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Mashup the OODA Loop

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Abstract

This paper provides an overview of several Web 2.0 applications and how they can be constructed via mashups to augment current Army Command and Control (C2) processes via the Observe, Orient, Decide, and Act (OODA) Loop concept. As defined by Wikipedia, a mashup is a Website or application that combines the content from more than one source into an integrated presentation. The benefits include (1) faster correlation of current data, (2) an ability to obtain previously unavailable data, and (3) an authoring environment that encourages end users (soldiers) to develop and share applications without having to wait during the traditional lengthy software development cycle.

Keywords: C2, Command and Control, Mashups, Web 2.0

Table of Contents

List of Figures

1 Introduction

This paper provides an overview of several Web 2.0 applications and how they can be constructed via mashups, defined in Section 2, to augment current Army Command and Control (C2) processes. The Observe, Orient, Decide, and Act (OODA) Loop will be de-constructed to highlight sections where Web 2.0 applications could increase the situational understanding of military commanders. The applications reviewed in this paper include Yahoo Pipes, Openkapow Robots, Flickr, and YouTube. The paper will also present use cases on how Web 2.0 technology can support the OODA Loop process for the United States (U.S.) Army.

The US Army (and by extension the US government) have created numerous stand-alone information systems that by definition hinder the sharing of information. In response, the Army has implemented expensive and lengthy programs designed to provide a Common Operating Picture (COP) or the more recent moniker User Defined Operating Picture (UDOP). These programs typically follow a traditional software development process of a lengthy requirements collection cycle followed by an even more lengthy development cycle. Web 2.0 tools offer the opportunity to break this traditional software development paradigm. The true power of Web 2.0 applications lie in the ability to share information between separate applications and the even more powerful ability of end-users to define their own set of desired information in a quick and timely manner. The most prevalent critique of the current software development process is that it takes too long and is too expensive.[1] The community aspect of Web 2.0 applications allows end users (e.g. Warfighters) to act quickly on their own requirements and ideas and allows them the ability to (1) create their own applications specifically designed to meet their needs, (2) modify applications that other soldiers have created, and (3) publish their applications to a library so other soldiers can use/modify them.

This paper does not propose that Web 2.0 technologies should replace the structured software development process or the existing military C2 systems; however, it does propose to extend the current C2 infrastructure with Web 2.0 technology to provide the user (soldier) with benefits observed on the public Internet and World Wide Web. The augmented infrastructure would include data repositories for image and video files (e.g., Flickr and YouTube) and information-sharing capabilities offered through tools such as mashups.

This paper focuses on the use of the OODA loop at the tactical level only. The utility of mashups at the operational and strategic level is a topic for another effort.

The biggest challenge organizations face when implementing a Web 2.0/mashup approach will not be the technology, but instead will be the culture of the organization. Organizations that foster risk taking and innovation will thrive in this new type of environment; however,

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[1] Charette, Why Software Fails, IEEE Article, http://www.spectrum.ieee.org/sep05/1685, Accessed 3 Mar 2008

organizations that are too staid in their processes will have a difficult time embracing this new development methodology.

This document contains the following sections:

Section 1: Provides the introduction to this document.

Section 2: Describes the Web 2.0 concept.

Section 3: Describes the OODA Loop.

Section 4: Discusses potential Army missions that could be enhanced by using Web 2.0 technology.

Section 5: Provides conclusions.

2 Web 2.0

2.1 Web 2.0 Description

Web 2.0 provides a new way for users to interact with and through the Internet. O'Reilly Media defined the phrase in 2004 to refer to a perceived second generation of web-based services such as social networking sites, wikis, communication tools, etc that emphasize online collaboration and sharing among users. Web 2.0 defines a new way for users to interact with the Web versus a new version of technical standards. Web 2.0 has also been defined as the transition of web sites from isolated information to sources of content and functionality.

Web 2.0 allows users to communicate with the data stored on servers and is typically performed via forms in a HyperText Markup Language (HTML) page, a scripting language such as JavaScript, or through Flash, Silverlight or Java applications. These methods use the client's computer to reduce server workloads and increase the responsiveness of the application.

2.2 Mashups

The term *mashup* was borrowed from the pop music scene. In the music business, a *mashup* describes a new song that is mixed from the vocal and instrumental tracks from two different songs (usually belonging to different genres). Like these "DNA-combined" songs, a Web mashup is an unusual or innovative composition of content often from unrelated data sources (e.g., video and text).

A mashup application has three components: the content/information provider(s), the mashup site, and the client's Web browser. These components are logically and physically disjoint and are likely separated by both network and organizational boundaries. The information content being "mashed" originates from the content providers and these providers are frequently unwitting of how their information is being used downstream. The mashup may or may not be executed where the mashup site is located as mashups can be implemented via traditional Web applications using server-side dynamic content-generation technologies like Java servlets, Common Gateway Interfaces, Hypertext Preprocessor, or Active Server Pages. The client's Web browser provides the user interaction and the rendering of the application and data.

2.3 Web 2.0 Applications

Mashup applications have been released by some of the leading companies in the information industry, such as Google, Yahoo, IBM, and Microsoft, along with some smaller niche players such as Kapow Technologies. A significant attribute of this type of development effort is the ability for the mass of Internet users that lack programming experience to contribute to the thousands of freely available mashups. This section describes four Web 2.0 applications: Yahoo Pipes, Open Kapow, Flickr, and YouTube.

2.3.1 Yahoo Pipes

Yahoo Pipes is a free online service that allows people without programming experience to remix popular streams of content types (e.g., Really Simple Syndication [RSS]) and create data mashups using a visual drag-and-drop editor. Yahoo Pipes also provides a library of pipes (currently numbering in the thousands) enabling users to copy, re-use, and modify pipes for their own design. Yahoo Pipes can provide a more focused set of news feeds than a traditional feed aggregator offered by sites like My Yahoo. The My Yahoo site allows the user to select news from a pre-designed set menu, whereas Yahoo Pipes allows the user to design the specific view with only the data sources and information of interest at the moment regardless of any pre-design by the content owner. Pipes also allows the analysis of data feeds that were previously inaccessible due to conditions such as high volume of data (too much to sift through) or foreign language constraints (information was not understandable). Another unique attribute of Pipes is the ability for a Web publisher to include RSS feeds on its pages without the need of specific pre- configured server-side software. Alex Iskold compares the power of Pipes to the revolution started by *relational databases*. He claims Yahoo Pipes is "the first GUI builder for the biggest database in the world – the web itself." [2]

The screen displayed in Figure 1 is an example of a Yahoo Pipe. This pipe allows the user to enter a place type (e.g., "Market Square"), a zip code (or location), a description of a photograph (e.g., "white van"), and a specified radius from the desired location. This information is filtered through a Yahoo Local Search and returns a list of pictures that meet these criteria. As a specific example, it can return pictures of trees in parks within a user-defined distance of a certain address. In addition, this pipe could return a picture of anyone named "Michael" or a "white van" that happened to be near the Baghdad Market Square.

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[2] Iskold, Alex, Yahoo Pipes and the Web as a Database, ReadWriteWeb.com, http://www.readwriteweb.com/archives/yahoo_pipes_web_database.php, accessed 1 Mar 08

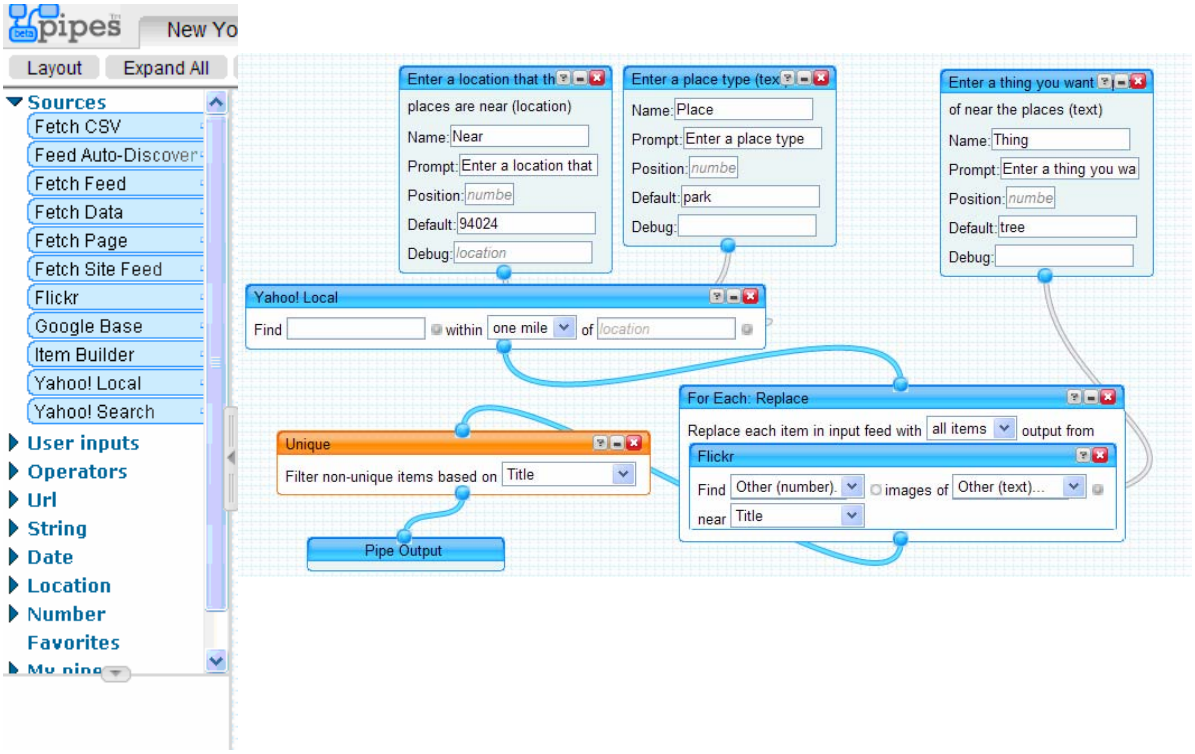

Figure 1 – Find Items Near Locations Pipe

2.3.2 Kapow Technology

Kapow Technology provides tools that enable users to access the extremely large amount of information on the network (Internet or intranet) that is not readily accessible by a defined Application Programming Interface (API). An API is the traditional method used to access information from a different system where the owner of the system defines which data is accessible to outside applications and in what format.

According to SOA (Service Oriented Architecture) World:[3]

> "In the increasingly competitive global economic environment, companies are driven to optimize every possible part of their businesses, which often requires ad-hoc access to data hidden inside Intranet and Internet applications to create business "mashups" or dashboards for optimal decision making. But today, approximately 99% of the content, data, and business logic are out of reach for most web application development and integration projects."

[3] The Kapow Mashup Server Powers Enterprise Mashups of Internet Data and the World Wide Web, SOA (Service Oriented Architecture) Magazine Article, 26 Feb 07, http://soa.sys-con.com/read/336818.htm

There are currently more than 150 million Web sites available on the Internet; however, only about 542 of them have published APIs.[4] The Kapow Technology tools allow users much greater access to this "hidden" data by enabling API-based access to a wide variety of structured data like databases and unstructured data such as video and text. The Portal Content Edition of Kapow provides a point-and-click interface to clip or scrape Web content and can incorporate the login and security mechanism resident on many sites. The Kapow server is a Java-based application that supports all leading operating systems, databases, data exchange formats, and Internet Protocols.

The output from the Kapow tools can be used directly by the consumer or as input to other tools such as Yahoo Pipes.

2.3.3 Flickr

Flickr allows users to search through pictorial databases maintained on Flickr servers by retrieving pictures marked with meta-tags. Flickr provides a significant mashup opportunity as it provides an API that enables other programs to access tags, photos, user names, and contacts Third party developers have written wrappers for the Flickr API that make it usable within other programming environments such as Flash, PHP, Python, Java, Perl, and Ruby.

2.3.4 YouTube

YouTube is a video-sharing site that allows users to upload videos to the YouTube server and make them "findable" by others by adding descriptions (tags) to the videos. The site contains a wide variety of different video styles such as movie and TV clips, music videos, video-blogging, etc. Users can post videos in a number of different formats: WMV, AVI, MOV and MPEG. The YouTube site translates the file into the Flash Video (FLV) format. This format is very useful because of its compatibility with most web browsers which enables users to provide a link to a video or embed it within another web page because each video is accompanied by the full HTML markup. This allows the video to autoplay within the web browser.

2.4 Use of Mashups in Real World Events

The technology to support mashup development has been available for several years. The scope of this paper prevents a thorough discussion of the numerous successful mashup efforts; however, one in particular is worth noting. This application was developed by a small public radio station in response to the need to provide critical information to the public during the large San Diego fires in late 2007.[5] The success of the project relied on using

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[4] *January 2008 Web Server Survey*, http://news.netcraft.com/archives/web_server_survey.html, accessed 5 February 2008.

[5] *How a small Public TV/Radio Station served it's public*, Robert Paterson's Web Blog, http://smartpei.typepad.com/robert_patersons_weblog/2008/02/kpbs---how-a-sm.html, accessed 7 February 2008.

Web 2.0 technology, but was only enabled because of the culture driven by the station's general manager who was "very supportive of granting autonomy". The culture driven by the general manager prepared the workers to act on their own initiative and to act fast. Before the fire, the radio station's Web site maintained a typical set of news stories; however, as the fire situation turned into a crisis, the Web site response was greatly slowed by the increase in traffic. The Web master decided to strip everything not directly related to the fire off of the site. The revised site carried only the fire headlines and a link to a Google map. This application allowed anyone to post pictures and text of their observations of the fire. It became a "living map" (reference Figure 2) and provided a much better understanding of the crisis than what the government officials were able to present.

Figure 2 - San Diego Fire Google Map Mashup

This new communications path became the station's only voice to its audience when the power to its transmission tower was destroyed by the fire.

This application was successful primarily because the General Manager recognized the impossibility of controlling (both in acquiring and disseminating) the myriad of information reports. Had the manager relied only on "official sources" to report the status of the fires, the station's customers would have had less understanding of the location and intensity of the various fires, escape routes, emergency services, etc.

3 OODA Loop

3.1 Background

Colonel John Boyd was one of the foremost military thinkers in the 20th century. His aviation theories significantly influenced the design of several U.S. aircraft designs in the 1970's and 1980's[6]. However, he is best known for the development of the OODA Loop. As defined by Col Boyd, the OODA Loop provides a construct for the military decision-making process. The OODA Loop concept has been used by numerous organizations, both in the military and in the business world, as a model for making decisions.

Most People that are familiar with the OODA Loop do not realize they are using a greatly simplified version (see Figure 3). In fact, according to Chet Richards[7], this version of the OODA Loop was never presented in any of Boyd's numerous briefings of his seminal work, and the simplified version does not capture the various decision making intricacies that Boyd knew to be present in complex environments.

Richards expounds that while this simplified version may be applicable to engineering-type applications, it does not work well in conflict scenarios since the simplified process is sequential, slow, and easy to disrupt. In addition there are definite quality and quickness tradeoffs. However, the most serious shortfall is the lack of a smart, adaptive adversary.

The expanded version of the OODA Loop (see Figure 4) was the actual one used in Boyd's briefings.[8]

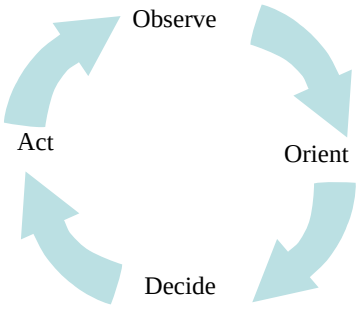
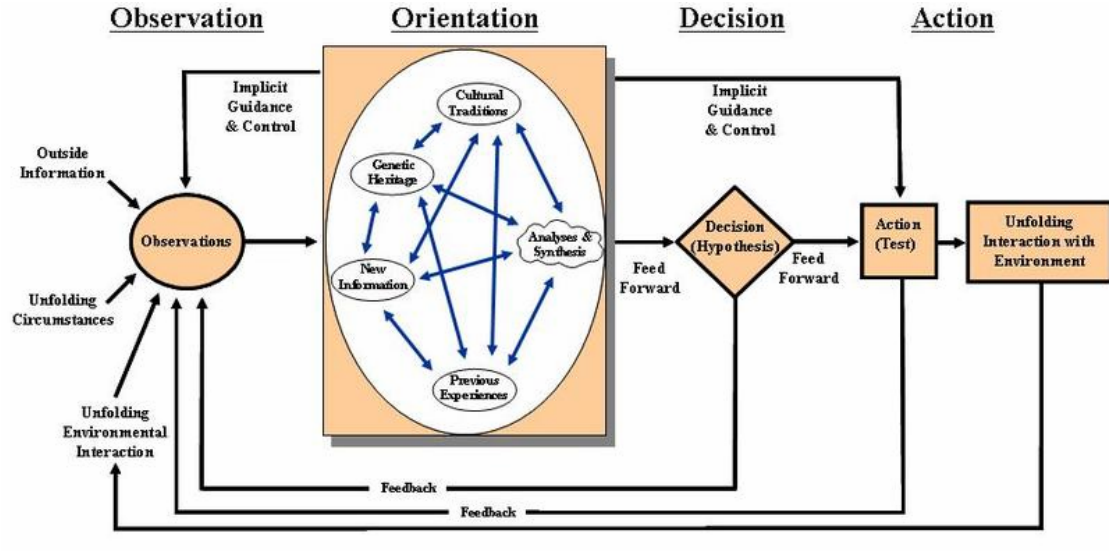


Figure 3 - OODA Loop (Simplified Version)

[6] Richards, Certain to Win, Xlibris Cooperation, June 2004

[7] Chet Richards was a close associate of the late U.S. Air Force Colonel John R. Boyd from the mid-1970s until Boyd's death in 1997. Boyd had asked him to review the mathematical portions of his first civilian paper, *Destruction and Creation*, and this led to a collaboration that eventually included applications to the business world.

[8] Richards, Certain to Win, Xlibris Cooperation, June 2004



Note how orientation shapes observation, shapes decision, shapes action, and in turn is shaped by the feedback and other phenomena coming into our sensing or observing window.

Also note how the entire "loop" (not just orientation) is an ongoing many-sided implicit cross-referencing process of projection, empathy, correlation, and rejection.

Figure 4 - Expanded OODA Loop

3.2 Speeding up the OODA Loop

The *complete* OODA loop provides a more intuitive and accurate model of the myriad of interactions and feedback mechanisms that are part of a complex decision making process. For many years, the military has focused on "speeding up the OODA Loop" to get inside the enemy's decision-making process. Richards provides insight in to how this technique of increasing the speed works within the OODA loop concept. According to Richards, "If action is flowing smoothly and (nearly) instantaneously from **orientation** [emphasis added], as it should the vast majority of the time, then the speed that counts is the speed to reorient in response to changing external and internal conditions. There is no case where slower is better."[9] By quckly constructing new data conglomerations or views, the mashup concept can be used to greatly increase the efficiency of the *orient* phase of the OODA loop.

The United States is currently fighting numerous large-scale counterinsurgency efforts. History has shown that counterinsurgencies can last 10-30 years. Given that, "the focus should not be on the speed of the decision, but on a current understanding of the situation.

[9] Ibid

Consequently, the 'Observation and Orient' become the critical element of the OODA Loop".[10]

The ability of analysts to construct new data conglomerations quickly using mashup tools means they will be able to adapt to the changing environment rapidly. Mashups will allow soldiers the ability to quickly *reorient* to the changing conditions on the battlefield. This reorientation is in marked contrast to the current development methodology that requires lengthy requirements determination and an even longer development process.

The applications described in this paper offer unique capabilities to increase the speed of the OODA loop processes, but it is the soldier-driven development of mashups that can be created to meet each unique environmental challenge and the ability to share and collaborate in the development of these mashups that offer the most powerful results. An infrastructure delivering the Web 2.0 technologies discussed earlier will enable soldiers to rapidly create and recreate new ways to sort, filter, process, and display all sorts of Web-based information such as patrol pictures/video, SIGACTS (Significant Activities), video, order updates, etc.

The strength of the Web 2.0 application resides in filtering and combining large data sources. Mashups enable the user to extract and present specific information of interest in near real time. Some of these information mosaics may be constructed today by traditional analysis tools, but they might take too long to be of tactical use. Bad things happen when we lose the battle initiative. In other words, if it takes us 24 hours to plan an operation and only 4 hours for the enemy to adapt to it, then **we are losing the initiative**. There are three specific areas in which Web 2.0 applications and mashups offer significant value to the speeding up the OODA Loop process. These are:

1. Web 2.0 and mashups can provide additional pieces of the intelligence puzzle by obtaining information and data from sources that were previously unavailable or difficult to gather and keep refreshed. In addition, the mashup concept will make it easier to access new systems and databases as they are brought on line since this approach is easier, faster, and cheaper than the traditional API development.
2. Web 2.0 and mashups can provide a faster collection of data and resulting correlation of information than the legacy systems offer. This provides for a faster OODA Loop and an increased overall battle rhythm. This increased battle rhythm results in more concurrent operations or operations that can be planned (and executed) faster than current systems allow.
3. Mashup tools are targeted to the end-user, not the developer, which allows actual Army soldiers (Knowledge Managers, Staff Planners, Intelligence Analysts, Battle Captains, etc.) to create their own mini-applications (tailored combinations of soldier-specific data feeds in a consistent presentation format) and not wait in the traditional software development queue for future additions or new system integration.

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[10] Hammes, Thomas, *The Sling and the Stone*, Zenith Press, 2006.

4 Potential Army Missions Enhanced by using Web 2.0 Technology

The mission vignettes described below assume that the Army has embraced Web 2.0 technology and has adopted capabilities such as providing digital cameras to patrols, installing a series of video and still cameras around combat zones, and implementing a Flickr and YouTube-like database of image and video files. One topic not covered in this paper is a "quick and painless" method to provide annotations describing the various files. Initial investigation into the time required to conduct after-action annotation indicates a minimal impact to the troops during their normal de-briefing process; however, additional research is required in this area. In addition, there is work being done to explore the use of software to provide an automated annotation process by being able to distinguish between such things as a white van and a blue sedan.[11]

4.1 IED (Improvised Explosive Device) Forensic Analysis

A car bomb explodes in a market square. Eyewitness reports indicate it was a white van. In minutes, the military intelligence analyst can construct a Yahoo Pipe that searches through all pictures of "white vans" at key intersections within a ten-mile radius of the explosion. This information can be used to help trace back to the location of the garage where the van originated and where the bomb was potentially constructed. This vignette will work best in environments where there are numerous automatic camera/video sensors along key roads and where the Army has set up a commercial Web site encouraging soldiers and Iraqis to post (and tag) their pictures. Another key source of information could be obtained by providing mashups into the repository of UAV (Unmanned Aero Vehicle) provided imagery/video with time and location metadata.

A sample of what this type of pipe would look like and the resulting information generated from it is described in Figures 5 and 6.

[11] *Combat Zones that See*, Sarnoff Technology Briefing.

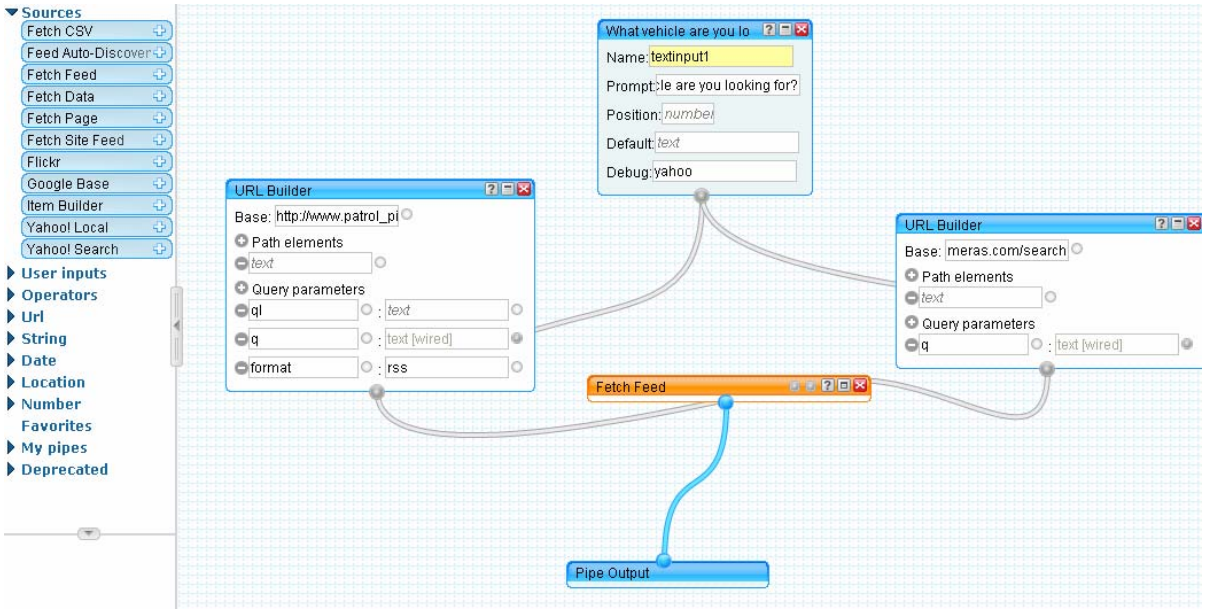

Figure 5 - IED Forensics Pipe (Notional)

Figure 6 - Notional Results for IED Forensics Pipe

4.2 Convoy Route Planning

A food and fuel resupply convoy is formed at U.S. Base 1 and travels to U.S. Base 2. To determine the safest route, the convoy planner checks recent mashups on the Army's convoy-planning Web site. The planner sees one that was developed during the previous week by another convoy planner that used related inputs. The planner quickly clones the Pipe to their desktop and makes some minor adjustments. In just a few minutes, the revised Pipe is up and running. The new Pipe combines multiple local newspaper feeds and video reports from convoys earlier in the day to identify potential traffic bottlenecks due to construction activities, cultural norms, activities (e.g., Thursday is "wedding day"), sporting events, etc. In addition, the results can be combed for possible routes of approach, escape, and obvious ambush sites. This technique can also be used to look for current road conditions (visibility, slickness, accidents, etc.). The route information is then submitted to the army convoy planning process.

5 Conclusions

The world is awash in data. Based on a report by Peter Lyman from the University of California at Berkley, the world produced about five exabytes[12] of new information produced in 2002.[13] The author believes that figure grows by approximately 30% per year. The military user is either overwhelmed with data from numerous sources or frustrated by the inability to obtain data easily from stove-piped systems. The total amount of data collected during a year is staggering (and growing). One report cited at least 50% of the information we currently collect goes unprocessed. We need a better infrastructure and better tools to process/analyze the data we already have. As stated in a recent Rand report: [14]

> In an age of abundant, almost limitless, information and communications capabilities, decision makers are increasingly faced with the problem of too much information, rather than too little. In today's information-oriented society, winnowing, filtering, correlating, and fusing information have become as important as acquiring the information, or (regrettably) even as important as its content, if not more so.

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[12] That's a 5 followed by 18 zeroes

[13] Lyman, Peter, How Much Information, 2003, School of Information Management and Systems, University of Southern California, Berkley, http://www2.sims.berkeley.edu/research/projects/how-much-info-2003/

[14] Builder, Banks, Nordin, Command Concepts: A Theory Derived from the Practice of Command and Control, Rand Publication, 1999

Combining the capability of various Web 2.0 applications via mashups in a well-connected operational environment appears to have much to offer to help tackle this problem. These mashups offer flexible soldier-driven tools designed to enable better searching and manipulating of the mountain of data resident in military systems. The use of a visual drag-and-drop development environment, such as provided by Yahoo Pipes, empowers non-programmers to create their own applications specifically designed to handle local problems.

One common truth echoed from users all over the world about software development is that it takes too long and is too expensive for feature enhancement or new system integration. The community aspect of Web 2.0 applications enables regular users (e.g., soldiers) to quickly act on their own ideas and allows them the ability to (1) create their own mashups specifically designed to meet their needs, (2) modify mashups other soldiers have created, and (3) publish their mashups so other soldiers can use them.

The mashup concept aligns with the U.S. military's desire to push decision-making power down to the lowest possible level. By providing a Web 2.0 technology environment, the Army will provide a controllable methodology that allows individual soldiers (Knowledge Managers, Staff Planners, Intelligence Analysts, Battle Captains, etc.) to design and develop their own analysis and processing tools. This approach will increase the rate at which we can adapt to changing environments.

A comment from a fellow MITRE analyst summarizes the mashup concept. [15]

> "The entire concept of operations for how services are built shifts from a 'pass-requirements-to-techies-and-wait-for-the-next-development-cycle' approach to a 'mash-it-up-right-now-and keep-it-if-it-works' approach and that approach only works if there is a community of users posting mashups, using mashups, modifying mashups and tagging useful mashups."

As with most progress in military development, it is not just the application of pure technology that solves problems. Instead it is the underlying culture of the organization itself that promotes change and risk taking by using new tools and doing old things in new ways to advance the state of the art of war and command.

[15] Telephone conversation with Jacob Heim, June 2007.

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