# Concepts for Collaboration in Campaign Design

Primary Topic: 3. Data, Information, and Knowledge
Secondary Topic: 2. Organizational Concepts and Approaches
Secondary Topic: 10. Operational Issues

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## Abstract

Planning experience in Iraq and Afghanistan refined *campaign design*, leading to its integration into doctrine. Campaign design establishes an understanding of the situation and problem, to enable development of an appropriate solution. It requires exploratory, multi-dimensional, collaborative, critical and creative thinking, revisited iteratively in response to ongoing assessment.

In design, all offered facts and theories are subjected to thorough critique from a wide range of perspectives. The multi-perspective team builds an accumulated model of the environment that is more trustworthy than the view presented by any one source. Drawing on a network of other agencies and international mission partners has proven critical to success. Likewise, the lessons of past experience can contribute greatly to vetting current analyses, approaches, and plans.

This paper discusses our first-of-its-kind effort to envision novel applications of technology to support this novel design methodology. We conceived, prototyped, and tested a wide range of capabilities, all integrated in the context of a web-based collaboration environment intended to support members of an extended design team as might be found at division and above, including representatives from other agencies and international mission partners. We report on the motivation, design, implementation, and end-user response to these capabilities.

# 1. Introduction to Campaign Design

Among the DoD's many responsibilities, Counterinsurgency (COIN) operations and the related portfolio of Stability, Security, Transition & Reconstruction (SSTR) operations now have equal importance with conventional force-on-force operations. The 2006 revision of U.S. Army FM 3-24 *Counterinsurgency* defined the role, importance, and general properties of an effective COIN campaign design process: exploratory, multi-dimensional, collaborative, and iterative in response to ongoing assessment. COIN campaign and SSTR operation designers must draw on sources and knowledge from all elements of national power, develop campaign concepts by thinking creatively and critically, and refine their designs by learning from experiences within and across campaigns.

## 1.1. Initial Definition of Campaign Design

FM 3-24, *Counterinsurgency*, introduced an approach to COIN campaigns and operations, noting many of the peculiar challenges of such situations. Foremost among those challenges is coping with long-running campaigns against adaptive enemies: *"In COIN, the side that learns faster and adapts more rapidly—the better learning organization—usually wins. Counterinsurgencies have been called learning competitions."* (FM 3-24, 2006, p. ix).

In addition to being changeable, COIN situations are usually very complex: *"The complexity of insurgency presents problems that have incomplete, contradictory, and changing requirements. The solutions to these intensely challenging and complex problems are often difficult to recognize as such because of complex interdependencies. While attempting to solve an intensely complex problem, the solution of one of its aspects may reveal or create another, even more complex, problem."* (FM 3-24, 2006, p. 4-1). The key to coping with this kind of complexity is to introduce an explicit campaign design process: *"The purpose of design is to achieve a greater understanding, a proposed solution based on that understanding, and a means to learn and adapt."* (FM 3-24, 2006, p. 4-1).

Such a design process can have great value: *"Campaign design may very well be the most important aspect of countering an insurgency. It is certainly the area in which the commander and staff can have the most influence."* (FM 3-24, 2006, p. 4-9). Unfortunately, *"While planning activities receive consistent emphasis in both doctrine and practice, discussion of design remains largely abstract and is rarely practiced. Presented a problem, staffs often rush directly into planning without clearly understanding the complex environment of the situation, purpose of military involvement, and approach required to address the core issues. This situation is particularly problematic with insurgencies."* (FM 3-24, 2006, p. 4-2).

This is not to say that campaign design is a foreign concept to U.S. commanders, but *"While traditional aspects of campaign design as expressed in joint and Service doctrine remain relevant, they are not adequate for a discussion of the broader design construct for a COIN environment. Inherent in this construct is the tension created by understanding that military capabilities provide only one component of an overall approach to a COIN campaign. Design of a COIN campaign must be viewed holistically. Only a comprehensive approach employing all relevant design components, including the other instruments of national power, is likely to reach the desired end state."* (FM 3-24, 2006, p. 4-4). There is a key point here: not only is campaign design essential to effective COIN operations, but an effective design process must be collaborative and range well beyond typical military channels—most especially to include Interagency (IA) and Host Nation (HN) participation.

A final key point is that the COIN campaign design process must be iterative: *"While strategy drives design, which in turn drives tactical actions, the reverse is also true. The observations of tactical actions result in learning and greater understanding that may generate modifications to the design, which in turn may have strategic implications. The COIN imperative to "Learn and Adapt" is essential in making the design process work correctly."* (FM 3-24, 2006, p. 4-4). *"…design is also continuous throughout the operation. As part of assessment, commanders continuously test and refine their design to ensure the relevance of military action to the situation."* (FM 3-24, 2006, p. 4-2).

For each iteration, we must define where COIN campaign design starts and where it ends. *"Design begins with identification of the end state, as derived from the policy aim."* (FM 3-24, 2006, p. 4-4). Design produces a framing of the COIN problem that can guide unified action: this includes a statement of commander's intent—the problem and approach to solving it—and a vision of resolution—usually a set of Logical Lines of Operation (LLOs). *"By broadly describing how the LLOs interact to achieve the end state, commanders provide the operational logic to link the various components in a comprehensive framework."* (FM 3-24, 2006, p. 4-5). Ultimately, *"The design—consisting of the commander's intent, vision of resolution and other guidance issued as the campaign unfolds, and end state—provides the framework within which subordinates exercise … initiative."* (FM 3-24, 2006, p. 4-6).

## 1.2. A Synthesized View of Campaign Design

We began our effort to understand campaign design in 2008. We spent considerable time tracking emerging doctrine over the next several years as guidance on campaign design spread beyond FM 3-24. Campaign design first received extended treatment in TRADOC Pamphlet 525-5-500 (TRADOC, 2008), and then appeared in a series of Army FMs: FM 3-24.2 (Army, 2009), FM 5-0 (Army, 2010), and FM 6-0 (Army, 2011). It also moved into joint doctrine, appearing first in a Joint Warfighting Center pamphlet (JWC, 2010) and finally in joint doctrine JP 5-0 (DoD, 2011).

In 2010, we carried out a cognitive task analysis of the design process involving interviews with operational design shops at SOCOM, SOUTHCOM, and ARCENT. We were also fortunate to have several opportunities to interact with students, faculty, and alumni of the U.S. Army School of Advanced Military Studies (SAMS), including extended observations of a seminar class focused on practicing design. SAMS had been designated as the lead organization for developing and teaching campaign design methods. Its instructors were thought leaders in conceptualizing, methodologizing, and teaching design. They produced a text on design that stands as the most detailed and comprehensive treatment of the topic to date (SAMS, 2010).

Based on observations, discussions, and readings, we synthesized an overall view of design captured in **Figure 1**. The figure highlights several aspects of campaign design:

1. Design is partially structured around a set of documents as inputs and products, indicated in the figure by the rectangles with folded-up lower-right corners. Design is initiated by the receipt of a mission that, in the commander's judgment, merits more extended study than might normally be carried out in traditional mission analysis. The commander assembles a design team—most likely led by senior members of the planning cell—and provides them with Design Guidance (e.g. desired Endstate, forces available, and time available). The team then incrementally (and iteratively) produces three main design documents: an Environmental Frame, a Problem Frame, and an Operational Approach.

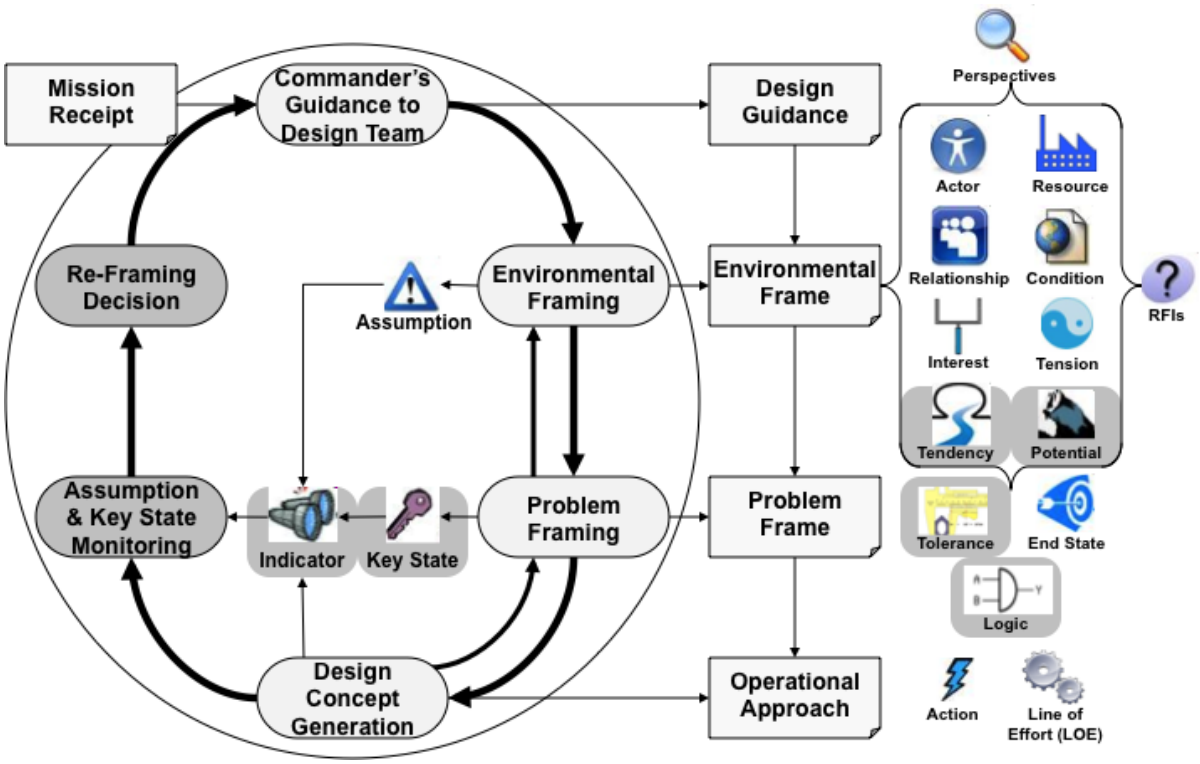


**Figure 1. Overall Schema for Campaign Design.**

2. Each of the major design products is produced as a result of efforts devoted to an activity shown as a labeled oval in the figure. The four main design activities producing the four main design products are drawn in a circle along with two additional execution-related activities. The clockwise circle emphasizes the overall iterative nature of design, but additional counter-clockwise arrows indicate that the three core activities of the design team frequently iterate, even within a single overall design cycle.
3. The various products and activities of campaign design are concerned with characterizing the environment, problem, solution, and execution, in part by reference to a set of conceptual categories, illustrated in **Figure 1** as labeled icons. For instance, the Environmental Frame should reflect an analysis of **actors**, **resources**, **relationships**, **conditions**, and so on. Many of these categories are relatively self-explanatory and would probably occur to anyone charged with characterizing an operational environment. Others are less obvious and more embedded in design theory. For instance, it is not surprising to say that we should be concerned with various actors' **interests** (what they want) but it can be useful to be reminded to explore and document those interests. It is also useful to be reminded to look for points where the interests of various actors come into **tension**. It is a critical point of design theory to highlight the ideas of **tendency**—where the system would likely go if we took no action—and **potential**—the envelope of possibilities for how it might plausibly behave given action on our part.
4. In addition to the recommended analytic categories, there are some crosscutting concepts deserving attention. All of the categories discussed above can potentially be used to describe the environment (or problem or solution) from different **perspectives**. The standard Political, Military, Economic, Social, Information and Infrastructure (PMESII) systems framework can provide a useful set of such perspectives. Similarly, there are

likely to be gaps in any analysis, and significant ones should be noted to generate Requests for Information (**RFIs**). Where RFIs do not generate desired clear results, the campaign may have to proceed based on **assumptions**.

### 1.3. Outstanding Problems Regarding Campaign Design

From this starting point, we identified outstanding problems facing campaign designers:

- Early doctrine introduced the notion of campaign design, but only at a relatively high level. The initial high-level description made the case for *why* design is important, and subsequent supplementary doctrine went on to clarify *what* constitute appropriate design products. However, there was relatively little definitive guidance on *how* to do design.
- Our support for design must not undermine the essential nature and value of design. Design is primarily a complex process of *critical and creative thinking*. Unfortunately, it is very difficult to define a specific, trainable, replicable, supported process that does not inhibit such thinking. In fact, there appears to be an inverse relationship between the amount of guidance and regimentation, and the amount of critical and creative thinking.
- Design can also be quite an expensive process, requiring time from commander, staff, and consultants, as well as input from the field, including creation of new Intelligence, Surveillance, and Reconnaissance (ISR) demands. To be accepted and practiced, design needs to be perceived as adding value, and must avoid placing unrealistic demands on limited resources.
- Design is an iterative process. Commanders and staffs must adjust when the operational environment shifts, which means it is critically important to identify triggers and methods for *reframing* the problem. Historically, there may be indicators of key shifts in the operational environment but they often go too long unrecognized. Campaign design doctrine recognizes the problem, but offered little concrete support for ensuring operational approaches are adjusted in keeping with the shifting realities in the situation.
- Personnel resource limitations typically preclude creation of standing design teams. Unavoidable turnover of personnel or periodic reconstitution of a team can exact a high cost on the design effort in terms of time, continuity, and cognition. Quick spin-up of team members can be critical in the struggle to adapt to the rapidly changing operating environments often found in COIN. Without rapid adaptation to changing conditions, history unfortunately shows that commanders work harder to solve the wrong problems.

## 2. Information Technology to Support Campaign Design

Our charge from the U.S. Army Communications-Electronics Research, Development and Engineering Center (CERDEC) was to conceptualize and prototype novel information technology in support of campaign design. Given the lack of detailed guidance on design processes, and given the fear that too much process would in fact destroy the very essence of design, some traditional tool development paths were not open to us. We could not start from a given process and focus on opportunities to automate particular steps. Instead, we started with a couple of key questions: *What might useful methods and tools for critical and creative thinking look like, and how can the contributions of all relevant stakeholders be efficiently coordinated?*

### 2.1. What do Designers Do?

Based on our discussion with design practitioners and experts, we boiled down much of what designers do to three main activities: (1) research, (2) discourse, and (3) production.

1. **Research** includes (1a) finding sources, (1b) noting information of general relevance, (1c) finding answers to specific questions, and noting when assumptions are being made in the absence of solid information, (1d) organizing the information and underlying sources so that team-members, other stakeholders, and participants in future iterations can more easily review, validate, and/or revise the design rationale, and (1e) preparing to present important information to other team-members in follow-on discourse sessions.
2. **Discourse** includes (2a) presenting significant findings to other team-members, (2b) offering supplementary, complementary or contradictory information, (2c) synthesizing information from several sources and perspectives, and identifying biases and trustworthy information (2d) prioritizing and winnowing aggregate understandings to focus on the most important issues, (2e) identifying gaps and supplementary information needs, and (2f) preparing to present the group consensus and caveats in larger team meetings.
3. **Production** includes (3a) refining, winnowing, and clarifying the group consensus, (3b) producing high-quality visualizations and focused briefings to share understanding with planners, commanders, and others, (3c) practicing/delivering briefings and incorporating feedback, (3d) producing written documentation of the design results, and (3e) reviewing, commenting, revising, and resubmitting the formal design documentation.

## 2.2. Where to Focus Tool Development Efforts?

Given project resource limitations we could not effectively explore support for all aspects of design. Given existing tools, there was no strong need to build new tools for some tasks. As a scope management decision, we did not address many aspects of the initial research step of *finding sources*. Google and existing intelligence repositories do a reasonable job. Bettering their performance is a major research undertaking in its own right. Nor did we develop custom support for most of the steps in production. Standard office applications like MS PowerPoint, Excel, Access, and Word offer many relevant features in a familiar, robust, and cost-effective form. Rather we focused on smoothing the transition from research and discourse to production, and providing linkages from final products to elements of an underlying knowledge repository.

Our efforts focused on offering the design team Knowledge Management (KM) support by (1) capturing and managing team knowledge, (2) enhancing team coordination, (3) promoting team efficiency, (4) fostering critical and creative thinking, and (5) facilitating design iteration. Approaches to addressing each of these goals are elaborated in the following sub-sections.

### 2.2.1. Capturing and managing team knowledge

Capturing and managing team knowledge means storing, in an organized fashion, all the material gathered and generated by the team, and making it more accessible and useful in the long run. Here "*all the material*" means source documents, notes on sources, discussion of sources and notes, models and visualizations of extracted information, production products, feedback for revisions, and lessons-learned.[1] Storing material "*in an organized fashion*" means having a filing structure with a place for everything, capturing significant relationships among items (e.g. derivation, co-reference, historical evolution). Finally, "*useful in the long run*" implies that stored materials can be readily accessed when needed—e.g. by search, browsing, or following links—and that selected pieces may be used for analysis and task support.

[1] We developed preliminary designs for capturing records of spoken discourse and supporting graphics, as well as information on campaign progress and activity outcomes, however resource limitations precluded building prototypes for these features.

We addressed these goals by integrating several commodity sub-systems, supplemented by application-specific custom data models and related tools. A *Content Management System* (CMS) provides storage of source, product, and process documents in various formats, while supporting search and retention of historical variants. A *structured wiki* built on top of the CMS supports organized note-taking and cross-linking of documents across the CMS, wiki, and wider web. Leveraging the CMS, the wiki also supports search and history tracking, while adding textual discussion threads. Custom *graphical tools* support visualizations of structured models in accordance with best campaign design practices. We built structured diagramming tools for entity/relationship and lines-of-effort (LOE) diagrams.

Integration among these components means that they share a common underlying data model, and can thereby can refer to one another and cross-link in useful ways. For instance, a wiki page with notes on a particular actor can cite and quote from underlying source documents, while an actor element in a graphical map can link to the actor wiki page. Presentation products built from a version of the graphical map should support drill-down through the diagram to the wiki page, and all the way back to supporting sources. Many of these linkages are created (semi) automatically by the system, as when custom text processing mechanisms recognize quotations from source documents, or find entity references in various source or analysis texts.

### 2.2.2. Enhancing team coordination

Enhancing team coordination starts with simply providing the above repository, organization, and access features. Wikis not only let designers capture notes on sources, but allow for (controlled) sharing and merging of such notes. Online discussion threads tied to wiki pages provide for a kind of asynchronous discourse. This is likely to be of particular use either for members of the core team with overlapping areas of focus (e.g. interested in the same actors, though perhaps from different perspectives), or for more peripheral team members trying to keep track of progress but on their own schedules (e.g. team leads, senior officers, and distant IA participants). Overall tracking of repository contents makes it easier for multiple team members to work on common artifacts with greater understanding of how they have been evolving and with less fear of irremediable information loss. It makes it easier to restore information deleted from previous versions or to revert entirely to some earlier state if that seems appropriate. An ability to subscribe to repository elements of interest and receive change notifications provides yet another way that the system can help keep team members synchronized.

### 2.2.3. Promoting team efficiency

Promoting team efficiency starts with making all the various information management functions easy to use and providing quick-targeted access to materials designers need. For instance, a pre-defined KM structure saves team time and reduces uncertainty about how to organize materials. Likewise, automated entity extraction and document linking further reduce time spent organizing materials. For the discourse phase, we sketched ideas for automated capture and semi-automated indexing of group discussions and supporting graphics as a way to reduce work for the team member designated as “recorder”; this would allow the recorder to focus more fully on noting the most important points—or better yet, participate more actively in the discourse. Complete capture, indexing, and linking of all team materials saves time when team members have to go looking for information they think they saw somewhere earlier.

Given an understanding of design methodology and its capture of design documents, a system can also easily be extended to support various forms of scheduling, task tracking, and

notification. Perhaps most essential for the design process, it can use captured records of assumptions and information gaps to help with the important Request for Information (RFI) management process. RFI management, when combined with Subject Matter Expert (SME) identification and change notification, can make substantial contributions to ensuring a design is grounded in facts and reflects the most complete, up-to-date information.

### 2.2.4. Fostering critical and creative thinking

Our approach to using IT to foster critical and creative thinking hinged on finding ways to use structured data and algorithms to help users avoid being overly rigid and limited in their thinking. We started by offering multiple views of entities being modeled. The user interface (UI) emphasizes analysis from alternative systems perspectives—starting with the standard PMESII breakdown, but allowing extensions or alternatives of a team's own devising. We also offer alternate visualizations of data: hyperlinked text, entity-relationship diagrams, or time-sequence diagrams. Different perspectives and views are appropriate to different analyses, questions, and even cognitive styles.

In keeping with the goal of winning the "learning competition" we implemented different versions of lessons-learned storage and retrieval, including pro-active retrieval based on data from the evolving design environment. Some stakeholders expressed concern that presenting "lessons" from previous campaigns might misdirect or over-constrain analysis while others were more comfortable that past experiences could usefully serve to flag potential issues and raise (rather than necessarily answer) questions. However, we also considered integrating into the UI a set of explicit question prompts developed by the SAMS faculty to promote reflection and broader thought. Similarly, it would be sensible to integrate a set of mini-tools tuned to supporting specific critical and creative thinking techniques documented and taught by SAMS (SAMS, 2010).

We considered but, for lack of resources, did not implement a set of yet more advanced extensions aimed at calculating coverage and density metrics over captured model fragments. The idea was to suggest facets of the situation that may not have received adequate attention—e.g. PMESII perspectives, actor types, relational factors, or cross-relationship tensions either missing from the model or not linked to problem and solution frames.

### 2.2.5. Facilitating design iteration

Facilitating design iteration includes both small- and large-scale iterations—cycles within a design team's day-to-day work towards a frame/approach, and cycles after an approach has been put into operation (i.e., when conditions suggest a need for reframing). Already-enumerated record-keeping, coordination, and notification capabilities most directly support the small-scale cycles. Below, we primarily address *reframing*, which is typically a major decision by the commander, and may involve reconstituting or setting up a fresh design team. Policies towards reusing research or analysis from prior iterations will likely vary across different commands, design teams, and situations. Some stakeholders expressed concern that a new design effort might be biased and undermined by wholesale importation of work from previous iterations. As a compromise, we decided to treat each major design iteration as a new workspace, but enable copying of elements from prior iterations/workspaces if desired.

One of the hardest questions is actually *when should reframing be undertaken*? Given the central idea of a "learning competition", we know that reframing is likely a critical step towards future success. Therefore, the design process ought to consider what can be done to facilitate good future decision-making about reframing. Our solution incudes tracking

assumptions and other unknowns that remain during initial operations. Ultimately, the object is to recognize when late-arriving information potentially invalidates assumptions and other aspects of the design approach. In follow-on work, we began to explore linkages from assumptions to planned tasks. In some cases, explicit information-gathering tasks are generated (e.g. ISR tasks) to fill identified gaps. In other cases, goal-directed tasks (creation of conditions) can be traced back to the logic—including the assumptions—underlying the task.

# 3. Implementation of the TEAM Tool

The discussion in the previous section amounts to a design survey of a hypothetical tool suite. We prototyped, integrated, and experimented with many of the capabilities described above. We refer to the resulting overall system as **TEAM**: Team Environment for Analysis and Modeling.[2] In the following sections we review TEAM's major features, tying them to the vision of IT for design support presented in the earlier sections.

## 3.1. Architecture and Core Data Model

TEAM is built in Java and leverages object-oriented software structures. We use the Eclipse Modeling Framework (EMF; http://eclipse.org/modeling/emf/) to define the data to be managed by the system. EMF is similar to (and translatable to and from) the Unified Modeling Language (UML). It allows definition of object types, attributes, relationships, and operations. The resulting models can be used to automatically generate Java code. The EMF data model can also be extended with annotations that can be used to drive additional custom code generation. We started with an EMF model that included classes for **campaigns**, **iterations**, **products**, **sources**, **actors**, **relationships**, etc.

Much of TEAM's core functionality was intended to align with typical CMS and wiki features. However, to support many of TEAM's more advanced features, we wanted a wiki that could manage not just plain HTML pages, but also structured data associated with such pages. Hence, we searched for an open-source Java-based wiki that would support structured data modeling and would allow for customization. We settled on the Daisy CMS/wiki (http://www.daisycms.org/daisy/index.html), following evaluation of the user community, and tests investigating how the system would perform when storing large volumes of data and operating under substantial load. Daisy became not only our CMS and wiki, but also TEAM's central data store. Daisy, in turn, uses MySQL and file-based storage under the hood. We used annotated EMF and custom code generation to create Daisy schemas for our data model and to do much of the work of specifying custom wiki page layouts for each object type.

As suggested by earlier discussion, TEAM also required development of custom data visualizations and editors. For these, we chose to build Java Swing applications that could be delivered through browsers using WebStart. Again, we were able to use EMF annotations and custom code generation to create an automatically extensible mapping and transport layer allowing communication between the Daisy repository and our diagramming tools.

An important result of these architecture and tooling choices was that is has become quite easy to extend and modify TEAM's data model, including its library of pre-structured wiki page types and corresponding set of graphical editors. Thus, for instance, when late in the original

[2] During development, the system was known as **SACCADE**: System to Aid Counterinsurgency Campaign Analysis, Design, and Evaluation. The simpler and more general TEAM acronym reflects commercialization efforts subsequent to the original SBIR project.

project it was pointed out that design tools would be much more compelling if they linked to the planning process, we were able to rapidly extend TEAM with new objects/wiki-pages providing support for early planning steps up to production of the commander's estimate.

### 3.2. Wiki and CMS Features

At its core, TEAM is largely a customized (and extensible) semi-structured wiki with CMS capabilities. Daisy provides a wealth of features, including: (1) user management and authentication; (2) user rights management and access control; (3) partitioning of data into separate sites or workspaces; (4) page creation, viewing, and WYSIWYG editing; (5) page version tracking, review, and reversion; (6) page commenting and change notifications; (7) PDF generation; and (8) document storage and full-text search.

**Figure 2** shows a screen shot of a representative TEAM wiki page—in this case, the top-level page for a sample campaign. Throughout development and in this paper, we use as our sample campaign "Operation Caspian Challenge," which was developed for a training exercise by the Battle Command Battle Lab. The page includes a wealth of features, including (1) TEAM branding; (2) constant top-level links and search capability; (3) a menu bar; (4) a navigation bar with links to major pieces of TEAM functionality; (5) a "breadcrumbs" bar to remind users of where the current page is situated in the larger wiki; (6) formatted page contents, including (7) a set of structured data fields.

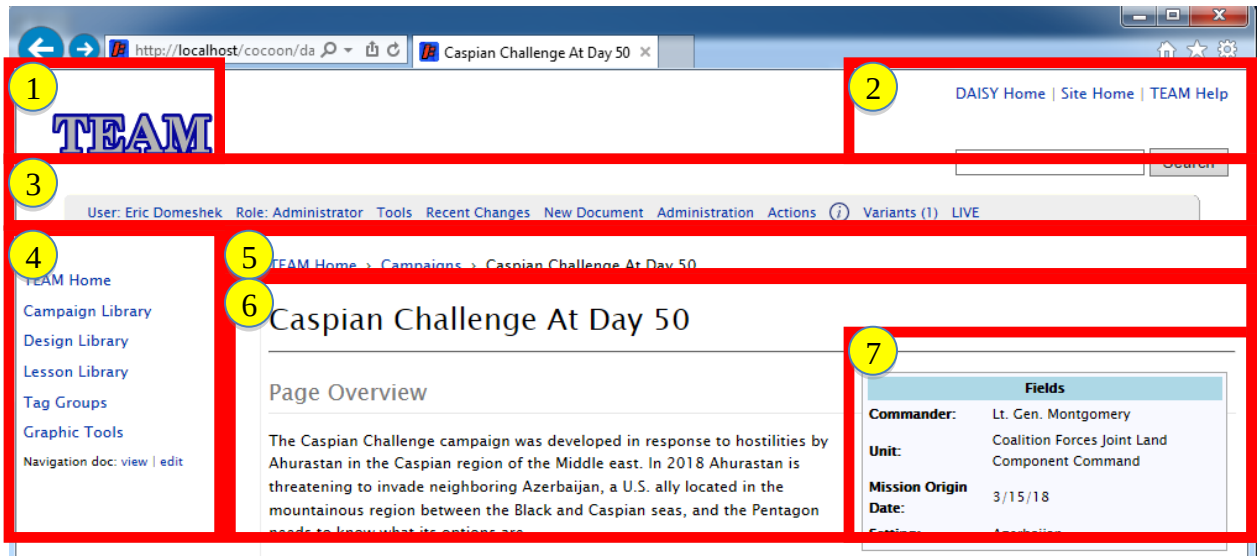


**Figure 2. TEAM Top-Level Page for a Campaign.**

**Figure 3** shows a screen shot of a Design Guidance page—the first of four major design product pages supported by TEAM. With this page, we are now within a particular iteration for the Caspian Challenge campaign design—that is, within a workspace where all data and model elements are specific to one loop around the big outer circle in **Figure 1**. This page has several custom page layout features: (1) an extended navigation bar that provides access to pages with various process-related pages, design (and planning) product pages, and index pages for model elements associated with this design iteration; (2) a custom navigation panel providing easy access to previous and next products, and previous and next iterations of the current product (Design Guidance); (3) a custom table of contents reflecting doctrinal guidance on what information should be included in the current product; and (4) an automatically generated hyperlink embedded in the page's text, discussed further below.

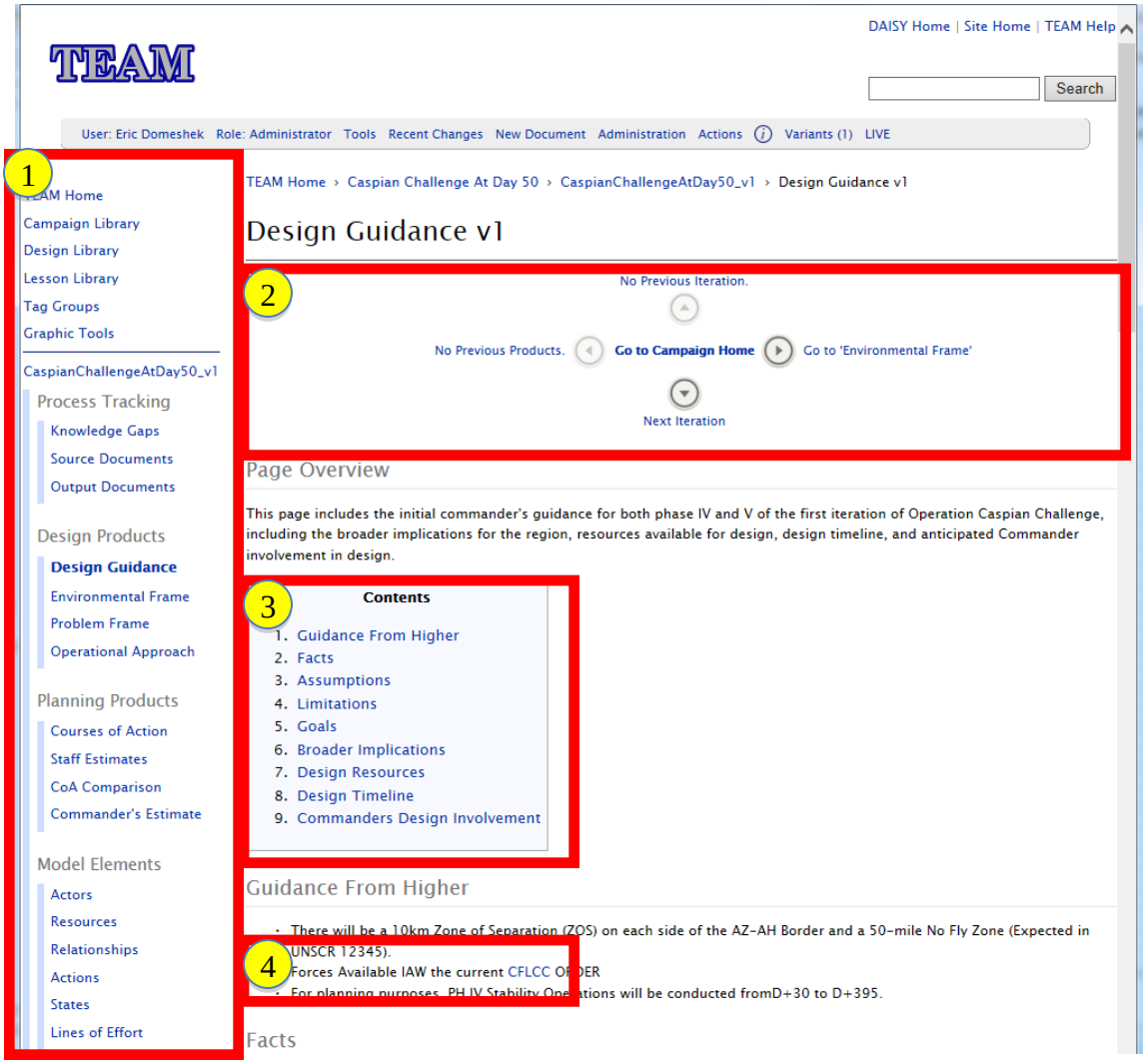


**Figure 3. First Major Design Page: Design Guidance.**

Initial hints at TEAM's richer capabilities appear in the "Process Tracking" and "Model Elements" navigation links (box 1), and the automatic hyperlink (the light-blue text "CFLCC" in box 4). Among the categories of model elements TEAM can track (in accordance with the overview in **Figure 1**) are *actors*. CFLCC is the name (actually an alias) for the Coalition Force Land Component Commander who appears as an actor in the model. All mentions of known model elements are automatically turned into hyperlinks to the corresponding elements' pages.

The "Source Documents" linked to under "Process Tracking" are all the raw research documents imported into the TEAM CMS by the design team. Each such document is stored in the Daisy CMS. Across a wide range of file formats, the text content of such files is stripped out and subjected to analysis. This enables the system's full-text search capabilities. More interestingly, it also enables automated entity extraction. Thus, when a source document is loaded into TEAM, the user is presented with lists of people, places, and organizations found in the document. If a model page already exists for that item, a link is automatically established. If not, the system makes it easy for the user to create a new page with an extracted entity's name. Such pages serve as a place for team members to accumulate source document extracts, notes, and analysis on entities of interest.

Model element pages, corresponding to the conceptual categories from **Figure 1**, are the way the team turns raw sources into the beginnings of a structured model. On model element pages, not only are mentions of other model elements automatically turned into hyperlinks to those elements pages, but also quotations from source documents are automatically turned into hyperlinks and citations to the underlying documents. Model element pages are actually composed of any number of underlying perspective-specific sub-pages. Typically members of a design team are assigned to focus on particular functional areas—perhaps PMESII systems. Thus the "economics" expert can work on an economics perspective sub-page for a particular model element while the "political" expert can work on the politics perspective sub-page. As team members work on research and fleshing out the accumulating model, TEAM provides tools to explicitly note assumptions and generate RFIs. The top of each model element page contains a table of such knowledge gaps. These gaps are aggregated and managed in the "Process Tracking"/"Knowledge Gaps" page.

Finally, remember that every model element page is also, simultaneously, a data object, and as such can contain structured data, including relationships. For instance, *actors* and *resources* are often linked to one another through *relationships*. Each actor page includes a table of such relationships down towards the bottom of the page layout. Just as the wiki includes tools to edit the text of a page, it also offers tools to edit structured data. Such data can also be manipulated from the diagram editors that provide graphical views of the data, discussed below.

### 3.3. Diagramming Features

TEAM's general infrastructure for building diagram editors that are linked to wiki pages has been used to build two main editors so far: (1) an Entity-Relationship editor, and (2) a Lines of Effort editor. **Figure 4** shows the Entity-Relationship diagram editor displaying a view focused on aspects of the political system for "Caspian Challenge." Each node and link in the diagram can correspond to a wiki-page/object. Many of the graphic display properties are tied to underlying data. For instance, node color is determined by the "Disposition" field, shown in the Properties pane at the lower left. Link thickness is determined by the user-assigned value of the "Importance" property. Edits to properties made in the diagram editor are automatically written back to the wiki page/object. New nodes and links created in the diagram editor can be linked to existing pages (or perspectives on pages) in the wiki, or can be used to create new pages/perspectives. The mouse pointer in **Figure 4**, it is over the node labeled "South Azeri People's Party." That node has a link icon in its upper left corner and a nearby tooltip noting that the node is linked to the political perspective of that group's wiki page. Clicking on the link will cause a browser page to drill down to the corresponding wiki page.

**Figure 5** shows the Lines of Effort diagram editor. As with the Entity-Relationship view, this visualization is one that is commonly used by designers and derives from recommendations in doctrine. Here, instead of *actors*, *resources*, *relationships*, and *tensions*, we are visualizing *states*, *actions*, and *LOEs*. Again, each graphical element can correspond to a wiki page/object with editable properties that control graphical attributes and affect the underlying wiki pages.

Diagrams created using TEAM's tools can serve several functions. First, they can help designers organize and think through their analysis of a situation. Second, they can be snapshotted and included in other wiki pages—usually in the major product pages. In fact, the two diagram formats were chosen because Entity-Relationship diagrams frequently provide the backbone Environmental Frames discussions and LOE diagrams are often used in presenting the Operational Approach. Third, TEAM can export these diagrams in PowerPoint format to serve

as a basis for preparing briefings. Objects in the PPT files can maintain hyperlinks into the TEAM system, facilitating live drill-down from visualization to model to sources.

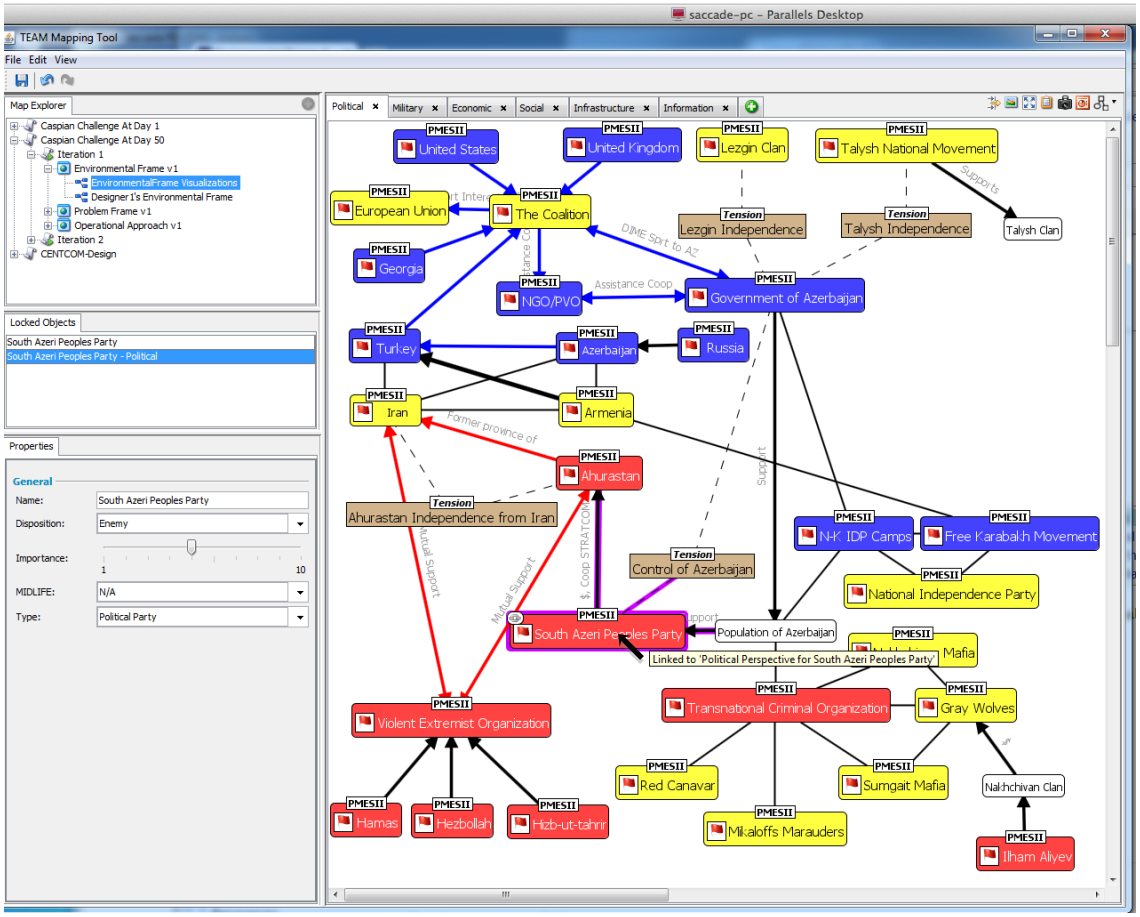


**Figure 4. TEAM's Entity-Relationship Diagram Editor.**

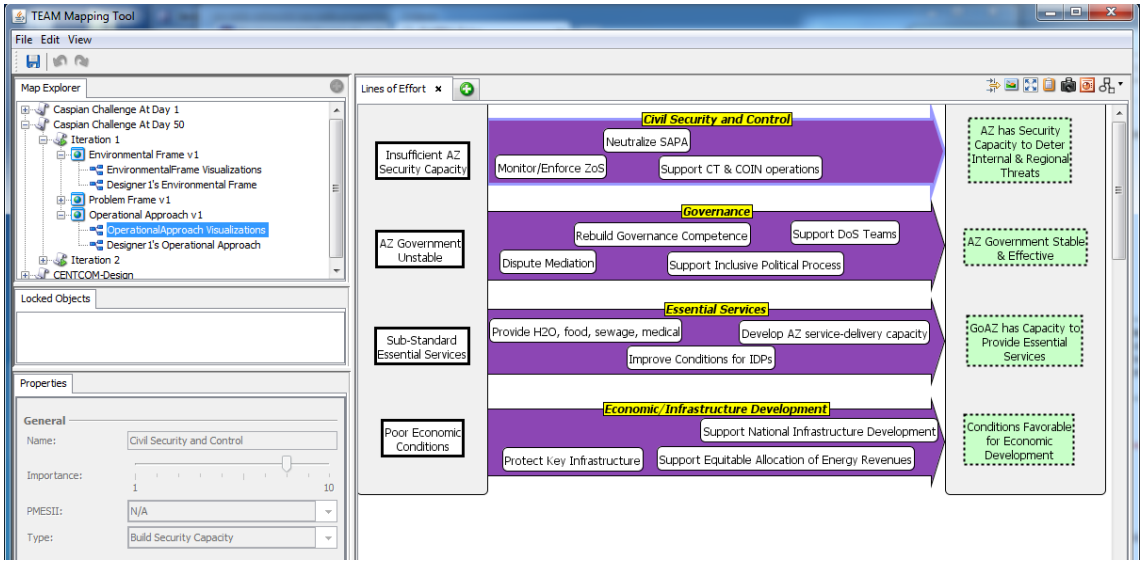


**Figure 5. TEAM's Lines of Effort Diagram Editor.**

### 3.4. Links to Planning

Though we were tasked with building tools to support design teams, the reality is that design is normally not performed in a vacuum. It has its greatest impact when supporting planning and execution. Since campaign design is a relatively new concept, and somewhat counter to dominant military culture, there is also natural resistance to new tasks and new tools for design. For both reasons, it became clear that TEAM's perceived and actual benefit would be increased by creating and demonstrating links to follow-on processes. We extended the TEAM wiki with pages/objects tied to the early steps of planning, including (1) specification of Courses of Action (CoAs), (2) development of Staff Estimates for proposed CoAs, (3) generation of an aggregate CoA Comparison, and (4) creation of the Commander's Estimate.

The extension illustrates several important points about TEAM:

- We were able to execute this extension with minimal effort due to the data modeling and code generation infrastructure we had established earlier. Four new page types required definition of four new classes to our object model and an addition to the navigation bar. As reflected in **Figure 3**'s highlighted "Contents" list, every wiki page can be structured to reflect doctrinal guidance on what information ought to be captured to complete some task or product. The four planning pages were each defined with appropriate sections.
- The information required for early planning is logically related to the information developed during design and captured in TEAM. The new "Course of Action" page type, shown in **Figure 6**, has sixteen sections. Four of them can be built up from data pulled from elsewhere. The just visible "Center of Gravity Analysis" section can auto-populate from the same required analysis on the "COA Comparison Page." The "Key Tasks" can auto-populate from the same section in the design's "Operational Approach." The "Staff Estimates" and "Evaluations" sections are both lists of links to other planning pages.
- Some useful planning visualizations specified in Army doctrine can be implemented directly in the wiki. **Figure 7** shows one of two version of a "COA Comparison" matrix implemented in TEAM and drawn from JP 5-0 (DoD, 2011).

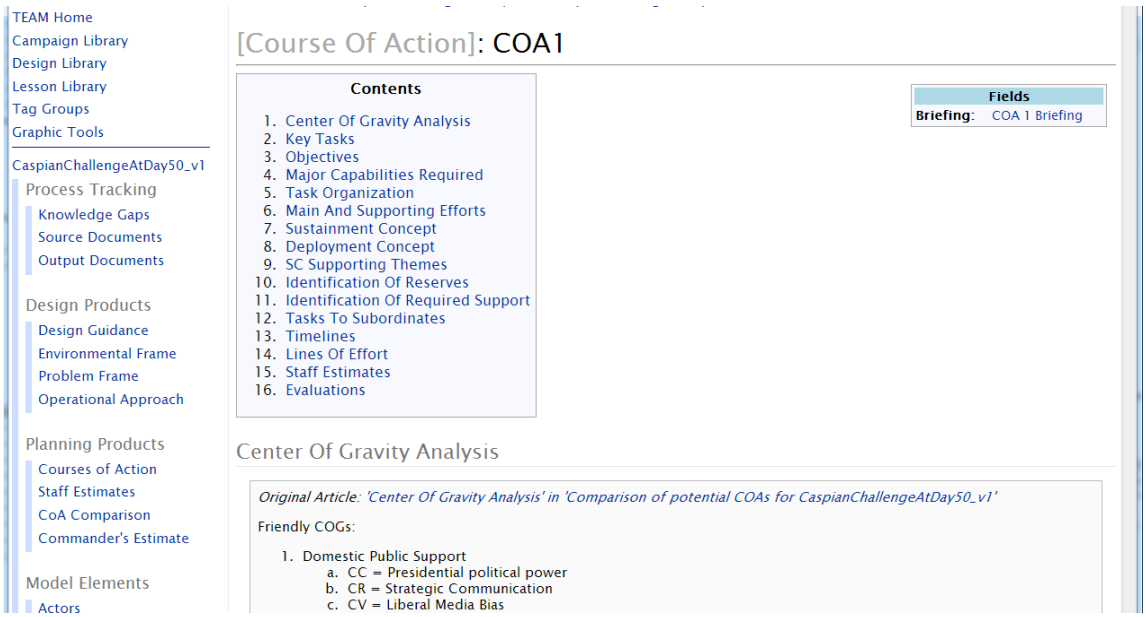


**Figure 6. Fragment from TEAM's Course of Action Page.**

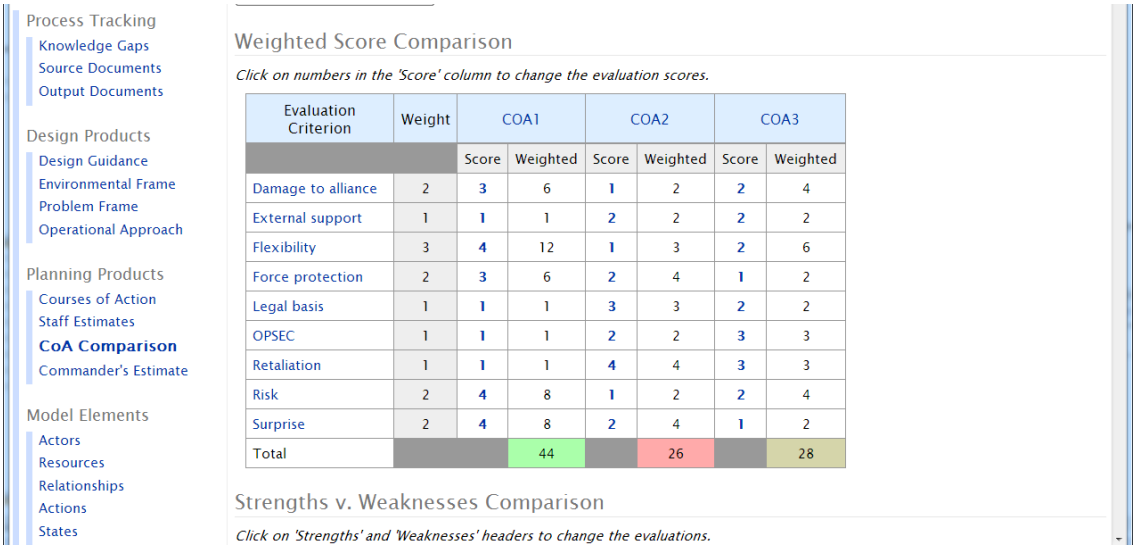


**Figure 7. Fragment from TEAM's COA Comparison Page.**

## 3.5. Lessons Learned Features

TEAM is a kind of knowledge repository. Though primarily designed to support working design teams by managing the masses of information relevant to an ongoing campaign, it also makes sense that information accumulating *across* campaigns might be useful as well. As noted, one of our proposed techniques for promoting critical and creative thinking is to provide access to lessons from previous experiences. Thus it was natural that TEAM would come to include a set of lessons-learned management features. We actually received supplementary funding from two sources to develop these features. CERDEC provided a small amount of funding to elaborate on existing features and support a pilot deployment with the Kansas National Guard Agribusiness Development Teams (ADTs). DARPA provided substantial funding to develop and integrate a new set of features focused on automated retrieval of video lessons learned.

### 3.5.1. Knowledge Management for ADTs

ADTs have played a key role in Afghanistan and other trouble spots where the U.S. has sought to promote stability by supporting agricultural and economic development. They were active in some of the most troubled Afghan provinces, bringing expertise, tools, and training to improve the agriculture and economies of rural populations. The activities undertaken by ADTs overlap substantially with those carried out by many non-governmental agencies (NGOs), but ADTs capability to operate in unsecure environments was a critical advantage. BG Eric Peck of the Kansas National Guard saw the accumulated experience from recent deployments as a rich resource to inform future ADT efforts. He also saw sharing that experience with the larger NGO community as a way to raise awareness about ADTs and facilitate future cooperation.

The materials the ADTs wanted us to manage were PowerPoint files that they referred to as "Storyboards." We adapted a faceted indexing scheme, where each facet (field of the larger index) was usually one or more terms ("tags") from a controlled hierarchical vocabulary ("tag group"). **Figure 8** shows a fragment of the ADT "Mission Type" taxonomy in TEAM's Tag Group editor (built as a web application using the Google Web Toolkit). TEAM provided a general capability for creating and editing tag groups and hierarchies of tags within groups. **Figure 9** shows a sample index for one of the ADT Storyboards. It includes the "Mission Type" field, which is shown with two tags from the corresponding tag group.

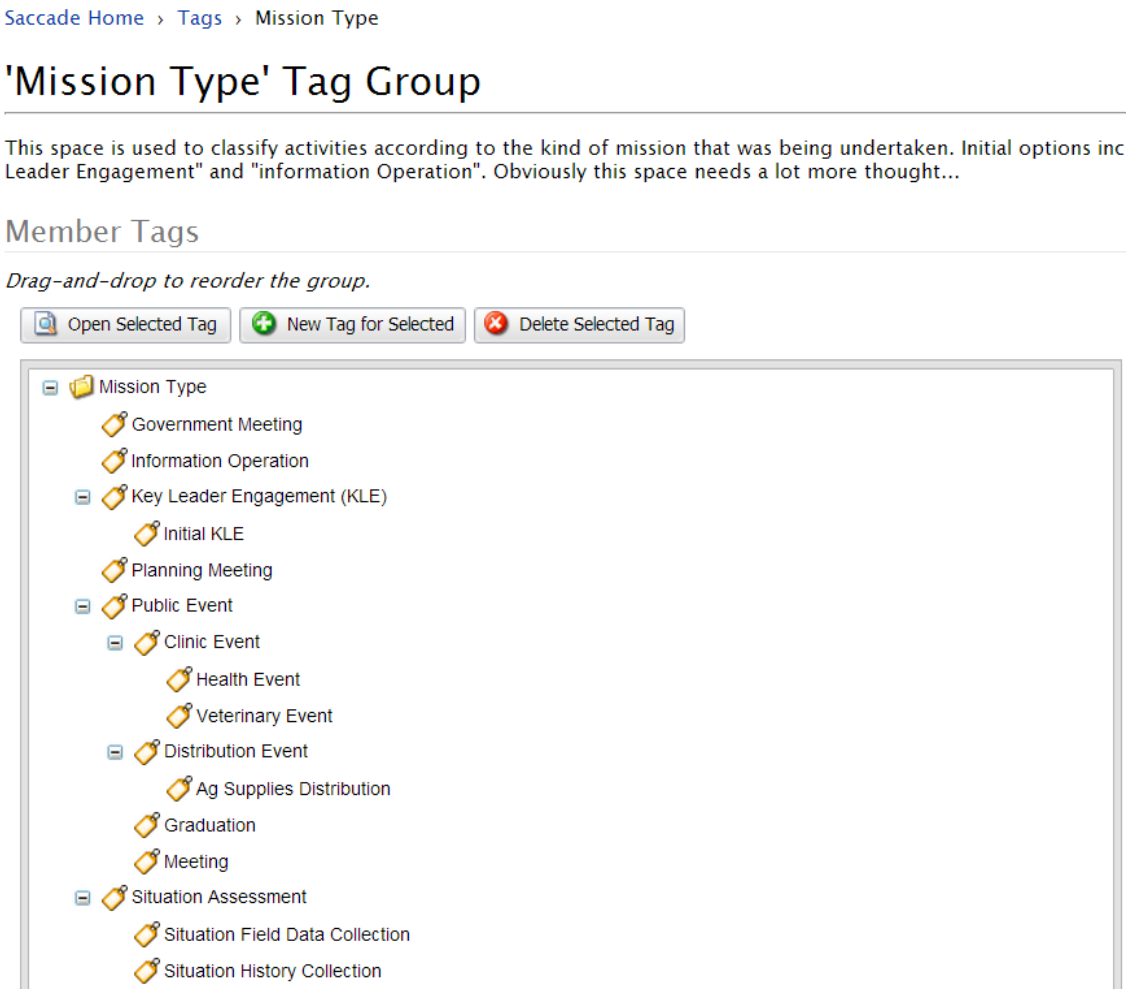


**Figure 8. Example Index Taxonomy for ADT Missions.**


**Figure 9. Sample Indexing Page for ADT Storyboards.**

### 3.5.2. Automated Retrieval of Video-Based Lessons Learned

The video-indexing extensions to TEAM were a major effort involving substantial work by Socratic Arts as a subcontractor to Stottler Henke. Socratic Arts is led by Roger Schank, one of the pioneers of artificial intelligence, and a long-time leader in semantic representations for complex stories. He is also a leading proponent of story-based learning, video-based story sharing, and semantic indexing for story retrieval. The foci of this DARPA-funded extension to TEAM included: (1) experimentation with methods for video story collection; (2) improved indexing schemes for lesson-bearing stories; (3) improved user interfaces for story-browsing; and (4) automated story retrieval based on integration with task-support tools—the TEAM design tools. The idea motivating such integration is that a story-retrieval advice-giving system should have a rich basis for understanding the user's current concerns and situation.

Here, our focus will be on discussing the integration of story retrieval with TEAM. Through a directed interview process, we collected several hundred video stories about recent experience in COIN settings, from a range of Government officials and military officers. We treated each video clip much like we did the ADT storyboards, though in this case the faceted indexing scheme was considerably more elaborate. The video indexes drew on theories of story representation and explored new tagging schemes focused on supporting cross-story linking in order to mimic naturalistic reminding and conversational flow. The most relevant point is that the conceptual schema developed for story indexing made use of the same major concepts and the same finer-grained distinctions reflected in TEAM's design-oriented data-model.

**Figure 10** is similar to the earlier **Figure 4**, however here the user has added a new tension linking Azerbaijan, Armenia, and the Free Karabakh Movement. That new tension is the currently selected node, and we can see its associated properties in the lower left pane. Most notably, it is characterized as being about **control** of **Nagorno-Karabakh**. "Control" is a tag defined in a taxonomy much like the tag groups shown earlier. Nagorno-Karabakh is a model element for this campaign. That node/page/object is tagged in its own right as a "province," which is a tag drawn from a tag group for characterizing actor types. Azerbaijan and Armenia are likewise model elements tagged as "countries." The Free Karabakh Movement is a model element tagged as a "nationalist group."

Elements selected from the overall pattern—countries and a nationalist group in conflict over control of a province—are subjected to automated partial matching against video story indexes. The pop-up dialog shown near the right edge of **Figure 10** (in response to a mouse-click on a "stories" icon, now hidden by the pop-up) shows the top three matching stories from TEAM's video clip library. These stories give an often-visceral feel for the kinds of situations that arise when nations and minority groups contend for territory in a COIN environment. For instance, the "Sunni Jailed without Due process" clip highlights problems that tend to arise in the legal system when there is strong division between the government in power and the people under the government's control; in particular, it highlights tradeoffs between maintaining security and encouraging development of a fair legal system. The "No Kurd Left Behind" clip highlights Iraqi Kurds' strong fear of genocide, and their consequent obsession with ensuring every Kurd and every Kurdish area was made safe from the dominant Iraqi groups—a background that must be understood in any attempts to deal with the Kurds and their demands. The "Golden Parachutes and War Criminals" clip discusses the possible long-term implications of letting war criminals get away with genocides versus the potential stability that may follow on achieving something like justice.

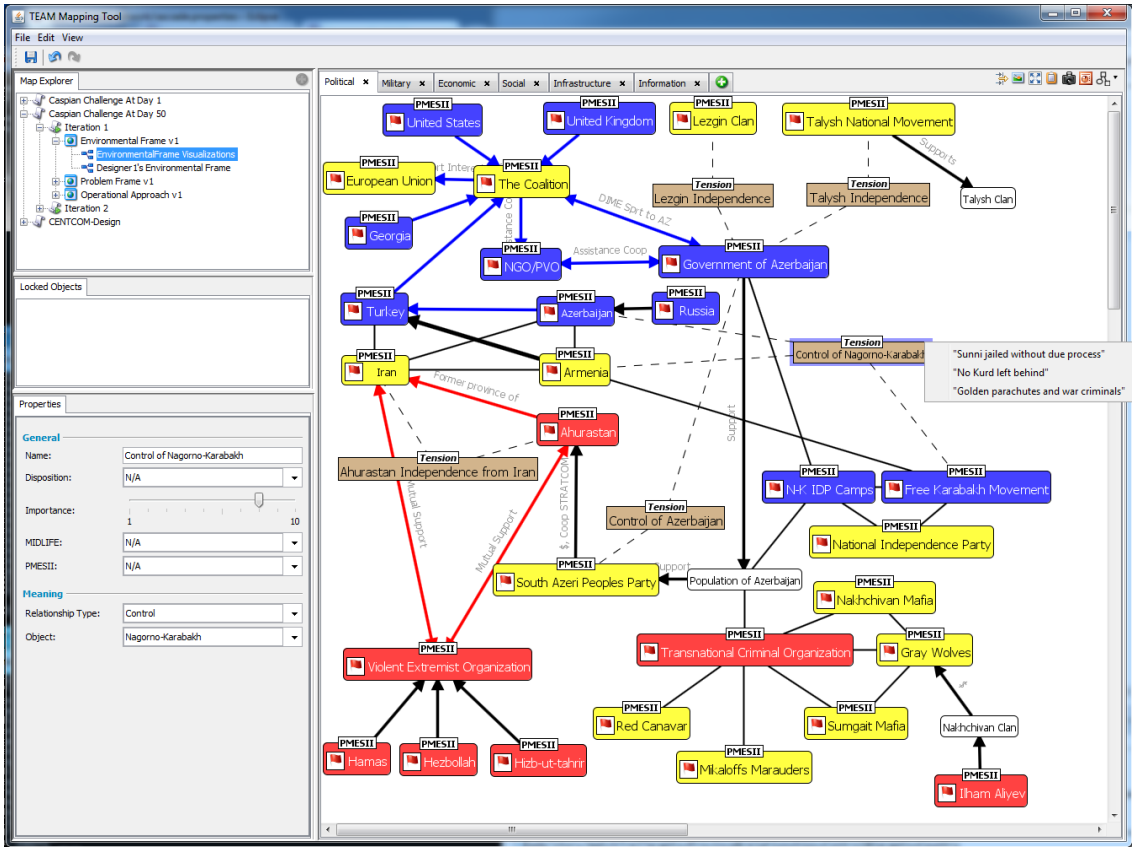


**Figure 10. Story Retrieval Based on TEAM Work-in-Progress.**

# 4. End-User Response and Future Directions

TEAM has been presented to a wide range of stakeholders interested in design. In addition to our sponsors at CERDEC and DARPA, members of the MCBL, instructors at SAMS, and our trial users, TEAM has been presented to audiences at SOUTHCOM, SOCOM, ARPAC, and JFSC. Most recently, TEAM was presented to the larger Joint planning community as part of the Joint Staff J-5 APEX Virtual Tech Demo series. Here we will focus discussion on two usage trials with two different user communities: (1) a one-week design exercise carried out at CENTCOM, and (2) a multi-month pilot of TEAM as a lessons learned repository carried out by the Kansas Army National Guard, Agribusiness Development Teams (ADTs).

## 4.1. CENTCOM Design Exercise

We supported a one-week unclassified CENTCOM design exercise studying transport in the vicinity of a foreign port city. We brought in our own network of six laptops—one of them acting as the TEAM server—and set it up in the MacDill Library. For four days, members of the team of about five designers came to the library and worked on these laptops. As an unexpected benefit, we were able to use one laptop to drive a smart whiteboard at the front of the room. It turned out that the user interface worked almost flawlessly on the whiteboard, even without a traditional mouse for input.

During their approximately three active days of work with the system, the team focused primarily on researching their Environmental Frame. They developed initial material covering 42 actors with 25 relationships. Working from open sources, they captured substantial

information on three-quarters of the 42 actors as wiki pages, generally making extensive use of the PMESII-based perspective sub-pages. They also developed four entity-relationship diagrams (3 as map overlays) and incorporated them into their draft Environmental Frame. They built a single initial LoE diagram as a start on their Operational Approach. Though we could not leave them a live repository, we were able to provide them a web page organizing all their material as a take-away.

The trial went surprisingly smoothly. All participants were excited about the capability and most asked when they could have it on SIPRNET. While there were suggestions for additional features, there were essentially no negative comments on existing features. The LTC leading the exercise was very enthusiastic and worked to promote TEAM in the CENTCOM planning organization. He arranged for his COL to view a short demonstration of the system during the exercise. Our presentation to the Joint Staff J-5 was a result of the positive reaction from the CENTCOM team.

Some of the particular values identified by the CENTCOM team included:

- Making it easier for SMEs to contribute their knowledge when and how they could;
- Reducing the impact of variability in team members schedules and lack of synchronous availability for all team members;
- Letting work proceed productively despite fluctuations in team composition, easing member swap-outs and ramp-up of inexperienced participants;
- Capturing and sharing distilled information from large resource bases, resulting in a deeper understanding;
- Not loosing information or understanding of the situation;
- Quickly gathering previous work and updating it, instead of requiring a restart from zero every time;
- Keeping assignments straight, making all members productive simultaneously, and preparing for maximum effectiveness of precious face-to-face sessions;
- Seeing important threads, opportunities, and highest payoff approaches more quickly;
- Rapidly building products from a deeper understanding to brief the bosses/commander;
- Facilitating transition of deeper understanding and operational approach to planners.

Our trial sponsor offered the following summary of the experience:

*Speaking on behalf of the planners from last week's effort, I'd like to thank you both for your time and efforts on the [TEAM] system and for your tutelage during the conduct of the test. We gained a significant amount of information and knowledge on the issue, and your prototype enabled that increase immeasurably.*

*Your system helped immeasurably in a key portion of our planning here. I thank you again for the opportunity to use your prototype.*

## 4.2. Army National Guard Knowledge Repository Pilot

We maintained a publically available TEAM server, hosted in the Amazon cloud, for over a year. During the first three months, the indexing features and terminology were still under development. The faceted indexing scheme, the tag groups, and their constituent tags were developed in consultation with subject matter experts from the ADT community. For the next four months the emphasis was on entering content—uploading and labeling sample ADT

storyboards. A member of the ADT community carried out the bulk of this work. About 200 storyboards were entered into the system. For the remaining months, the system was available for use by the ADT community and any interested members of the larger NGO community.

Feedback from the ADT team was strongly positive. The technical lead for the ADT group, responsible or entering most of the Storyboards, provided the following feedback:

> *The upload of the storyboards was seamless. You guys have done a great job getting this set up. … Again, nice job. The interface was a pleasure to use.*

The ADT project manager provided the following description and assessment:

> *I'm going to say that you are probably looking at about a dozen users that I know of but the link is on the ADT website and I can't say how many other people from outside just go in there. Among those using it have been military personnel who have trained outgoing ADTs. They went in there so that they could search for particular regions and see what sorts of activities were going on so they could build training scenarios. I know the coordinator of the ADT missions at the Guard Bureau has used it when he's gotten queries from other organizations about ADT activities. For example, USAID had recently asked about wells and so LTC [X] went in and did a search to find storyboards on wells. There are also civilian researchers who have gone into there in order to get a feel for what sort of things ADTs do on this kind of stability operation.*

### 4.3. Future Directions

It has been a long road from CERDEC's identification of a need, to our development of a deep understanding of design and associated support problems, to conceptualization of a set of responsive capabilities, to the creation of a testable prototype offering integrated versions of many of those capabilities. However, we have finally arrived at the point where initial experience suggests we can offer real support to designers.

The road from promising prototype to fielded system looks to be just as long, or longer. We face substantial hurdles of finding long term support in a time of declining funding, of satisfying all the various IT standards and certifications in a time of growing cyber insecurity, and of adding the many stakeholder-requested design-support and planning-integration features without a fielded baseline. It does not help that, with the winding down of commitments in Iraq and Afghanistan and with shifts in personnel, the impetus behind design in the DoD seems to have somewhat dissipated.

We continue to search for opportunities to apply and mature the technology described here. We were able to carry out an initial study applying TEAM to operational planning in a maritime setting. Again, TEAM's modeling approach made it relatively easy for us to extend the range of planning products with a new "LOE Breakdown" display and a set of plan-related model elements including **objectives**, **effects**, **measures of effectiveness** (MOEs), **measures of performance** (MOPs), **indicators**, **tasks**, **decision points**, **decisive points**, and **commander's critical information requirements** (CCIRs). These linked constructs provide structured documentation of the *rationale underlying planning decisions*. The idea is to forge connections between design concepts, plan rationale, and execution results so that it become easier to interpret reports from the field: *Why* was information requested? *What does it mean* in terms of success, failure, or need to reframe and re-plan? The goal remains adaptive planning, in tune with what we believe, know, and discover about the changing environment and the adapting enemy.

## 5. References

Army (2006). FM 3-24: *Counterinsurgency*. Headquarters, Department of the Army, Washington, DC, 15 Dec 2006.

Army (2009). FM 3-24.2: *Tactics in Counterinsurgency*. Headquarters, Department of the Army, Washington, DC, March 2009.

Army (2010). FM 5-0: *The Operations Process*. Headquarters, Department of the Army, Washington, DC, March 2010.

Army (2011). FM 6-0: *Mission Command*. Headquarters, Department of the Army, Washington, DC, September 2011.

DoD (2011). JP 5-0: *Joint Operational Planning*. Joint Chiefs of Staff, Washington, DC, 11 August 2011.

JWC (2010). Pamphlet 10: Design in Military Operations: A Primer for Joint Warfighters. United States Joint Forces Command, Joint Warfighting Center, 20 September, 2010.

SAMS (2010). Art of Design: Student Text, Version 2.0. U.S. Army School for Advanced Military Studies.

TRADOC (2008). TRADOC Pamphlet 525-5-500: *Commander's Appreciation and Campaign Design*. Department of the Army, Headquarters TRADOC, Fort Monroe, VA, 28 January 2008.

## 6. Acknowledgements

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