Net-Centric Performance Improvement

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> "It's not good enough to be capable of fighting big armies and big navies and big air forces on a slow, ponderous basis. We have to be able to move quickly and have to be agile and have to have a smaller footprint. And we have to be able to deal with the so-called asymmetrical threats, the kind of threats that we're facing with terrorists and terrorist networks. So I think the people in this department understand it and that they're making good progress on it."
>
> Defense Secretary Donald Rumsfeld

The US military is currently in a process of transition, developing and applying new concepts to its operations to meet the changing circumstances that have emerged since the cold war ended. This transition requires decision-makers to think about how equipment and doctrine must change to meet new conditions; it also requires new thinking about how best to develop and support the human element. As the military becomes a flexible and technologically sophisticated force capable of meeting the demands of asymmetrical warfare, it must also develop a flexible and technologically sophisticated approach to human performance.

With fewer personnel, more specialized roles, and more sophisticated equipment, there is as great a need to transform the approach to performance support as there is to transform doctrine, organization, and equipment. Using traditional training-oriented approaches to support this transformation would be the human performance equivalent of fighting with "big armies…on a slow, ponderous basis" (Rumsfeld, 2003). Training approaches must be updated, supplemented, and sometimes replaced by non-training solutions that support on-the-job performance, provide a user-centered design of equipment, and support or replace the human role through automation.

Opportunities to Improve Human Performance

There are distinct opportunities in DoD to improve how human performance is currently viewed:

- There is a tendency to focus on solutions without a proper focus on problem definition.
- Individuals in fields such as planning, procurement, information technology, human factors, human resources, research, and training, who are tasked with improving performance, often operate in isolation from each other and their end-users.
- There is often a bias toward a particular type of solution (training, equipment, human factors, doctrine, and technology). People trained in a particular solution type tend to assume their solutions are the correct ones.
- Attention has not focused adequately on systematically sharing knowledge across a variety of organizational units. Performance knowledge, when captured, tends to be in non-standard document formats which have limited distribution even if digitized.
- While attention is being paid to standardization and reuse of digital content for training, there is little consideration of standards for capturing, reusing, and sharing knowledge about human performance.

We propose development of a unified system for performance improvement by which the organization continually monitors performance at every level, analyzes problems collaboratively, builds targeted improvement interventions (e.g. new training, equipment, and processes), evaluates their effectiveness, and shares knowledge at every step.

What do we mean by performance?

On-the-job performance comprises the individual behaviors, technical skills, and cognitive processes that produce results for the organization. Performance is more than training, test scores, task lists, equipment, and technology. It is individuals using these and other tools to achieve the results that fulfill organizational goals. When individuals accomplish results relative to a role they have performed, they contribute to the higher-level goals of the organization and its processes.

Framework for Performance Improvement

A framework provides a structure for a variety of approaches that can be tailored to specific groups or situations rather than a set of rigid rules for a single correct way of developing systems. A framework for new more agile methodologies is the foundation of our proposed unified system. The key characteristics of this framework are:

- *A human performance orientation to problem-solving*. Thinking on performance problems should be focused on outcomes and not be dominated by those trained in a particular solution type.
- *Object thinking throughout the process*. Knowledge of problem analysis, design, and evaluation should be standardized, componentized, and shared in the same way as envisaged for digitized support solutions (e.g. SCORM objects).
- *Collaboration.* Problems should be solved by cohesive teams (including actual performers) supported by collaborative information environments. The web is used to maximize careful scrutiny from the early analysis stage onward.
- *Visual modeling*. Graphical models can illustrate concepts and relationships among performance roles, goals, processes, and unit missions. These form the basis for collaborative brainstorming and an organizational structure for reusable knowledge.
- *Rationale management.* Decision points in a process are justified by a rationale that describes what alternatives were considered and the criteria on which decisions were made.
- *Configurability*. An agile approach to methods of conducting warfare should be supplemented by agile methods of human performance improvement. In general, performance improvement practices are likely to benefit from giving those involved the freedom to use the skills they have learned through experience rather than locking them into a specific methodology. In a configurable system, there is flexibility in methods but standardization of outputs and format.
- *Integrated system of IT Support for the entire lifecycle.* There are many information "systems" available that support various stages of the performance improvement process. There is *not* an integrated "system of systems" that supports the continuous improvement of performance. Such a system should include repositories of reusable and sharable knowledge to support greater efficiency in the performance improvement process.

Performance Improvement Process

A self-sustaining performance improvement system in any organization operates at two levels. First, there are processes, the methods people use to monitor and improve performance. Second, there is the information technology system that supports the processes. Often these operate in silos. Synthesizing both the methods and the technologies and focusing them on on-the-job performance (OTJP) is a fundamental goal of creating a net-centric performance improvement system. Although any organization would claim to be interested in OTJP, their support functions are often misdirected as they concentrate on what is ancillary to OTJP.

Process Activities

The framework described above will link in different ways to the main activities for the performance improvement process within any organization. The main activities we would identify are illustrated in **Figure 1**.

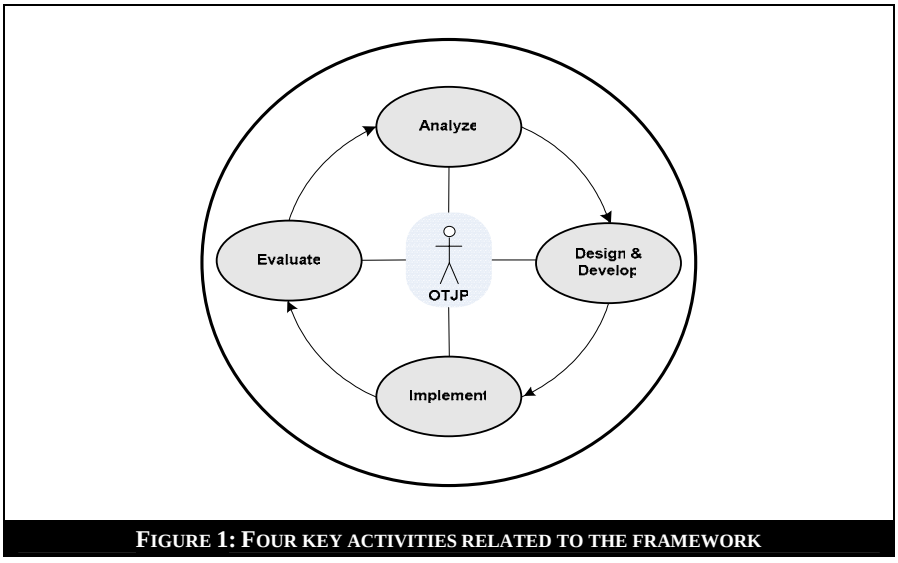

FIGURE 1: FOUR KEY ACTIVITIES RELATED TO THE FRAMEWORK

On-the-job performance is the central piece of performance improvement. A transition to continuous performance improvement in the military means applying research and resources directly to OTJP, where they can have the greatest impact. This transition will require analysts to shift their emphasis to roles and results rather than job titles and tasks. Focusing on specific tasks for specific jobs may very well improve task and process improvement ("Doing things right"), but it will not necessarily help the organization reach its goals ("Doing the right thing"). According to Robinson and Robinson (1996), the question central to performance is: "Are you doing the right things right?" This is the primary concern for performance analysis.

> "The fledgling problem solver invariably rushes in with solutions before taking time to define the problem being solved. Even experienced solvers, when subjected to social pressure, yield to this demand for haste. When they do, many solutions are found, but not necessarily to the problem at hand. As each person competes for acceptance of a favored solution, each one accuses the other of stubbornness, not of having an alternative point of view."
>
> Gause and Weinberg (1992)

Performance analysis should not be about determining requirements for a favored solution. It should be about identifying all the factors contributing to or inhibiting performance by focusing on a performer and his or her work environment. This should be a continuous process rather than a discrete one aimed at developing a specific solution. When the need for improvement is identified, a full range of performance interventions, informed by experience, should be considered.

The **design and development** activity of performance improvement is where solutions to performance deficiencies identified in analysis are actually planned and created. All interventions should be founded on careful performance analysis where the full range of performance interventions was considered.

The **implementation** activity is where the solutions that impact OTJP are made available to performers. Because there is such a wide range of solutions that can be used to enhance performance, users must access them in a number of locations and through a number of mechanisms.

The performance **evaluation** activity involves the continuous monitoring of how personnel are performing on the job. The data from performance evaluation can also be used to assess the impact of a new solution on OTJP. Evaluation examines the effectiveness of a solution by comparing pre- and post-intervention data and then providing feedback to the rest of the system. Using data-driven evaluations enables OTJP to achieve the desired results.

A Case Study

A computer hardware manufacturing company established a new assembly process in response to decreased productivity and increased assembly mistakes and damaged goods. Most people thought it was a smooth transition until production data revealed otherwise. The client recommended that employees be trained on the new assembly process. Upon further analysis, consultants recognized that the problem was not a knowledge/skills issue. Data collected indicated that workers were not receiving the critical parts for the new assembly process. In addition, a lack of communication between employees existed. After the implementation of process and human performance oriented solutions, errors were reduced by 43%, productivity increased 31%, and on-time deliveries increased 46%. The initial solution to the problem wasted resources, and without thorough analysis, performance would have likely remained unchanged.

Clark and Estes (2002)

Each of the activities above can be supported by a number of specific methods. However, not all methods are directly focused on OTJP. In the military two examples of specific units that are developing methods with a specific focus on OTJP are the US Coast Guard's Performance Technology Center (www.uscg.mil/tcyorktown/ptc/index.shtm) and the Navy's Human Performance Center (www.ott.navy.mil/index.cfm?RID=WEB_OT_1000954). Information on other methods is available through the international society for performance improvement (www.ispi.org).

Performance Improvement Technology

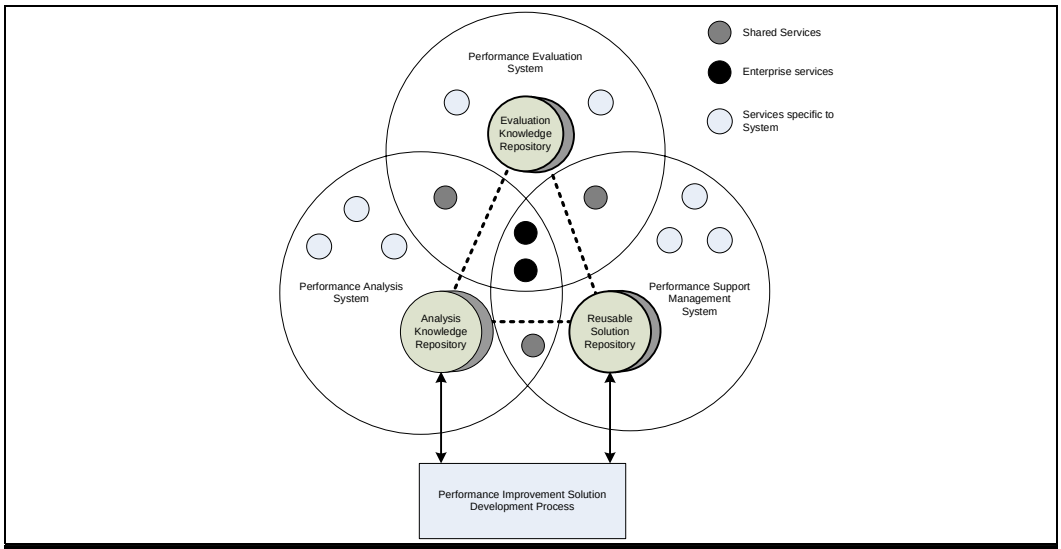

FIGURE 2: IT ARCHITECTURE FOR NET-CENTRIC PERFORMANCE IMPROVEMENT

One of the key ideas in the framework is the use of an integrated IT system to support the function of performance improvement. In **Figure 2**, we illustrate a high-level information technology architecture for such a system. In this system, three key activities of performance improvement have a corresponding set of software services to support them. There are also common services to handle such things as collaboration between users and security. The performance improvement system identifies performance interventions and how they are delivered and evaluated; it does not mandate the development of the intervention since it is a solution-neutral system. The purpose for all the information that flows through the system is to achieve performance results on the job.

Service-Oriented Computing

> "Service Oriented Computing (SOC) is the new emerging paradigm for distributed computing and e-business processing that has evolved from object-oriented and component computing to enable building agile networks of collaborating business applications distributed within and across organizational boundaries."
>
> **The New Computing Paradigm for the Networked World (2003)**

The basic idea behind service-oriented computing is that instead of delivering software as integrated packages of services in a one-size-fits-all mode, software applications are configured by selecting from a number of web-based software components that work together through a set of standard communication interfaces. A conventional software package such as Microsoft Office, for example, provides a number of services to the user (e.g. spell checker, online help, table editing), but they are delivered to all users as one fixed package (**Figure 3**). By contrast, the advantages of service-oriented computing are that:

- You pay for the services you actually use.
- The user interface is less complex as access to only relevant services is included.
- You can add new services or substitute better ones from other suppliers.
- The user, not the supplier, controls the update, change, and configuration of the services.

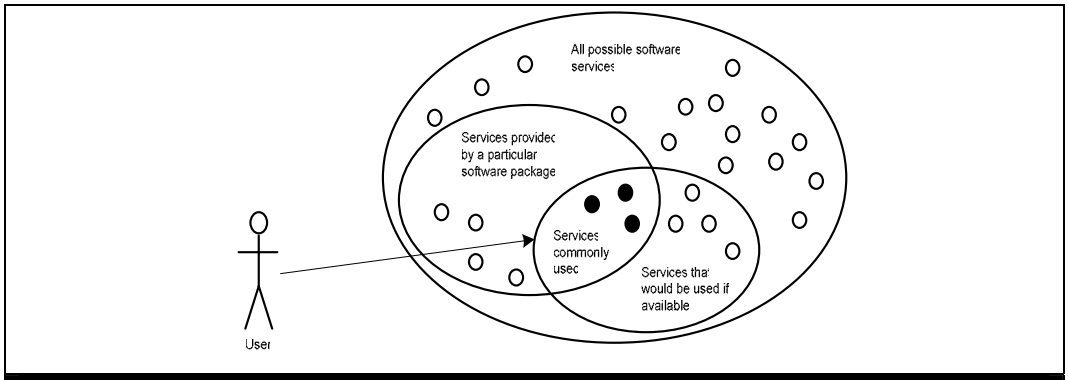

FIGURE 3: CONVENTIONAL COMPUTER APPLICATIONS WHERE SERVICES ARE DELIVERED IN PACKAGES ON LOCAL MACHINES

Service-oriented computing allows customized interfaces to be designed for a specific group, method, and terminology; underlying data handling services translate the different surface data models to an underlying generic standard used in the repository (**Figure 4**). Automated search triggered by new data entry would be able to identify relevant prior analysis throughout the DOD and related government agencies. For example, if a group in the Navy began an analysis project which contained roles or goals similar to those in a previous Coast Guard project, once the relevant elements have been identified, they could be presented not only in the Coast Guard's original data format but also in a format and terminology conformant with the Navy's methodology. This would make it easier for the end user to assess the relevant materials from the previous performance analysis and apply them to the current project.

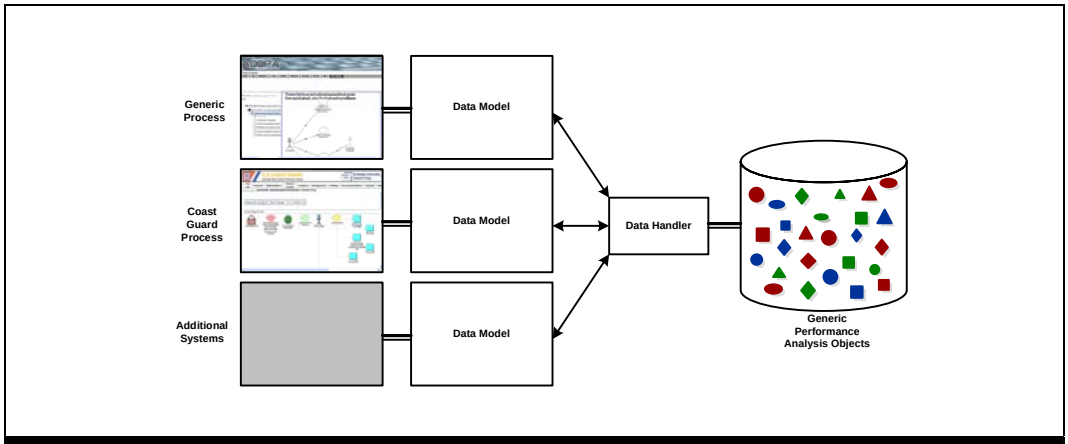

FIGURE 4: CUSTOMIZED TOOLS CONFORMANT TO THE FRAMEWORK SHARING DATA

Performance Analysis System

The Knowledge Communities Research Group has conducted research on how software conforming to the framework can facilitate the performance analysis activity. Two proof-of-concept prototypes have been developed to demonstrate different instances of this class of software. One of the instances is generic, and the other is tailored to the approach of the Coast Guard's methodology (**Figure 5**). Further information and demonstrations of these tools are available at the KCRG web site (www.lpg.fsu.edu/kcrg/). Both instances are based on the configurable, service-oriented approach to computing described above.

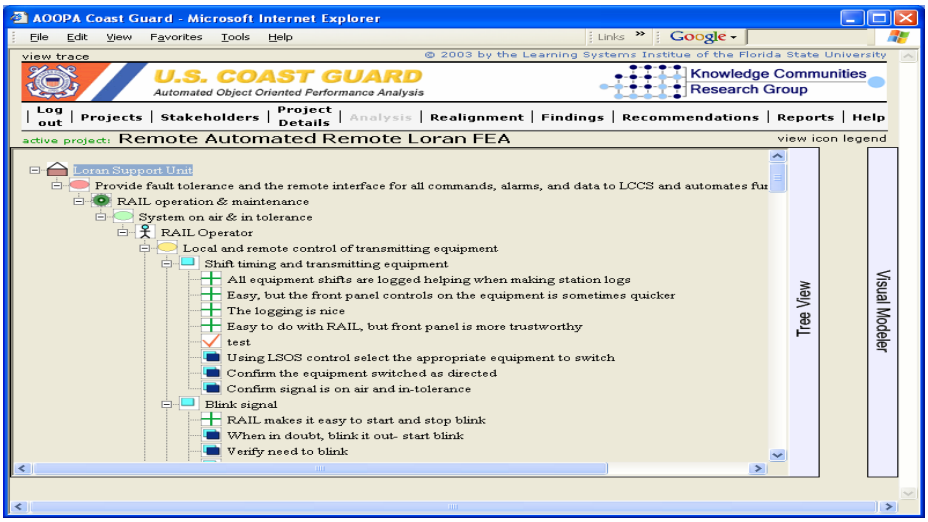

FIGURE 5: PROTOTYPE ANALYSIS TOOL BASED ON THE COAST GUARD'S HPT METHODOLOGY

Performance Support Management System

We propose a performance support management system (PSMS) as the one-stop center for performance support and performance monitoring. This moves beyond packaged systems currently used for delivering learning and content, managing human resource processes, and handling personnel matters. A PSMS, as we envision it, would combine many of the services found in a variety of current software packages such as content management systems (CMS), learning management systems (LMS), learning content management systems (LCMS), and human resource management systems (HRMS).

We would extend object orientation in the PSMS to include all forms of digital performance support, not just learning. We would also organize the access to resources based on the role/goal structure identified in performance analysis rather than on job titles, task lists, or curricula. In addition to the individual role level support, it is likely there will be the need for general organizational and unit level support. The PSMS is not meant to be only a conduit for the support required for every performance goal in an organization; it would also be a central location for the display of performance indicators.

	Goals	Performance Indicators	Performance Support
Organizational Level			
Unit/Process Level			
Individual Role Level			

TABLE 1: ALIGNMENT IN THE ORGANIZATIONAL HIERARCHY

In the system and its corresponding individualized user interface, one can imagine the alignment of goals as a two-dimensional matrix (**Table 1)**. Information is provided for the three levels of performance along the side. Each of these levels contains goals, performance indicators, and performance support displayed along the table header. Alignment should exist from the organizational level down to the individual performer level of performance. This alignment can be viewed as a hierarchy of goals starting with the organization, moving to the unit/process level, and ending with the most specific goals at the individual performer level.

A relatively recent trend in many systems is to provide an individualized view of a service in a web-based system. This is the case with the Army Knowledge Online system and many LMS. In the PSMS, the interface does not organize the user's view of information around courses or lists of documents; instead, the individual performer's interface would be set according to the work processes in which he or she is involved, his or her roles in the organization, the goals and objectives established for that person's work, his or her performance indicators, current level of performance, and direct access to those performance support items that can be provided by the system.

The PSMS should not be limited to access through a personal computer. Mobile (e.g. personal digital assistants), embedded, and wearable computing have the potential to deliver electronic performance interventions in the form of job aids, portable knowledge bases, and just-in-time learning aids. One new technology that could help in dynamically configuring the personal view of the PSMS is Radio-Frequency Identification (RFID). Briefly, a tiny RFID transmitter emits a radio signal that can be used to uniquely identify itself. Performers could have an RFID chip in their identification badge, which can be used by RFID-aware devices in conjunction with the PSMS to load the performer's profile and transparently provide that performer with an array of performance support instruments. An example of this in operation might be in a warship where an embedded computer in an engine component is networked to a PSMS. It could be programmed to recognize the presence of a sailor and, from his or her RFID badge, determine from a personal profile what roles and goals are relevant to the current location (e.g., operate, maintain, check) and then automatically display the relevant support (e.g., check procedure, weekly checklist form). In some cases, the computer could monitor his or her performance of the task and automatically update individual performance indicators.

Objects and Repositories

Currently, the primary method of communicating understanding of problems in the military is through large Microsoft Word, PowerPoint, or Adobe .pdf documents, which are not organized in any standard format. It can be difficult to find a document relating to a specific problem. When the document is located, finding specific information within it is not always easy. One solution to this might be common document formats. However, we believe there is a need to move beyond the traditional document-centric view of knowledge communication. The next stage toward increasing reuse and sharing is to granularize the components of knowledge contained in a document (i.e. create objects), organize objects according to a taxonomy, and store them in a searchable database repository.

This net-centric performance improvement system relies on objects that serve a variety of purposes. An object is any digital resource that can be stored, reused, and shared. The three main types of objects we would identify are analysis objects, solution objects, and evaluation objects (**Figure 6)**. Object repositories facilitate reuse and sharing by providing a centralized location where objects can be stored and found.

Analysis objects capture knowledge about on-the-job performance goals, and have data containers for the desired level of performance ("should") for a particular goal and the typical level found in the organization ("is") at a particular point in time (step 1). Gaps (i.e. unacceptable divergences between should and is) are used as a basis for choosing the most appropriate performance interventions. Performance analysis identifies standard measures for individual performance by observing, surveying, or interviewing exemplary performers who routinely reach or exceed expectations that contribute to organizational goals. These standards are captured and stored in an analysis object. The objects and the graphical models to which they are attached help analysts and stakeholders understand the performance system within the organization and form a foundation for solution development and evaluation.

Solution objects are created or retrieved from a repository, combined to form a performance solution package, and delivered to users (step 3). Solution objects will vary according to the solution type (e.g. software service, SCORM object, change order for equipment).

Evaluation objects serve as containers to be filled with data each time that individual's performance is measured on that particular performance. When an analysis object is created (see step 1 in **Figure 6**), it is used as a template for creating individual evaluation objects for each person who will be assigned the associated performance role (step 2). Each individual will view the data in his or her evaluation objects through the PSMS (step 4). Timely feedback of "is" data compared to "should" data feeds directly to individual performers through the PSMS and will help them take personal responsibility for improvement.

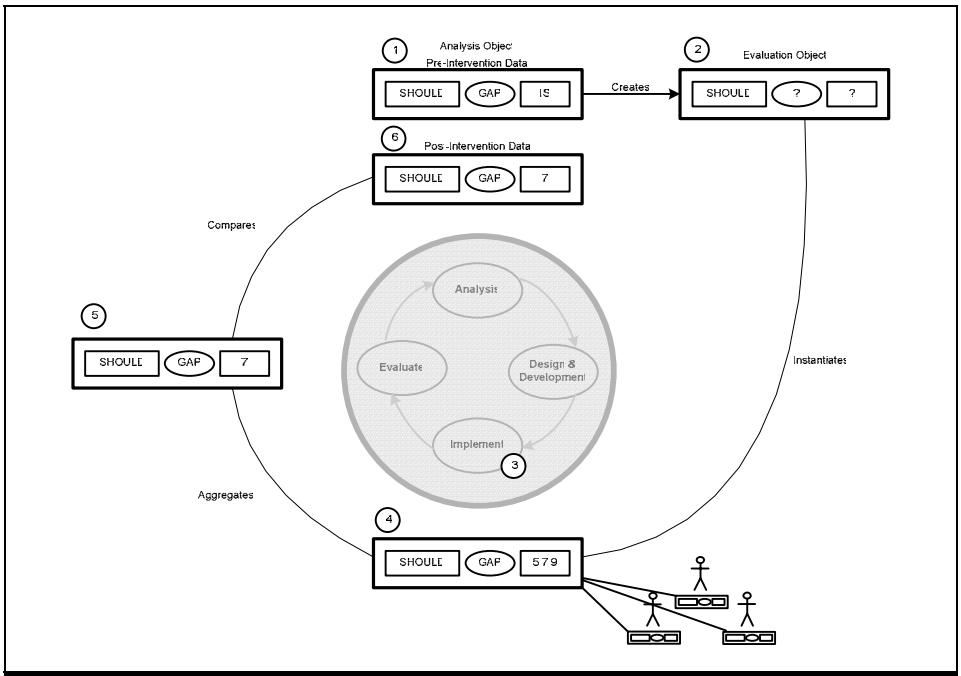

FIGURE 6: OBJECT PATH

The evaluation system aggregates the data from each individual's evaluation objects into higher-level objects (step 5). For example, there could be an evaluation object for each infantry battalion that aggregates the data from all the individuals in that unit on a certain performance (e.g., accuracy with the M16). Unit and individual data can be used to identify exceptional performers so analysts can document and disseminate the knowledge about what the exceptional units/individuals do that the others do not. The total aggregation of all performance data from the evaluation objects of those using a new intervention, such as improved equipment or better training, technique can be compared against those not using it.

The aggregated evaluation data is compared to the data in the original analysis object (step 6). If the post-intervention data has improved sufficiently, the support is made available on a wider, ongoing basis. If performance has not improved sufficiently, another round of analysis checks are completed to see if the performance is still deficient due to faulty analysis, design, development, implementation, or evaluation of the intervention. Corrections are made, and another iteration of the cycle begins. This cycle, once in place, continuously monitors performance and makes adjustments much as a thermostat regulates the comfortable temperature of a house.

Conclusion

This document has described a framework that combines (1) the activities of performance analysis, intervention development, intervention implementation, and performance evaluation supported by (2) a unified IT system using a services-oriented computing architecture. The result is net-centric performance support, a human/computer system that, once institutionalized, would help an organization monitor and continually improve human performance (**Figure 7).** The system would provide up-to-date performance measures and feedback to analysts, stakeholders, and performers to create a self-sustaining performance improvement system.

The model combines the three main performance-related activities: analysis, implementation, and evaluation in a solution neutral way. The fourth activity, solution development, is independent inasmuch as it involves a large number of possible interventions, each of which will have its own methods and IT support tools. Solution development is constrained by input from the performance analysis system and, in the case of digital solutions, having the output delivered through a single performance support management system. The summative evaluation of solutions is facilitated by the performance evaluation system. Three interlinked repositories exist in the system for the sharing and reuse of performance analysis, support, and evaluation. The system centers around on-the-job performance and relies on collaboration of stakeholders throughout the activities.

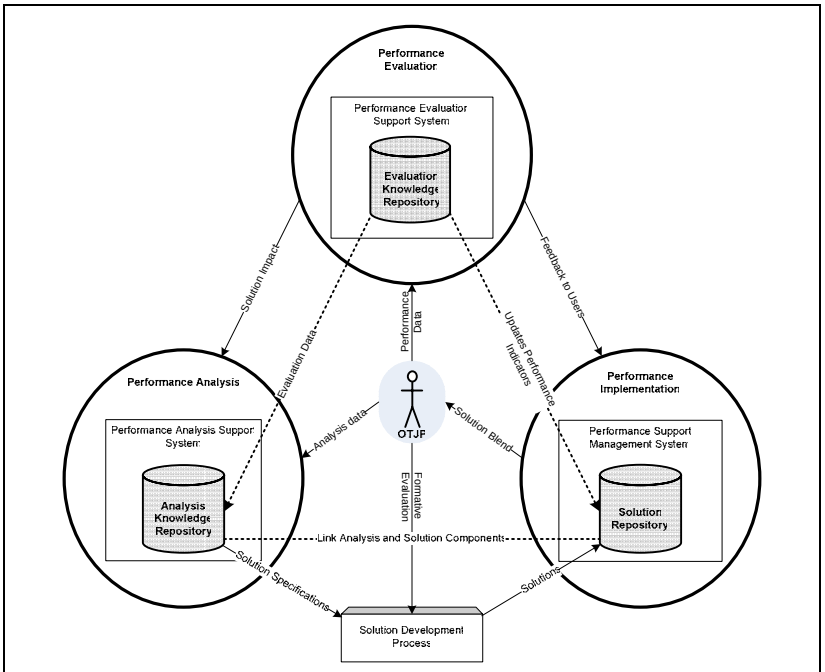

FIGURE 7: SERVICE SPECIFIC TOOLS CONFORMANT TO THE FRAMEWORK SHARING DATA

Florida State University's Knowledge Communities Research Group has already begun research on how such a system would work in practice. Prototypes of the performance analysis system have been constructed and evaluated. The group is now ready for the next step in research — to design and construct prototypes of the performance support management system and the evaluation system. Once these prototypes have been developed and integrated with the existing analysis prototypes, it will provide a fully operational model of how a net-centric performance improvement system could work and how it facilitates transformation of performance improvement throughout the military.

