

# **Analysis of Human–Computer Interaction in the Expeditionary Warfare Decision Support System (EDSS)**

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## **Abstract**

The Expeditionary Warfare Decision Support System (EDSS) is an Office of Naval Research (ONR) sponsored system designed to improve the planning of expeditionary operations. ONR requested that the Applied Physics Laboratory, University of Washington (APL-UW) and the Naval Research Laboratory (NRL) investigate the human-computer interaction (HCI) components of EDSS. Additionally, APL-UW and NRL were tasked to provide user interface recommendations to the EDSS developers. To do this the HCI team followed a user-centered design (UCD) approach and studied EDSS users and their tasks, which resulted in an in-depth user task analysis of expeditionary planning. A medium-fidelity interface prototype was created based on the user studies and the principles of UCD. The prototype presented a more streamlined and intuitive order of tasks and improved window organization. The positive feedback from this prototype allowed for a more comprehensive list of user interface recommendations. A majority of these recommendations were incorporated into a follow-on version of EDSS. HCI and UCD have implications for future versions of EDSS and other Navy decision systems, and particularly for Net Centric Warfare.

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## I. Introduction

Expeditionary warfare planning is one of the most complex endeavors in modern military operations. The process of projecting power ashore includes operations over water, under water, in the air, and on land. Planning considerations range from detailed study of tidal information to determining how and when to move bullets from ship to shore. Also, the complexity of the planning increases when military operations involve multiple services or multiple warfare areas. Hence, expeditionary warfare is even more complex because it is inherently a joint operation (Joint Doctrine for Amphibious Operations—Joint Pub 3-02, 9/19/2001). Therefore, planners must master the full spectrum of multiservice operations, and also navigate the oftentimes conflicting procedures of separate military organizations.

This report describes the work accomplished for the Office of Naval Research (ONR) to support the Expeditionary Decision Support System (EDSS), which is a computer-based system designed to improve Navy and Marine Corps expeditionary planning. The current EDSS system provides powerful tools to develop a plan and monitor its real-time execution.

ONR requested that the Naval Research Laboratory, Washington, D.C. (NRL), and the Applied Physics Laboratory at the University of Washington, Seattle, WA (APL-UW), investigate the human-computer interaction (HCI) aspects of EDSS and provide recommendations for improvement. In the process of studying EDSS and expeditionary warfare, NRL and APL-UW visited several sites, interviewed subject matter experts, participated in EDSS training periods, and went aboard ship during an at-sea amphibious exercise.

The following sections 1) review the key concepts and techniques of HCI and user-centered design (UCD); 2) describe the process that the investigative team followed; 3) provide the results of the user interface analysis; 4) summarize the team's recommendations and their implementation; and 5) provide a conclusion and suggest implications for future design considerations. The latter are in response to the needs of a major military initiative, Net Centric Warfare, which has implications far into the future for transforming military operations. This initiative recognizes that at the center of all technology is the human user. EDSS may have a valuable role in this operational transformation.

## II. Human–Computer Interaction and User-Centered Design

At the request of the ONR sponsor, APL-UW and NRL were tasked to investigate the human–computer interaction (HCI) aspects of EDSS and provide support to the EDSS developers. (Note: EDSS developers were the main team responsible for the EDSS software and not the APL-UW/NRL team.) The general consensus prior to the start of the HCI work was that, while EDSS was a capable application, its iterative development cycle had resulted in a cumbersome and unintuitive user interface.

Coincident with the start of the HCI work, the EDSS developers were preparing to begin a major code redesign to support changes in the Department of Defense’s Common Operating Environment (COE). This offered an opportunity to make relatively low-cost changes to the interface paradigm with a high payoff in usability. With that goal in mind, the HCI team felt that the principles of UCD should be applied during the redesign effort. The following section provides background information on key concepts and techniques of HCI and UCD.

### What is Human–Computer Interaction?

The discipline of human–computer interaction is relatively new. One of the most broadly accepted definitions of HCI is that it is concerned with the design, evaluation, and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them. (*ACM SGICHI*, 1992) The field has grown rapidly due to the exponential expansion of computer systems into nearly all facets of human activity. HCI is multidisciplinary. The field includes computer scientists, linguists, communication experts, sociologists, psychologists, and many others.

HCI research and application involves a variety of thrusts such as human perception and its relationship to graphical user interfaces, or the impact of mental models on a system’s ease of use. Yet, at the core of HCI is the concern that computers need to be designed with human capabilities in mind, and that human performance requirements should be factored into the overall design of any computer system.

“Underlying all HCI research and design is the belief that the people using a computer system should come first. Their needs, capabilities and preferences for performing various activities should inform the ways in which systems are designed and implemented. People should *not* have to change radically to ‘fit in with the system,’ [rather,] the system should be designed to match their requirements.” (*Preece*, 1994)

### Usability

The process of improving a computing system so that it meets the needs and capabilities of a user is often described as increasing the system’s usability. This term can be interpreted several ways. Jakob Nielsen, a well known usability expert, describes the factors of a usable system: learnability—the system should be easy to learn and help the user toward mastery; efficiency—once the system is mastered, the user should achieve a high level of productivity; memorability—a casual user should be able to return to the system without having to relearn the

system; low errors—systems should have few bugs and be able to recover quickly from a system failure; satisfaction—systems should be pleasant to use so that users like using them (*Barnum, 2002*).

## The Need for User-Centered Design

The knowledge gained from the study of HCI and usability has led to a new paradigm in computer system development called user-centered design (UCD). UCD was developed to address the complaint that computer systems were too complicated. The six principles of UCD expressed by Vredenburg et al. (2002) are:

- Set business goals—determine the target users
- Understand users—the needs of users are the driving force
- Design the total user experience—every aspect of the system can affect the user
- Evaluate designs—user feedback is required
- Assess competitiveness—users often have more than one option
- Manage for users—continue to seek user feedback and include user needs during the systems' life cycle

UCD is a way of achieving more effective systems by challenging the designers to mold the system around the user. Designers must start with the users' needs before deciding the technological approach. Good UCD leads to increased usability because UCD is "...an approach to designing ease of use into the total user experience with products and systems. It involves two fundamental elements—multidisciplinary teamwork and a set of specialized methods [for] acquiring user input and converting it into design." (*Vredenburg et al., 2002*)

Another aspect of UCD is that it leads to better "situational awareness" because the system is designed after a thorough understanding of the users' tasks and information needs (*Endsley, 2003*). For decision systems like EDSS, situational awareness should be a primary concern.

## Task Analysis

Because one of the essential tenets of UCD is designing for the human in the system, designers need to understand the work users must accomplish. In the fields of HCI and cognitive engineering there are several different methodologies used to develop knowledge about users and their work requirements. These methods can generally be grouped together as task analysis.

Task analysis had its origins in the studies by Taylor and others (*Annet, 2000*) of human motions on factory assembly lines. These techniques evolved as the machines used by humans grew more complex and required more than just physical interactions. The development of computing systems that automate human processes or aid in high-level decision making requires an even deeper understanding of human involvement and thought processes.

One of the more powerful methodologies is called cognitive task analysis (CTA), which "...attempts to apply current concepts in cognitive psychology to the analysis of complex tasks." (*Schraagen et al., 2000*) A full CTA requires in-depth study of how a person processes information, forms concepts, and makes a decision based on those concepts. One method to

extract this type of information is to have subject matter experts (SME) perform a representative task and externalize their internal thoughts. This *Think Aloud* protocol typically requires the recording of all verbalizations and the subsequent analysis of each statement. Full analysis of all the *Think Aloud* statements can typically take months of work.

Considering the short time frame we had to provide design recommendations to the EDSS developers, and the complexity of the decisions in the expeditionary planning domain, we decided to employ a simpler methodology called user task analysis (UTA). A UTA involves learning from an SME during interviews, observations, and from published materials such as doctrine and procedural descriptions [standard operating procedures (SOP)].

## **Total User Experience**

Once an understanding of the user is achieved, the design of any cognitive system, that is, a system with humans in the loop, should focus on meeting the identified needs of those humans. This should be developed with a holistic viewpoint and a consideration for the total user experience. This experience includes such items as training and the user's system and social environment. The design should focus on solutions to user problems, not solutions to technology challenges.

One way toward achieving a system that is both usable and useful is to include people from a variety of disciplines in the design team. This allows the incorporation of different perspectives on the needs of the user. People with field or operational experience and those with multimedia or technical communications training can greatly enhance the total user experience by providing design recommendations that go beyond solving system engineering problems. The team needs to consider issues such as workflow, training, maintenance, and integration with other tools in the users' workplace.

Another user experience issue that engineers often relegate to a low priority is the look and feel of the system interface, or, its visual appeal. A distinctive user interface enhances the user experience because it plays to the human desire for proportionality, clarity, and color. Proponents of great looking Web sites, for example, recognize the value of appearance and distinctive design for drawing in users, keeping them interested, and in getting them to come back. Lindholm and Tapani (1994) cite beauty as an important property for an interface.

There are a variety of techniques that the design team can use to help achieve a good user-centered design, such as heuristic check lists and cognitive walkthroughs, but two of the most important are rapid prototyping and usability testing.

Briefly, rapid prototyping is the early development of a user interface that ties together the information inputs and the system outputs. A prototype can be either low, medium, or high fidelity, but considering the fast pace of modern software development, most teams rarely have time to develop a high-fidelity prototype prior to lock-in of the design features. The intent is to test ideas before the final design has been decided, not just before it is implemented.

The prototype plays a significant role in the early stages of usability testing. A low-fidelity prototype can be brought to users and their feedback can be factored into the early stages of the system design. As the design becomes more complete, the development of software use cases

should be checked against the user's needs as described in the task analysis, and by additional interviews with users.

Finally, after most of the design decisions have been made, usability testing becomes most important. A high-fidelity prototype should be created that allows for the completion of real tasks. Users should be observed using this system and data from those observations need to be analyzed. Usability testing does not have to be a time sink or costly. Several researchers (*Barnum, 2003*) have shown that a small number of users (3 to 5) who are observed by human recorders (i.e., sophisticated recording systems are not necessary) can catch up to 80% of a system's usability problems.

These UCD principles and techniques formed the foundation for the HCI team's investigation effort and the subsequent user interface recommendations. These are described in the following sections.

### III. Investigation and Analysis

As described in the previous section, the HCI team determined that the redesign of the EDSS user interface should follow UCD principles. The best time to employ UCD is at the beginning of a software development project, but in this case the UCD procedures had to be altered to accommodate a program that had already been fielded. An additional consideration was the desire to produce interface design recommendations as soon as possible. To accomplish this goal the team adopted a two-step process. They focused on the usability of the EDSS program at the start of the investigation and then moved to a more comprehensive user task analysis. The ultimate goal was to gain a sufficient understanding of the expeditionary warfare domain.

#### Usability Study

The usability study was conducted by several methods. The first task was an interview with an EDSS subject matter expert (SME). The SME had extensive knowledge of the EDSS program and the expeditionary warfare domain. He provided an in-depth demonstration of EDSS capabilities. This was filmed and later used for team training. A second period of data collection was accomplished during a scheduled EDSS training period on the USS *Tarawa* (LHA-1) at pier side, San Diego. An HCI team member participated in the training and then observed the sailors and marines during their training, documenting when the trainees had difficulties learning or using the system.

One of the most important user studies was an observation period spent on the USS *Iwo Jima* (LHD-7) during an amphibious exercise. Here, a team member observed multiple training activities and the operational use of EDSS in exercise planning, and conducted numerous interviews with Marine and Navy personnel. Extensive notes on the use of the EDSS application during simulated wartime situations provided the best understanding of its strengths and weaknesses.

In addition to working with users, the EDSS developers provided the HCI team with a version of EDSS 1.X. The HCI team reviewed all the functions in the application and filmed the completion of different tasks. The availability of a running system was invaluable for the development of the redesign recommendations.

The first result of these interactions with users was the development of a workshop. Its main objective was to introduce some of the usability issues discovered and also provide an overview of UCD principles to the EDSS developers. The workshop was held in July 2002 and a variety of UCD topics were presented (see Appendix A). A discussion during this workshop led to the initial thoughts on a new human-computer interface paradigm.

#### User Interface Analysis

Following the workshop, the HCI team focused on the EDSS user interface. The team determined that the most significant impact they could have on EDSS would be to help improve how users interacted with the menu and windows of the current fielded system. The investigative team conducted an initial analysis to discover why users were having difficulty traversing EDSS 1.X. We discovered a number of factors. Most notable were: 1) the system

lacked workflow or a first-to-last step organization; 2) windows opened on top of one another, covering the map and causing users to become confused because they could not see their previous entries; 3) similar or related tasks were not grouped logically; and 4) users had to go through too many steps to complete a task.

Table 1 shows the top level menu structure of the EDSS 1.X version reviewed by the HCI team. The team learned that this menu structure evolved on a sometimes ad hoc basis, and the result was a confusing structure for the user. For example, in the first menu the term “Operational Areas” was unclear. Are these ship operating areas, ground areas, air areas, or is something else intended? Under this menu are several lines for tasks, such as load or save. But there is also a line for the task of import or export. How is importing different from loading? There are numerous other examples where the menus were sometimes poorly described or the capability they offered the user was placed in an area that was not intuitive and hence difficult to locate in the user workflow.

**Table 1. EDSS 1.X Top Level Menu Structure  
(Menus in parentheses are planned but not implemented.)**

<p><b><u>O</u>perational Areas</b></p> <p>New Area ...</p> <p>Load ...</p> <p>Save ...</p> <p>Delete ...</p> <p>Import ...</p> <p>Export ...</p> <p>Exit</p>
<p><b><u>D</u>isplay</b></p> <p>Plot toggles...</p> <p>Time/Distance Lines...</p> <p>Spider Web...</p>
<p><b><u>A</u>OA Mgmt</b></p> <p>(Objective)</p> <p>(Order of Battle)</p> <p>Areas ...</p> <p>4W Grid Assignments ...</p> <p>Asset Positions...</p>

<p><b><u>Envr DB</u></b></p> <p>Database</p> <p>    Depth Profile ...     (Wind)     (Tide)     (Wave)</p> <p>Models</p> <p>    Surf Forecast ...     Surf Observations ...     (Tide Model)</p>
<p><b><u>Assault Plans</u></b></p> <p>(Doctrine) (Lessons Learned) Plan Data</p>
<p><b><u>Logistics</u></b></p> <p>Serial Database ... Serial Tracking...</p>
<p><b><u>Reports</u></b></p> <p>Landing Craft Performance .....</p> <p>Landing Craft Availability ...</p> <p>Landing Craft Employment...</p> <p>Helo Availability ...</p> <p>Helo Employment ...</p> <p>AAV Availability...</p> <p>AAV Employment...</p>

After a review of the top level menus, the HCI team selected several major tasks and performed the workflow required of the tasks. The team found that the workflow required was not well thought out and could often be frustrating. Windows would pop up and overlay the window on which the user was working. Users got lost as they navigated to the new window to enter data and then tried to return to their previous window. The tasks involved in building a Sea Echelon Area are a case in point: the Unix-based version (UBV) EDSS 1.X required either 15 steps to create a 4W Grid (Table 2) or 13 steps to create a Freehand Area (Table 3).

**Table 2. Create 4W Grid**

<p><i>Begin</i></p> <ol style="list-style-type: none"> <li>1) Select “AOA Management/Areas” from EDSS Menu bar</li> <li>2) Select “Add” from Area Directory panel</li> <li>3) Select “Grid” from list of area types (<i>4W Grid Specifications Window is displayed</i>) Enter 4W Grid Specs</li> <li>4) Enter name of Grid</li> <li>5) Select Lat/Lon field then click on map to set Lat/Lon of Grid center, <b>OR</b></li> </ol>
<p><i>Enter Latitude and Longitude in Lat/Lon fields</i></p> <ol style="list-style-type: none"> <li>6) Enter Disposition Axis</li> <li>7) Enter number of Cells</li> <li>8) Enter Cell Spacing Distance</li> </ol>
<p><i>Name 4W Grid Cells</i></p> <ol style="list-style-type: none"> <li>9) Select “AOA Management/4W Grid Assignment” from EDSS Menu bar</li> <li>10) Click “4W Grid” button (<i>a list of 4W Grids is displayed</i>)</li> <li>11) Select a 4W Grid from list</li> <li>12) Enter user-specified name in “Name” field</li> <li>13) Select “Assignment” field, then click on cell to name on map, <b>OR</b></li> </ol>
<p><i>Enter Cell ID in “Assignment” field</i></p> <ol style="list-style-type: none"> <li>14) Enter comments in “Remarks” field</li> <li>15) Select cell color from color list</li> </ol>

**Table 3. Create Freehand Area**

<p><i>Begin</i></p> <ol style="list-style-type: none"> <li>1) Select “AOA Management/Areas” from EDSS Menu bar</li> <li>2) Select “Add” from Area Directory panel</li> <li>3) Select “Polygon” from list of area types</li> </ol>
<p><i>Enter Freehand Area Specs</i></p> <ol style="list-style-type: none"> <li>4) Enter name of Area</li> <li>5) Select area type (Area/Zone is default)</li> </ol>
<p><i>Specify Freehand Area points</i></p> <ol style="list-style-type: none"> <li>6) Select “Insert Pt” button</li> <li>7) Click on the map to create points; each click creates a new point; when last point has been created, select the “Close” button to close the area and end the insert point mode, <b>OR</b> key in Lat/Lon coordinates of the point(s)</li> </ol>

*Insert new point(s) in existing Freehand Area*

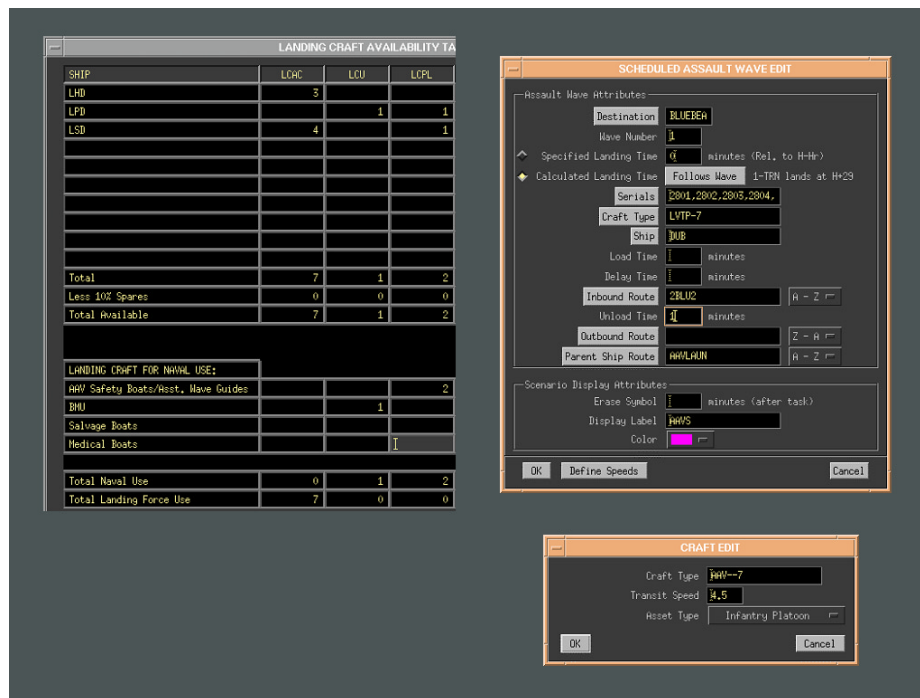
- 8) Select a field from the list of points; the new point will be inserted BEFORE the selected point
- 9) Select the “Insert Pt” button
- 10) Click on the map to create points; each click creates a new point; when last point has been created, select the “Close” button to close the area and end the insert point mode, **OR** key in Lat/Lon coordinates of the point(s)

*Move existing Freehand Area point*

- 11) Select field of point to move
- 12) Click on map; the point will move to the position of the click
- 13) Select the “Close” button to re-close the area

Similarly, there were 14 steps to create a Q-Route, or 9 steps to create a Boat Lane. Once the user created a new Boat Lane, the lane was rendered as a Q-Route. To edit the Boat Lane, the user followed the previous Q-Route editing procedures. Either way, these tasks were unnecessarily complicated.

Figures 1–3 show the largely text-based screens of EDSS 1.X with confusing window layering. Again, one of the most significant problems we found with the interface was the windows management. Windows popped in front of other windows and users had trouble finding the window they needed. Also, users had difficulty finding the appropriate task menu to achieve their desired workflow. These menus were neither grouped logically nor named intuitively.



**Figure 1. Landing Craft and Assault text-based windows in EDSS 1.X**

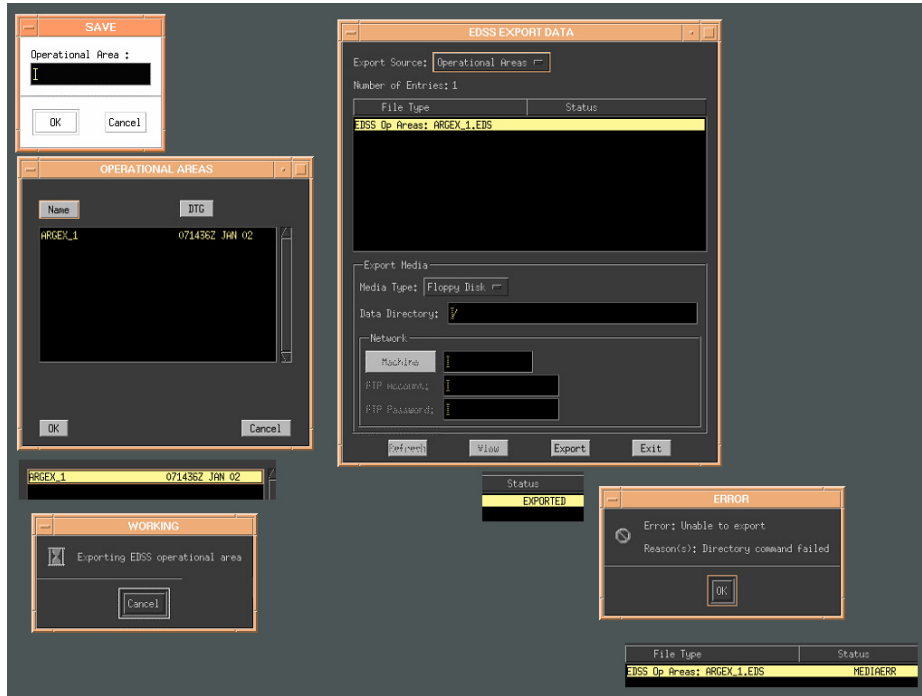


Figure 2. View at start up of EDSS 1.X; this shows all level 2 tasks under the Expeditionary Planning supertask.

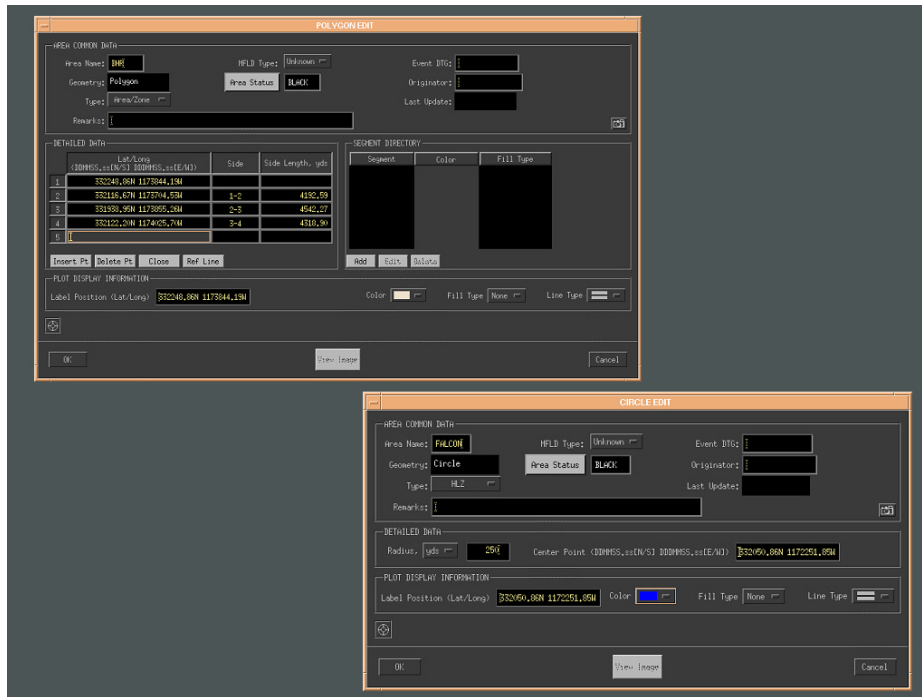


Figure 3. EDSS 1.X—editing 4W Grid parameters

## User Task Analysis

The first major phase of the user task analysis was completed at sea, during an amphibious exercise off the U.S. East Coast. The exercise included several ships, an embarked amphibious group commander, and a fleet marine force. One member of the HCI team was invited to participate and was allowed to observe users as they were trained on EDSS. The team member was also able to interview several other exercise participants. Table 4 outlines the observed training.

**Table 4. Observation Record of EDSS Training on USS *Iwo Jima* (LHD-7).**

Time	User	Comments
August 13, 2002 (Tuesday) 7:05 AM (approximately 1 hr 15 min. with time for system glitches not counted)	Marine BLT – Pvt.  Ops specialist. Experienced with software systems and served as regulation writer.	<p>Serial tables – listing of equipment in order to keep an organized evolution of debarking or embarking via LCAC or other &lt;&lt;became much more familiar with these later&gt;&gt;</p> <p>Found out that within operational area it is possible to have multiple beaches.</p> <p>Do all actions in 1 table before going on to the next action when editing speeds under scheduled assault wave.</p> <p>EDSS capability for LOS (line of sight): the ability to present height and define an area for the projection of what is visible from a point. Marines liked this for determining which area would be a viable approach to a LZ or action area.</p> <p>Technical question re: Q-Route, the Navy considers it a mined area route. In EDSS, Q-Route is any route used; thoughts are to just call it “Routes” thus making it possible to design multiple routes without the confusion of nomenclature.</p> <p>Should “Basic Decisions” be a step when it really seems to be a part of most cells? It is separate in the manual so wondering what it really refers to here.</p> <p>Another separate section in the manual is design display. That also seems to be something that is done and refined throughout. I think particularly for expert users it would be something not considered a lot because they have defaults in their mind from the beginning.</p>

Time	User	Comments
<p>August 13, 2002 (Tuesday) 9:00 AM (approximately 2 hr with many interruptions for general explanations and system crashes)</p>	<p>Navy SAC – QM1 – works in Ops specialty. Not an expert computer user.</p>	<p>Wanted to do everything with the mouse and “point &amp; click,” and did not like “key” commands.</p> <p>Very uninformed about amphibious operations in general. Much training time was also spent explaining the purpose of various EDSS activities. These will be more important to him as he goes for promotion so it was recognized as a training tool as well as a planning tool. Steps were explained as create Operational Area, then do the 4-W grid, then the boat lane and finally boat lanes.</p> <p>When creating beach center and boat lanes, it was possible to get points automatically.</p>
<p>August 14, 2002 (Wednesday) 7:30 AM (ended at 9 AM)</p>	<p>Navy SAC – QM1 – session 2. (He had mid watch the night before and was pretty tired.)</p>	<p>Performance requirement for 4W Grid should include something re: providing sufficient operational area for participating ships.</p> <p>Boat lane is a defined area on the chart for craft to use when heading towards the beach. It is plotted perpendicular to the beach and generally starts approximately 4,000 feet from shore.</p> <p>Designing routes includes planning the timing for all craft in and out with on/off load times figured in. Factors that need to be considered (besides not bumping into other craft) are speeds up and down depending on loads, sea conditions, and safety.</p> <p>Apparently there is a lot of convention for some of the design factors. I think the use of a default based on convention would be a time saver. Ability to change if need be could still be included.</p> <p>Ship-to-shore movement may be for individual craft or waves of craft with individuals then figured. Decisions are wave assault order, paths, delays.</p> <p>Landing plans need to have actual times and relative movements displayed.</p> <p>Part of boat lane construction is to determine the need for a sea lane extension. This is an area added to the beginning of the boat lane to allow for all craft to be dropped off. The newer version of EDSS has this capability.</p>

Time	User	Comments
August 14, 2002 (Wednesday) 13:05 PM (approximately .5 hr)	Marine BLT – Sgt.  Ops specialist	<p>Computer smart but did not want to have to worry about all that “Navy” stuff.</p> <p>Basically followed same steps as used for Cpl. yesterday.</p> <p>Ended up taking him to SAC to show him the LOS feature, which is still not installed on the desktops because of not having external floppy drive.</p> <p>No serial table availability either, which is the other thing they would have been interested in at that time.</p> <p>They were doing some preliminary work to prepare for when they were going to get the order to begin planning. I wonder if that would be a true example of how long it would take them to do one from scratch?</p>
August 14, 2002 (Wednesday) 13:35 PM (approximately .5 hr)	Marine BLT – E3  Ops specialist	<p>Followed the same procedure as the one before and had the same limitations.</p> <p>These guys were good on computers and had a fair amount of knowledge about amphibious planning.</p> <p>They were really interested in the maps, which were not functional at this time</p> <p>Lots of limitations identified because system was not on the LAN and could not access information available through GCSS.</p> <p>There seemed to be a real tendency to get lost in the software as to whether they were doing sea or land ops and which things were important for them. Possible to include some way of identifying which ops area they are interested in working? Thus marines who are only plotting from beach to action area would not have to even see some of the other stuff if they have no desire to modify the boat lanes, etc. defined by someone else. Particularly valuable when EDSS becomes mobile and worked by all rather than as stand-alone as it was here.</p>

<b>Time</b>	<b>User</b>	<b>Comments</b>
August 15, 2002 (Thursday) 8:00 AM (approximately 2 hr)	Navy – QM1 Session 3 (much less fatigued and much more interested)	Put on machine that finally is up and running like it is supposed to be at this point.  Fair amount of training remembered. Still getting lost some though.  Import and exporting functions were not working correctly and then when checked it was impossible to tell what files were the ones (if any) that had been created. Could not see date/time stamps. Made suggestions about changing that.  Found other places where some buttons were not consistent.  Made suggestion to have a “formal” HF evaluation of software to check for inconsistencies prior to getting too far along. Easy to have these when there are so many modifications going on all the time.
August 15, 2002 (Thursday) 10:00 AM (approximately .5 hr)	Marine BLT – E3. (did not even work in the area but saw what was happening and wanted to try it out)	(No comments)
August 15, 2002 (Thursday) 18:00 PM (approximately 1.5 hr)	Navy – QMC works in ops (had an intro on 8/12 but there were so many problems with the software, I did not take any training/planning notes)	During earlier training he professed not to know a lot about amphibious operations. A lot of time spent with how to get from screen to screen. Said that he did not know GCSS.  He remembered a LOT from the earlier session despite all the problems there were then. I ended up starting his training and he was able to help me out when I got stuck.  At this time he also seemed more interested than he did in the initial session.  Was shown all features this time and seemed to have a good grasp of what EDSS could do for them.

The second phase of the user task analysis involved an in-depth review of the pertinent references and military doctrine. The results of this data collection are compiled in a user task analysis found in Appendix B. The study detailed the first two steps of the mission planning

processes: Mission Analysis and Course of Action (COA) development. This identified the sequence and steps in decision making. Further breakdown of subtasks focused on two relevant tasks for our purposes here: Sea Echelon Areas and Routes or Boat Lanes. The study identified the information and performance requirements, the process involved, and the primary decision makers.

The next section describes the recommendations that were provided to the EDDS development team. These recommendations had their origin in the initial usability studies, but the knowledge we gained from the extensive user interaction and task analysis gave these recommendations a more solid foundation.

## IV. User Interface Design Recommendations

### The Recommendations

Based on the study of EDSS and the tasks involved in expeditionary planning, the investigative team developed the following recommendations (see Appendix C for the full report).

The graphical user interface (GUI) needs to:

- keep the map window in the center of the user's vision; all other interface windows form around the map window
- restrict window proliferation by using a single working window with tabbed panes
- offer a workflow listing as a series of tasks that segue directly to the required data entry tabs
- provide an asset manager window that links objects in the map window to their individual data entry tabs
- provide a quick way to animate a COA with a playback slider bar
- provide a consolidated list of all tasks that provides a hyperlink to the actual workflow task
- provide "tool tip" pop-ups (abbreviated help explanations) when the user moves the mouse over key elements of the GUI

The investigative team conducted an intermediate analysis as a transition toward the HCI prototype. Figure 4 represents the steps involved in creating a new OpArea that were taken from EDSS 1.X. The resulting workflow allows planners to select a task and plan a route with access to all information clearly visible on the screen. This redesign is based on an object-action interface (OAI) model that allowed designers to decompose a complex information problem into a comprehensible and effective solution through the use of task hierarchies and networks, and information actions that are then translated into interface metaphors or objects (*Shneiderman, 1998*).

To help the team explain its ideas for a new interface paradigm, a medium-fidelity prototype was developed. This prototype (Figure 5 is a sample screen shot) was written in Java and was platform independent. It featured a new task organization, a regrouping of data entry windows, and a new way of grouping assets. The prototype also allowed a user to complete a real task, which was the development of a 4W grid and the assignment of ship names, boat lanes, and landing zones. This prototype was essential in convincing the developers and key EDSS SMEs of the usefulness of the new interface design.

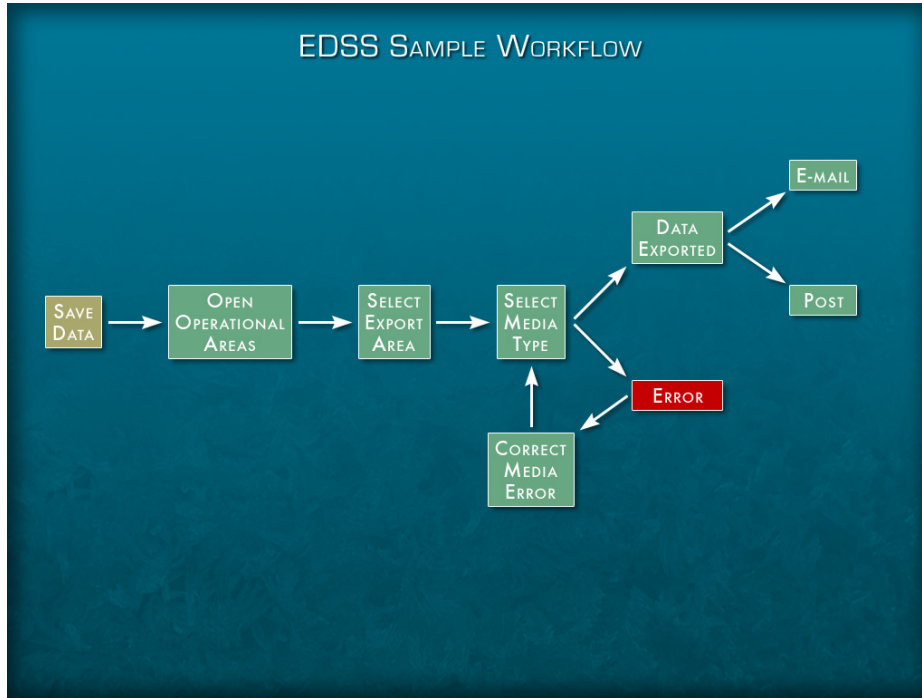


Figure 4. Unix-based version's new operational area workflow

The screenshot displays the EDSS user interface with a central map showing a coastal area with various operational areas and routes. On the left is a 'Task Manager' pane with a tree view of functions. On the right is an 'Assets' pane listing various elements like 'Op Areas', 'Echelon Areas', and 'Routes'. At the bottom, a 'Working Window - Edit - Linked Routes - LHA2B1' is open, showing a table of route links and a summary table for 'LHA : LHA 1'.

Leg	Start Position	End Position	Length	Course	Speed (kts)	LHA : LHA 1	
A-B	3708.1293N 02131.7633E	3708.1293N 02131.8870E	3.2	089	5.0	Avg Speed over Water	12 knots
B-C	3708.1293N 02131.8870E	3708.1314N 02133.7420E	1.48	095	5.0	Avg Speed over Land	n/a
C-D	3708.1314N 02133.7420E	3708.1451N 02132.5561E	0.51	075	3.0	Unload Time Mobile Cargo	10 min
D-E	3708.1293N 02131.7633E	3708.1293N 02131.8870E	0.10	041	2.0	Unload time Bulk Cargo	30 min
E-F	3708.1293N 02131.8870E	3708.1314N 02133.7420E	1.48	028	5.0	Refueling Time	15 min
F-G	3708.1314N 02133.7420E	3708.1451N 02132.5561E	0.51	075	5.0	Max Cargo Weight	180
						Max Cargo Square Feet	2300

Figure 5. New EDSS user interface prototype recommendation

Based on the feedback from the prototype, the HCI team recommended that the following features be included in a new EDSS user interface:

- Task Manager (TM): lists supertasks and their corresponding tasks and subtasks as a vertical workflow graph. The TM also has a Task Index that lists all tasks in alphabetical order and provides a hyperlink to the appropriate task element in the TM workflow.
- Map Window (MW): displays the selected map from Global Combat Support System-Maritime (GCCS-M) and geographic overlays created by EDSS. The other windows form around the periphery of the MW.
- Asset Manager (AM): provides a list of all map objects, such as the routes the user has created and the craft the user has chosen to include in the plan. With the AM the user is able to view the number and status of routes and craft. The AM shows all objects' relationship to one another.
- Working Window (WW): groups all data for an object or task in one location. Different types of data for an object or task are accessible via tabs. When the user selects a task, all of the screens of data are displayed in the WW in a tabbed format. This lets the user know immediately upon selecting a task or object what types of data can be edited. Data entry fields that flow in a linear fashion for a task are listed with tabs from left to right. This mimics the workflow.
- Playback Bar (PB): allows the user to perform one of the following: 1) play forward/backward; 2) step forward/backward in increments (user specified—one hour, one minute, one second, for example); or 3) step to the beginning or end using the buttons at the right of the Playback Area.

## Implementation

These recommendations were presented and refined during several meetings. The EDSS developers accepted the recommendations with a particular preference for the following: 1) docking structure that prevents window overlays; 2) separation of air from surface routes with solid and dotted lines; 3) green signifying a required task, orange as optional tasks; 4) playback bar as a constant on the screen, allowing users to execute at any time during the event as well as during mission planning, and to start the playback/scenario at any point; and, 5) capability to continually check the effects of plan implementation and changes.

Although there was some support for the idea of the Asset Manager (AM), this section of the redesigned UI was not implemented. We still believe, however, that the Asset Manager could add important functionality because it shows quickly all the routes and the geographic areas in current use. The developers considered that showing everything in an operational area could cause confusion because there are hundreds of items. However, the docking structure handles this situation through the use of layer toggles and buttons that allows users to decide what additional operational areas or assets are displayed during the planning phase. (Again, this solution is based on the object–action interface model.)

Dockable windows means that what is not deemed germane at the moment can be hidden. The docking structure is a tool to aid planners and serves as a memory jog, so they know the full range of possibilities in a given area. It is important to reiterate here that the AM provides the number and status of both linked and unused routes and craft, thus indicating what is missing in a

given task. Providing these capabilities to the user ensures the necessary control over the planning process.

The EDSS developers were tasked with a major development effort that required rewriting a feature-rich application in a new programming language to run on a new operating system. It is understandable that they could not implement all the recommended improvements during their initial revision. What follows is an analysis of EDSS 2.X Windows-based version (Figure 6) as it relates to the HCI prototype.

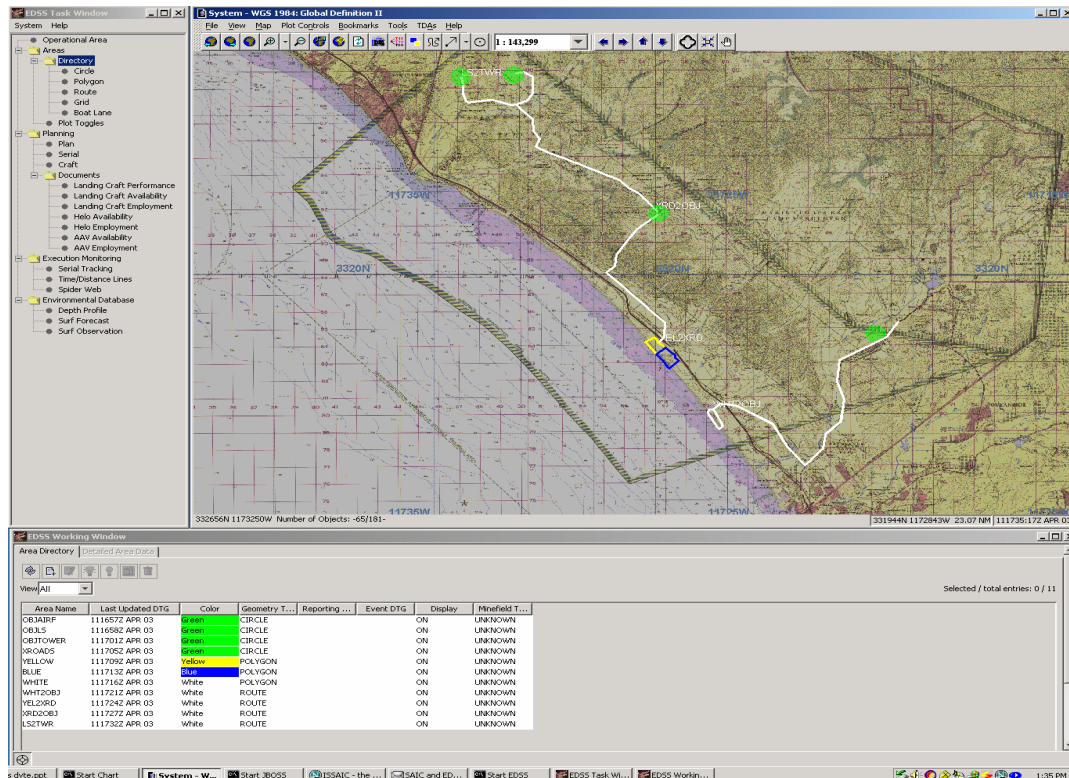


Figure 6. Implemented EDSS 2.X Windows-based version

## EDSS 2.X Windows-based Version

To review, in EDSS 1.X UBV user windows popped up over other windows. This created a cluttered, confusing interface. It was often difficult to access the map or other windows when needed because the overlays could obscure other windows completely.

The HCI team's proposed solution was a docking version of the EDSS interface. Instead of windows overlaying each other, a set area was established for each window. User input and navigation windows also docked to the main map window, which allowed users to see everything at one time, maximizing screen space. If a window needs to be larger, the user can click the maximize button to enlarge the specified window.

EDSS 2.X WBV utilizes a docking structure that allows user input and navigation windows to be viewed concurrently with the main map window. But the WBV could utilize more panes in order to present more data at the same time.

In the EDSS 1.X UBV users had a difficult time finding menu items to carry out task assignments. For each assignment there was a series of tasks to complete in a particular order. The menu items in the UBV did not correspond to any particular workflow, and as a result, users became confused as they tried to find the items necessary to carry out an assignment. In addition, it was difficult for users to remember all of the steps necessary to carry out an assignment.

The HCI prototype listed tasks and subtasks in a vertical workflow tree located in a docked window to the left of the main map. This allowed users to open and close task folders and to find necessary subtasks to carry out an assignment in the proper order. Users could select any item in any order, but the layout of the workflow provided a visual reference for the user with a suggested order for each task to be performed.

EDSS 2.X WBV provides a vertical workflow graph located in a docked window to the left of the main map. It provides a list of tasks and subtasks in a folder tree structure. The menu is organized by user tasks, providing a visual reference for the user on how to carry out tasks and subtasks. The map remains visible on the screen at all times as does the working window.

In EDSS 1.X the playback controls were difficult to use, and prevented the user from playing the simulation at anything other than a fixed rate. Although the HCI team has not tested EDSS 2.X, we assume that the EDSS 1.X UBV programming has not been modified to correct this situation because of the considerable difficulty. However, it is important to note that EDSS 2.X is undergoing a redesign, EDSS 3.X, based on user input, which will further user enhancements. This redesign has become an iterative process that correctly places the user at the center.

## V. Conclusions

We were tasked to investigate possible improvements to the human–computer interaction of the EDSS and provide recommendations to the system’s development. The recommendations of the HCI team were of value in an effort to convert the EDSS from a Unix-based (1.X) to a Windows-based version (2.X). To achieve this goal, we adopted a user-centered design approach (UCD).

Following the principles of UCD we:

- Observed EDSS users
- Observed EDSS training
- Studied the EDSS interface
- Observed people completing expeditionary warfare planning tasks in the field
- Interviewed Marine Corps and Navy personnel
- Completed an in-depth review of expeditionary warfare planning doctrine

Based on these observations and studies we developed a preliminary expeditionary warfare user task analysis (Appendix B) and a solutions design for a new EDSS user interface (Appendix C). The EDSS development team accepted many of our recommendations. The most significant changes implemented by the team were the recasting of the windowing framework and a new workflow menu structure.

The EDSS developers had a difficult task. They not only had to convert current functionality from one operating system to another, but they also wanted to improve the overall “look and feel” of the application. In order to help them envision our proposed changes, we developed a medium-fidelity prototype of the EDSS interface. This prototype proved useful during design meetings and may have accelerated the acceptance of our recommendations.

Our task ended before we were able to complete a usability study of the EDSS version 2.X. While observational data have not been collected to determine if the recommended user interface changes are a measurable improvement, informal feedback has shown that users have welcomed the new interface because of its enhanced clarity and improved workflow (G. Palmer, personal communication, January 20, 2004). If EDSS continues to evolve and additional capabilities added, a comprehensive usability study would ensure that the software continues to meet user needs and sponsor expectations.

The one area of concern is that while EDSS has improved greatly, the present development plan may not meet the desired goal of creating a comprehensive expeditionary warfare decision support system that supports decision making in the new paradigm of Net Centric Warfare (NCW). This military strategic initiative recognizes that the human user of technological systems is at the center of all activity. The NCW concept has implications now and far into the future for transforming military operations. Some of its most important tenets include: improving the speed of command, creating a greater shared awareness, increasing collaborative planning and execution, breaking down barriers to essential information, and increasing the speed of information from the producer to the user. EDSS can have a role in all of these issues.

For several reasons, however, EDSS may fall short of NCW goals. First, the majority of current EDSS users (based on our observations and discussions) are typically junior personnel. Meeting their needs, and incorporating their feedback into upgrades, may limit the wider use of EDSS by the senior level planners for whom EDSS was initially designed. Second, EDSS needs to include more high-level tasks/goals of these senior decision makers. This need has been documented in the user task analysis. Lastly, and most significantly, the rapidly evolving technology of Net Centric Enterprise Services needs to be included in subsequent EDSS iterations.

Our final assessment is that there are key improvements that EDSS should incorporate to meet the future needs of NCW including:

- Real-time collaboration through the development of a common planning picture
- Web services technology that allows for multiple station and platform independent planning
- Security services pioneered for NCW to allow information sharing that is typically compartmentalized, yet essential for big picture analysis
- Tools designed and developed for senior decision makers that focus on increasing their situational awareness

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## Appendix A: UCD Workshop Agenda and References

### Workshop on User-centered Design (UCD) Considerations for EDSS

**Date:** 30 July 2002

**Place:** SAIC Headquarters, Tysons Corner, VA

**Sponsor:** Office of Naval Research, Littoral Combat FNC

#### Agenda:

- 0830–0845: Introduction & Overview: Bob Miyamoto
- 0845–0900: UCD General Principles: Jim Ballas
- 0900–1000: UCD Principles Applied to the Expeditionary Warfare Domain: David Jones
- 1000–1050: Past examples of UCD applications: DMARS & Environmental Site Analyzer: Bob Miyamoto
- 1050–1100: Break
- 1100–1200: EDSS Issues & MEDAL COE 4.X Example: Shawn Faust
- 1200–1300: Lunch
- 1300–1345: Open Discussion: Identification of HCI & UCD Issues for EDSS
- 1345–1430: Interface Design and Evaluation: Jim Ballas
- 1430–1530: HCI from a User Perspective: Janet Olsonbaker & Troy Tanner
- 1530–1615: HCI as an Instance of Language Use: Derek Brock
- 1615–1630: Break
- 1630–1700: Review and Wrap-up: David Jones

#### UCD References for the Workshop

##### *Books*

Vredenburg, Karel; Scott Isensee, Carol Righi. *User Centered Design: An Integrated Approach*, 2001

Lewis, Clayton & John Rieman. *Task-Centered User Interface Design: A Practical Introduction*, 1994

##### *Web Links*

[http://www-3.ibm.com/ibm/easy/eou\\_ext.nsf/Publish/570](http://www-3.ibm.com/ibm/easy/eou_ext.nsf/Publish/570) (good site with a lot of info on UCD)

<http://www.user-centereddesign.com/index.html> (a company specializing in UCD services)

<http://www.well.com/user/riander/obstacles.html> (addressing obstacles to UCD)

<http://www.cognetics.com/lucid/> (Web site devoted to logical user-centered interaction design)

[http://www.stcsig.org/usability/topics/articles/ucd%20\\_web\\_devel.html](http://www.stcsig.org/usability/topics/articles/ucd%20_web_devel.html) (how to design a UCD Web site)

<http://www.ejeisa.com/nectar/inuse/6.2/contents.htm> (handbook of UCD—hyperlinked on Web site)

<http://hcibib.org/tcuid/> (HTML version of the book: *Task-Centered User Interface Design: A Practical Introduction*, by Clayton Lewis and John Rieman)

## Appendix B: Expeditionary Warfare Decision Support System (EDSS)—Final Report on User Task Analysis

### Report Overview

This is the final report of the EDSS **User Task Analysis** project. For the purposes of this report we have defined **user** as any person at the command and/or staff level involved in planning amphibious operations. We evaluated the Joint Doctrine for Amphibious Operations and the Marine Corps Planning Process (MCP) depending on the subtask being analyzed and the doctrinal source with the best information on the process. The goal of this analysis is to help facilitate the human-computer interface design process for EDSS. All questions about this work should be directed to James Ballas at NRL-DC.

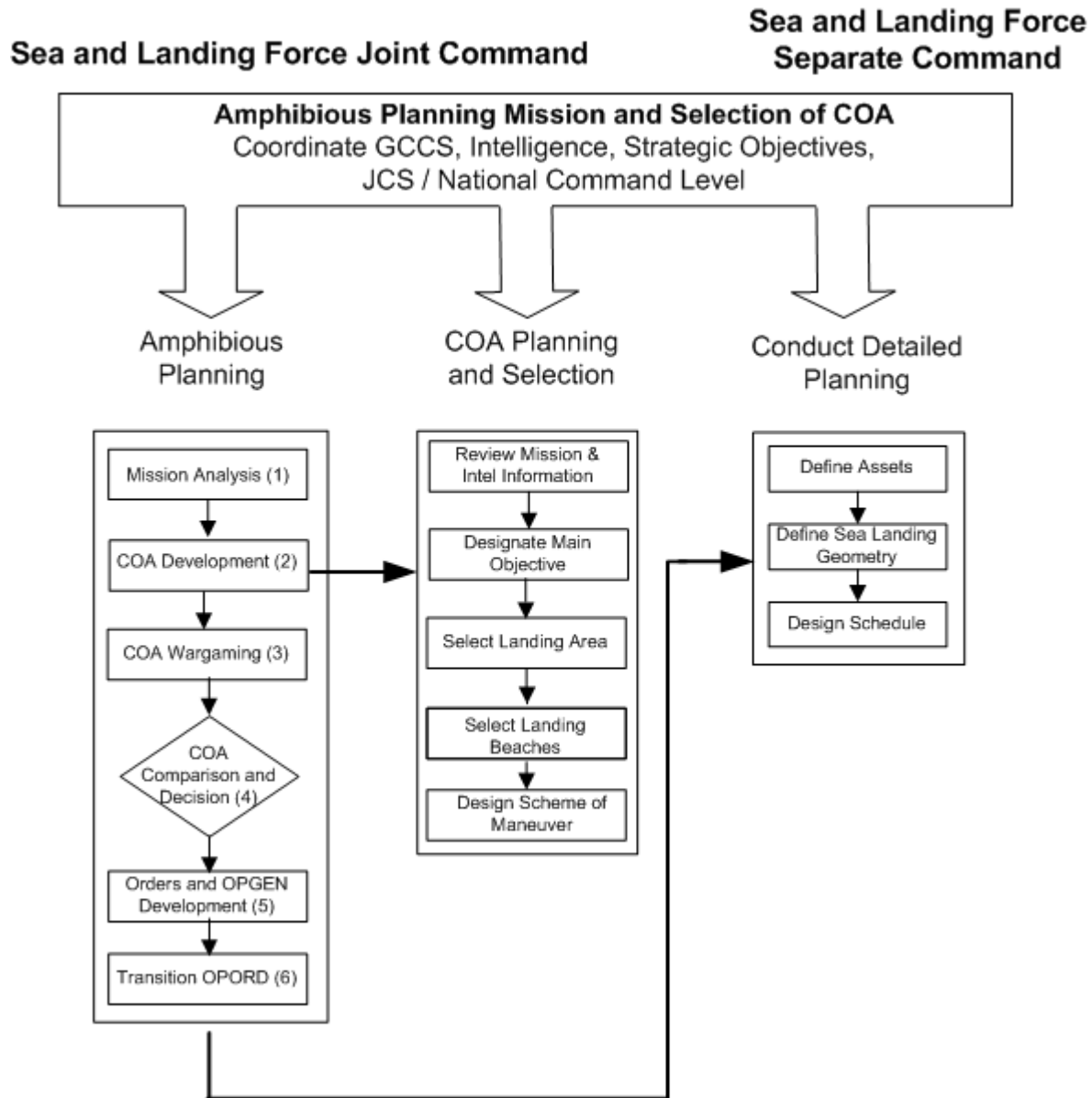
This report is divided into the following sections

- Initial NRL Analysis
- Tasks Analysis Methodology
- Task Analysis Results
  - Mission Analysis - MCP
  - Analyze/Select Landing Area & Analyze/Select Landing Beach - Joint Planning Process
  - Course of Action Development - MCP
  - Conduct Detailed Planning - EDSS HCI Mapping
  - Definitions and Doctrinal Sources

### Initial NRL Analysis

The initial analysis conducted by NRL is shown in the diagram below. Several elements of this diagram are worth noting. First, high level planning guidance comes from the national command level and is focused on strategic objectives and Joint and/or coalition operations (shown in the rectangular box). Second, the left side of the diagram indicates amphibious planning process under a Joint command structure, while the right side of the diagram indicates that detailed planning is typically planned by separate Navy and Marine Corps commanders. Third, the Amphibious Planning process depicted on the left of the diagram illustrates the six step planning model used by Joint and Marine planners.

For the purpose of this report the first two steps of mission planning process were analyzed - **Mission Analysis** and **COA Development**. The middle arrow indicates an initial breakdown of the task analysis for COA selection process. The right arrow indicates the Detailed Planning task analyses. Subject matter expertise was derived from both Joint and Marine Corps Planning Process doctrine. The overall task hierarchy shown below was used for the subsequent task analyses.



### Task Analysis Methodology

The general task analysis methodology is similar to approaches used in human factors and systems engineering. Typically, higher order tasks are broken down into manageable subtasks and analyzed as a sequence of steps. A formal task analysis often involves observing users of a system and building and testing prototypes to measure task performance. Due to constraints of this project an abbreviated informal task analysis was used in its place. The subject matter expertise used to analyze the tasks are based on current military doctrine combined with the results of a sea trial aboard the USS *Iwo Jima* in 2002.

### *Task Descriptions*

Each task/subtask was analyzed to determine what information is needed as input to the task, what are the human performance requirements essential to completing a task, who are the decision makers, what are the cognitive, perceptual, and analytical stages used in the planning process, and what products are produced such as maps, narratives, instructions, guidelines, and other data used during planning and mission execution. This information is incorporated into a task record shown below, which is part of each task analysis.

### *Task Record*

Informational Requirements (Inputs)

NEMTL Human Performance Metrics (Requirements)

Primary Decision Makers (Commander Level)

Process (Cognitive Analysis)

Product (Outputs)

### **Mission Analysis**

Mission Analysis is the first step in planning an amphibious operation. The purpose of mission analysis is to review and analyze orders, guidance, and other information provided by a higher command and produce a mission statement that drives the rest of the amphibious planning process.

Mission Analysis using Joint planning process and the MCPP are very similar. The User Task Analysis in this report is based on the MCPP doctrinal publication **MCWP 5-1 W/CH 1, 9/24/01**

The task analysis method is the same that was used in prior analyses of Course of Action development, and the Detailed Planning for EDSS.

### **Task Analysis**

A graphic depiction of the Mission Analysis process is shown below. This model does not do justice to the issues of concurrent planning steps where multiple components of the Mission Analysis planning are done in parallel. This model also does not reflect the highly iterative process used at the command and staff levels when building the analysis plan.

<b>TASK: Marine Commander Reviews Orders</b>	
Information Requirements	Input from higher command as WO, OPORD, or OPPLAN. Intel on friendly/enemy forces, battlespace, situational awareness
Performance Requirements	
Primary Decision Makers	Commander
Process	<p><b>Commanders Orientation:</b> Begins planning process by visualizing battlespace and mission and communicates this vision to the OPT through the most important element of the CBAE – the commanders <b>intent</b>. This is <b>directed at both planners and executors</b>. This focuses on the enduring part of a mission, the “why”. As situational awareness grows the commander may refine his intent using an iterative purpose-method-end state paradigm.</p> <p><b>Commanders Guidance:</b> Guidance is <b>directed to the planners</b> and provides the battle staff and OPT with additional insight about the resources needed to accomplish the mission, and what the force needs to do. It might be based on the six warfighting functions, or the sequence of actions to produce the desired end state. This is handed off to subordinate commanders and the OPT</p>
Products	CBAE
EDSS HCI Mapping	

<b>TASK: OPT Briefs Staff on Commanders Intent and Purpose of Mission</b>	
Information Requirements	CBAE, Higher Command Intel and IPB products
Performance Requirements	
Primary Decision Makers	Chief of staff, OPT, G-2, and subordinate battle staff

Process	<p>OPT leads the planning process and focuses on the “how” and “what” of the mission - meaning the strategy/tactics and identifying the necessary resources. Identifies the purpose of the mission. Briefs planning and battle staff on Higher HQ CONOPS so they understand how their operation fits into a larger mission</p> <p>OPT briefs the staff on the current enemy/friendly situation, Intel, IPB products, and the purpose of the mission and the Commanders Intent and assists the G-2 in the planning process. Ensures that the staff understands the command relationships internal to the Joint force and the MAGTF</p>
Products	CCIRs
EDSS HCI Mapping	

<b>TASK: Identify Tasks Needed to Accomplish Mission</b>	
Information Requirements	Commander Guidance, OPORD
Performance Requirements	
Primary Decision Makers	OPT, G-2, and subordinate battle staff
Process	<p><b>Identification:</b> Identifies tasks necessary to accomplish mission including specified, implied, and essential tasks. Implied tasks should be linked to specified tasks that are not SOP. Essential tasks apply to the force as a whole and form the basis of the mission statement.</p> <p><b>Analysis:</b> Implied tasks are derived by analysis of how the unit will accomplish the specified tasks across the six warfighting functions. COG provided by G-2 and Commanders orientation are analyzed. OPT analyzes the area of interest and influence, and the AO to determine if additional resources will be required</p>
Products	Task list (specified, implied, essential) contained in OPORD
EDSS HCI Mapping	

<b>TASK: Review Available Assets and Identify Shortfalls</b>	
Information Requirements	Task list, OPORD, COG,
Performance Requirements	
Primary Decision Makers	Commander, OPT
Process	Identify assets and resource shortfall, flesh out SME shortfalls, determine additional constraints and restraints, determine assumptions, proposes additional CCIR's to commander, identifies additional RFI to be submitted to higher HQ in the commanders name,
Products	CCIR's, RFI's
EDSS HCI Mapping	

<b>TASK: Draft Mission Statement</b>	
Information Requirements	OPORD, all prior products and documents
Performance Requirements	
Primary Decision Makers	Commander
Process	OPT prepare a mission analysis brief and WO for the commander. This is an iterative process that may follow the purpose-method-end state model. Once approved the OPT develops recommendations for commanders planning guidance and issues mission statement.
Products	WO, Mission Statement, Commander Intent and Planning Guidance, CONOPS, CCIR's, command relationships. Orders for preliminary actions such as Recon and Survail, staging logistics, special equipment requirements, time lines, planning meetings,
EDSS HCI Mapping	

## Joint Planning Process

This section describes the joint planning process used to plan an amphibious operation integrating Navy and Marine commands. The JPP is very similar to the MCPP. The six step model is show below.



An amphibious operation is an integrated plan jointly developed by the CATF and CLF as indicated in the **Joint Doctrine for Amphibious Operations**. The CATF is a naval officer and CLF can apply equally to a Marine and/or Army command. (In Chapter IV: Approach to Planning and Primary Decisions the Marine Corps or Army is not mentioned and are referred to as the “landing force”.) The steps in planning a COA for a Joint Amphibious Operation is shown in the diagram below.

Integral to the Joint planning process is developing the COA, which is the most difficult part of the process. The general planning in Steps 1–4 are broken down into 10 Primary Decisions indicating who owns which decision. Joint decisions are made by the CATF and CLF commands mutually (1–6, 10), and individually (7–9). The order of decision making approximates the logic and flow of the six step model.

PRIMARY DECISIONS RESPONSIBILITIES MATRIX			
PRIMARY DECISION	May be contained in the order initiating the amphibious operation	Decision	Decision made not later than step
1. Determine Amphibious Force Mission(s)	X	MUTUAL	1
2. Select Amphibious Force Objective(s)	X	MUTUAL	1
3. Determine Courses of Action for Development	X	MUTUAL	2
4. Select Course of Action		MUTUAL	4
5. Select Landing Areas		MUTUAL	4
6. Select Landing Beaches		MUTUAL	4
7. Determine Sea Echelon Plan		CATF	4
8. Select Landing Force Objectives		CLF	4
9. Select Landing Zones and Drop Zones		CLF	4
10. Select Date and Hour of Landing	X	MUTUAL	4

CATF Commander, Amphibious Task Force     
 CLF Commander, Landing Force

NATO Decision Matrix (Comparison Only)

NATO planning is not analyzed but a broad decision matrix is shown below to compare the NATO process with the Joint planning process. This chart is shown for comparison reasons. The overall decision process closely parallels the Joint sequence (while the tasks themselves differ). One of the greatest distinctions is the CLF has much more responsibility in the NATO matrix because of the greater complexity of the mission when having to coordinate between coalition and multinational forces. Note: This process resembles the matrix in the 10/8/1992 version of JP 3-02.

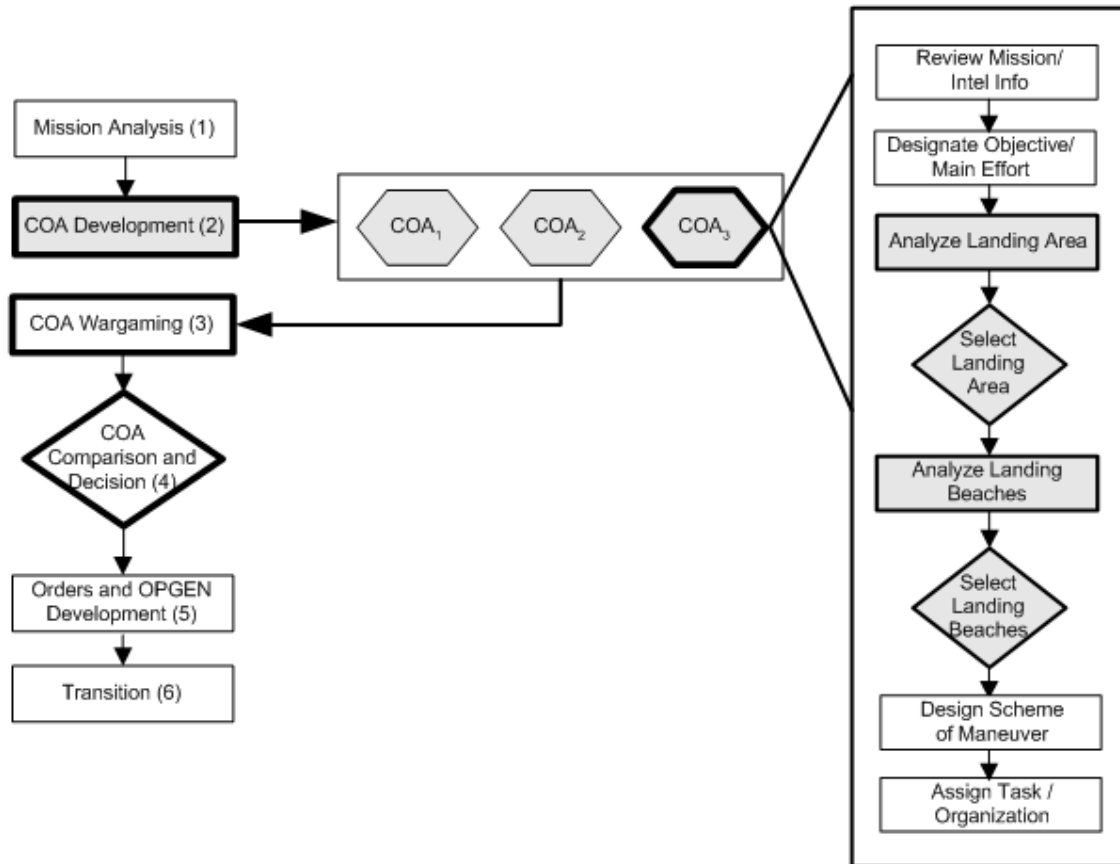
NATO-UNCLASSIFIED

ATP-8(A)

BASIC DECISIONS (Note 1) (a)	May be Contained in Initiating Directive (b)	CATF (c)	CLF (d)	SHARED (e)
1. Select Amphibious Task Force Objectives	X			X
2. Select Amphibious Task Force General Courses of Action				X
3. Determine Landing Force Mission	X		X	
4. Designate Landing Sites		X		
5. Determine Landing Force Objectives			X	
6. Determine Beachheads			X	
7. Select landing Areas			X	
8. Formulate Landing Force Concept of Operations Ashore			X	
9. Select Landing Beaches			X	
10. Select Helicopter Landing Zones			X	
11. Select Fixed-Wing Aircraft Landing Zones and Drop Zones	X		X	
12. Select D-Day and H-Hour	X			X

Note 1 -- All Basic Decisions made by CLF are subject to review/concurrence by CATF from a supportability perspective. The reference number of Basic Decisions on the table does not establish the priority order in which they have to be taken.

Two subtasks were selected for analysis. The grey boxes on the right of the diagram indicate the subtasks that were analyzed under COA Development. The graphic below depicts the JPP in greater detail and the two subtasks that were analyzed: **Analyze / Select Landing Area, Analyze / Select Landing Beaches**



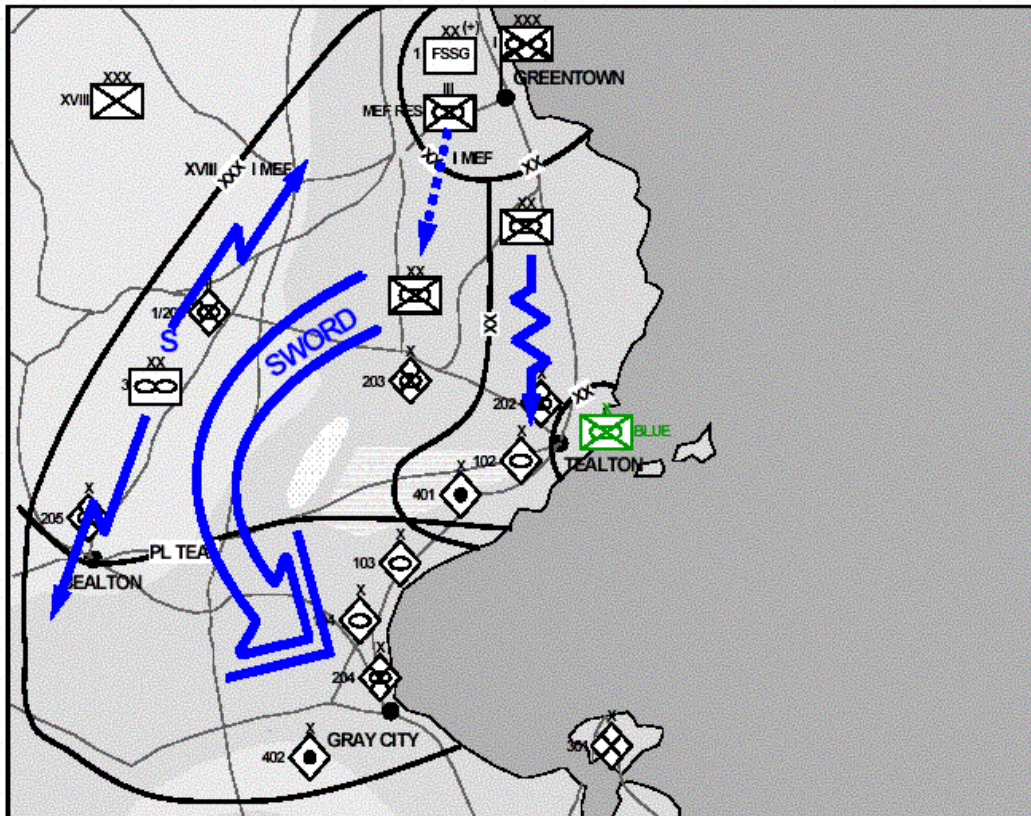
### Task Analysis Results

The purpose of the UTA was to understand two subtasks conducted in the Joint planning process as shown below in the grey shaded boxes. Two subtasks were analyzed. The hyperlink goes directly to the task analysis record for each task.

**Analyze and Select Landing Area**

<p>Information Requirements</p>	<p><b>Naval Considerations:</b> Ability to support the landing and subsequent operations; Degree of shelter from sea and weather; Hydrography of beach approaches off-shore and near shore including tidal information, beach gradient, beach exits, terrain bordering beach and Naval desirability; Extent of mineable waters; Hostile ability to defeat mine countermeasures; Practicality of improving unloading facilities; Hostile disposition and capabilities; Possibility of early seizure and rehabilitation of port facilities</p>
<p>(Source: JP 3-02 – 9/19/2001)</p> <p>Shown Graphically</p>	<p><b>Marine Considerations:</b> Landing area must be suitable for conventional, displacement landing craft and causeway ferries. Requires data on beach head, transport areas, fire support areas, airspace operated by close supporting aircraft, land included in the inland to accomplish objectives, hostile capabilities, coastline configuration inland terrain, combat service support requirements</p> <p><b>(Marine) Air Considerations:</b> Ability to achieve and maintain local air superiority and perform interdiction and close air support; Own forces locally based air warfare capabilities; Command and control capabilities and deconfliction ability; ability to support the landing and subsequent operations; Hostile counter air capabilities and disposition; possibility of early seizure and rehabilitation of facilities</p> <p><b>Ship-to-Shore Considerations: In development</b></p>
<p>Performance Requirements</p>	<p>MCPD detail the performance requirements for amphibious assault, demonstration, and withdrawal.</p> <p>M8: Y/N Did assault meet the stated objectives?</p> <p>M10: ≥ 90 % of execution checklist completed on time?</p> <p><b>Source:</b> CVBG Warfare Commander’s NMETL version 1.3; Naval Mission Essential Task List (NMETL) Development Handbook</p>
<p>Primary Decision Makers</p>	<p>CATF designates potential landing sites and provides the CLF with information</p> <p>The CATF weighs the capabilities of the naval force, the operational requirements for the air, land and sea areas. CATF delineates the sea area and airspace requirements to establish each beachhead tentatively selected by the CLF</p>
<p>Process</p>	<p><b>Select COA   Analyze Landing Area   Selection of Landing Area</b></p> <p><b>Full Guidance for this process is detailed in MSTP 5-0.2</b></p>
<p>Products</p>	<p><b>COA graphic and narrative. See Figure 6-2 in MCWP 5-1 w/CH1 (page 41)</b></p> <p><b>Diagram of Landing Area</b></p>

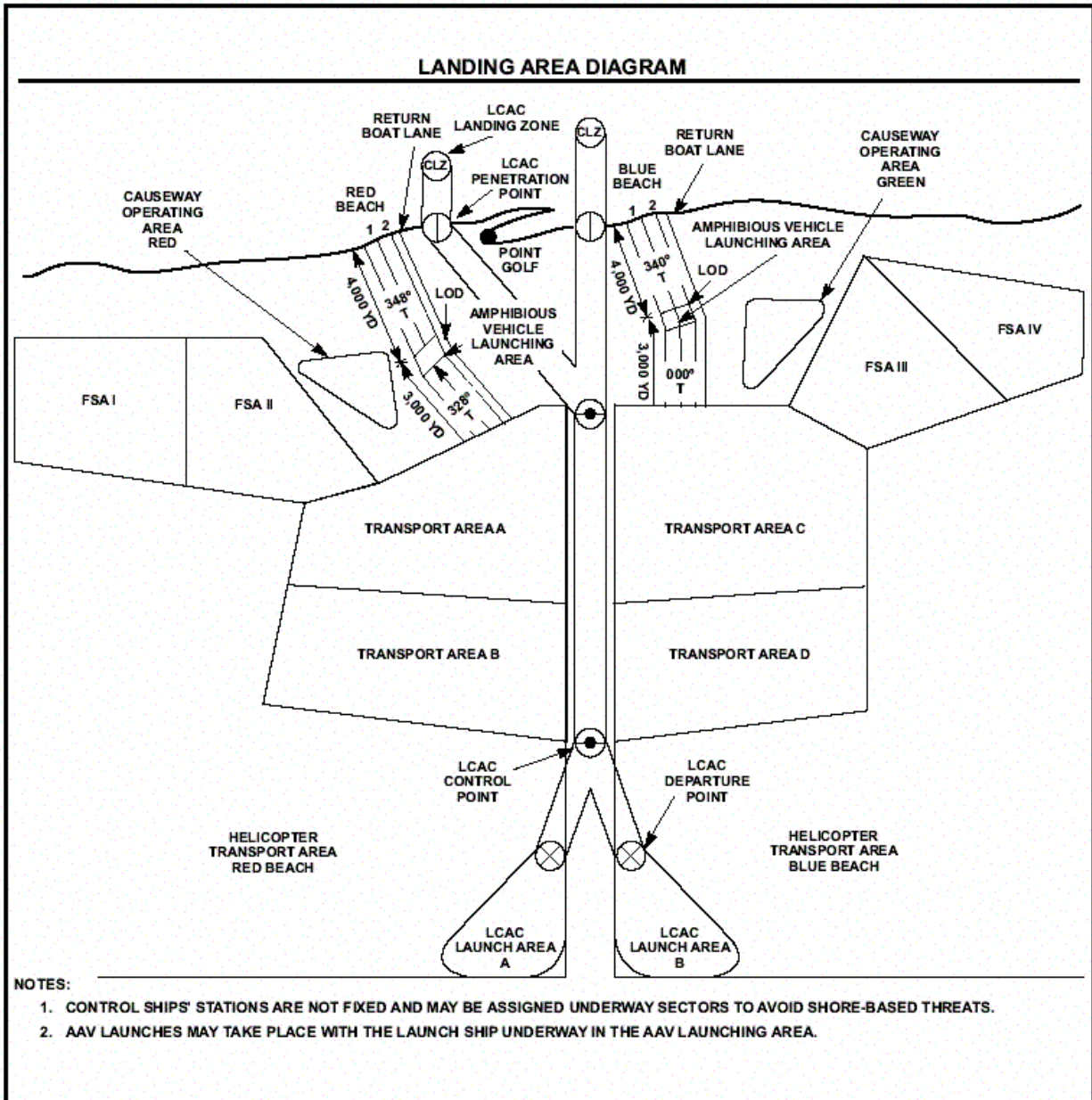
### Example of COA Diagram and Narrative



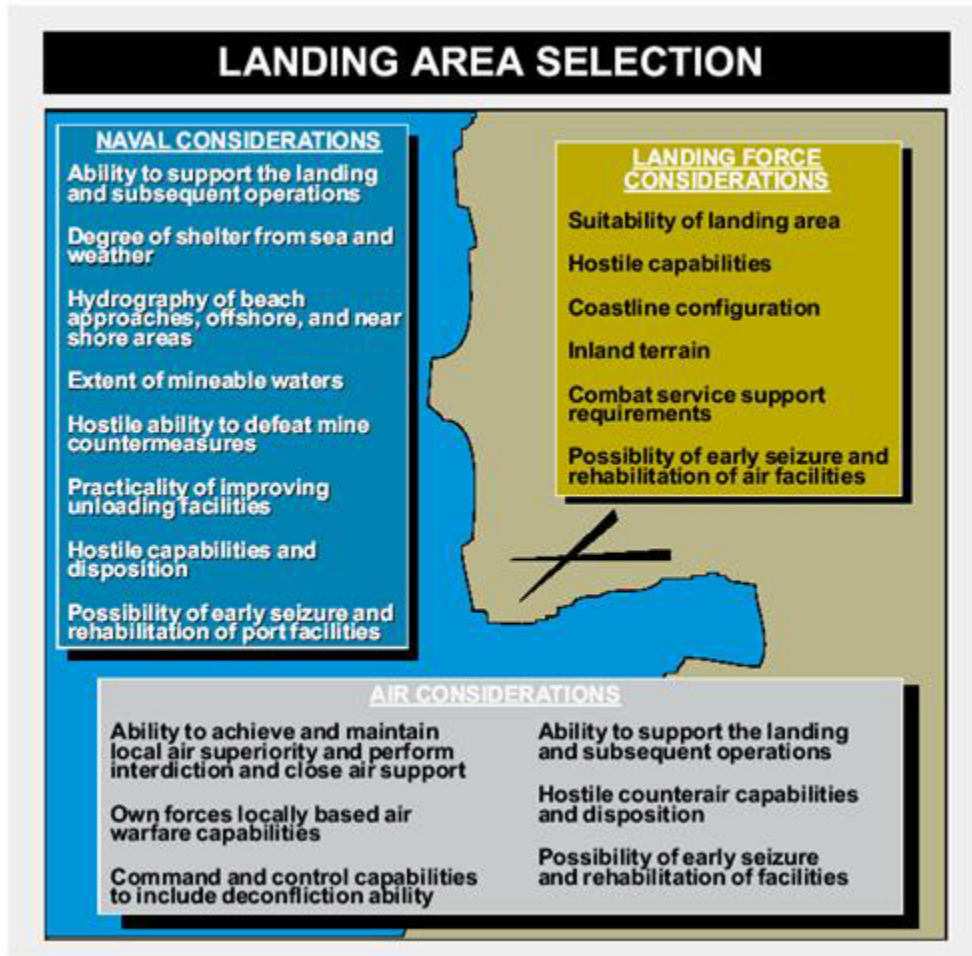
On order MEF conducts an envelopment to defeat enemy first operational echelon forces north of Gray City. **Close Operations:** In the east a division conducts a supporting attack in zone to fix the first tactical echelon. In the west a division, as the **MAIN EFFORT**, attacks along **AXIS SWORD** and defeats the second tactical echelon. **Reserve:** A regiment follows the main effort prepared to contain enemy forces capable of threatening the main efforts movement south. If not committed north of PL Teal, the reserve is prepared to block enemy reinforcements from the south. **Deep Operations:** MAW initially disrupts the 402<sup>nd</sup> Artillery Regiment's ability to mass fires on the main effort and limits the 103<sup>rd</sup>, 104<sup>th</sup> Armored Brigades, and the 204<sup>th</sup> Mechanized Brigade from reinforcing the first tactical echelon. When the main effort crosses PL Teal the MAW disrupts enemy second operational echelon forces from committing to the MEF zone. **Rear Operations:** A battalion task force acts as the MEF's TCF with the priority of responding to a Level III Threat to the MEF's class III fuel depot vicinity Greentown to ensure the uninterrupted flow of Class III. The FSSG establishes CSSA in vicinity of Tealton and Grey City to provide combat service support to MEF units. **Security:** The MAW screens to the west to protect the MEF's western flank. This phase concludes with enemy first operational echelon forces defeated north of Gray City.

Figure 6-2. Course of action graphic and narrative.

Landing Area Diagram



*Landing Area Selection Considerations – Graphic Representation from JP 3-02*



*Analyze / Select Landing Beach*

Information Requirements  (Source: JP 3-02 – 9/19/2001)	Selected after the landing area has been determined. Landing beaches are selected from within the selected landing areas.
	Landing beach is that portion of a shoreline usually required for the landing of a battalion landing team. Or might be the portion of the shoreline that is a tactical locality (such as the shore of a bay) where a force should be landed.
	Factors important to selecting a landing beach include the Naval, Marine, and Joint criteria used in selecting a landing area. Suitability for landing craft and AAVs. Offshore approaches and tidal conditions. Number, location, and suitability of beach support areas, beach exits, and nearby infrastructure. Landing beaches are designated by color and subdivisions designated by number (e.g. Green beach, Red Beach 1). <b>Ship-to-Shore Considerations:</b> In development

Performance Requirements	<b>More detailed information included in MSTP and Student Document handout.</b>
Primary Decision Makers	Mutual decision between CATF and CLF
Process	<b>Select COA   Analyze/Select Landing Area   Analyze Landing Beach   Select Landing Beach</b>  Commanders and staff must also begin developing their “commanders guidance for fires”, ensure the JFC targeting process is shaping fires and integrating them into a joint fire support plan
Products	<b>COA graphic and narrative. See Figure 6-2 in MCWP 5-1 w/CH1 (page 41)</b>  <b>Diagram of Landing Area</b>

### MCPP—COA Development

The Marine Corps have developed their own internal planning process that compliments the deliberate or CAP (crises action planning) outlined in JOPES (Joint Operation Planning and Execution System). The MCPP is virtually identical to the Joint Planning Process, the same six step model is used for planning as shown below. The differences come with respect to determining the COA at the detailed planning level.



**Marine Corps Planning Process**

This section describes the task analysis for determining the COA as documented in the MCPP

#### *Description of Planning Steps*

1. **Mission Analysis** - The first step in planning with the purpose to review and analyze orders, guidance, and other information provided by higher headquarters and produce a **mission statement**. This step drives the remainder of the process. Similar for JOPES and MCPP.

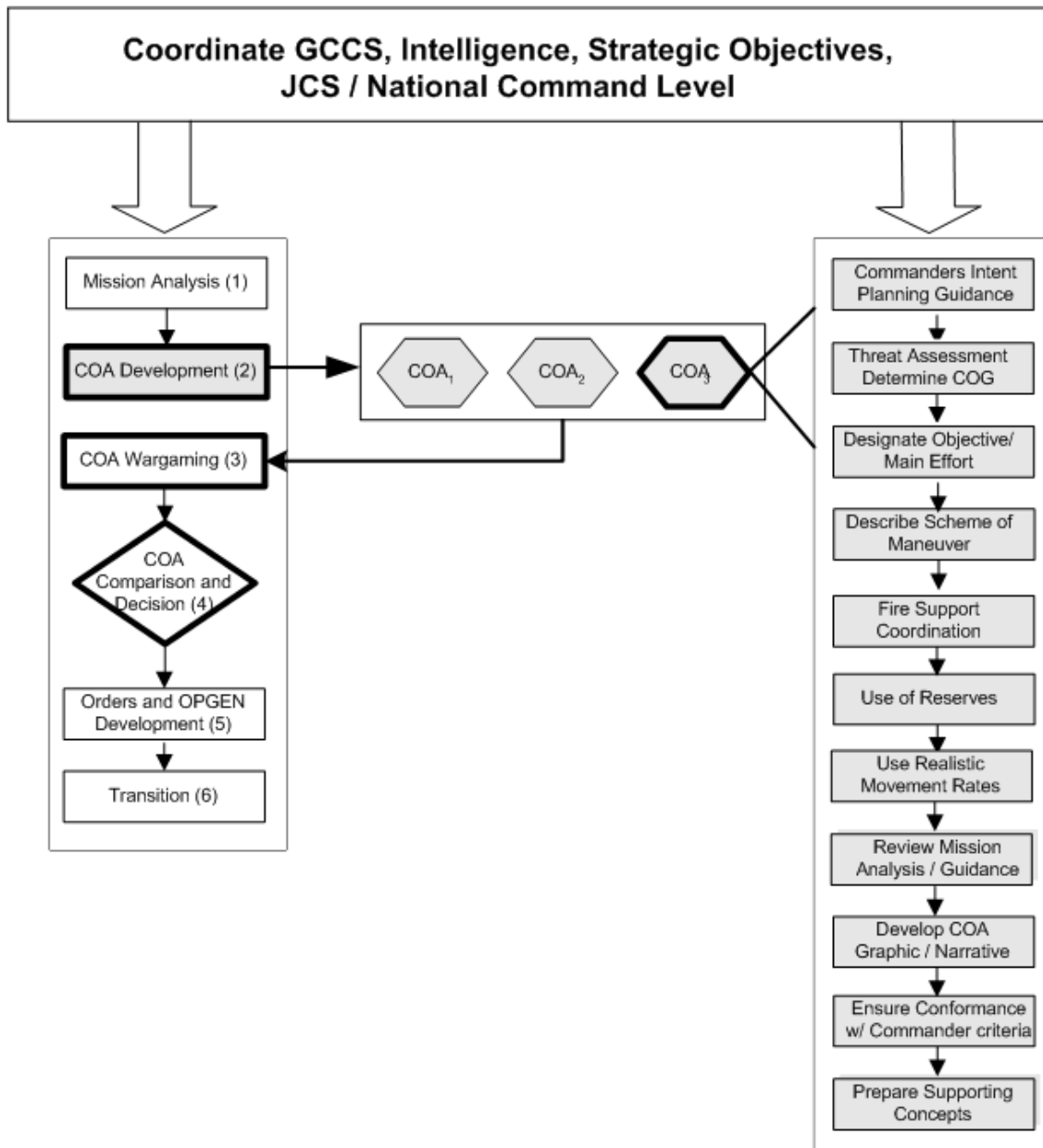
2. **COA Development** – A COA is a broadly stated potential solution to an assigned mission. The COA development step of the process is designed to generate options for follow-on war gaming and comparison that satisfy the mission, intent, and guidance of the commander.
3. **COA War game** – The COA war game allows the commander, his staff, and the OPT to gain a common understanding of friendly and threat COAs. The war game helps determine the advantages and disadvantages of each COA and allows war fighting functions to be synchronized across the battlespace (close, deep, and rear). It also identifies branches and potential contingency plans for changing the mission.
4. **COA Comparison / Decision** – In COA comparison and decision, the commander evaluates all friendly COAs against established criteria, then against each other, and selects the COA that best accomplishes the mission. The commander may refine the mission statement (including the commander’s intent and essential tasks), concept of operations, and identify any branches of the chosen COA that should be developed. This step requires the involvement of the commander, the subordinate commanders, and their staffs from start to finish.
5. **Orders Development** – Orders development communicates the commander’s intent, guidance, and decisions in a clear, useful form that is easily understood by those who must execute the order. The order should only contain critical or new information—not routine matters normally found in SOPs. The chief of staff or the executive officer, as appropriate, directs orders development.
6. **Transition** – Transition ensures a successful shift from planning to execution. It enhances the situational awareness of those who will execute the plan, maintains the intent of the concept of operations, promotes unity of effort, and generates tempo.

### *Joint and Individual Commands*

The diagram below depicts the task analysis of the MCPP and specifically the planning process used to develop a COA. The left side showing the six step planning model is a Joint planning operation between the Navy and Marine commands. The more detailed planning of the COA on the right is **the internal process used by the Marines for planning the COA for an amphibious operation.**

**Joint Naval/Marine Command  
CATF / CLA**

**Marine / CLF**



The process of developing a COA, war gaming it, assessing the outcomes of each COA and gaming them with each other is a highly iterative and fluid process. The plans developed must be flexible enough to deal with changing theater and/or situational requirements.

COA development is shown on the right side of the diagram, and is an internal process undertaken by the Corps. There are 11 tasks in the process. The diagram implies an ordered contiguous process, but in reality many of these tasks are performed in parallel, or non-sequentially based on the interdependencies of each of the tasks.

## Task Analysis Results

The COA is a potential solution to an assigned mission. Developing a COA is an iterative process designed to generate multiple action plans, war game them, then evaluate and select the best COA.

Information Requirements	<b>Command Level Input:</b> Mission statement, commanders intent, and commanders planning guidance
(Source:  <b>MCWP 5-1 w/CH1)</b>	<b>Input Products:</b> Updated IPB products (enemy COAs, doctrinal, situational, and event templates, high value targets); Specified, Implied and Essential Tasks, Warning Order; Restraints/constraints; Assumptions; Resource and SME shortfalls; COG analysis (friendly, enemy); Approved CCIR's; RFIs' Initial staff estimates
Performance Requirements	<b>Course of Action Criteria:</b> Make sure COA satisfies requirements for Suitability, Feasibility, Acceptability, Distinguishability, and Completeness
Primary Decision Makers	The Commander in cooperation with the OPT (Operations Planning Team);  Details on the command and control are delineated in accordance with the concepts and principles in JP 0-2, Unified Action Armed Forces (UNAAF).

<p>Process</p>	<p><b>1. Commanders Intent / Planning Guidance:</b> The OPT concentrates on the following two questions: <i>What do we want to do? How do we want to do it?</i></p> <p><b>2. Threat Assessment and COG:</b> OPT first focuses on the enemy then reviews the friendly situation. Looks at relative combat power to use friendly strengths (COGs) to exploit enemy critical vulnerabilities in developing COAs. The OPT uses the information products specified above.</p> <p><b>3. Designate Objective / Main Effort:</b> Identify the main effort by stage to help develop tasks for supporting units</p> <p><b>4. Describe Scheme of Maneuver:</b> Deep, Close, and Rear operations</p> <p><b>5. Determine Fire Support Coordination Measures:</b> In coalition operations it is essential to use doctrinally accepted and clearly understand fire support and control measures to facilitate coalition cross boundary fires and minimize fratricide</p> <p><b>6. Reserve Units:</b> Identify location and conditions for committing the reserves</p> <p><b>7. Use Realistic Movement Rates:</b> Ensure they are based on actual capabilities and the effects of weather and terrain. See MSTP 5-0.3 MAGTF Planner’s Reference Manual</p> <p><b>8. Review Mission Analysis:</b> Review commanders and guidance/ This might allow the OPT to recommend new CCIR</p> <p><b>9. Develop COA Graphic and Narrative:</b> Depict unit symbols and other graphics correctly. Check COA narratives to insure all subordinate units have been tasked. This product must clearly describe how the unit will accomplish its mission and describe the scheme of maneuver. A more detailed list of requirements and outputs is described in MCWP 5-1 w/CH1 Part VI: COA Development.</p> <p><b>10. Ensure Conformance with Commanders COA Criteria:</b> Ensure COAs meet the COA criteria both generic (MWCP 5-1) and specific commander planning guidance</p> <p><b>11. Prepare Supporting Concepts for each COA:</b> Make sure all actions are integrated and synchronized. Once the commander selects a COA for CONOPT these provide the basis for concepts of Intel, Fires, Logistics, maneuver.</p>
<p>Products</p>	<p><b>COA graphic and narrative. See Figure 6-2 in MCWP 5-1 w/CH1 (page 41)</b></p> <p><b>Supporting documents and maps and information</b> <b>OPORD or OPPLAN</b></p>

## Task Analysis: Conduct Detailed Planning

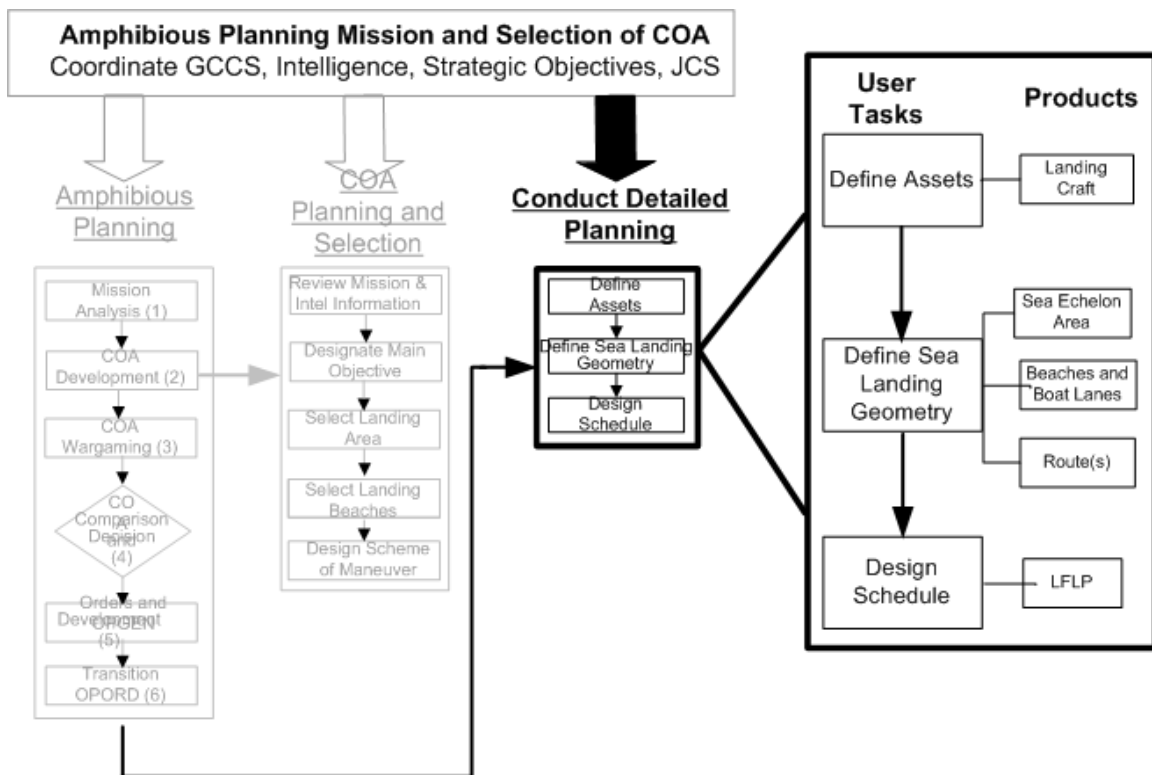
The EDSS menu structure was analyzed to map the existing HCI functionality to a detailed functional analysis of the tasks described below. The diagram highlights the **Conduct Detailed Planning** process (in bold boxes). Three primary **User Tasks** were identified

Define Assets

Define Sea and Landing Geometry

Design Schedule

These tasks were broken down into their associated **Products** shown as the smaller boxes to the right of each task.



### Source Documents

Joint Mission Essential Task List (JMETL) Development Handbook

VBG-WC-Amph-NMETL.xls

**User Task Data Structure**

<b>TASK:</b> Define Assets <b>PRODUCT:</b> Landing Craft	
Information Requirements	Types and number of landing craft relevant to the operation that are available for each ship in the landing force. Need to know the capabilities or have a resource available.
Performance Requirements	TBD
Primary Decision Makers	EDSS Users
Process	<p><b>Actions Taken:</b> Create an inventory of available craft with capabilities.</p> <p><b>Decision Making:</b> Appropriateness of each for the tactical situation and conditions. Need for maintaining reserves and/or need for naval support.</p>
Products	List of landing craft available for landing force with default craft parameter knowledge.
EDSS HCI Mapping	Planning : Documents : Landing Craft Performance / Landing Craft Availability

<b>TASK:</b> Design Sea and Landing Area Geometry <b>PRODUCT:</b> Sea Echelon Area	
Information Requirements	Ship information: Names, Types, Current disposition; Load out; Area information: Environmental (tides, winds), Landing priority table; Assault Schedule: wave numbers, timing, beaches, units, serials; Gunfire support schedule; ATO
Performance Requirements	Produce Grid TBD. Meets OP requirements
Primary Decision Makers	EDSS Users

Process	<p><b>Actions Taken:</b> Review OPORD, Landing Plan, Other Messages; Review Commander's Intentions; Layout map to be used to make grid; Understand map scale; Choose grid type; Name grid; Layout grid; Produce detailed grid data (position, axis, segment size); Add labels at desired positions; Add graphical information (e.g., color); Calculate corner points; Assign ships to grid segments</p> <p><b>Decision Making:</b> Grid location, Grid size, Grid geometry, Axis disposition, Number of segments, Segment size, Labeling, Ship assignment and reassignment</p>
Products	4WG with Ships Assigned
EDSS HCI Mapping	Areas: Directory: <b>Grid</b>

<b>TASK:</b> Design Sea and Landing Area Geometry <b>PRODUCT:</b> Beaches and Boat Lanes	
Information Requirements	Data from intelligence – either HUMINT with GPS receiver or imagery sources. Information about minefields, exits. Metoc information to include, information regarding prevailing winds, currents, lunar data. Suitability for landing craft in use.
Performance Requirements	Produce diagram of the beach and boat lane in XX minutes that meets all tactical requirements.
Primary Decision Makers	EDSS Users
Process	<p><b>Actions Taken:</b> Review all available intel. Collaborate with participant commands to insure decisions meet all operational requirements. Produce detailed description (position, size); Add labels at desired positions; Add graphical information (e.g., color).</p> <p><b>Decision Making:</b> Beach, beach size, boat lane width, depth, need for extension. Display data.</p>
Products	Defined beach and boat lane.
EDSS HCI Mapping	Area: Directory: <b>Boat Lane</b>

<b>TASK:</b> Design Sea and Landing Area Geometry <b>PRODUCT:</b> Route(s)	
Information Requirements	Which craft are to be used in wave. Ingress and egress routes. Beach and inland, METOC data, appropriate craft speed for legs of routes given sea conditions.
Performance Requirements	Efficient use of sea/land air space for ingress and egress
Primary Decision Makers	EDSS Users
Process	<p><b>Actions Taken:</b> Review all transit conditions to determine need for modifications in planning. Produce a detailed diagram of routes. Add labels and graphical information as required.</p> <p><b>Decision Making:</b> Routes which match terrain, hostile constraints, and meets tactical requirements for air, sea, and land movements.</p>
Products	Graphic with landing routes and overland transit
EDSS HCI Mapping	Area: Directory: <b>Route</b>

<b>TASK:</b> Design Schedule <b>PRODUCT:</b> Landing Force Landing Plan	
Information Requirements	Landing plan(s) will need default landing craft parameters with modifications required by conditions. Serial load information to determine factors contributing to on and off load times and other mission critical timing.
Performance Requirements	Produce a workable landing plan in collaboration with all mission participants.
Primary Decision Makers	EDSS Users
Process	<p><b>Actions Taken:</b> Review serial load data for efficient on and off load of equipment. Review all information from all sources to select optimal H-hour.</p> <p><b>Decision Making:</b> Timing of transits to and from ship to shore and to and from beach and HLZ to objective.</p>

Products	Landing Plan
EDSS HCI Mapping	Planning: <b>Plan</b>

## Doctrinal References

The resources used to analyze the planning process were derived from military doctrine. The primary doctrinal sources that were referenced are shown in the list below:

Joint Doctrine for Amphibious Operations – Joint Pub 3-02, 9/19/2001

Joint Doctrine for Landing Force Operations – Joint Pub 3-02.1, 1/1/1999

Joint doctrine governs the joint activities of the US military for multinational and interagency operations and provides guidance to Joint Force Commanders. This doctrine takes precedence over Service doctrine unless directed by the JCS. In terms of amphibious warfare planning joint doctrine incorporates both Naval and Marine Operations.

Marine Corps Planning Process<sup>1</sup> – MCWP 5-1 W/CH 1, 9/24/01

**Marine Corps doctrine** (MCPD) are intended for Marine Corps operations with a unitary command and recognizes the commanders central role as the decision maker, and also joint operations with a shared Naval command.

### Rapid Response Planning Process (R2P2) – EWTGLANT, Ops 3.1

### NATO Doctrine for Amphibious Operations – NATO ATP 8(A)(B), Vol. 1

**NATO doctrine** is oriented towards multinational operations and the coordination and planning of US Armed Forces with Allied forces (as well as Joint Task Force and Joint Commands). A quick check of NATO doctrine was consistent with the MCPD and Joint Doctrine.

<sup>1</sup>Formally MSTP Pamphlet 5-0.2 – Operational Planning Team Guide, Part IV, 3/01

## Terms and Definitions

**Amphibious operation** (JP 1-02) An attack launched from the sea by naval and landing forces embarked in ships or craft involving a landing plan on a hostile or potentially hostile shore. As an entity, the amphibious operation includes the following phases: A. planning – The period extending from issuance of the initiating directive to embarkation. B. embarkation – The period during which the forces, with their equipment and supplies, are embarked in the assigned shipping. C. rehearsal – The period during which the prospective operation is rehearsed for the purpose of (1) testing adequacy of plans, the timing of detailed operations, and the combat readiness of participating forces; (2) ensuring that all echelons are familiar with plans, and (3) testing communications. D. movement – The period during which various components of the amphibious task force move from points of embarkation to the objective area. E. assault – The period between the arrival of the major assault forces of the amphibious task forces in the objective area and the accomplishment of the amphibious task force mission.

**Beach capacity** (JP 1-02) An estimate, expressed in terms of measurement tons, or weight tons, of cargo that may be unloaded over a designated strip of shore per day.

**Course of action** (JP 1-02) 1. a plan that would accomplish, or is related to, the accomplishment of a mission. 2. The scheme adopted to accomplish a task or mission. It is a product of the Joint Operation Planning and Execution System concept development phase. The supported commander will include a recommended COA in the commander's estimate. The recommended COA will include the concept of operations, evaluation of supportability estimates of supporting organizations, and an integrated time-phases data base of combat, combat support, and combat service support forces and sustainment. Refinement of this data base will be contingent on the time available for COA development. When approved, the COA becomes the basis for the development of an operation plan or operation order

**Landing area** (JP 1-02) The part of the objective area within which are conducted the landing operations of an amphibious force. It includes the beach, the approaches to the beach, the transport areas, the fire support areas, the air occupied by close supporting aircraft, and the land included in the advance inland to the initial objective.

**Landing beach** (JP 1-02) That portion of a shoreline usually required for the landing of a battalion landing team. However, it may also be that portion of a shoreline constituting a tactical locality (such as the shore of a bay) over which a force larger or smaller than a battalion landing team may be landed.

**Landing plan** (JP 1-02) In amphibious operations, a collective term referring to all individually prepared naval and landing force documents that, taken together, present in detail all instructions for execution of the ship-to-shore movement.

**Mission** (JP 1-02) 1. The task, together with the purpose, that clearly indicates the action to be taken and the reason therefore.

**Mission Analysis.** (JP 3-02) Review and analyze orders, guidance, and other information provided by the establishing authority in the order initiating the amphibious operation and to produce an amphibious force mission statement(s). Produces planning guidance that will focus the staffs in COA development. Makes the following decisions: determine amphibious force mission; select amphibious force objectives. The input is the higher commander's warning order, OPLAN or OPORD.

**Operation order** (OPORD) (JP 1-02) A directive issued by a commander to subordinate commanders for the purpose of effecting the coordinated execution of an operation.

**Operation plan** (OPLAN) (JP 1-02) Any plan, except for the Single Integrated Operation Plan, for the conduct of military operations. Plans are prepared by combatant commanders in response to requirements established by the Chairman of the Joint Chiefs of Staff and by commanders of subordinate commands in response to requirements tasked by the establishing unified commander. Operation Plans (OPLANS) are prepared in either a complete format (OPLAN) or as a concept plan (CONPLAN). The CONPLAN can be published with or without a time-phased force and deployment data (TPFDD) file. An OPPLAN for the conduct of joint operations can be used as a basis for development of an operation order (OPORD). An OPPLAN identifies the forces and supplies required to execute the CINC's Strategic Concept and a movement schedule of these resources to the theater of operations. The forces and supplies are identified in TPFDD files. OPLANS will include all phases of the tasked operations. The plan is prepared with the

appropriate annexes, appendixes, and TPFDD files as described in the Joint Operation Planning and Execution System manuals containing planning policies, procedures and formats.

**Sea echelon area.** (JP 3-02) In amphibious operations, an area to seaward of a transport area from which assault shipping is phased into the transport area, and to which assault shipping withdraws from the transport area.

**Scheme of maneuver** (JP 1-02) The tactical plan to be executed by a force in order to seize assigned objectives. See FM 101-5.

**Serial** (JP 1-02) An element or a group of elements within a series which is given a numerical or alphabetical designation for convenience in planning, scheduling and control.

**Serial assignment table** (JP 1-02) A table that is used in amphibious operations and shows the serial number, the title of the unit, the approximate number of personnel; the material, vehicles, or equipment in the serial, the number and type of landing craft and/or amphibious vehicles required to boat the serial; and the ship on which the serial is embarked.

**Staff estimates** (JP 1-02) Assessments of COAs by the various staff elements of a command that serve as the foundation of the commander's estimate.

**Stowage plan** (JP 1-02) A completed stowage diagram showing what material has been loaded and its stowage location in each hold, between-deck compartment, or other space in a ship, including deck space.

**Subsequent operations phase** The phase of an airborne, air assault, or amphibious operation conducted after the assault phase. Operations in the objective area may consist of offense, defense, linkup, or withdrawal.

**Warning order** (WARNO) (JP 1-02). 1. A preliminary notice of an order or action which is to follow. 2. A crisis action planning directive issued by the Chairman of the Joint Chiefs of Staff that initiates the development and evaluation of COA by a supported commander and requests that a commander's estimate be submitted. 3. A planning directive that describes the situation, allocates forces and resources, establishes command relationships, provides other initial planning guidance, and initiates subordinate unit mission planning.

## Appendix C: User Interface Design Recommendations for EDSS

### Recommendations Summary

This section includes the recommendations APL-UW made for redesigning the EDSS graphical user interface (GUI). These recommendations are reinforced by the results of the User Task Analysis of Expeditionary Warfare Planning (see Appendix B). Users have been observed at several locations—on several ships and during one amphibious exercise. With the identification of user tasks, the menus and buttons were designed to reflect these. These recommendations were offered to improve the usability of the EDSS GUI.

The GUI needs to:

- keep the map window in the center of the user’s vision; all other interface windows form around the map window
- restrict window proliferation by using a single working window with tabbed panes
- offer a workflow listing as a series of tasks that segue directly to the required data entry tabs
- provide an asset manager window that links objects in the map window to their individual data entry tabs
- provide a quick way to animate a COA with a playback slider bar
- provide a consolidated list of all tasks that provides a hyperlink to the actual workflow task
- provide “tool tip” pop-ups (abbreviated help explanations) when the user moves the mouse over key elements of the GUI

### Overview of the Improved Graphical User Interface

The recommended EDSS GUI was divided into five sections: **Task Manager**, **Map Window**, **Asset Manager**, **Working Window**, and **Playback Bar** (Figure A3-1). Each component resides in a separate window. By default, the windows are docked together in the configuration below. Each of the four main windows can be maximized to fill the entire screen, or the windows can be undocked and arranged in a different order, if, for example, the user has dual monitors.

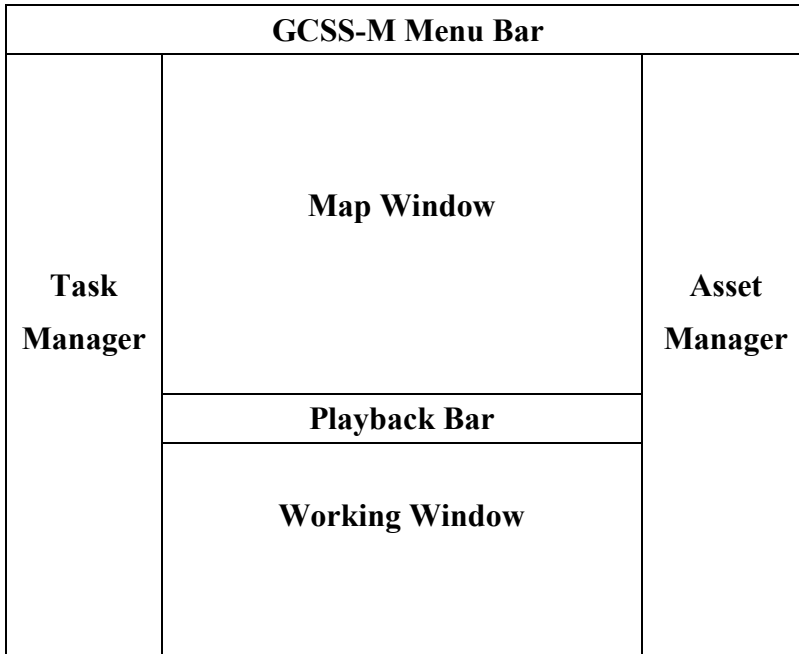


Figure A3-1. Location of EDSS window components

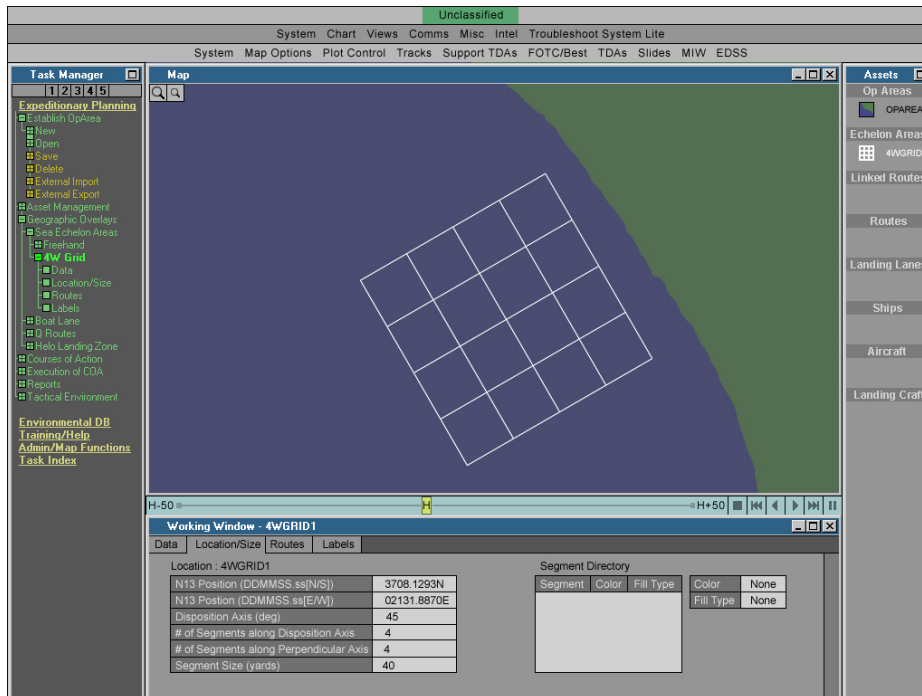


Figure A3-2. APL-UW prototype 4W Grid creation

All modules/windows have a maximize button that allows them to fill the entire screen. This is primarily for the Map Area and Working Window, each of which can contain large amounts of data. The default GUI layout implements a tiling structure that allows the user to view many types of data concurrently. The maximize button allows the user to give more screen space to a selected module/window when there is too much data for a smaller window.

- **Task Manager (TM)** lists supertasks and their corresponding tasks and subtasks as a vertical workflow graph. TM also has a Task Index that lists all tasks in alphabetical order and provides a hyperlink to the appropriate task element in the TM workflow.
- **Map Window (MW)** displays the selected map from Global Combat Support System-Maritime (GCCS-M) and geographic overlays created by EDSS. The other windows form around the periphery of the MW.
- **Asset Manager (AM)** provides a list of all map objects, such as the routes the user has created and the craft the user has chosen to include in the plan. With the Asset Manager the user is able to view the number and status of routes and craft. The AM shows all objects' relationship to one another.
- **Working Window (WW)** groups all data for an object or task in one location. Different types of data for an object or task are accessible via tabs. When the user selects a task, all of the screens of data are displayed in the working window in a tabbed format. This lets the user know immediately upon selecting a task or object what types of data can be edited. Data entry fields that flow in a linear fashion for a task are listed with tabs from left to right. This mimics the workflow.
- **Playback Bar (PB)** The user can perform one of the following: 1) play forward/backward; 2) step forward/backward in increments (user specified—one hour, one minute, one second, for example); or 3) step to the beginning or end using the buttons at the right of the Playback Area.

## Details of the Interface Components

### *The Task Manager*

- When the mouse is clicked on the task name in the TM it turns light green and all tasks under it, required or optional, unroll.
- If the mouse is clicked on the task a second time, the task returns to its unlighted status and the items roll up.
- The color green indicates that a task is a required step of the workflow. A green bar connecting two tasks indicates the user must perform one or the other of the tasks. Orange indicates the task is an optional step.
- Each supertask only contains the tasks required to complete its workflow. The Index option at the bottom lists every possible subtask needed to carry out a task, such as building an OpArea. Tasks are listed alphabetically.
- When a user selects a subtask, the task name and box turn to white in the Task Area, and the task data screens are displayed in the Working Window.
- The tool tips clarify the meaning of the green and orange coding of the outline bullets, as well as the meaning of the connecting bars between the bullets.

*The Menu Hierarchy*

The task organization in the Task Manager follows the general workflow for expeditionary planning, but it is understood that the EDSS program may be used for a variety of subtasks outside of the full plan development. The TM allows for quick navigation to the tasks used most often.

Table A3-1 is a comparison of the APL-UW prototype menu structure to EDSS 1.X UBV menu structure. The left column is in the order that the proposed menu structure should appear, while the right column is the original EDSS 1.X menus. There is not a one-to-one correlation between the two. The prototype menu structure is an attempt to create a workflow task list. Some of the tasks that appear currently in subwindows have been brought into the menu list. (Note: the inactive menus of EDSS 1.X have not been shown.)

Table A3-1.

<b>Prototype EDSS Menu System</b>	<b>EDSS 1.X Menu System</b>
<p><b>Expeditionary Planning</b>  <b>Establish OpArea</b>                      New                      Open                      Save                      Delete                      External Import                      External Export</p>	<p><b><u>S</u>ystem</b>                      Version 1.1.0.5                      Operational Areas  <b>New Area ...</b>  <b>Load ...</b>                      Save ...  <b>Delete ...</b>                      Import ...                      Export ...                      Exit</p>
<p><b>Asset Management</b>                      Landing Craft Performance                      Landing Craft Availability                      Helo Availability                      AAV Availability                      Serial database</p>	<p><b><u>R</u>eports</b>                      Landing Craft Performance ...                      (combine w/ <b>Asslt Plans</b>)                      Craft Parameters...                      Landing Craft Availability ...                      Helo Availability ...                      AAV Availability  <b><u>L</u>ogistics</b>                      Serial Database ...</p>

<p><b>Geographic Overlays</b>                  Sea Echelon Areas                      Freehand                      4W Grid                          Location                          Size                          Data                          Labels                  Boat Lane                      Create                      Edit                      Delete                  Q Routes                      Create                      Edit                      Delete                  Helo Landing Zone                      Add                      Edit</p>	<p><b><u>AOA</u> Mgmt</b>                  Areas ...                  4W Grid Assignments ...                  Asset Positions...</p>
<p><b>Courses of Action</b>                  Landing Plan Data                  Landing Craft Employment                  Helo Employment                  AAV Employment</p>	<p><b><u>Assault</u> Plans</b>                  Plan Data                      Landing ...  <b><u>Reports</u></b>                  Landing Craft Employment ...                  Helo Employment...                  AAV Employment...</p>
<p><b>Execution of COA                  (new functions)</b>                  Serial Tracking                  Display saved overlays                  Display realtime tracks</p>	<p><b><u>Logistics</u></b>                  Serial Tracking ...</p>
<p><b>Reports</b>                  Create OPTASK                  Create Intel Request                  Create Planning Documents</p>	<p><b><u>Reports</u></b>                  Planning Documents...</p>

<b>Tactical Environment</b> Input Surf Observation Input Beach Profile Run Surf Forecast Run Tide Forecast	<b><u>Envr DB</u></b> Database Depth Profile ... Models Surf Forecast ... Surf Observations ...
<b>Environmental DB (new functions)</b> Import TEDS Import Wave Overlay Import Weather Overlay	<b><u>Envr DB</u></b> Database Wave...
<b>Training/Help</b> Landing Craft Parameters Doctrine Lessons Learned Simulated Plans	
<b>Task Index</b>	

### *Task Manager Explanation*

The Task Manager has two purposes: provide a list of all the tasks a user can perform, and provide a workflow, from top to bottom, of each task and its subtasks. There are several top-level tasks, or level 1 tasks such as Expeditionary Planning, Environmental DB, Training/Help, etc., and level 2 tasks such as Establish OpArea, Asset Management, Courses of Action, Execution of COA, Reports, and Tactical Environment. Each time a task or subtask branches into its subtasks, a new level is displayed. Some tasks might have only three levels, while others have five or six.

To indicate if a task or subtask has other subtasks, a plus sign is displayed in an icon to the left of the task/subtask. If a subtask is the final level, no sign is displayed in the icon to the left. Green indicates a required task/subtask, and orange indicates an optional task/subtask. This is intended to help the user become familiar with required and optional steps for a task. If two subtasks have their icons linked together, such as New and Open under Establish OpArea, the user must choose one or the other, meaning that the step is required, but there is an option as to how it is carried out. The above explanation should be included under the "Help Function."

The Task Index contains every level 2 task available in EDSS, listed alphabetically, as well as all of their subsequent tasks. Task Index is intended to provide a place where a user can perform one, or a few tasks, without having to work within the workflow of a top level task. For example, if a user simply needs to load an OpArea and build a 4W Grid, rather than have to use the workflow for Expeditionary Planning, the user opens the Task Index, and uses it to load an OpArea and build a 4W Grid.

By default, when a user selects a level 1 task, all level 2 and 3 tasks are displayed for that task, listed from top to bottom. Each task level is indented to the right of the previous task level. Displaying levels 1 through 3 of a selected task is intended to allow the user to see the general workflow of the task while keeping everything on one screen for ease of viewing. The user can expand any level 3 task to view its subsequent subtasks at any time. This allows the user to decide which portions of the workflow to view in detail. At the top of the TM are buttons labeled 1, 2, 3, 4, 5. Clicking one of these buttons expands/contracts the current Level 1 Task to Level 1, 2, 3, 4, or 5. This gives the user a quick way to expand the workflow of every task all the way to level 5, or collapse it to level 2 or 3 without having to manually click the expand/collapse icon for each task/subtask.

## **Working Window**

- Contains tabbed windows that provide default parameters for the selected task
- Clicking on a tab brings that tab and its parameters to the front
- These parameters can be edited, or blank spaces filled
- Some parameters may be chosen from a predefined set, such as color.
- Some tab windows may require additional actions from the user, such as submitting edited parameters to the database; these should appear as buttons along the top portion of the tabbed window
- If there are more parameters than can be displayed in the predefined screen area for the WW, a scroll bar will appear on the right side of the tab window

Researchers found this window to be the most complex UI for EDSS. Its conversion from EDSS 1.X required the most effort in the UI redesign. Much of the parameter window had unused space and could be more efficiently presented in the tabbed view. Other parameter windows needed to be divided into separate tab windows.

## **Asset Manager**

- The Asset Manager (AM) gives the user a complete view of linked routes and crafts, unused routes, and unused crafts, all of which can be independent of the current display in the WW
- The AM differs from the TM in that it gives the user the relationship of each element in the plan to every other element
- Selected Objects are displayed in white
- Route types (solid for surface, dotted for air) and route colors are displayed in the AM
- Icons representing craft types are displayed beside the craft name; the AM can contain many other objects as well
- If multiple grids are in a plan, they are displayed in the AM as well
- Elements in the plan were divided into a tree structure in each section

The AM contains a list of every object/component that the user has added to EDSS: OpAreas, Sea Echelon Areas, Boat Lanes, Routes, all Vehicles, etc. The AM is important because it lists everything the user has added, and the AM can be edited. It is also important because it shows the user what has not been added to the scene, i.e., what pieces are missing for a given task. Use of EDSS 1.X provoked questions such as: Are there routes along the 4W Grid? Is there a Sea Echelon Area that is not currently displayed in the map? Which vessels follow which Routes? These questions can be answered more easily if there is a place on the screen that holds every component. EDSS uses a map screen that can be moved and/or magnified. As a result, components that a user needs to access are often not on the screen.

In addition, users found it difficult in EDSS 1.X to determine which ships and types of ships were linked to each route. The surface ship icon is the same regardless of ship type. A window that provides not only a list of components, but icons that quickly distinguish ship/aircraft types, and provides information about which craft are linked to which routes, helps the user make sense, visually, of how all the pieces fit together.

The AM is also useful when one user creates a plan, saves it, and gives it to another user. The new user should not have a difficult time figuring out what components are included or missing. With an AM any user has a quick, efficient way of viewing a plan and knowing what is loaded in the plan and how those pieces fit together.

## **Playback Bar**

- Displays minimum and maximum relative H-hour values and the current playback time
- Can drag the playback slider to the desired time
- EDSS played 1.X back the plan one frame per second (fps). It would be useful if the user could select the video frame rate. If there are no hardware constraints, i.e., if the system can process the data at 1 fps, or if this is not a design issue, smooth video (24–30 fps) conveys accurate motion to the user, and, if at all possible, we recommend that it be implemented.

The Playback Bar (PB) represents a timeline from a user-specified H-hour to a user-specified H+hour. One use of the PB is to play the scenario from start to finish once the user has loaded the OpArea, built Sea Echelon Areas, Boat Lanes and Routes, and specified which vehicles follow which routes. The PB gives the user a way to view how all components change with time. EDSS 1.X playback could only be used once the entire plan was built. This method does not allow the user to check the playback of the plan as it is being built.

It would be helpful if the user could add a boat lane and a ship to a route, and then be able to view these components over time. As users add each component they could use the playback to see ship movement coordination. To give the user this ability to view components that move over time at any stage in the plan development, the PB should be present at all times. It should be grayed out when there are no components that change over time, and then displayed in its normal state once the first time-dependent element is added. This lets users know when they can start using the playback feature. If for some reason users did not want the PB visible, they could remove it, as with any other window, but it should be visible by default so the user is aware of the playback feature and can easily step forwards and backwards along the timeline.

## **Map Window**

Due to the requirement to use the underlying map functions of GCCS-M, we recognize that there may be limitations to what can be improved in the map window. However, we do have various additional recommendations that could improve the clarity of the overlays produced by EDSS, but we need to further investigate what is possible in future versions of EDSS and also compare these ideas against the Defense Information Infrastructure (DII) user interface recommendations.

# REPORT DOCUMENTATION PAGE

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<b>13. ABSTRACT</b> ( <i>Maximum 200 words</i> )  The Expeditionary Warfare Decision Support System (EDSS) is an Office of Naval Research (ONR) sponsored system designed to improve the planning of expeditionary operations. ONR requested that the Applied Physics Laboratory, University of Washington (APL-UW) and the Naval Research Laboratory (NRL) investigate the human-computer interaction (HCI) components of EDSS. Additionally, APL-UW and NRL were tasked to provide user interface recommendations to the EDSS developers. To do this the HCI team followed a user-centered design (UCD) approach and studied EDSS users and their tasks, which resulted in an in-depth user task analysis of expeditionary planning. A medium fidelity interface prototype was created based on the user studies and the principles of UCD. The prototype presented a more streamlined and intuitive order of tasks and improved window organization. The positive feedback from this prototype allowed for a more comprehensive list of user interface recommendations. A majority of these recommendations were incorporated into a follow-on version of EDSS. HCI and UCD have implications for future versions of EDSS and other Navy decision systems, and particularly for Net Centric Warfare.				
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