

Human Performance Benefits of Standard Measures and Metrics for Network-Centric Warfare

Joanne Pester-DeWan, PhD

Pacific Science & Engineering Group
9180 Brown Deer Road
San Diego, CA 92121
USA
Joanne@pacific-science.com

Heather Oonk, PhD

Pacific Science & Engineering Group
9180 Brown Deer Road
San Diego, CA 92121
USA
hmoonk@pacific-science.com

Abstract

The ability to achieve human performance improvement is limited by the lack of infrastructure or process to support coordination among US Navy organizations in tracking and using a common set of human performance measures, metrics, and results. The Metrics Ontology tool is a system that provides researchers, system developers, designers, trainers, and others concerned with human performance measurement, access to commonly defined and structured measures, definitions, and measurement results. The Human Systems Integration (HSI) community is collaborating to develop the tool as a way to encourage a common language of measures and measurement and to support the sharing of newly created measures and previously collected data across Navy organizations.

The Ontology tool allows users to:

- Browse measures and metrics,
- Retrieve previous assessment results, and
- Share assessment results with other user communities.

In summary, the Ontology tool provides assessment communities with a shared, integrated repository of measures, metrics, and assessment data for accurately and completely tracking performance measures and assessment results.

1 Background

The ability for achieving human performance improvement outcomes is limited by the lack of infrastructure or process to support communication and coordination among HSI organizations in tracking and re-using a common set of human performance measures, metrics, and results. Barriers to effectively manage human performance improvement are manifested in:

- Assessment databases that do not “talk” to one another and do not address multiple assessment levels (e.g., individual, team, organization levels),
- Varying assessment perspectives (e.g., mission and task performance verse platform-centric),
- Little standardization / consistency in measures and metrics used to assess human performance,
- Inability to baseline and track human performance over time, and
- Inability of assessment tools to track results, along with the contextual information – assessment environment (e.g., where the assessment was implemented, assessment purpose, etc...), system assessed, system purpose, etc.

The Metrics Ontology tool is a system that provides access to commonly defined and structured human performance measures, definitions, and measurement results. It is designed for use by HSI researchers, system developers / designers, trainers and others concerned with human performance measurement. Various HSI communities of interest (COI) are collaborating to develop the Ontology tool as a common frame of reference for measures and measurement. The intent is to support and encourage the sharing of newly created measures and previously collected data across HSI organizations.

2 Usage

The Ontology tool allows users to gain access to human performance measures, metrics, and results. Users can browse measures and metrics, retrieve previous assessment results, and share their own assessment results with other Navy user communities. Three modes of access are currently available:

- Browsing the Ontology: This is a useful feature for users who are preparing for or conducting a human performance assessment in a new or unfamiliar domain. Browsing provides guidance on human performance measurement by allowing users to access and visualize a standard set of human performance measures and metrics.
- Searching the Ontology: This is a useful feature for setting benchmarks, drawing human performance comparisons, retrieving historical data, and standardizing measures and metrics across user communities. Users can locate and retrieve measures, metrics, lessons learned, and assessment results, along with the context information necessary to understand, interpret, or apply those results.
- Submitting results to the Ontology: A standardized mechanism for users to share previous assessment results, along with contextual information, with various user communities.

3 Architecture

Figure 1 presents a high-level overview of the repository components and how they can be accessed and updated. The term “repository” refers to the relational database used to store the measures and assessment results and their contextual interrelationships. The term “repository tool” refers to the interface through which users store and access information in the repository. It allows each major group of users to access or see the organization of the information in a format, structure, or terminology that is consistent with their perspective.

Three main types of information are stored in the repository:

- Measures. Measures of performance are stored in a standardized taxonomy that can be browsed or searched by a user to identify measures that can be applied to his or her particular situation.
- Results. Data taken using those measures, along with the context information necessary to understand, interpret, or apply the measurement results. (Note that submission and storage of measurement results are not prerequisites for inclusion of information about the measures themselves.)
- Guidance and lessons learned on how individual measures should be applied. (Includes strengths and weaknesses, interpretation of results, and when to or not to use the measure).

4 Taxonomy

The basis for the ontology is a repository of human performance data that has been categorized and structure according to a defined taxonomy. The taxonomy was constructed by evaluating existing taxonomies of measures and by obtaining samples of the types of metrics needed for acquisition focused HSI efforts. A graphical overview of the taxonomy is provided in Figure 2. As can be seen, nine assessment categories have been identified. Each of these categories is further divided into measurement categories that are simply groupings of similar measures. Each measurement category is made up of various measures and metrics. These are simply functions or mechanisms used to quantify a behavior, process, or attribute, which is operationally defined in sufficient detail to be used with a criterion. Quantification is usually performed with respect to number (quantity) or time. Example criteria might include a required performance standard (e.g., bombs on target within .02 seconds).

All the assessment categories are intended to be applicable to the assessment of individuals, teams, or systems. The definitions of these different assessment scopes are as follows:

- Individual (I): Measures that may be applied to a single person in the execution of a task.
- Team (T): Measures that may be applied to multiple individuals functioning as a team or that can only be applied to an individual in the context of a team that are executing a task
- System (S): Measures that may be applied to a technological system that is used to support one or more individuals executing tasks or functions.

Different sections of the metrics taxonomy are expected to be applicable to different assessment scopes, as indicated as a (I), (T), and/or (S) in Figure 2.

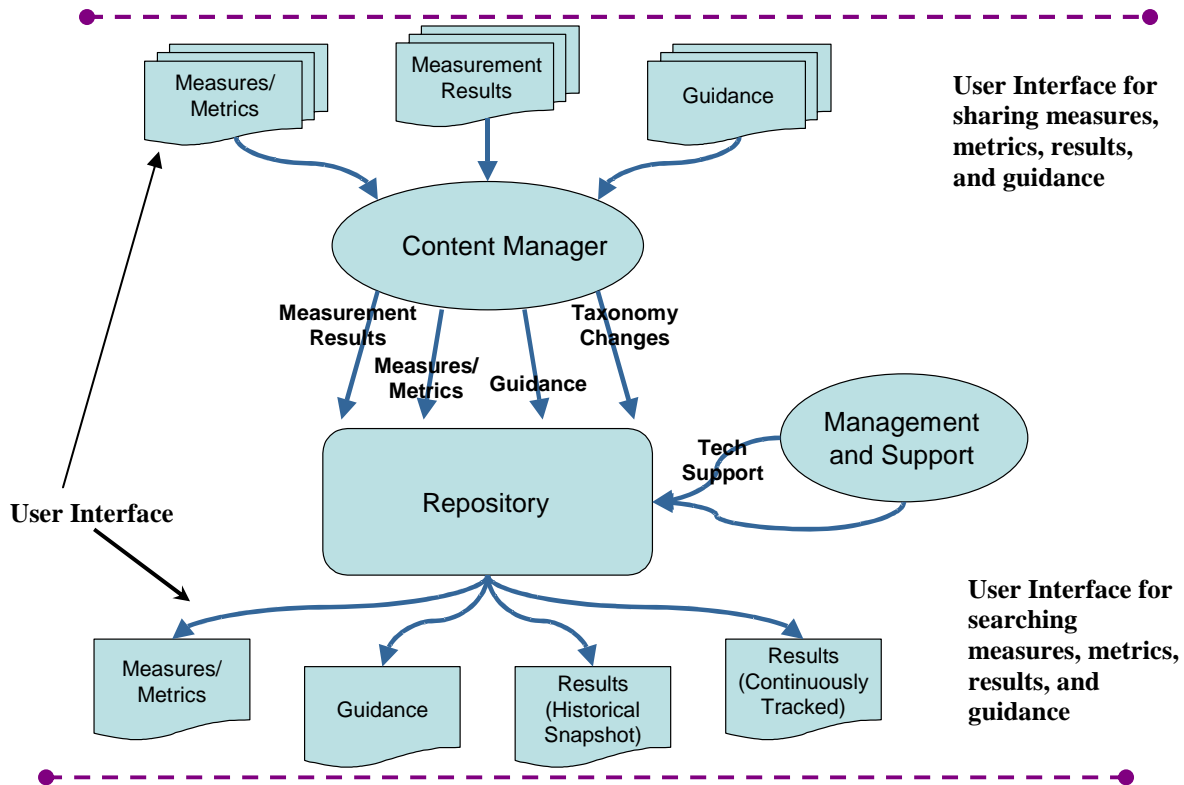


Figure 1: An Overview of Repository Components.

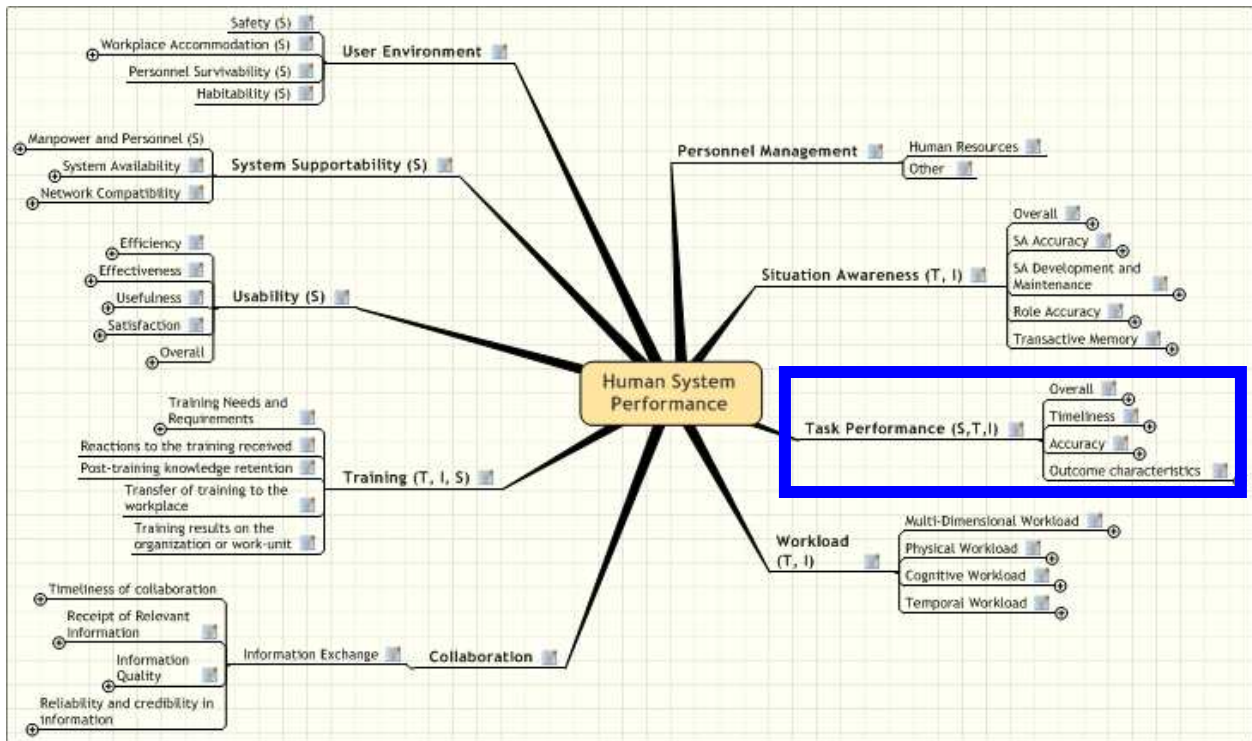


Figure 2: Human system performance metrics taxonomy.

Figure 3 takes a single assessment category, Task Performance, and illustrate the various measurement categories, measures, and metrics defined for it. Task Performance is defined as measures related to the execution or completion of a task or function, which are typically assessed with variables such as time, percent, quantity, or capacity. Task Performance is broken into four Measure Categories that are defined as:

- Overall: In addition to specific measures of the time or accuracy associated with executing a task, overall or composite measures to describe task performance may be constructed.
- Timeliness: Measures concerned with the length of time required to complete a task or some portion of a task. These measures may be modified or combined with other measures to assess the rate at which tasks are performed or the proportion of total time spent on various categories of operator tasks.
- Accuracy: Measures that address the correctness of an operator task or decision. Alternatively, the precision of an operator response or action (whether within or outside acceptable limits) may be of interest. Accuracy may refer to the correctness of the decision made by an operator or the precision with which the resulting action is executed.
- Outcome characteristics: A measure of task performance based on the quantification of some output, product, or end state of the task.

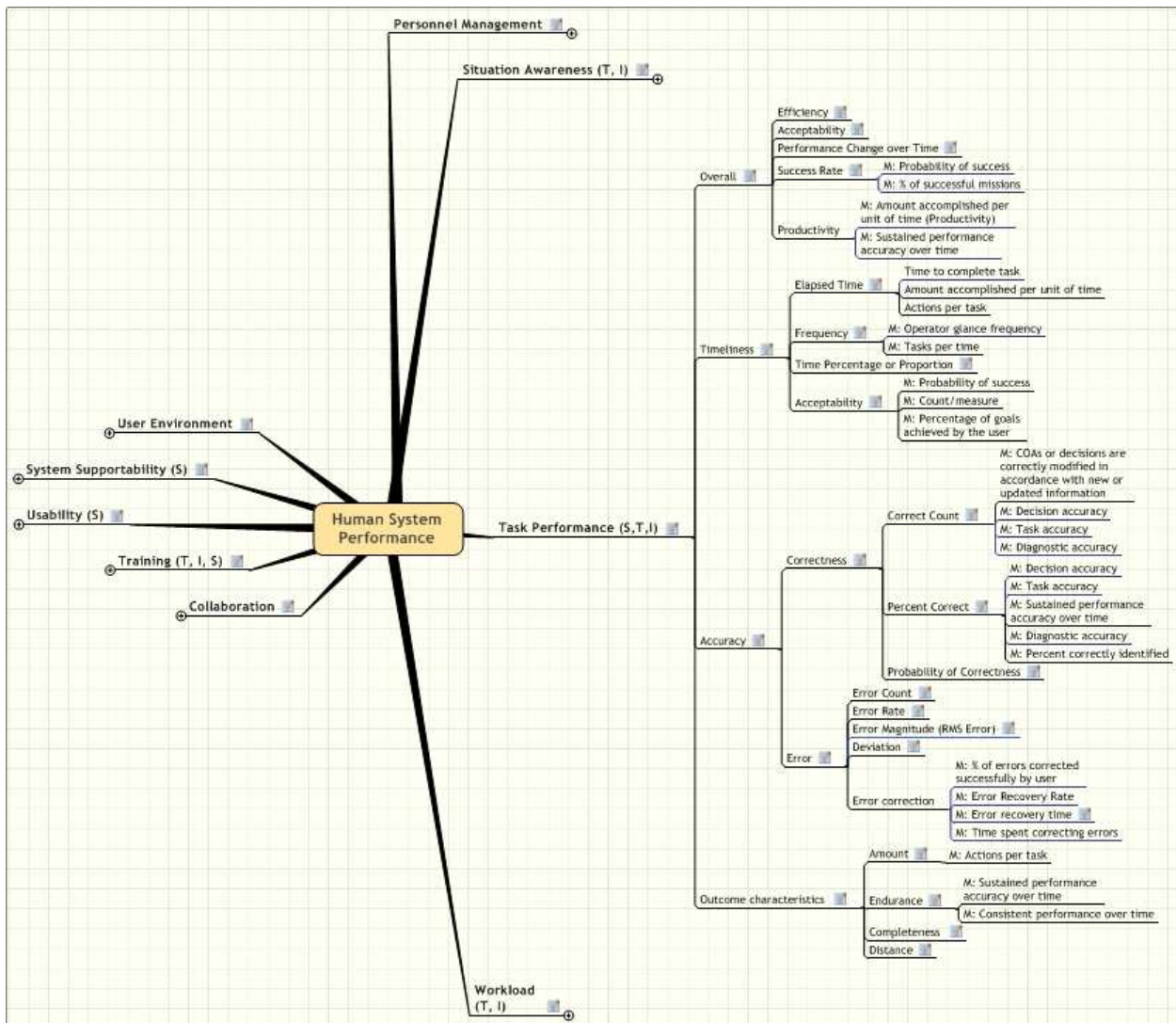


Figure 3. Task performance taxonomy.

5 Approach

To complete this taxonomy/ontology, a set of tasks and associated deliverables have been identified.

5.1 Guidance and Documentation

- **Terminology:** This will research and select for common use appropriate definitions for terms and nomenclature relevant to human performance measurement in an acquisition context. This will also include definitions for terms necessary to describe the structure, content, and functionality of the measures repository.
- **Obstacles to Measurement:** This will identify significant or frequent obstacles to being able to measure human performance in the context of specific programs or operations. The list of obstacles will also be used to identify requirements and uses of the measurement repository to overcome the obstacles.
- **Repository Business Rules.** These will pertain to the process of entering information (new results or new measures) into the repository and updating the taxonomy or organization of measures. A “Content Manager” has been proposed to review measures and results that are submitted, but the operating principles of such an organization must be identified for the repository to be fully compatible.

5.2 Measures and Taxonomy

- **Measures and Selection Guidance:** This will document specific measures of human performance, along with guidance information for the selection and application of measures to be included in the measures repository.
- **Measures Taxonomy:** This will include both the categorization of the measures and additional major attributes used to describe or differentiate measures.

5.3 Measures Repository

- **Measures Repository:** This will provide for storage and access of human performance measures and measurement results. The repository will include the capability to store information and the user interface through which users “push” measures and results into the repository and “pull” measures, results, and guidance information out of the repository.

6 Summary

The two primary objectives for the measures and metrics efforts are to develop a list of human performance measures that can be applied to the development and acquisition of systems and platforms and to develop a repository to store those measures and measurement results, along with a user interface (ontology tool) that allows access to that information.

The Ontology tool will allow users to browse measures and metrics, retrieve previous assessment results, and share assessment results with other user communities. It will provide assessment communities with a shared, integrated repository of measures, metrics, and assessment data for accurately and completely tracking performance measures and assessment results.