecture (SOA) is focused on reusable and accessible packets of functionality that are not bounded by traditional systems. There are no built in best practices to adapt. Second, the NCOW vision is enterprise in its scope and will require an enterprise perspective with regards to architecture, policy, governance, metrics, and cultural change. The net-centric vision is upsetting the exiting operating model. Finally, the unfolding of the transformation will be very different and less easy to articulate in traditional forms (e.g., DoDAF). As submitted above, transformation in the past could be described as achieving the defined end state. In this case, the end state will be harder to articulate to a high degree of specificity we are accustomed to in traditional technology implementations. Consequently, it will be harder to execute a transformation along the traditional programmatic linear path (i.e., define requirements, select technology, implement and integrate technology, train users, etc.).

By way of an example that may illuminate the full ramifications of this type of transformation consider the invention of the electric motor. Its introduction to industry did not really create increased productivity gains until the industrial engineers of early 1900's figured out how to use it effectively to create an assembly line.<sup>1</sup> They created a new operating model to unleash the full power of the electric motor. However, this did not entail just moving employees from batch production shops to assembly line ones; plant design, company-wide procedures and oversight, performance metrics, employee training, and procurement practices all had to be rethought and re-executed. It is quite likely that there was a fair amount of experimentation and it wasn't until several iterations later that the operating model we see today was settled upon. In other words, the end state was not "architected" and then implemented as we have come to expect with a traditional technology projects.

As noted above, traditional Command and Control (C2) and more so combat support systems are based on the premise of preconceived and/or routine functions and access to data automated to achieve economy of scale efficiencies. Net-Centric Operations and Warfare is based on the premise of supporting both the routine and non-routine; providing information both structured and unstructured, to routine and unanticipated users; and leveraging data for both routine needs and unanticipated needs. Consequently, the desired net-centric environment is inherently dynamic it is not possible to articulate a definitive end state *a priori*. Specific portions of the Global Information Grid (GIG) *systems* architecture can and have been defined (e.g., GIG-Bandwidth Expansion, Net-Centric Enterprise Services (NCES), Joint Tactical Radio System (JTRS)), but architecting the Net-Centric Environment (NCE) for DoD in DoDAF is neither possible nor necessarily desirable. It is not possible because the NCE will not be a system as in the current technology paradigm. Current and emerging net-centric technology and its application are demonstrating pieces if the overall puzzle that contribute to the NCE, but not as a single enterprise solution. It is not desirable because to define a system

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<sup>1</sup> New York Times, "American Companies Show an Edge in Putting Information to Work", 12 January 2006.

architecture in DoDAF is to define its boundaries which is inimical to net-centricity. The NCE will require room to evolve over time to take advantage of new and better technology and new and more urgent requirements. In fact, a net-centric environment is one that can adapt and should never be too narrowly defined.

However, a prescription to achieve the NCE must also include more than a technical perspective. The lesson of the assembly line example is that to harness the agility of a NCE technology, DoD must also develop the doctrine that supports operating in the agile net-centric world.

Therefore, the net-centric transformation can be characterized by several key tenets that should drive how the transformation is managed. Specifically, they are:

- The Net-Centric Environment should not be too tightly defined from an architectural perspective and cannot be properly articulated in DoDAF. A new approach to enterprise architecture will need to be devised to better articulate the dynamic nature of net-centricity.
- A supporting operating model needs to be established to harness the people and process dimensions of this transformation. Specific policies, governance structures, and metrics need to be put in place to modify behavior.
- The Net-Centric transformation is not a linear process, but rather a “condition” required to progress towards the net-centric vision.

These characteristics will require a different approach to transformation. First and foremost, an operating model should be initiated and evolved to better align policy and governance to technology decisions. As has been discussed above, this transformation does not involve integrating proven technology and packaged applications into the status quo. This transformation will require technology decisions made on the basis of emerging and evolving requirements. An operating model will facilitate creating these requirements sooner and then serve to better leverage the portfolio of technology going forward. The required attributes of this model will be presented in the following section of this paper.

Finally, the operating model cannot in all probability be defined to any degree of specificity at the outset. It will require experimentation. Experimentation will require a laboratory that replicates the conditions of the envisioned net-centric environment. This will require creating these conditions in a practical manner that can get the learning/requirements process started to guide both the development of the operating model, but also the incorporation of viable technologies. The last section of this paper will present specific practical recommendations to jumpstart this process.

## What Is Needed?

### *Design through Service Oriented Enterprise Architecture*

A critical initial step in transforming towards the net-centric vision is to be able to visualize for the widest audience the future state. DoDAF has been the standard architectural language for several years. However, the major drawback of the DoDAF perspective is that it is system focused, designed to support the systems integrator accomplish its task. The “entering argument” in DoDAF is processes and their constituent activities with the output being a system or systems integration design to provide functionality. In designing the net-centric environment, entering argument will need to be functionality or services in to order to manipulate data to provide information to the enterprise. The ultimate goal is to architect an environment that can accommodate unanticipated users and needs as well the routine. Although, traditional architecture views are useful, a truly transformational architecture cannot stop there. These two design approaches will have to co-exist in order to transform to the net-centric vision.

BearingPoint’s approach to this design challenge is to leverage both DoDAF and SOA design principles in order to apply an Service Oriented Enterprise Architecture (SOEA). An SOEA approach does not directly describe the end state, but rather describes the three critical service areas necessary to transform an organization and how they should mature over time to achieve a desired future state. Specifically, the BearingPoint SOEA approach possesses the following characteristics:

- The architectural process exists in a continuum of maturity. BearingPoint has developed as part of a team a maturity model based on the Capability Maturity Model (CMM). The resulting SOA Maturity Model provides a means to align desired operational impact with an organizations ability to accommodate change.
- Facilitates design of the operating model for the net-centric environment (NCE). This means describing procedures and processes in three key areas: 1) Mission execution in the NCE; 2) Managing the NCE; and 3) (given the recognition of increasing maturity) Evolving the NCE.
- Provides for process to service mapping. As noted above, services are the key element in the net-centric environment. However, human organizations still accomplish goals through processes. Consequently, a SOEA must provide a clear traceability between these two elements. Additionally, the SOEA will need to provide a clear mapping of services and legacy/planned systems.
- Establishes clear linkage between the architecture and portfolio management process. The SOEA is not an end-state, but rather a means to achieve IT portfolio optimization.
- Demonstrates relationship of service providers, users and portfolio of services. Consequently, the SOEA will characterize services as follows:

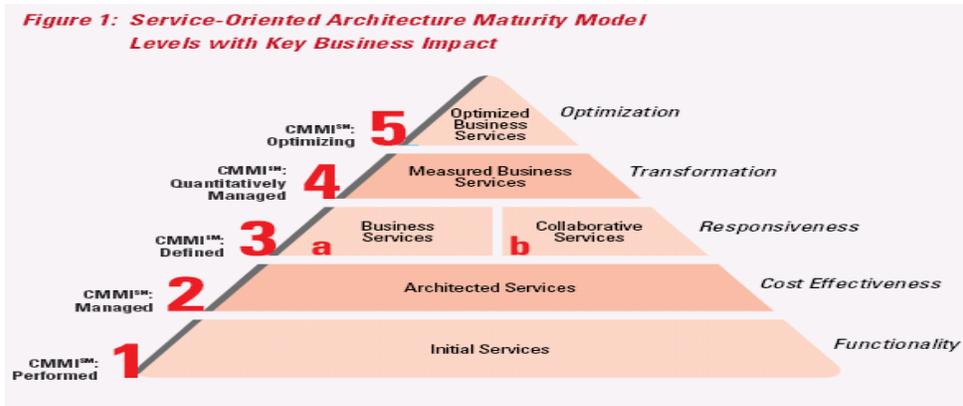
- ***Functional Area Services*** - Those services necessary to support enterprise activities and processes. They may be enterprise wide or domain specific with a people, Community of Interest (COI) focus.
- ***Information/Data Integration Services*** - Those services required to make data visible, accessible, understandable, trusted, and interoperable in accordance with the DoD Net-Centric Data Strategy.
- ***Network/Communication Enabling Services*** - Those services necessary to provide the physical infrastructure for communication and transport within the enterprise. The GIG infrastructure and NCES initiatives are examples.

### ***Implementing in an Dynamic Environment through Maturity Modeling***

As noted above, the concept of maturity is critical to net-centric transformation. Since it will be difficult to define the To-be state and measure transformation progress along a linear path of milestones, an alternate, dynamic transformation model must be employed in applying the SOEA approach. BearingPoint believes this can be accomplished through maturity modeling. By combining definable and measurable levels of net-centric maturity with a service oriented enterprise architectural construct it will be possible to establish a reference model to guide the transformation even though there can be no fully defined end state.

Consequently, in partnership with Sonic Software, AmberPoint, and Systinet, BearingPoint has developed the SOA Maturity Model (SOA MM) to guide SOA-adopting organizations in capturing the business value of their transformation vision and to be able to benchmark SOEA progress within their organization. This streamlined process drives the focus of initial SOEA implementation appropriately on the measurement of technical feasibility and functional results.

The SOA MM delineates the approach to designing, implementing, and deploying information systems so as to maximize the benefits to the implementing organization. Built to leverage the success of the CMMI Maturity Model in providing a common framework for defining and assessing process improvement in software and other engineering endeavors, the five levels of SOA Maturity align with the corresponding CMMI levels. Figure 1 depicts this relationship.



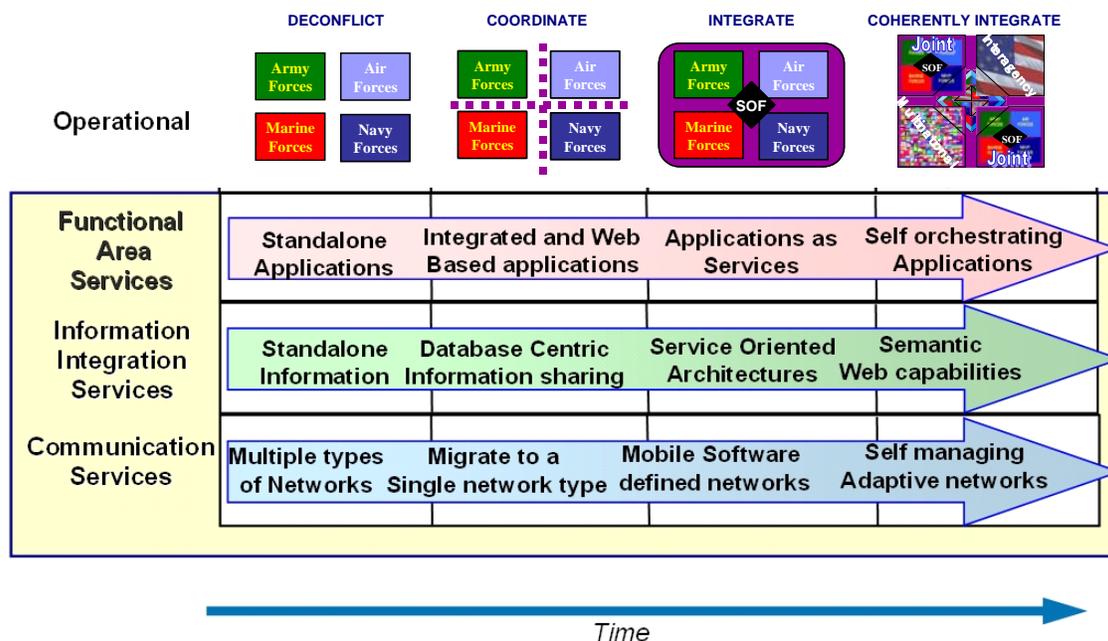
**Figure 1: Service Oriented Architecture Maturity Model**

Each Maturity Level drives different benefits to the organization and supports the overall SOEA implementation strategy. Across each Maturity Level, the model defines the key attributes driving the measurement and evaluation of SOA technology and service capability. These include:

- Prime Mission/Functional Area Benefits;
- Scope;
- Critical Technology Success Factors;
- Critical People & Organizational Success Factors;
- Selected Relevant Standards;
- Key Goals; and
- Key Practices.

Therefore, the SOA MM can provide a benchmark to measure candidate technologies and facilitate functional requirements development based on desired Functional Area, Data, and Network Services. For example, the Initial Services represented at SOA Maturity Level 1 represent the initial learning and project phase of SOA adoption. In many current instances this may mean services are imbedded in standalone applications and are not accessible. An initiative to move towards more integrated and web based applications will require identifying, refactoring as required, and architecting these services (Level 2). Achieving the next maturity level will also entail testing the net-centric technologies in a laboratory environment and measuring them against the desired functionality of the higher level.

The specific mechanism by which SOEA and maturity model are leveraged to manage the transformation is through the development and use of a Service Reference Model (SRM). An SRM allows an enterprise to use the same modeling method and patterns to depict all its services and processes across all its subordinate units. It is the analytic tool that provides a standardized and logical way of mapping business processes so that they can be compared to and aligned with their respective data requirements and other business processes. Figure 2 depicts an overview of how a SRM helps align mission operational goals to an increasingly mature SOEA.



**Figure 2: SOEA Service Reference Model**

***Desired Attributes of an Operating Model***

As noted above, the design of the Operating Model must enable three key aspects of the Net-Centric Environment. Specifically, these are:

- Execution of enterprise mission or functional processes and activities;
- Management of the overall NCE; and
- Evolution of the NCE to incorporate better technologies and processes.

In other words, the Operating Model must allow warfighting and combat support personnel to do their job, manage the environment behind the scenes, and allow continuous improvement without disruption to capability.

The BearingPoint approach to this challenge is to identify and address the attributes that affect the model’s ability to deliver these three aspects. The main attributes are discussed below:

- The central design principle of the Operating Model should be a framework in which services are provided and consumed based on warfighter, intelligence and business mission area functional requirements, both ongoing and ad hoc. This *NCE services “market”* approach is the cornerstone of the NCE as the assembly line was of the new industrial age. Execution of mission and functional area activities is facilitated by DoD personnel entering the services marketplace and “consuming” required services. Suppliers provide services based on demand and are compensated for their provisioning, innovation, etc. by that same demand.

- This necessitates a major rethinking of *DoD acquisition management*.<sup>2</sup> The goal is to create an environment conducive to maximizing both government and industry goals in a NCE. The creation of a services marketplace in which products/services thrive or expire based on their merit shifts the “buying” decision from the tradition acquisition processes to the mission area consumers based upon actual usage and quality of a specific product/service provided by or demanded by the services marketplace. This approach has significant regulatory and policy ramifications.
- *Governance mechanisms* to execute and maintain the overall Operating Model will need to account for the provisioning of and access to net-centric services and information, their orchestration, and performance/quality of service monitoring. This attribute will support the behind the scenes management of the NCE and will also require new policies and procedures. Additionally, this requirement will fuel private sector research and development of new technologies to manage these governance processes.
- *Net-centric services portfolio management* is an extension of the acquisition and governance features. Services portfolio management is a logical outgrowth of the services marketplace concept. Ultimately, net-centric services portfolio management shifts from a subjective, annual business case development exercise to an objective, metric-based process that can maximize the NCE and customer satisfaction. The net effect is the minimizing of technical risk and cost by harnessing the power of market demand, and placing the responsibility of innovation on the vendor. This attribute not only supports the management of the NCE, but also its evolution. A true metric-based portfolio management process can create incentives for both consumers and providers of services to act in a manner that enhances outcomes.

### ***The Transformation Environment***

The ultimate outcome of leveraging SOEA design principles to create a net-centric Operating Model is not to establish a static condition, a new status quo. Rather, the goal is to create a transformation environment or set of conditions that ever improving technologies can be rapidly incorporated into the network without major disruptions to mission accomplishment. Consequently, while some aspects of the Operating Model need to be scoped, defined, and built to “kick off” the transformation (e.g., service monitoring tools), not every last detail can or should be. The Operating Model will create the conditions for adaptive behavior.

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<sup>2</sup> See GAO Report: *DoD Management Approach and Processes Not Well Suited to Support Development of the Global Information Grid*, January 2006.

## **Practical Recommendations**

Articulating, even architecting the Operating Model is a necessary but not sufficient step for transformation. Critical to its implementation is to facilitate experimentation that allows practical solutions to operating issues to be identified and resolved to drive requirements for future systems and capabilities. However, an environment for experimentation does not exist.

For example, the Department of Defense and the Services are attempting to align to several top-down net-centric transformation initiatives (e.g., Global Information Grid (GIG), Net-Centric Enterprise Services (NCES)) and to manage the introduction of innovative concepts involving Service Oriented Architecture (SOA) and Portfolio Management. However, these concepts often clash with the bottom-up realities of non-integrated solutions, custom-developed applications, lack of data visibility, and the costly maintenance of redundant systems.

Furthermore, DoD is struggling with an inability to define To-be capabilities outside the context of incremental improvements to today's solutions. Enhanced solutions compliant with technical and architectural mandates can only be developed in an environment where the community understands the potential future capabilities and can articulate their business requirements in that context. To compound the problem, the Department's ability to test and pilot the concepts of SOA and net-centricity using evolving technology is severely limited. As a result, a large gap remains between transformation goals and executable changes to C2 or combat support systems.

Consequently, there is a need for a "test-bed" environment to provide a means to overcome these issues through experimentation. Such a test bed approach must be able to simulate the conditions that would be present in a net-centric environment to aid in visualizing requirements net-centric solutions.

### ***Test Bed Description***

In support to our overall design approach, BearingPoint recommends a creating a test bed environment to dramatically improve the quality of the functional and technical requirements provided to implementing agencies. A prototyping test bed is needed to expand users' vocabulary for expressing what they need by showing them a richer lexicon of what is possible when applying new technologies and techniques. With the benefit of such a test bed, requirements for future combat and combat support capabilities are more likely to be innovative and transformational rather than merely incremental. Instead of being confined to speeding up the existing steps involved in how work is done today, a prototyping test bed can be used to empower users to find new ways to accomplish the same work in less steps. Without such a test bed, requirements for future systems will likely remain constrained by current views of processes and applications that are based on closed-system and point-to-point integration architectures.

By way of analogy to visualize the value and role of the test bed, we see it as similar to a sand box for children. The desired outcome of time in the sand box is fun. The main ingredient is sand. Facilitating services are the plastic tools. Exactly how the tools are used or what the “output” of the time in the sand box is unpredictable. It may be sand castles, ditches, or random piles. In the net-centric test bed scenario, the sand is data; the plastic tools are net-centric services. The net-centric outcome equivalent of fun is a clear set of requirements on how the Operating Model can and should work. The services facilitate mission or business outcomes in totally unpredictable ways. However, the patterns of use constitute the Operating Model.

Consequently, the test bed should provide the following benefits:

- Model the future capabilities to support and improve the development of NCE for specific mission and functional areas in DoD with respect to process, data, and network requirements,
- Demonstrate future technologies to drive forward-looking user requirements, and
- Test vendor solutions based on the emerging/evolving requirements of a net-centric environment, not in the context of vendor-defined parameters.

### ***Major Components***

Based on our approach and a current survey of the technology marketplace, BearingPoint believes there are several key components necessary to make a test bed environment approximate the envisioned NCE that can be provided by the market today. Logically, these components must either provide or simulate services that fall into the categories discussed above (i.e., Functional Area, Data/Information, and Network Services). Additionally, each component should be able to simulate a desired level of maturity in accordance with the proposed SOEA Service Reference Model (see Figure 2, above) in order to test various alternative scenarios. The output of the mission or functional “use case” is a set of process, data, and network requirements that better define the emerging Operating Model.

Therefore, grouping the test bed components accordingly, we recommend the following capabilities:

- Functional Area Services Components – The components in this group serve to replicate and/or simulate the specific mission or functional area “use case” that is being analyzed for transformation.
  - User Experience – This module provides the practical user interfaces tailored to the specific use case to be tested. At a lower level of maturity (e.g., stand alone applications) the test bed will leverage legacy processes and systems. At a higher level of maturity (e.g., applications as services) this module will need to simulate service capabilities and processes.

- Future State Modeling – This module’s function is to monitor, capture, and document the behavior of use case participants in various scenarios. This module is critical to generate the outputs that will help describe and demonstrate the emerging Operating Model.
- Data/Information Services Component– The purpose of this component is to replicate and/or simulate the data environment envisioned in the Net-Centric Data Strategy.<sup>3</sup> Depending on the level of maturity to be simulated this component will provide the test bed environment with a range of behind the scenes data/information integration levels from the current state of stand alone information to semantic web capabilities to make data visible, accessible, and understandable.
- Network Services Component – The role of this component is to replicate (and where possible leverage) the emerging GIG Enterprise Services (GES) infrastructure underlying the NCE to include security/information assurance, services orchestration, and service quality monitoring. Many of the governance mechanisms of the overall Operating Model are provided in this component.

With these components in place, the test bed environment can be employed to model and test the SOEA with various scenarios of technology introduction, investment, and risk.

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<sup>3</sup> DoD Net-Centric Data Strategy, 9 May 2003.

## **Conclusion**

The transformation of combat and combat support systems and processes towards a Net-Centric Environment is an extremely complicated and multi-faceted challenge. The marketplace does not currently offer commoditized solution technologies or proven methodologies to facilitate this transition in a manner that maintains alignment between theoretical capabilities and practical necessities. However, by taking an enterprise perspective to the dynamic design issues and applying practical experimental techniques, DoD can better create the conditions for net-centric transformation and ensure alignment between the state of the art and the state of the practice.