

Collaborative Editing and Analysis of Alternatives using ArcGIS Server, Java Server Faces, and SOA

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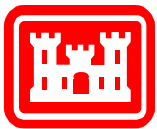
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Matt Petre, Senior GIS Developer

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Birmingham, AL



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of Engineers

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SERVICES, INC

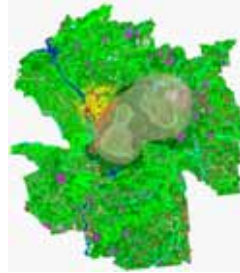


Problem Domain: Integrated Planning, Simulation, and Analysis

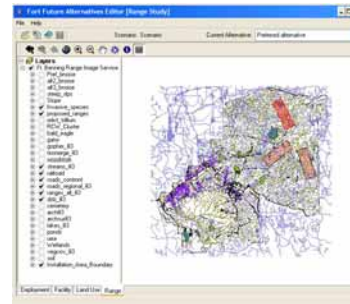
Use multiple, cross-domain analyses and simulations to assess possible outcomes of plans



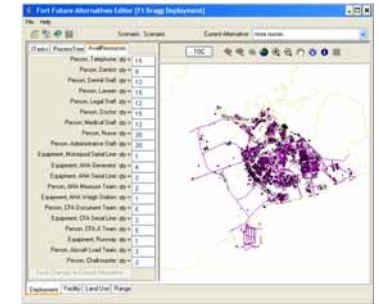
Collaborative Web-based Decision Support



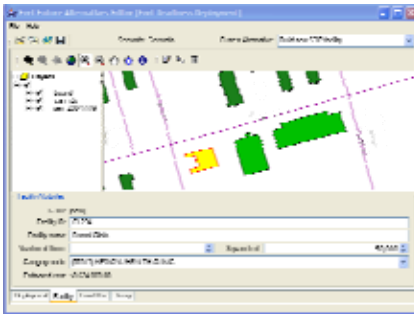
Encroachment and Land Use Simulation



NEPA Analysis for Range Siting



Deployment Process Studies



Facility Siting



Critical Electrical Infrastructure



Critical Water Infrastructure

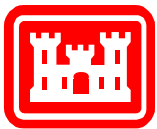


Airborne Plume Modeling

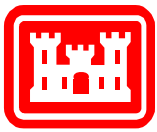


Technology Challenge

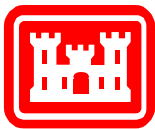
- Many simulation and analysis applications require geospatial data
- Need a way for stakeholders to create, modify, and assess alternative courses of action on the web → to collaborate
 - (Without the need for highly skilled GIS professionals to make each change)
- Need a protocol for decision support systems to initialize, track, and get results from analysis and simulation software
- Simulation software needs to be able to gain access to geospatial data for each alternative



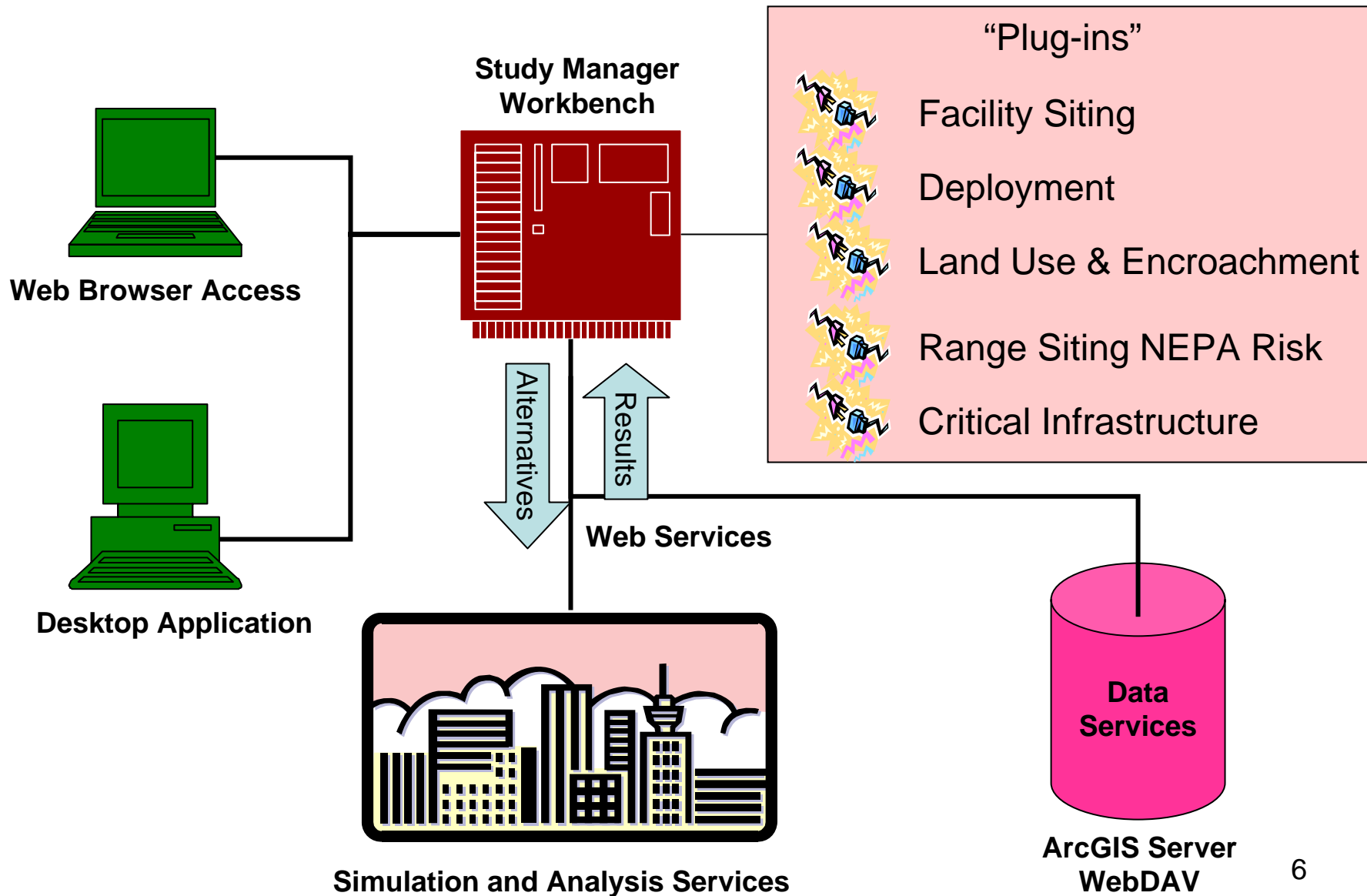
- Use a Service-Oriented Architecture
- Set up services to:
 - Perform decision support: manage studies, alternatives, data, and results
 - Manage geospatial data for alternative Courses of Action (COA)
 - collaboratively edit geospatial and other data
 - Manage other types of data
 - Perform analysis and simulation

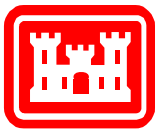


- Define system endpoints
- Determine data requirements for common DSS
- Create abstract control and data schema
- Create communication protocol
- Conduct proof-of-concept test of protocol and schema using a simple DSS with multiple simulation systems.



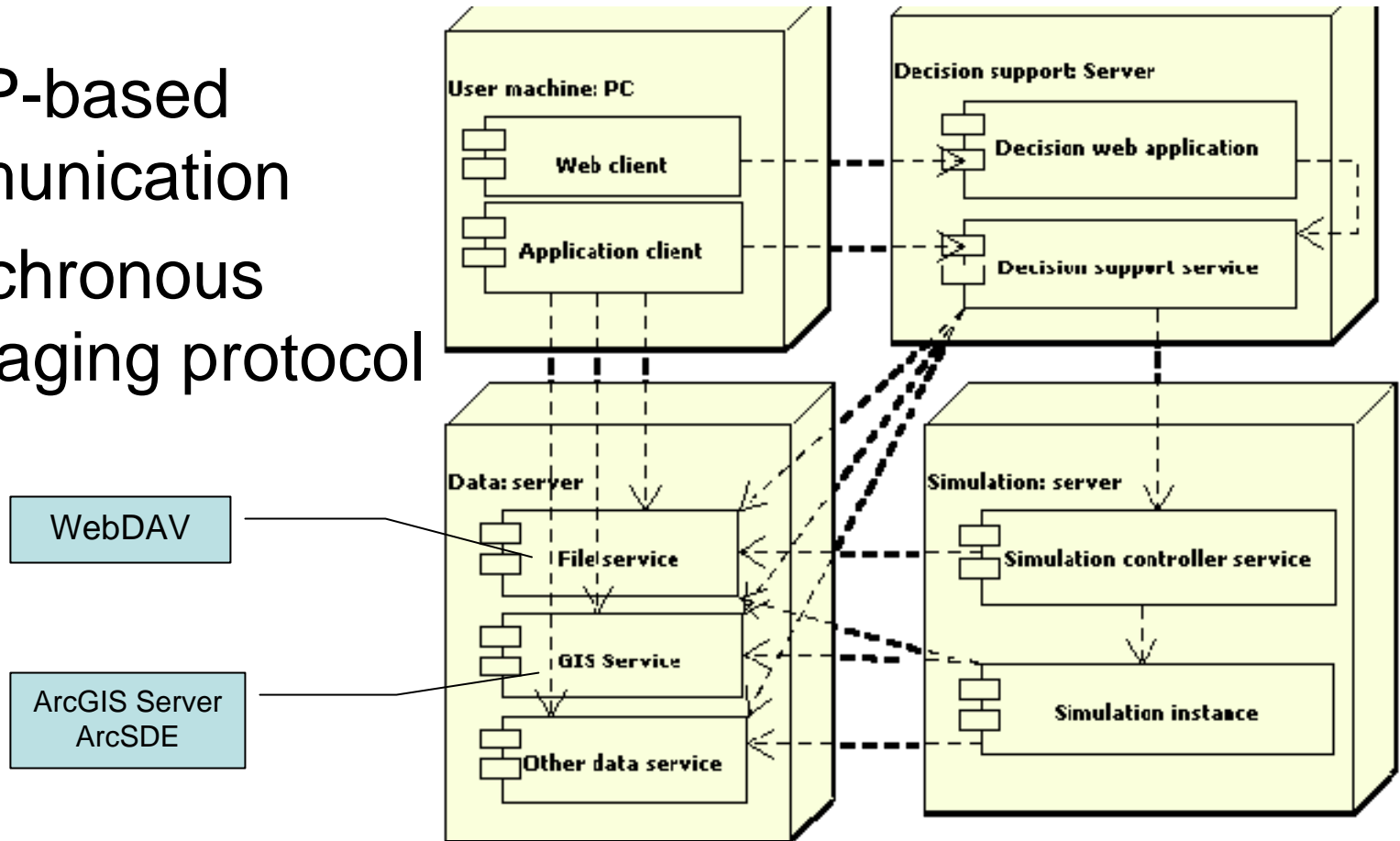
System Architecture (J2EE Framework)

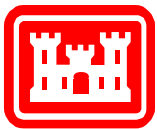




System Endpoints

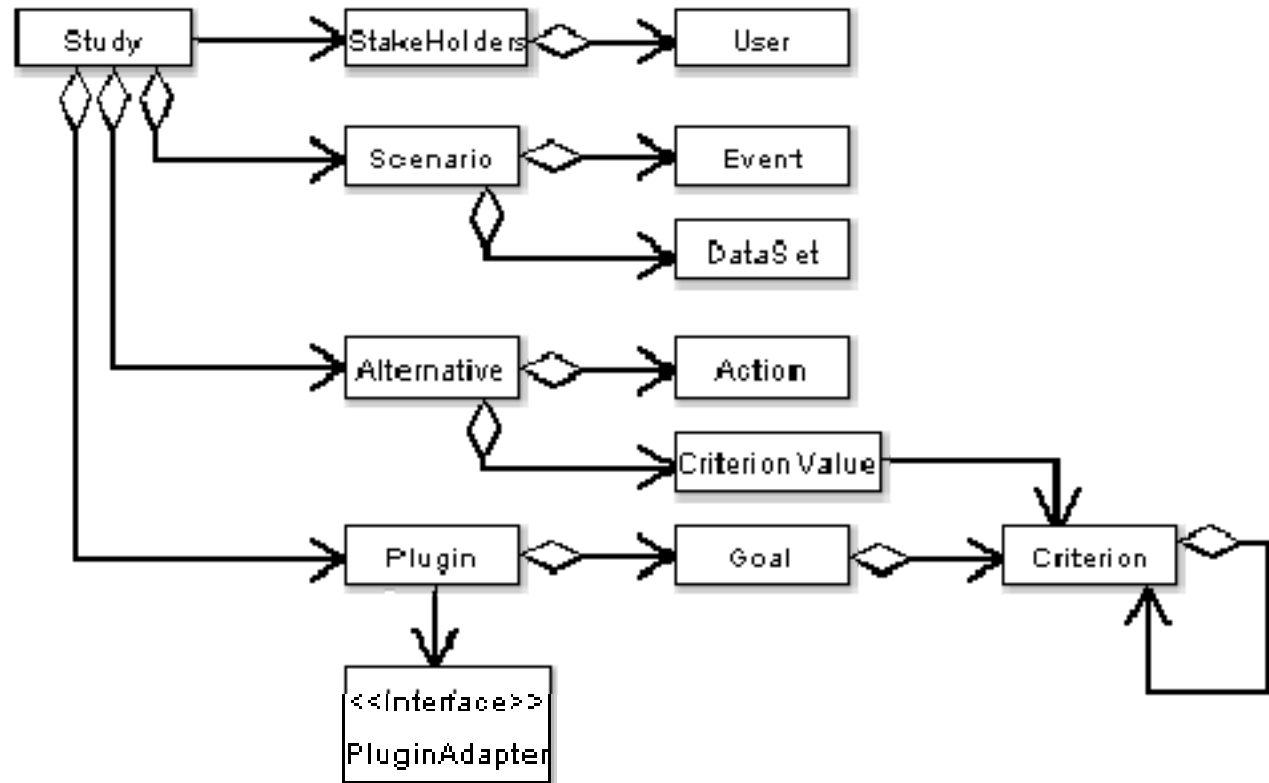
- SOAP-based communication
- Asynchronous messaging protocol

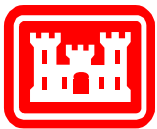




Abstract Concepts

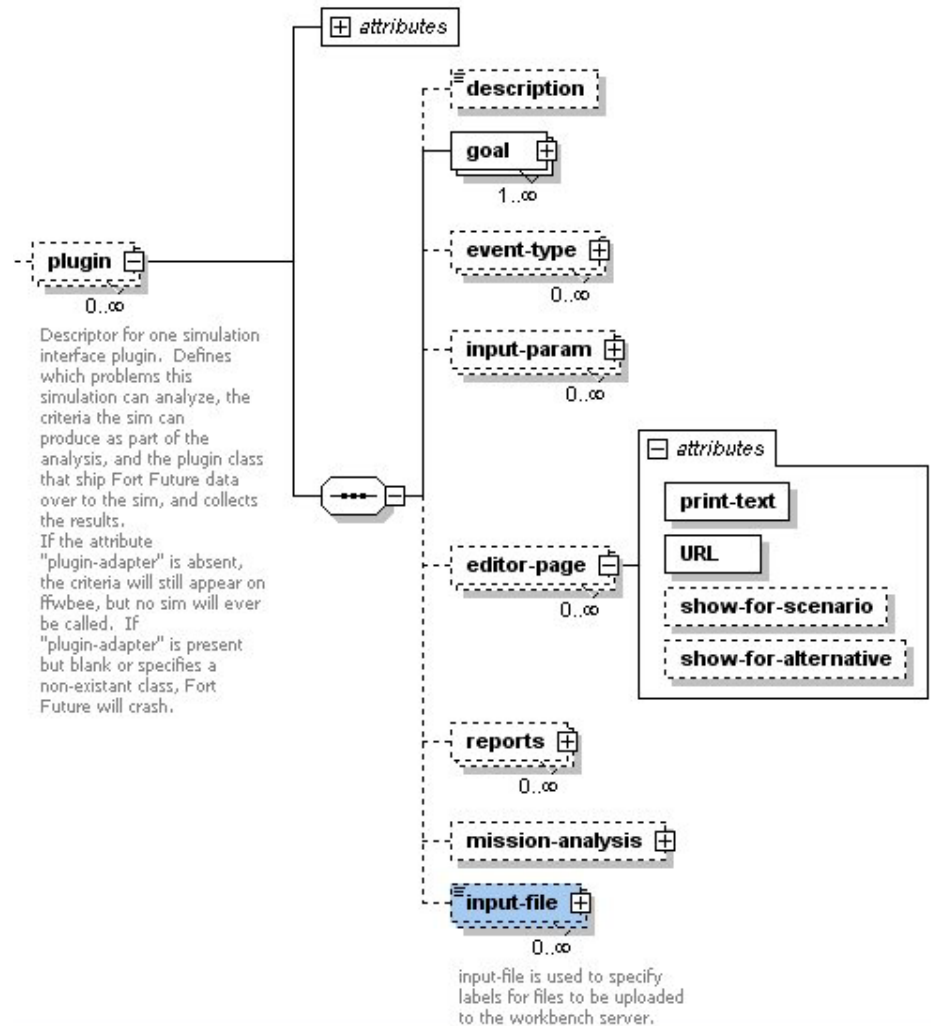
- Study
- Stakeholder
- Scenario
- Event
- Dataset
- Alternative
- Action
- Plugin
- Goal
- Criterion
- Criterion Value

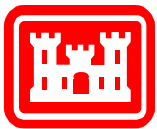




Simulation System Meta-data

- Simulations register with DSS using XML
- DSS can call PluginAdapter methods
- PluginAdapter has access to study data
- PluginAdapter formats input for sim, controls execution, and retrieves results using SOAP & XML
- DSS compares criteria and alternatives

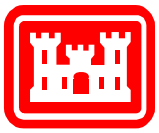




PluginAdapter Methods and Protocol

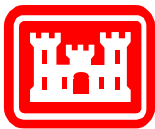
- For each remote plugin and study, DSS uses SOAP call to:
 - Initialize service to run a job for all alternatives
 - Create inputs
 - Including preparing geospatial data
 - Start jobs
 - Get status
 - Get results
 - Tell service to delete data
- Optional
 - Abort all or each job





- Configure Data Sets
- Create study
- Invite Stakeholders
- Set up scenario
 - Narrative
 - Select Data Sets for study
- Create alternatives
- Edit alternatives
 - ArcIMS and Map Objects – Java Webstart
 - ArcGIS Server and Java Server Faces
- Run Simulations
- Collect results
- Compare alternatives
- Iterate





Setting Up Datasets

Fort Future: View Data Set - Microsoft Internet Explorer

Address: <http://naboo.cecer.army.mil/ff/dataset/view.do?dataSetId=9a26c1a8-69e5-11db-9b19-c77ecf56bbdf>

FORT FUTURE View Data Set Study Data Admin Logout

study manager > Local add: dataset/view.do You're logged in as Fort Future Administrator [change]

Fort Future Data Sets

- Eglin AFB
- Ft Readiness
- Ft. Benning range data
- Ft. Bragg cantonment
- LSA Readiness
- LSA 2
- no location
- Readiness AFB
- Readiness Field

Data Set

Data Set Properties

Name: Ft Readiness

Description: A generic installation dataset

[Change »](#)

GIS Data

- [Select GIS location](#)

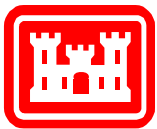
FT_READINESS [services](#)

File Data

- [Upload file data](#)

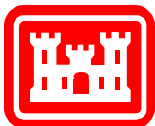
File Name	Plugin	Description	
tst-Ft_R.scenario	VirtualInstallation3	Deployment Scenario File	delete
unitABC-2006-0518.xls	VirtualInstallation3	Deployment Unit File	delete

Local intranet



ArcGIS Server/ArcIMS Configuration using XML

```
- <location name="FT_READINESS">
- <service name="FT_READINESS" type="ArcGIS" datasrc="SDE" connectclass="notused"
  host="kamino.cecer.army.mil" port="notused" servicename="FT_READINESS"
  collection="FT_READINESS" file="notusedyet" pre="notusedyet">
  <layer name="road_centerline_edits" position="0" visible="true" accessible="true"
    serviceType="IMAGE" lookupname="road_centerline_edits" />
  <layer name="structure_existing_area_edits" position="1" visible="true" accessible="true"
    serviceType="IMAGE" lookupname="structure_existing_area_edits" />
</service>
- <theme name="ROADS">
  <layer layername="road_centerline" edittype="BASELINE" servicename="FT_READINESS" />
  <layer layername="road_centerline_edits" edittype="EDITS" servicename="FT_READINESS" />
  <layer layername="road_centerline_baseline_edits" edittype="BASELINE_EDITS"
    servicename="FT_READINESS" />
</theme>
- <theme name="NOGROWTH">
  <layer layername="nogrowth" edittype="BASELINE" servicename="FT_READINESS" />
  <layer layername="nogrowth_edits" edittype="EDITS" servicename="FT_READINESS" />
  <layer layername="nogrowth_baseline" edittype="BASELINE_EDITS"
    servicename="FT_READINESS" />
</theme>
- <theme name="FACILITIES">
  <layer layername="structure_existing_area" edittype="BASELINE" servicename="FT_READINESS" />
  <layer layername="structure_existing_area_edits" edittype="EDITS"
    servicename="FT_READINESS" />
  <layer layername="structure_existing_area_baseline_edits" edittype="BASELINE_EDITS"
    servicename="FT_READINESS" />
</theme>
</location>
```



Creating A Study

The screenshot shows a Microsoft Internet Explorer browser window displaying the Fort Future web application. The address bar shows the URL: <http://naboo.cecer.army.mil/ff/study/description/edit.do?studyId=c88d923c-69e5-11db-9b19-c77ecf56bbdf>. The page title is "Fort Future: Study: Description - Microsoft Internet Explorer".

The application interface includes a navigation menu with "Study", "Data", "Admin", and "Logout" options. The current study is titled "Study: deployment study". The user is logged in as "Fort Future Administrator".

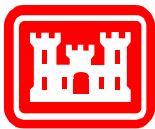
The main content area shows a breadcrumb trail: "study manager > study". A progress bar indicates the current step: "Overview" (selected) → "Scenario" → "Alternatives" → "Simulation/Analysis" → "Outcomes".

The "Description" section contains the following text: "Use this screen to name the study and to provide descriptive information." Below this, there are three input fields:

- Name: deployment study
- Description: Test multi-user alte
- Location: Fort Readiness to LS.

At the bottom of the form are two buttons: "« Back" and "Next »".

The footer of the page includes contact information: "If you experience problems with this application, or have a suggestion, please contact the webmaster at ff_webmaster@cecer.army.mil." It also features a "Privacy Policy" link and the U.S. Army Corps of Engineers logo with the text "U.S. Army Corps of Engineers® Engineer Research & Development Center".

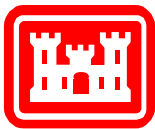


Setting The Study Scope

The screenshot shows a Microsoft Internet Explorer browser window titled "Fort Future: Study: Scope". The address bar contains the URL: <http://naboo.cecer.army.mil/ff/study/scope/edit.do?studyId=c88d923c-69e5-11db-9b19-c77ecf56bbdf>. The page header includes the "FORT FUTURE" logo, the text "Study: deployment study", and navigation links for "Study", "Data", "Admin", and "Logout". Below the header, a breadcrumb trail shows "study manager > study > scope" and a login status "You're logged in as Fort Future Administrator [change]". A navigation bar contains buttons for "Overview", "Scenario", "Alternatives", "Simulation/Analysis", and "Outcomes", with "Overview" being the active tab. On the left, a "Study Manager" sidebar lists links for "Description", "Scope", "Goals and Criteria", and "Stakeholders". The main content area is titled "Scope" and contains the following text: "This page shows the types of study problems that Fort Future is configured to support. Choose one or more problem statements or questions from the list below by selecting the box next to it, then select Next." Below this text is a list of study problem categories, each with a folder icon and a list of questions with checkboxes:

- Power Projection**
 - None of these.
 - Installation-Level Deployment**
 - End to End Deployment**
 - How does force flow impact the time for a deploying unit to reach operational readiness?
- Power Projection (old software version)**
 - Deployment Process Simulation
- Training and Testing Encroachment Analysis**
 - How do proposed regional plans alter training opportunities on the installation?
- Facility Acquisition**
 - What will be the cost of new facilities?
- Assess Range Risk**
 - What are the risks and impacts of placing a range at a specific location on this installation?

At the bottom of the main content area are "Back" and "Next" buttons. The browser's status bar at the bottom right shows "Local intranet".



Setting Goals and Criteria

Fort Future: Study: Goals - Microsoft Internet Explorer

Address: <http://naboo.cecer.army.mil/ff/study/goals/edit.do?studyId=c88d923c-69e5-11db-9b19-c77ecf56bbdf>

Study: deployment study

study manager > study > goals

You're logged in as **Fort Future Administrator** [change]

Overview → Scenario → Alternatives → Simulation/Analysis → Outcomes

Study Manager

Overview

- [Description](#)
- [Scope](#)
- [Goals and Criteria](#)
- [Stakeholders](#)

Goals and Criteria

Based on the study scope that was selected on the Scope page, Fort Future has found plugin modules to support your study. The major headings listed below supported *goals* and the subheadings indicate supported *decision criteria*. For each criterion that you select below, the plugin module will provide quantitative data that will be reported in a decision matrix in the Outcomes section. Choose one or more criteria from the list below by selecting the box next to it and then select Next.

- [Analyze Cost](#)
 - Facility cost
- [How does force flow impact the time for a deploying unit to reach operational readiness?](#)
 - Time required for deploying combat unit to meet operational readiness.

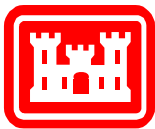
« Back Next »

If you experience problems with this application, or have a suggestion, please contact the webmaster at ff_webmaster@cecer.army.mil.

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Add Stakeholders

Fort Future: Study: Stakeholders - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address <http://naboo.cecer.army.mil/ff/study/stakeholders/edit.do?studyId=c88d923c-69e5-11db-9b19-c77ecf56bbdf>

FORT FUTURE Study: deployment study Study Data Admin Logout

study manager > study > stakeholders You're logged in as **Fort Future Administrator** [change]

Overview → Scenario → Alternatives → Simulation/Analysis → Outcomes

Study Manager

Overview

- [Description](#)
- [Scope](#)
- [Goals and Criteria](#)
- [Stakeholders](#)

Stakeholders

Select a user name to edit the study roles assigned to that user.

- [Add/remove stakeholders](#)

Username	Roles
administrator	Manager
dlevine	Master Planner, Member
mcase	Environmental Staff, Member
mpetre	Architect, Member
wsmith	Directorate of Public Works, Member

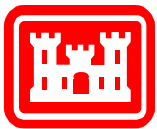
« Back Next »

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Associate Datasets with Study

Edit Study Data Sets

Available Datasets

- Eglin AFB
- Ft. Benning range data
- Ft. Bragg cantonment
- LSA_2
- no location

Study Datasets

- Readiness AFB
- Ft Readiness
- Readiness Field
- LSA Readiness

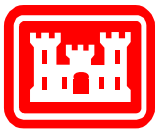
« Remove Dataset(s) »

Add Dataset(s) »

Datasets assigned to this study:

- Readiness AFB**
- Ft Readiness**
- Readiness Field**
- LSA Readiness**

« Back Next »



Setting Up Alternatives

The screenshot shows a Microsoft Internet Explorer browser window titled "Fort Future: Study: Manage Alternatives". The address bar shows the URL: <http://naboo.cecer.army.mil/ff/study/alternatives/list.do?studyId=c88d923c-69e5-11db-9b19-c77ecf56bbdf>. The page content includes a navigation breadcrumb "study manager > study > alternatives", a user login "You're logged in as Fort Future Administrator", and a process flow diagram: Overview → Scenario → Alternatives → Simulation/Analysis → Outcomes. The main heading is "Manage Alternative Courses of Action". Below this is a welcome message and a list of alternatives in a table.

Study: deployment study
Alternative: "As-Is" Alternative

Study Data Admin Logout

study manager > study > alternatives You're logged in as Fort Future Administrator [change]

Overview → Scenario → Alternatives → Simulation/Analysis → Outcomes

Study Manager

Alternatives

From here you can create and edit alternatives, as well as manage the domain-specific data within them.

Manage Alternative Courses of Action

Welcome to the Course of Action (COA) management page. You can edit COAs by selecting their name from the list of alternatives below. You can also enable, disable, copy, or delete a COA by selecting a command to the right of the COA name. If a COA is disabled, it will not be considered when simulations or analyses are run.

- [Create a new Course of Action](#)

Active	Name	Description	Commands
<input checked="" type="checkbox"/>	"As-Is" Alternative	What happens if we take no action?	copy delete
<input checked="" type="checkbox"/>	Add bypass roads and facilities	Will bypassing congested central area improve throughput at readiness field?	copy delete

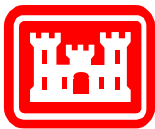
« Back Next »

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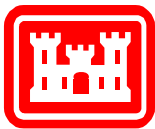
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Shared and Custom Editors

The screenshot shows a Microsoft Internet Explorer browser window displaying the Fort Future web application. The browser title is "Fort Future: Study: Show Alternative - Microsoft Internet Explorer". The address bar shows the URL: <http://naboo.cecer.army.mil/ff/study/alternatives/show.do?studyId=c88d923c-69e5-11db-9b19-c77ecf56bbdf&altId=22d7f99d-6f8>. The page content includes a navigation menu with "Overview", "Scenario", "Alternatives", "Simulation/Analysis", and "Outcomes". The "Alternatives" section is active, showing "Edit Alternative" details for a study named "deployment study" with the alternative "Add bypass roads and facilities". The user is logged in as "Fort Future Administrator". The "Alternative Properties" section shows: Name: Add bypass roads and facilities; Description: Will bypassing congested central area improve throughput at readiness field?; Active: true. A "Change »" button is present. The "Domain Editors" section lists several options: Manage Units, Edit Schedule, Edit Roads, Edit Facilities, Edit Task Assignments, Edit Water Network, and Edit Power Grid. The Study Manager sidebar on the left shows "Alternatives" with links for "As-Is" Alternative and "Add bypass roads and facilities".



Deployment Alternatives Editor – MapObjects Version

Fort Future Alternatives Editor [Ft Bragg Deployment]

File Help

Scenario: Scenario Current Alternative: more nurses

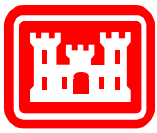
ITasks ProcessTree AvailResources

Person, Telephone:	qty = 15
Person, Dentist:	qty = 9
Person, Dental Staff:	qty = 12
Person, Lawyer:	qty = 15
Person, Legal Staff:	qty = 12
Person, Doctor:	qty = 15
Person, Medical Staff:	qty = 12
Person, Nurse:	qty = 30
Person, Administrative Staff:	qty = 20
Equipment, Motorpool Serial Line:	qty = 1
Equipment, AHA Generator:	qty = 4
Equipment, AHA Serial Line:	qty = 2
Person, AHA Measure Team:	qty = 2
Equipment, AHA Weigh Station:	qty = 1
Person, CFA Document Team:	qty = 5
Equipment, CFA Serial Line:	qty = 2
Person, CFA JI Team:	qty = 5
Equipment, Runway:	qty = 1
Person, Aircraft Load Team:	qty = 3
Person, Chalkmaster:	qty = 2

Save Changes to Current Alternative

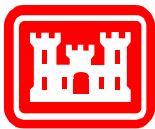
Deployment Facility Land Use Range

TOC



Using ArcGIS Server and Java Server Faces

- Spiral 1: MapObjects thick client approach
 - used ArcIMS to provide data
 - too slow – too much data to download
 - Java Webstart worked, but introduced authentication/authorization difficulties.
- Spiral 2: Web server-based editing
 - Adopted ESRI ADF with ArcGIS 9.1
 - ArcGIS Server uses ArcSDE
 - DSS web application only communicates with ArcGIS Server (not directly with ArcSDE)
 - Alternative edits stored on dedicated edit layers, identified by unique alternative GUID
 - Baseline geospatial data not changed.



Road Editor

The screenshot shows the Fort Future Road Editor web application running in Microsoft Internet Explorer. The browser window title is "Fort Future Editor - Microsoft Internet Explorer". The address bar shows the URL: <http://naboo.cecer.army.mil/ff/gis-editor/roadEditor.jsf?studyId=c88d923c-69e5-11db-9b19-c77ecf56bbdf&altId=22d7f99d-6f8e-11db-a76f-a6a352>. The application header features the "FORT FUTURE" logo and navigation icons for "Study", "Data", and "Admin Li". Below the header, the user is logged in as "Fort Future Administrator".

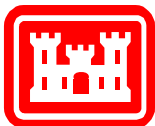
The main interface includes a "Study manager" section with the following settings:

- Study: Multi-node deployment
- Alternative: Add bypass roe
- Location: READINESS_FI
- Editor: Edit Roads
- Editing Layer: road_centerline

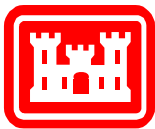
The "Layers" panel on the left lists the following layers:

- road_centerline_edits
- structure_existing_area_edits
- nogrowth_edits
- READINESS_FIELD.road_cen SUBTYPEID
 - PRIMARY
 - SECONDARY
 - TERTIARY
- READINESS_FIELD.structure SUBTYPEID

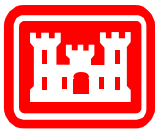
The central map area displays a road network with a scale bar indicating 0.2, 0.1, 0, and 0.2 Miles. A "Done Editing" button is located at the bottom of the map. The "Attributes" panel is visible on the right side of the map.



Facilities Editor



Water System Editor



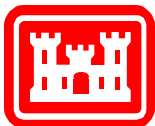
Power System Editor

The screenshot displays the Fort Future Editor web application running in Microsoft Internet Explorer. The browser window title is "Fort Future Editor - Microsoft Internet Explorer". The address bar shows the URL: <http://naboo.cecer.army.mil/ff/gis-editor/powerEditor.jsf>. The application interface includes a top navigation bar with "Study", "Data", and "Admin Li" icons. Below this is a status bar indicating the user is logged in as "Fort Future Administrator".


The main interface is divided into several sections:

- Study Manager:** A sidebar on the left containing dropdown menus for "Study:" (Multi-node deployment), "Alternative:" (Add bypass roe), "Location:" (LSA_READINE!), "Editor:" (Edit Power Grid), and "Editing Layer:" (electrical_cable).
- Layers Panel:** A sidebar below the study manager showing a list of layers with checkboxes and color swatches:
 - structure_edits (yellow)
 - structure_baseline_edits (light green)
 - electrical_gen_point_edits (red)
 - water_fitting_pnt_edits (blue)
 - water_pump_pnt_edits (orange)
 - water_res_pnt_edits (light blue)
- Main Map:** A central map area displaying a power grid with green lines, black nodes, and various colored polygons. A scale bar at the bottom indicates distances of 0.1, 0.05, 0, and 0.1 Miles.
- Attributes Panel:** A panel on the right side of the map, currently empty.
- Toolbar:** A horizontal toolbar above the map with various navigation and editing icons.






At the bottom of the browser window, a status bar displays the text: "Polyline - Click to start line. Click again to add vectors. Press Ctrl key while clicking, or double-click to add last vector a". The system tray shows "Local intranet".



Managing Simulations



Study: deployment study

 MyFF
  Admin
  Account
  Logout
  Help

organizer > study > simulate
You're logged in as **Fort Future Administrator** [change].

Overview → Mission → Alternatives → Simulation/Analysis → Outcomes

Study Manager

Simulation

This page sets up and starts simulations for the current study. Only "active" simulations are started, and only "active" alternatives are sent to those simulations. To edit global parameters for each simulation, click the name of that simulation.

Manage Simulations

Welcome to the Simulations management page.

Active	Name	Description
<input checked="" type="checkbox"/>	Virtual Installation	Deployment simulation using DIAS

Start Selected Simulations

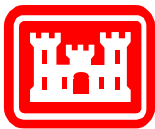
« Back
Next »

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Running Simulations

organizer > study > simulate

You're logged in as **Fort Future Administrator** [change]

Overview

Mission

Alternatives

Simulation/Analysis

Outcomes

Study Manager

Simulation

This page sets up and starts simulations for the current study. Only "active" simulations are started, and only "active" alternatives are sent to those simulations. To edit global parameters for each simulation, click the name of that simulation.

Simulation Status

- Page refreshes every 60 seconds. [Refresh page now.](#)
- [Abort all simulations.](#)

Virtual Installation



15%

Abort

"As-Is" Alternative & <test>



15% Running

Abort

more nurses



15% Running

Abort

Total



15%

« Back

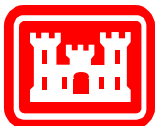
Next »

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Viewing Simulation Results

Sample from Spiral 1. Spiral 2 simulation service in progress



Study: Ft Bragg Deployment



organizer > study > outcomes

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Overview

Mission

Alternatives

Simulation/Analysis

Outcomes

Study Manager

Outcome

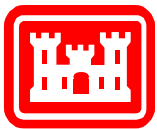
- [Decision Matrix](#)

View Outcomes (Compare How Well COAs Meet Goals)

Scenario: Scenario	COA 1 "As-Is" Alternative & Details...	COA 2 more nurses Details...
Determine power projection time (hours)		
Total Time to Complete	27.1	24
Total Personnel Idle Time	3,290	2,870
Average Personnel Idle Time	17.2	15
Total Personnel Group Wait Time	2,960	2,590
Total Personnel Travel Time	84.5	84.5
Average Personnel Travel Time	0.442	0.442
Total Personnel Resource Wait Time	329	277
Average Personnel Resource Wait Time	1.72	1.45
Total Vehicle Resource Wait Time	34.8	33.4
Average Vehicle Resource Wait Time	0.891	0.856

« Back

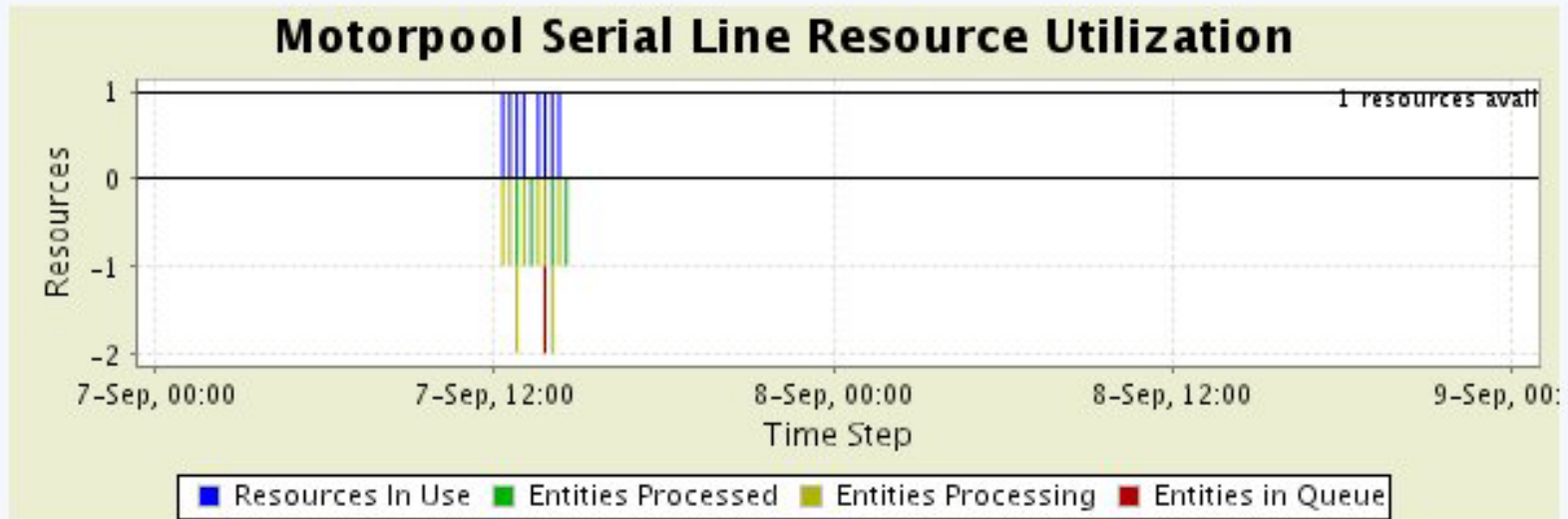




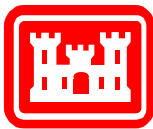
Protocol Supports Simulation-Specific Results

Select “details...” for each alternative Course of Action

Motorpool Serial Line Details




Total resources available	1
Max resources used in a time step	1
Max entities processed in a time step	1
Max entities processing in a time step	1
Max entities queued in a time step	1
Total time resource was needed	2h 15m








Sample Spiral 1 Decision Matrix for Range Risk

US Army Corps
of Engineers



Study: Range Study

organizer > study > outcomes You're logged in as **Fort Future Administrator** [change]

Overview → Mission → Alternatives → Simulation/Analysis → Outcomes → Reports

Study Manager

Outcome

- [Decision Matrix](#)

View Outcomes (Compare How Well COAs Meet Goals)

Scenario: Scenario	COA 1 Preferred alternative	COA 2 Alternative two
Analyze Range Risks	Details...	Details...
Land Use and Traffic patterns	0.773	0.823
Air Quality	1	0.931
Noise	0.893	0.902
Water Quality	0.891	0.902
Wetlands	0.814	0.824
Water Body Modifications	0.823	0.833
Floodplain	0.814	0.824
Coastal Zone	0.929	0.945
Wildlife and Vegetation Alterations	0.814	0.824
Threatened and Endangered Species / Sensitive Species	0.814	0.824
Socio-Economic and Long-term Productivity	0.817	0.826
Hazardous Materials / Hazardous Waste	0.29	0.303
Visual Effects	0.826	0.835
Cultural Resources	0.817	0.826
Energy Use	0.899	0.909
Estimated Total Cost of Mitigation	0	0

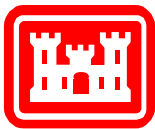
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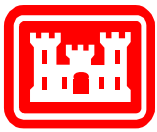




Range Risk Details...

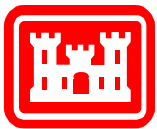
Range Risk Matrix

	Land Use and Traffic Patterns	Air Quality	Noise	Water Quality	Wetlands	Water Body Modifications	Floodplain	Coastal Zone	Wildlife and Vegetation Alterations	Threatened and Endangered Species / Sensitive Species	Socio-economic and Long-term Productivity	Hazardous Materials / Hazardous Waste	Visual Effects	Cultural Resources	Energy Use	Physical Impact:	Management and Externalities	Cumulative
1 Construction	0.914	1.000	0.965	0.970	0.940	0.940	0.940	0.983	0.940	0.940	0.940	0.875	0.940	0.940	0.970	0.337		
a. Clearing	0.924	1.000	0.985	0.990	0.961	0.961	0.961	1.000	0.961	0.961	0.961	0.695	0.961	0.961	0.990	0.449	0.770	0.540
b. Horiz Construction	0.892	1.000	0.945	0.950	0.921	0.921	0.921	0.965	0.921	0.921	0.921	0.655	0.921	0.921	0.950	0.248	0.770	0.342
c. Vertical Construction	0.928	1.000	0.965	0.970	0.941	0.941	0.941	0.985	0.941	0.941	0.941	0.875	0.941	0.941	0.970	0.343	0.770	0.439
2 Operations & Maintenance	0.943	1.000	0.982	0.984	0.956	0.956	0.956	0.994	0.956	0.956	0.959	0.893	0.959	0.959	0.988	0.429		
a. Ammunition	0.919	1.000	0.955	0.955	0.931	0.931	0.931	0.975	0.931	0.931	0.931	0.660	0.931	0.931	0.960	0.291	0.770	0.387
b. Unit Activity	0.942	1.000	0.980	0.980	0.951	0.951	0.951	0.995	0.951	0.951	0.966	0.700	0.966	0.966	0.995	0.438	0.770	0.530
c. Equipment (unit)	0.937	1.000	0.975	0.980	0.951	0.951	0.951	0.995	0.951	0.951	0.951	0.685	0.951	0.951	0.980	0.399	0.770	0.493
d. Wastes	0.955	1.000	0.995	0.995	0.966	0.966	0.966	1.000	0.966	0.966	0.971	0.660	0.971	0.971	1.000	0.472	0.770	0.561
e. Maintenance	0.951	1.000	0.990	0.995	0.966	0.966	0.966	1.000	0.966	0.966	0.966	0.700	0.966	0.966	0.995	0.493	0.770	0.580
f. Targets	0.955	1.000	0.995	1.000	0.971	0.971	0.971	1.000	0.971	0.971	0.971	0.705	0.971	0.971	1.000	0.528	0.770	0.611
3 Closure	0.896	1.000	0.942	0.934	0.906	0.916	0.906	0.950	0.906	0.906	0.906	0.629	0.916	0.906	0.937	0.204		
a. Dormancy	0.901	1.000	0.945	0.935	0.911	0.921	0.911	0.955	0.911	0.911	0.911	0.830	0.921	0.911	0.940	0.218	0.770	0.309
b. Clearing	0.892	1.000	0.940	0.930	0.901	0.911	0.901	0.945	0.901	0.901	0.901	0.625	0.911	0.901	0.935	0.191	0.770	0.279
c. Cleanup	0.892	1.000	0.940	0.930	0.901	0.911	0.901	0.945	0.901	0.901	0.901	0.625	0.911	0.901	0.935	0.191	0.770	0.279
d. Re-use	0.901	1.000	0.945	0.940	0.911	0.921	0.911	0.955	0.911	0.911	0.911	0.635	0.921	0.911	0.940	0.220	0.770	0.312
Cumulative	0.773	1.000	0.893	0.891	0.814	0.823	0.814	0.929	0.814	0.814	0.817	0.290	0.826	0.817	0.899	0.309		
Score with significance	0.773	1.000	0.893	0.891	0.814	0.823	0.814	0.929	0.814	0.814	0.817	0.290	0.826	0.817	0.899	0.791		0.835



Summary and Future Work

- Proof of concept for a DSS-Simulation protocol was successful
- Collaborators were able to edit alternatives over the network
- Results of editing provided as data to simulation services
- XML-based registration could be made more dynamic using WSDL
- Protocol could be incorporated into the Military Scenario Definition Language (MSDL) as meta-control language
- With pluggable architecture, new simulations can be added at any time, and different simulations can be run within the same study



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<https://ff.cecer.army.mil/ff/home.do>
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