Web 2.0 and Warfighter Training

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ABSTRACT: *Web 2.0 services refer to web-based applications that allow a user to create and publish their own unique content. They also include services that allow mass collaboration among self-organized communities. Tim O'Reilly defines Web 2.0 as any set of tools that are able to harness the collective intelligence of groups of people and put that to work toward a shared goal. These services focus on distributed collaboration, information sharing, interoperability, and information reuse – many of the same issues that military simulation projects face.*

Simulation-based training has always wrestled with issues in user interfaces, collaboration, networking, standardization, and interoperability. These problems have often been more advanced than those faced in the business IT and C4I communities. As a result we have developed a culture in which we develop our own software, hardware, and networking solutions. However, recent advances in fields like computer gaming and business IT have shown that commercial technologies can become the basis for simulation systems. Over the last two years consumer IT applications have emerged that may have useful application in distributed simulation. Social networks, wikis, blogs, web page tagging, photo and video sharing, and tools for personal 3D game development have all attracted significant attention in the commercial world by bringing distributed processing technologies to the mass consumer.

Web 2.0 companies are creating tools which answer important problems around distributed, interoperable, interactive, user centered experiences. This paper identifies many of these applications, defines useful categories for understanding them, and illustrates valuable applications in simulation and training. Just as computer games brought powerful commercial technologies to military training, Web 2.0 applications have similar potential which is not yet generally recognized. The goal of this paper is to begin a dialog on the useful application of these technologies within the interactive simulation community.

1. Introducing Web 2.0

The World Wide Web has gone through a number of significant growth stages since its popularization and public access to HTML documents via the original Mosaic browser. Most recently, the Web has become a much more participative medium. Instead of one party publishing information for the masses to read, the web has become more of a two-way exchange of information that allows all participants to create and publish personalized forms of information. This new shared, social, participative, two-way medium is generally referred to as "Web 2.0". There is currently no single agreed upon definition for Web 2.0, nor is there a clear boundary between what is considered 2.0 and what is 1.0 or 1.5. Several descriptions have been put forward.

> "Web 2.0 is the business revolution in the computer industry caused by the move to the internet as platform, and an attempt to understand the rules for success on that new platform. Chief among those rules

is this: Build applications that harness network effects to get more people use them." [1]

"harnessing collective intelligence" [2]

"Web 2.0 is participatory, collaborative, inclusive, creator/user-centric, unsettled, and very information-intensive." [3]

"weapons of mass collaboration" [4]

"participatory web", Bart Decrem on Wikipedia

All of these emphasize the collaborative and shared nature of Web 2.0 applications. Web Logs, more commonly known as *Blogs*, allow anyone to create an online diary, newspaper, gossip sheet, weather station, radio station, community bulletin board, or a number of other shared publishing services. Blogs introduced web pages that could be edited, updated, and modified constantly. They also allow readers to contribute their ideas, knowledge, and perspectives on the original posting. They begin a dynamic, two-way conversation on the web. They were

presaged by bulletin boards, chat rooms, and list servers, but offered a degree of openness to the world and ease of use that led to their explosive adoption across the net. *Wiki's* take this openness one step further. Each posting or page does not have to originate from a site owner and is not necessarily controlled by a single author. Instead it levels the playing field, making all authors equal. Wikipedia has become the most widely recognized and widely used wiki with over nine million collaboratively created articles in 253 languages.

An exhaustive list of Web 2.0 applications is impossible. But at a Web 2.0 conference sponsored by O'Reilly Publishing, participants attempted to distill the core attributes of these services (Figure 1). A number of these services will be used in this paper as examples of powerful tools for military training and simulation. This paper does not attempt to define each of the services. For a complete understanding of each, see the references or visit the web site for the service and experience it first hand. Nearly all of them are open to the public and invite your participation free of charge. Also, in the world of search engines, there is no need for any author to provide explicit instructions for locating these services. Every reader can simply ask a search engine for directions to these services and receive reliable directions to the correct location.
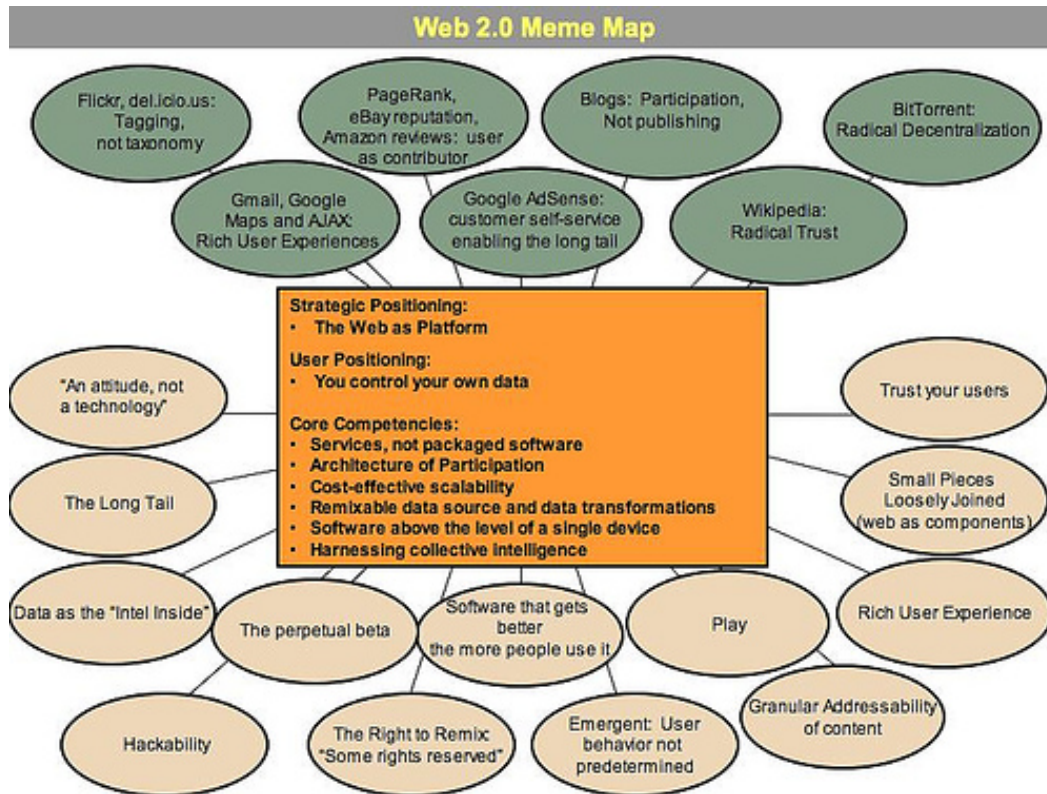

Figure 1. An attempt to define Web 2.0 through examples and big ideas that emerged from an O'Reilly Web 2.0 conference. [2]

Web 2.0 applications have been experimented with and adopted to some degree by one of the largest technology companies in the world, IBM. As they have used these, company leaders have come to an understanding of their power and their independence. One author from IBM maintains that, "This is not something you can force. By its very nature, social media are organic, bottom-driven and democratic. The users decide what technologies they want to use and how they want to use them. You must always remember – and respect – the fact that social media are social" [5].

Each application of Web 2.0 or social media also requires that sufficient numbers of people gravitate toward and contribute to the project. Henry Chesbrough has noticed that, "Open-oriented projects must compete for contributors – and most do not succeed in this competition. … On Source Forge, for example, one can find tens of thousands of projects that intend to use an open source method for software development. A casual visit to the site, however, reveals that a few dozen at most have received any significant support from individual software contributors" [6]. By their very nature some or

many of these services will fail due to lack of interest and a shortage of contributed labor.

The power of these technologies lies in their ability to attract and support a community of interested users, and to transform themselves into a toolset that can empower communities to accomplish shared goals. Established commercial, government, and social organizations rely on both a command and control and a financial incentive model to accomplish their goals. Social media rely much more on the personal interests of the individual participants.

In this paper we will begin a discussion on how Web 2.0 or social media can be applied to the organization, creation, and execution of military training events. To our knowledge, such a discussion has not been undertaken before, so many of the ideas presented are nascent and are backed by few working applications or experiments. However, simulation-based training is social, interactive, adaptable in real-time, globally distributed, collaborative, and heavily reliant on digital data. It shares many characteristics with the new social media that have been labeled Web 2.0.

2. Center of Focus

The value of creating tools that allow mass collaboration was given credence by James Surowiecki's book, *The Wisdom of Crowds*, in which he exposed the general populace to the idea that products and services emerging from the shared knowledge, skills, and experiences of a large user base are usually superior to those emerging from a single person or small group [7]. Those ideas have encouraged hundreds of entrepreneurs to create tools that foster this type of creativity. Recently, this has even extended to the writing of books which explore the power of collaboration. At least two books, Lessig's *Code v.2* [8] and Liebert's *We Are Smarter Than Me* [9] were the result of mass collaboration to create the main ideas for the book and to contribute pieces of content.

In our studies to understand Web 2.0 and how it can be used in military training, we have experimented with a large number of these services and made an attempt to categorize them and identify the core of their abilities. These categories are shown in Figure 2.

Individual	Ego-centric	*Facebook, MySpace*
	Idea-centric	*Millions of Blogs*
	Interest-centric	*del.icio.us, Digg, StumbleUpon*
	Activity-centric	*Twitter*
Group	Information-centric	*Wikipedia, Intellipedia*
	Delivery-centric	*YouTube, Flickr, Slide*
	Skill-centric	*Open Source, Linux*
	Organization-centric	*Guilds in WoW, Everquest*
World	Geo-centric	*Second Life, Active Worlds, Entropia, There.com*

Figure 2. Web 2.0 applications have unique areas of focus which create useful categories for grouping and understanding them.

The figure gives a layered and cleanly separated view of these tools. That is a simplification that is not necessarily characteristic of each service. We also expect each service which survives its initial launch to become more intertwined with and indistinguishable from the other surviving services. The figure is helpful in understanding the variety that exists and lays the groundwork for their application to a specific domain in the next section.

2.1. Individual

Many services are the expressions of a single individual. These allow individual users to take action and add their own unique contributions to the world. Social networks like *Facebook, MySpace,* and *LinkedIn* allow people to

express themselves, to explain who they are and share what they want the world to know or think about them. These are generally "ego-centric" services. *Blogs*, on the other hand allow a single author to express his or her ideas to the world. These ideas are not necessarily intended to be authoritative, universal, or binding beyond the author. *"del.icio.us", Digg,* and *StumbleUpon* allow millions of web surfers to make public their own interest in the web that they surf. The tags that are created do not carry the ideas of the tag author, but rather express the author's interest in content created by others. A recent addition to this group is *Twitter* which is very similar to a blog. But, rather than serving as a platform for expounding ideas, it might be described as a "micro-blog" which encourages the author/owner to post extremely short messages describing their immediately current activities. It is like a running stream of to-do list items that are being checked off. At the end of a single day a "twit" (a person who uses Twitter) may have posted a hundred tiny statements of their sequential activities.

2.2. Group

From individual creativity we step into information that is the collaboration of a group. *Wikipedia* creates articles that are centered on sharing information. The goal is to allow multiple authors to combine their knowledge to create a resource that is as reliable as a traditional encyclopedia that is created by a few selected experts. This service is said to be "information-centric". *YouTube* and *Flickr* allow an author to post work that he or she has created completely offline and using different tools. These are all about delivery to a mass audience without the intervention of an editor or an approval filter. YouTube insures that videos of interest to people can remain accessible at all times. The traditional broadcast media (e.g. NBC, CBS, and ABC) have required that the audience watch an item when the networks determine that it will be available. YouTube breaks this limitation and makes all media available at all times. Flickr does the same for still photos. This is a delivery-centric model of social media. *Open Source* programming projects like Linux and its family of supporting applications, as well as numerous collaborative projects on sites like Source Forge, are focused on bringing together the skills of people who can contribute to a specific product. These tools are not about allowing free expression from all comers, but are about leveraging the skills of people who can make software better. *Massively Multiplayer Online Games* (MMOGs) like World of Warcraft, Everquest, and Ultima Online have evolved internal player guilds that attempt to create a traditional organizational structure from large numbers of independent players. Their goals are similar to traditional business and government organizations, to create entities that can accomplish more

by working together than any one player can accomplish alone. To some degree these organization-centric guilds have validated the importance of structure and bureaucracy in achieving larger goals.

2.3. World

Finally there are *Geo-centric services* which organize information and activities into the shape of a three-dimensional world. These include projects like Second Life, Active Worlds, Entropia, There.com, and all of the MMOGs that each attract thousands or millions of players. These place information according to geography and require navigation that is spatial. In some circles these are not considered Web 2.0 services because they are not usually hosted on the web (not yet), but they are certainly a form of social media. Since this paper is focused on military training, which is generally very geo-centric these tools do provide valuable services for our domain.

3. Training Applications

Now that we have shown a number of types of social media and shown how each focuses on a different form of information sharing, we can explore how these tools may be useful in a specific domain like military training and simulation. As we paint this picture, it is important to recognize that none of these tools was created specifically for this domain. Therefore, each offers some capabilities that are useful and other capabilities that do not fit our needs. The tools also provide overlapping capabilities and leave some holes in coverage of our domain. A seamless fit of the domain would require a custom application that is built specifically for this community and that is completely funded and maintained by this community. The advantage of applying publicly available and increasingly familiar tools like the Web 2.0 set is that the development, maintenance, and improvement costs can be shared with a larger community. This characteristic is one of the main reasons that IBM chose to put its corporate software development and deployment investments behind the Linux open source community rather than continuing to create its own custom and proprietary applications.

Military training has a five phase lifecycle as shown in Figure 3. We will examine each of these in turn. In this paper we refer to the use of Web 2.0 services that are on the open Internet. This is done to communicate the ideas clearly. Real military applications would generally requiring hosting these services on a private network that meets security constraints. Readers should not assume that these services can only exist on the open Internet.
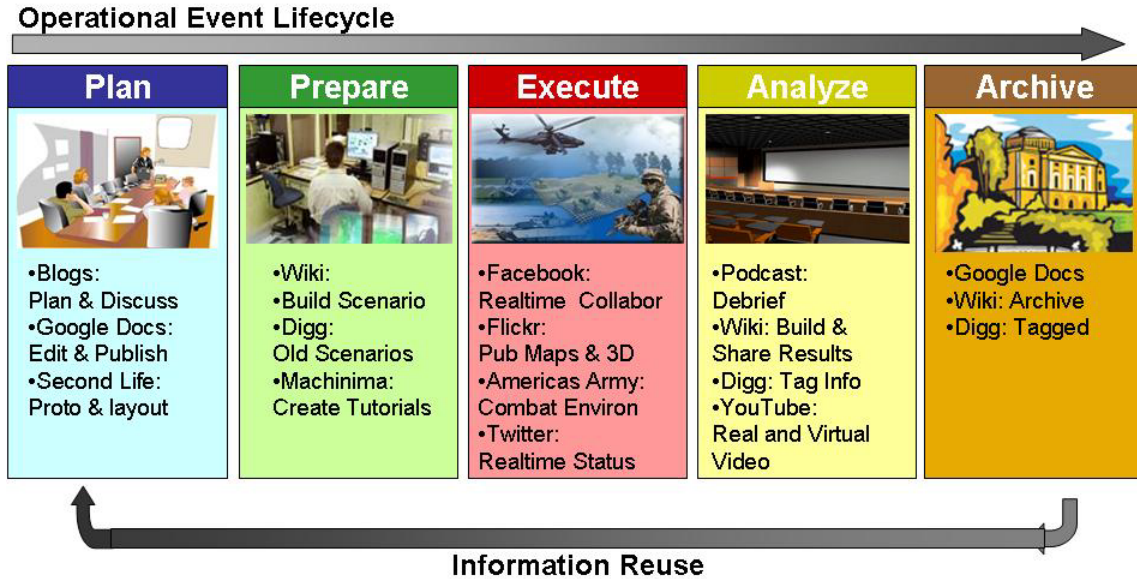
Operational Event Lifecycle

Plan	Prepare	Execute	Analyze	Archive
•Blogs: Plan & Discuss •Google Docs: Edit & Publish •Second Life: Proto & layout	•Wiki: •Build Scenario •Digg: Old Scenarios •Machinima: Create Tutorials	•Facebook: Realtime Collabor •Flickr: Pub Maps & 3D •Americas Army: Combat Environ •Twitter: Realtime Status	•Podcast: Debrief •Wiki: Build & Share Results •Digg: Tag Info •YouTube: Real and Virtual Video	•Google Docs •Wiki: Archive •Digg: Tagged

Information Reuse

Figure 3. Web 2.0 applications can be applied across the simulation lifecycle.

3.1. Planning

Events begin with a planning phase in which proponents define which military organizations will be trained; what facilities, equipment, and tools will be used; when the training will occur; what the objectives of the training will be; and how these objectives will be captured in a scenario. This work has traditionally been done through the use of numerous face-to-face meetings, teleconferences, presentations, white boarding, and the creation of a set of planning documents. It is facilitated through the ample use of the Microsoft Office tools and the exchange of documents via email. Teleconferences are used to reduce travel and to allow more frequent collaboration across teams that are geographically dispersed.

The obvious application of social media to this phase focuses on bringing together a distributed group of people, capturing the ideas of the group in a single set of documents, and coordinating the administrative information for the group. There have been a number of collaboration tools for group meetings including teleconferences, video teleconferences, Net Meeting, WebEx, Adobe Breeze, and others. Social media adds 3D virtual worlds to this mixture. While all of the earlier systems require the purchase, installation, and local administration of the communication tools, 3D worlds like Second Life, Active Worlds, and There.com can be accessed totally at the discretion of the user. At any time any given group can create new or access existing accounts in these worlds and walk into them for a meeting. They provide a virtual world for full-body avatar-to-avatar, rather than face-to-face meetings.

Second Life also includes voice over IP and we expect it to become standard in other worlds in the future.

For the creation and exchange of shared documents, there are a number of options. A wiki allows a very wide group of users to contribute to and collaborate on a single copy of a document. This eliminates the process of emailing a single document around a group with the ever present risk of losing mark-ups or adding them to an older version of the document. Services like JotSpot, WikiSpaces, and PBWiki attempt to meet this need for collaborative editing of documents. Google has added to this with their online Google Docs that focus on providing formats that match those of the Microsoft Office suite – text, presentations, and spreadsheets [10].

For administration of group activities Blogs are useful for posting announcements, identifying new information, and scheduling meetings. Google also offers online shared Calendars that can be used for scheduling.

Most military operations, including training events, rely heavily on references to geographic information like the placement and movement of forces. One approach to this is through a Google Maps Mashup that allows users to place objects on the map and indicate a time for them to take an action. To our knowledge there is currently no collaborative tool of this type. Another approach would be to build up scenarios inside of a 3D world like Second Life. Again, the tools for doing this in a practical way are not available yet. Planned actions for the live and simulated entities in a training scenario could also be

scheduled on a Google Docs Calendar without the geographic links.

3.2. Preparation

The preparation for a training event includes creating a scenario that identifies the real and simulated units that will participate, identifying the actions they will take, and the times at which those actions will occur. This requires the creation of lists and tables of data and the organization of units on a geographic map. This is traditionally done with spreadsheets, databases, paper maps, and specialized simulation tools.

This is an area in which existing Web 2.0 tools appear to be too immature to serve this domain. Shared Google spreadsheets and wiki pages can make contributions, but lack the ability to efficiently edit this information in a useful form. Online collaborative XML editors would be one valuable contribution. Online collaborative maps with drag-and-drop features along with links to external database files would be another. As we consider the process of creating a scenario database, it is clear that no one tool would be sufficient for the job. It would require integrating the capabilities of a map display, scheduling tool, and database at a minimum. This is one reason that we speculated that Web 2.0 tools which survive will begin to integrate and merge with each other. We suspect that other domains have similarly complex problems which could be addressed with richer tools.

3.3. Execution

The actual execution of a training event usually involves custom created military simulation applications. Second Life and Active Worlds provide similar 3D environments, but lack the extensive set of models which control the actions of the units/avatars and the scheduling mechanisms that keep everything synchronized. However, a number of computer games provide most of these same services. Games like Americas Army, World of Warcraft, and Everquest provide shared 3D worlds with models that represent the physics of object movement, weapon exchange, the consumption of supplies and hundreds of other operations. Two-dimensional, map-based games have been much less popular in the commercial market, so there are few remaining examples of these. But in many cases, this is just a simplified view into the same world that is modeled in 3D.

Potentially an MMOG could be created which adheres to the physical and behavioral reality of the world and provides an "always on" environment in which to execute training, something like World of Warcraft, but focused on the military training customer. There have been a number of partial explorations in this direction, but nothing near a complete system has been created to our knowledge.

3.4. Analyze

Military training events generate a lot of data describing the performance of the units under training. This data is collected in the form of the network data stream, specific data items from within the applications, and image captures of the maps at key points. The information is usually stored as records in database applications or to custom-formatted files. As mentioned above, we are not aware of collaborative, online database tools for recording this type of information. But it can certainly be streamed into a traditional database which is accessible by tools like Google Maps, Google Earth, and Google Docs. These would allow the display of geographic information in 3D and 2D forms, as well as displaying sequences of map images. The animated screens of the map tools could be captured as MP3 or AVI files which could be posted and shared via YouTube and screenshots could be distributed via Flickr.

Analyzed data is usually displayed in the form of graphs and charts, something that can be done in a shared collaborative manner with Google Docs spreadsheets. The data posted can be formatted according to the needs of those who are using it.

3.5. Archive

A large exercise can generate many gigabytes of data from all of the phases described above. This information may exceed the capacities of some of the collaborative tools. For archival purposes the information could be streamed off to a service like Amazon's Simple Storage Service (S3) where a gigabyte can currently be rented for a dollar a month, and prices are expected to drop significantly in the future.

Wikis can be used to capture summaries of the event which can be reviewed by anyone. These may serve as the central focus point from which pointers lead to videos on YouTube, photos on Flickr, charts and documents in Google Docs, and computer data archives in Amazon S3.

3.6. More

The quick summary of the exercise lifecycle provides some of the most obvious applications of Web 2.0 services. But, these events are filled with dozens of support activities which could make use of the services as well. For example, YouTube could be used to distribute videos that familiarize the training audience with their mission and objective, or that give instructions on how to use specific pieces of equipment.

Twitter could be used as a monitoring system for the status of computers on the network, being updated through a software API rather than from a human-facing GUI.

Any part of the data can be tagged with the del.icio.us or Digg services to allow participants to identify information that they find particularly useful. As with Internet web pages, these tags serve as votes for the most valuable data in the archives.

4. Mapping and Virtual Worlds 2.0

Since this paper focuses on the military training domain, the application of geo-centric tools is particularly important. Traditionally, military systems of all types have created custom mapping applications and 3D rendering solutions. In recent years several commercial products have emerged which are targeted at military users, and are now being adopted across multiple projects or products. However, there has been little or no use of consumer mapping and rending services like Google Maps and Earth, Second Life, Active Worlds, Entropia, OLIVE, and Multiverse.

An examination of these tools reveals that there are some truly useful capabilities which could be applied to military problems. Figure 4 provides a few examples of these capabilities. Google Maps, Flash, and Shockwave all bring the advantage of working within a web browser. They do not require the installation of map-specific applications and have the ability to stream background maps from a remote server. If these web-based and virtual world tools had the ability for multiple users to create and insert objects into the world in real-time, they may be able to displace the current family of custom mapping and scene graph tools.

Figure 4. Military mapping tools have traditionally been custom applications. But a number of web-based or commercial solutions are available in this area.

5. Conclusion

Web 2.0 social media services have attracted a significant amount of investment money and advertising revenues. Like many computer and Internet businesses before them, this money has allowed them to create powerful and useful products. Previous generations of business leaders have been accustomed to high technology coming from "serious businesses" like defense, space, manufacturing, and construction. But more recently, the cutting edge of software technologies has been coming from consumer and entertainment focused industries like computer games, video over IP, and social media.

Military customers are in the unaccustomed position of having to look beyond their traditional suppliers to find cutting edge technologies and the 21st century mindset that understands when and where to use them. The military was slow to adopt the global Internet, the web, browsers, and other Web 1.0 products and services. Given the current military focus on security and information assurance, all of the Web 2.0 services described here raise issues with the security of information. This mindset will prevent our community from remaining on the leading edge of technology.

Who decides when to experiment with Web 2.0 technologies? At what point do these powerful tools become main stream enough to be considered part of a military system? By the time they are main stream those who adopt them are the laggards at the tail end of technology.

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