

## **Using Web 2.0 (and Beyond?) in Space Flight Operations Control Centers – What to Try? What to Avoid?**

Word processing was one of the earliest uses for small workstations, but we quickly learned that desktop computers were far more than e-typewriters. In similar fashion, the advent of “Web 2.0” capabilities, e.g., advanced search engines, chats, wikis, blogs, social networking, has supersized the tools we could use to sculpt and manage the avalanche of information and decisions needed to operate space vehicles in real time. However, “could” doesn’t necessarily equal “should”, and we must wield two-edged swords carefully to avoid stabbing ourselves. This paper examines some Web 2.0 tools and suggests which ones might be useful or harmful in real time space operations control environments, based on a ) the author’s experience at Marshall Space Flight Center’s (MSFC) Payload Operations Integration Center (POIC) for the International Space Station (ISS) and b) an informal survey of other space ops control organizations and centers. There’s also some discussion of what offerings may come from beyond the current cyber-horizon.

# Using Web 2.0 (and Beyond?) in Space Flight Operations Control Centers

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Word processing was one of the earliest uses for small workstations, but we quickly learned that desktop computers were far more than e-typewriters. Similarly, “Web 2.0” capabilities, particularly advanced search engines, chats, wikis, blogs, social networking, and the like, offer tools that could significantly improve our efficiency at managing the avalanche of information and decisions needed to operate space vehicles in real-time. However, “could” does not necessarily equal “should”. We must wield two-edged swords carefully to avoid stabbing ourselves. This paper examines some Web 2.0 tools, with an emphasis on social media, and suggests which ones might be useful or harmful in real-time space operations control environments, based on the author’s experience as a Payload Crew Communicator (PAYCOM) at Marshall Space Flight Center’s (MSFC) Payload Operations Integration Center (POIC) for the International Space Station (ISS) and on discussions with other space flight operations control organizations and centers. There is also some discussion of an offering or two that may come from beyond the current cyber-horizon.

## I. Introduction

**F**LIGHT CONTROL requires monitoring and evaluation of a phenomenal amount of data. Some situations, e.g., launch, dynamic flight, and critical or emergency Space Station operations, require split-second, crystal clear decisions. Other scenarios, such as payload operations and/or station keeping, require contemplation of multiple options over an extended period of time, accounting for both specific instances and accumulated trends. No matter how much automated assistance is available or applied, humans must ultimately make the decisions that fly the mission.

### **What could social media possibly have to do with flight operations?**

The first-glance discontinuity between the two may arise because well-known examples of social media, e.g., Facebook and Twitter, are usually experienced (or often merely observed as activities of our friends and/or families) in the sense of “social” as “friendly companionship or relations.” Another sense of “social” is the **interactions among organisms and their collective co-existence. This is just as important as the interactions among aeronautical systems and their collective co-existence.**

While NASA uses social media quite a bit for public affairs, the tools are new to most of its other work environments including flight control operations, technically and especially culturally. Both engineering and flight operations data support systems take advantage of dynamic data manipulation capabilities inspired by Web 2.0, but discussions with individuals at several NASA centers has not identified wide use of social media.

**Discussions with about 50 colleagues indicate that fewer than 10% can readily define the core mechanisms, strengths, and contexts of social media tools in a work environment, though most have had contact with some tools, often at home.**

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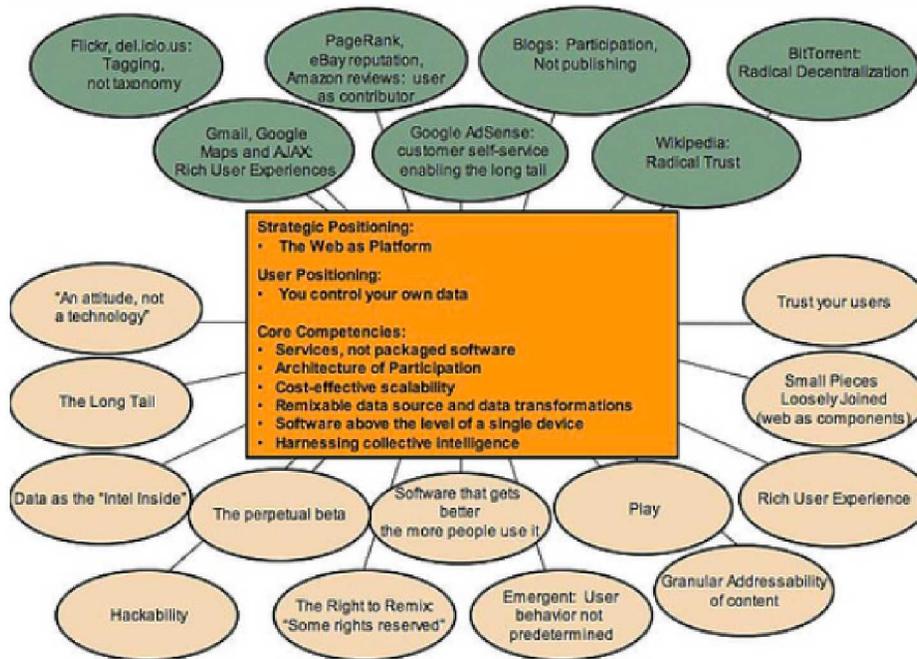
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## II. A Web 2.0 Primer

### A. Just What is “Web 2.0”?

The term Web 2.0 was popularized by Tim O’Reilly, founder of a major U.S. technology transfer firm and a promoter of the open software movement. In 2004, he and other computer industry gurus observed that companies that survived the bursting of the dot-com bubble in the early 2000’s had certain things in common that were fundamentally different than before the collapse.<sup>1</sup>

In O’Reilly’s words, “...Web 2.0 doesn't have a hard boundary, but rather, a gravitational core. You can visualize Web 2.0 as a set of principles and practices that tie together a veritable solar system of sites that demonstrate some or all of those principles, at a varying distance from that core.”<sup>2</sup> Figure 1 illustrates this concept.



**Figure 1 – Web 2.0: A Gravitational Core and its Resulting Solar System**

**NOTE** –Web 2.0 has an open, “free to the end user” nature that relies significantly on Web advertising to pay service providers. Of course, government and restricted user base sites typically do not have advertising, so such entities may contract with the provider for dedicated/secure servers or license the technology and host it themselves. It’s not unusual for Commercial Off-The-Shelf (COTS) data portals to include social media engines.

Here’s a thumbnail characterization of Web 2.0:

Emphasize services over content.  
Users manage the data and how it reaches them.  
Promote online collaboration and sharing among users.

Web 1.0 was commerce. Web 2.0 is people.  
Web 1.0 and email are one-to-many.  
Web 2.0 is many-to-many, with one-to-one capabilities

## B. Why is Social Media Important?

There are distinct differences between data, information, and knowledge:

- Data is fact without context.
- Information is data presented in context.
- Knowledge of what to do with information enables sound decision making, regardless of project phase.

The bottom line is that PEOPLE hold the knowledge, even if assisted by databases, web sites, and the like. Social media and networking link people more effectively, resulting in better knowledge sharing and better decisions.<sup>3</sup> It does this in at least two ways:

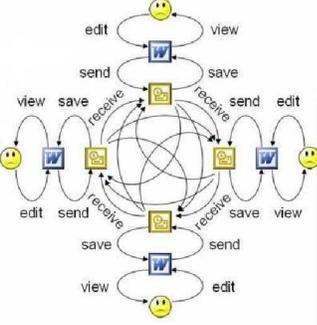
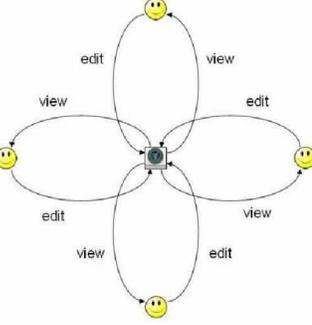
- Collaborative tools enable conversations among known interested parties across geographic and/or time gaps, and by capturing and/or cataloguing the results instantly.
- Search engines introduce conversations to previously unknown interested parties, multiplying collective knowledge and participation.

There is so much more to operations and engineering than just the results or deliverables. Process and interim results can be as important as (and sometimes more important than) final products, especially for follow-on and/or derivative projects and efforts. Social media and other modern tools enable real-time capture of both the relationships and transactions that comprise the knowledge sharing process, concurrently with simplifying work that needs doing anyway. This leads to insights and opportunities that are otherwise missed.

## C. Significant Terms

Table I identifies some major terms, techniques, and applications typical of Web 2.0. Subsequent discussion focuses on how most of these can benefit flight control operations. Many improvements may apply to other disciplines. Some terms are included just for cognizance.

Term	Definition	Distinction From Traditional Methods
Social Media	Media designed to be disseminated through social interaction, created using highly accessible and scalable publishing techniques.	Transform broadcast media monologues (one to many) into collaborative dialogues (many to many).
Blog	A diary published on the World-Wide Web, usually written by an individual but sometimes by corporate bodies. ...contributes to the easy exchange of ideas... The home page usually shows the most recent article and links to earlier articles, the owner's profile, and web logs written by the owner's friends. There is usually a facility for readers to add comments to the bottom of articles.	<p>Information is free-flowing and discoverable, as opposed to 'stovepiped' and sanitized.</p> <p>Reader comments to blog entries provide valuable perspective and contrasts, plus answers to questions, problems, issues, or opportunities raised in or triggered by independent of the main post. These may be of value to the blogger and other readers.</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p><b>Email Communication Thread</b></p> </div> <div style="text-align: center;"> <p><b>Blog Communication Thread</b></p> </div> </div>
Wiki	A collaborative website that users can easily modify via a web browser. A typical wiki allows participants to edit, delete or modify content, including the work of other authors. This has worked	Eliminates proliferation of email chains with embedded content. Spend time editing, not transmitting/receiving.

Term	Definition	Distinction From Traditional Methods	
	<p>surprisingly well because contributors tend to be more numerous and persistent than vandals, and old versions of pages are always available. (It is possible to limit editing but allow comments.) Wikis are often used to power community websites, for personal note taking, in corporate intranets, and in knowledge management systems. "Wiki" (pronounced ['wiki] or ['viki]) is a Hawaiian word for "fast."</p>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p><b>Email Collaboration</b></p>  </div> <div style="text-align: center;"> <p><b>Wiki Collaboration</b></p>  </div> </div>	
RSS	<p>A de facto, XML-based standard for automatic syndication of Web content, typically blogs, news, etc., but could syndicate a web app. Site authors create an RSS feed of their content and register it with an RSS publisher. Users configure their reader to subscribe to desired feeds. RSS readers show changes for all feeds user opts into, but original feed can be accessed for in-depth research. The acronym has many meanings - the most common is "Really Simple Syndication".</p>	<p>Instead of spending time searching sites of interest to find information, new information on those sites finds the user. By using a reader application or web site instead of email, the info is available and consolidated, and not an interruption.</p> <p>In workplace settings, conducting a project with a web tool with an RSS feed provides more incremental, timely updates to the team and the project manager than periodic emails and status meetings. This hones troubleshooting and enhancement activities.</p>	
Social Network Site or Service (SNS)	<p>A website and/or application that builds online communities of people who share interests and/or activities, or who are interested in exploring the interests and activities of others. SNSs encourage new ways to communicate and share information. Examples: Facebook, MySpace, Plaxo, LinkedIn, Twitter, and Yammer.</p>	<p>Facilitates sharing of information through the social graph, the digital mapping of people's real-world social connections. Connections and development of the community can be as important as the information.</p>	
Folksonomy	<p>Collaborative creation and management of tags to annotate and categorize content.</p>	<p>Bottom-up classification system means information conforms to users' preferences instead of forcing users to conform their thinking to the data's presentation.</p>	
Facebook	<p>An extremely popular SNS with over 350 million active users. Users create and customize their own profiles with photos, videos, and information about themselves. Friends can browse the profiles of other friends and write public or private messages on their pages.</p>	<p>(See SNS definition)</p>	
Twitter	<p>A free social networking and micro-blogging service. Users send and read "tweets", text-based posts up to 140 characters long. Users may subscribe to – "follow" - others' tweets, and may view them via browser, dedicated app, and/or receive via email or mobile phone text message. Also permits direct messages between individual users.</p>	<p>Archives of an individual's tweets are readily available, even if not following them.</p> <p>Brevity of tweets provides opportunities for text mining and trend analysis across traffic streams. Use of tags enhances this.</p>	

<b>Term</b>	<b>Definition</b>	<b>Distinction From Traditional Methods</b>
Yammer	A service similar to Twitter, focused on organizations – each org’s network is private, and is based on email domain. Groups within the company can be formed. Basic membership is free, with paid advanced services and configurations available. Tweets are short, but not limited to 140 characters, and may have attachments.	
Social Bookmarking	Bookmarks are saved on a website with user-assigned tags, and thus may be identified/accessed in multiple contexts. Bookmarks are available to other users (general public or established “friends”) or may be kept private.	User’s bookmarks are available on any networked computer using any browser.  Users with common interests benefit from each other’s bookmarks, simply by searching on tags.
Mind Map	A radial, non-linear diagram showing relationships among items linked to and arranged around a central key word or idea. Often used as a brainstorming tool.	Depiction of a semantic network of ideas shows their relative importance from a given perspective or context. This is closer to the way the human mind works than the traditional hierarchies in which information is stored or documented. Eventually, it may be possible to have self-maintaining dynamic links between mind-maps to the context-relevant information buried in configuration management hierarchies.
Portals  (not a Web 2.0 term, but relevant to discussion)	An extension to traditional dynamic Web applications, combines fragments provided by portlets (various applications and/or servers) into a single Web page. Portals and Web 2.0 services can cross-references each other. Portal technology is mature and widely used throughout NASA.	Promotes seamlessness from a user perspective.
Mashup	A web page or application that combines data or functionality from two or more external sources to create a new service. Integration is usually fast and easy, often using open interfaces and data sources to produce results not intended for any of the original pieces. (Example: AlertMap (hisz.rsoe.hu) mashes data from over 200 sources into a worldwide map of weather, biohazard, and seismic situations.) Term comes from the music industry technique of blending multiple songs and/or multimedia elements into a new work.	Often produces hybrid or “melting pot” display, while portal technology presents content in a non-overlapping, side-by-side “salad bar” style.
Webinar	Web-based seminar. . . A workshop or lecture delivered over the Web. . . may be a one-way Webcast, or there may be interaction between the audience and the presenters. May include audio and/or video streams.	In addition to enabling remote presentation of charts, many webinar applications include text chat, multivoting, and other interactive features that, when recorded, capture the collaborative process.

**Table 1 – Some Major Web 2.0-Related Techniques and Applications<sup>4</sup>**

### III. Current Uses of Social Media in Engineering Support and Flight Operations

As noted in the introduction, production uses of social media at NASA seem to be primarily in public affairs. Twitter has been used to keep subscribers inside and outside NASA apprised of Mars rover activities and astronaut endeavors. This provides good insight and inclusion, but does not use social media to actually drive operations.

An internal NASA Social Network Site, appropriately named Spacebook, was begun in 2008 by Goddard Space Flight Center and is evolving. There is also a Yammer site for the NASA email domain. MSFC is revamping an internal blog/wiki service and has begun to introduce the MSFC community at large to Social Media. A resulting primer is publicly available at <http://bit.ly/8rPon6>.

The author is aware of four large-scale engineering support efforts that include social media capabilities:

- The Constellation Program's Integrated Collaborative Environment (ICE) has several thousand registered users and is being expanded to serve a variety of Exploration and other projects across the Agency. It has wiki capabilities that are customized to user organization preferences and also supports traditional applications for file management, requirements definition, etc. Blogging and other Web 2.0 applications could be added.
- The NASA Engineering Network, sponsored by the NASA Office of the Chief Engineer serves several thousand NASA engineers across the agency with technical communities of practice for disciplines such as Guidance Navigation and Control, Structures, and Systems Engineering. The service includes a semantic search engine, wikis, forums, expertise location, collaborative document authoring, and sharing of NASA lessons learned.
- MSFC's Engineering Knowledge Management (ME KM) system, which is going "live" in early 2010 after 4 years of development, embeds engineering practice and workflows to capture and reuse knowledge, best practices, and lessons learned. It provides access to internal/external information, knowledge content, training and subject matter expertise, and will be offered as a Center-wide professional collaboration and enterprise search platform.
- MSFC's Ares Engineering Operations Network (AEON) is a web-based portal for a) accessing and analyzing Ares manufacturing, test, and performance data, and b) establishing user communities, including blog and wiki capabilities. The Huntsville Operations Support Center (HOSC) is looking into expanding this portal to provide services to the International Space Station (ISS) payload operations community.

The following flight operations applications have come to the author's attention:

- A satellite operations team at UC Berkeley has configured its exception monitoring equipment to automatically Twitter team members if certain conditions arise until a team member notifies the computer that the message has been received. That team member then assumes responsibility for coming in or logging in to the control center to address the problem.
- At JSC's Mission Control Center (MCC-H), some non-critical communication between front and back rooms is handled via instant messaging (IM), thus reducing some voice loop and email clutter. (However, MCC-H does not consider IM to be official information.) Also, a wiki-driven for-reference-only knowledge base of tips, tricks, and lessons learned is maintained. It is indexed by discipline and discipline-specific subcategories, with "search across all" capability.

The author welcomes news of other engineering and/or operations uses of social media.

## IV. Concepts for Enhancing Flight Control Operations via Social Media

Please try not to be too analytical (a tall order for operations types, engineers, scientists, and such!) when encountering these concepts for the first time, as this could obscure the overall sense and context of possibilities. Give the ideas a little time to seep in. The purpose of this paper is to promote (and maybe even provoke) lively discussion that morphs into deeper analysis, followed by practical evolution. One way to get real is to dream first.

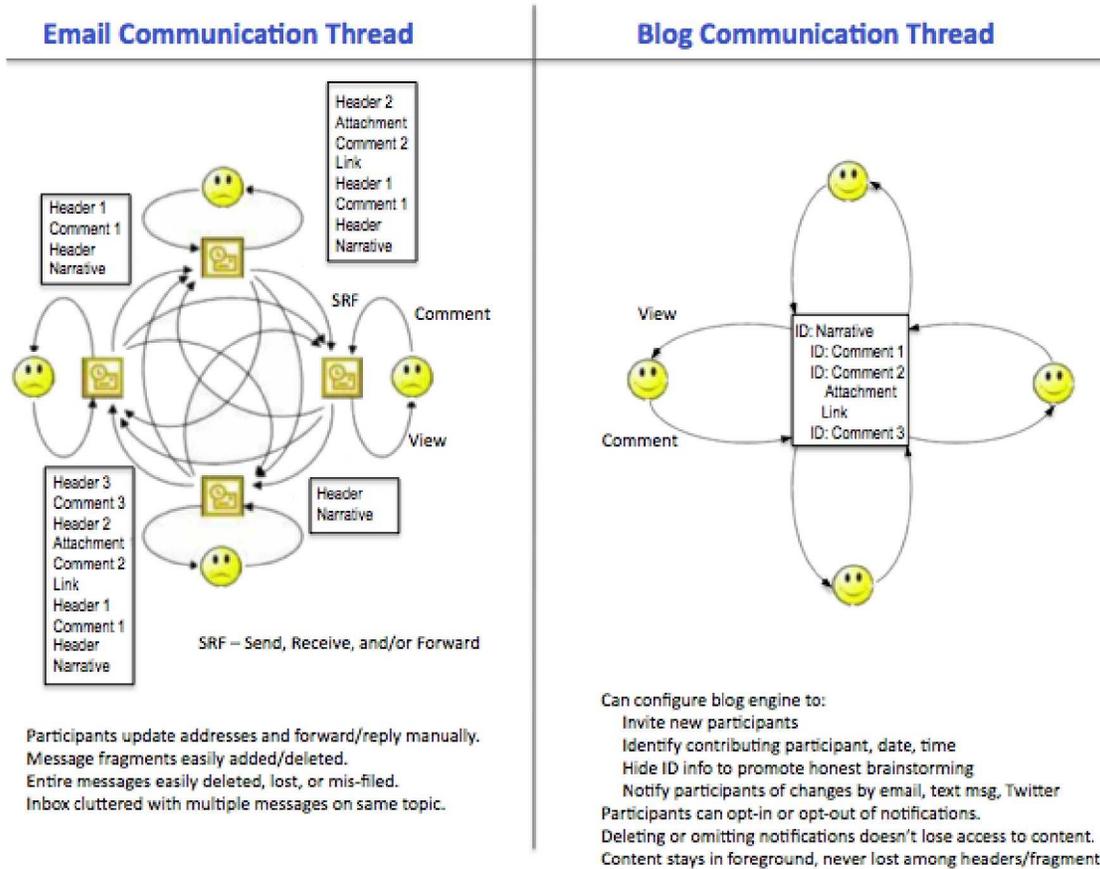
In this discussion, distinctions will be made between **nominal applications** of Web 2.0 techniques, e.g., administrative uses that would benefit both common office settings and operations environments, and **ops-unique applications**, e.g., uses that capitalize on a method's features in a manner specific to the nature and special needs of operations.

Most of these ideas, especially for ops-unique applications, are embryonic, and would require some modification of existing social media engines.

### A. Blogs

**Concept: Use blogs to replace email threads concerning specific issues [nominal application]**

Blogs are popularly implemented as individual diaries with room for outside comments, but the author believes there is tremendous potential for release from the bondage and confusion of email chains, as shown in Figure 2.



**Figure 2 – Email Chain vs. Blog**

Two reasons that blogs are not commonly used for discussing issues come to mind:

- Culturally, we are not used to blogging. (Perhaps we are victims of our own technological success, e.g., the advantages over email chains are obvious, but we're so busy answering emails that we haven't taken the time to learn how to blog.)
- Means of cataloguing the blogs and controlling intended participant access are not as well understood as for email. "Intended" could have a number of meanings, from specific invited participants only (analogous to email's "To:" distribution) to specific groups (by name or position) to a given work community at large. How does one easily keep track of actionable and desired informational blogs?

One way of handling the cataloguing and access problem would involve an enabling service that behaves very much like an email client, except that each "message" could be an email, blog, or wiki with which the user is involved. (Google Wave and Zotero, each of which has a .com site by the same name, already hint at this.) The author believes that robust, intuitive management schemes of this nature will be available within a year or two.

Operations control environments often have extremely well-regimented schemes for managing the workflow of planning documents and requests. Perhaps these architectures could be harnessed to handle "issue blogs".

With regards to the cultural issue, the author hopes that both individuals and organizations will regularly reserve and jealously protect at least a little time, say 5% of one's work hours, for learning new things, whether or not they seem directly related to current tasking. The payoff would be huge.

**Concept: Use blogs as position-specific console logs [ops-unique application].**

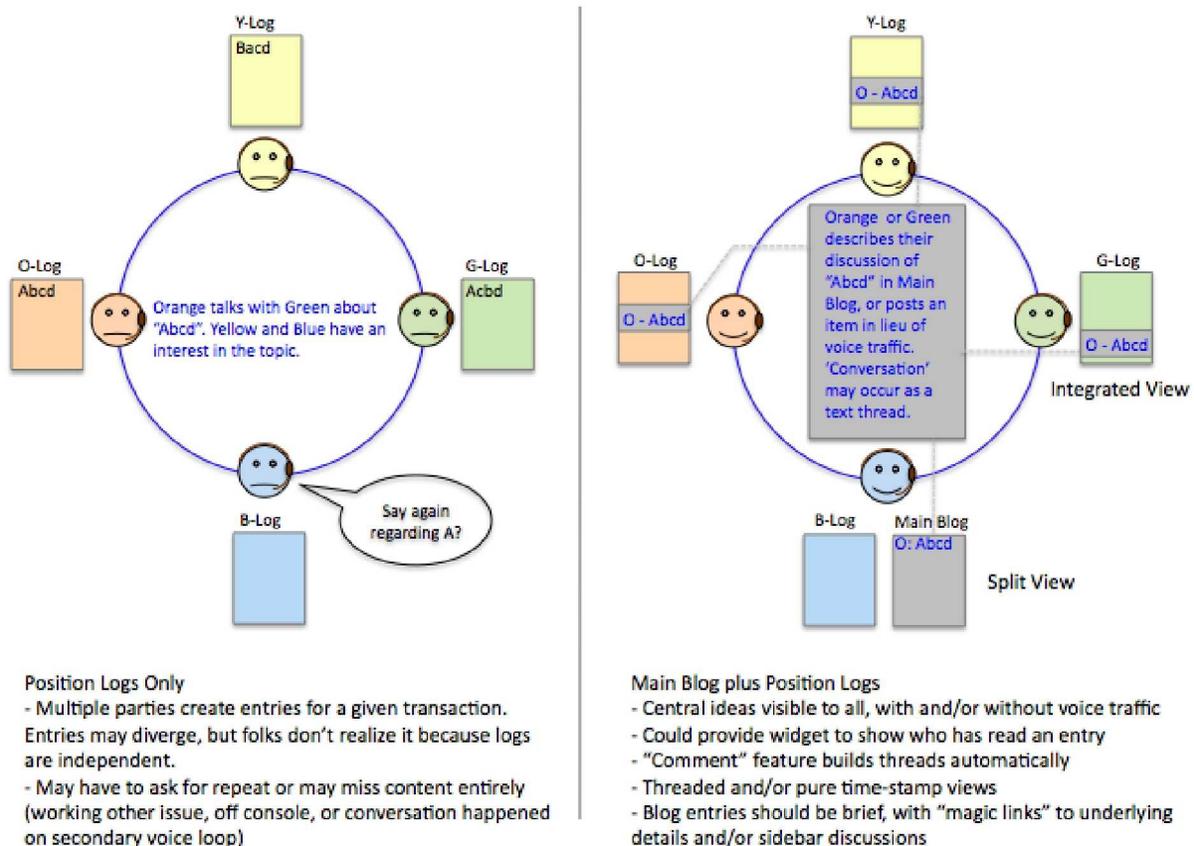
At MSFC's Payload Operations Integration Center (POIC), each console position maintains a console log, which is defined as "a brief narrative of significant operational events". This definition goes back decades to the Spacelab Program, and the concept of operations logs literally goes back to ancient times. Today's technology makes it possible to capture an incredible amount of data, and operations personnel have a natural tendency to strive for comprehensiveness, so the challenge now is robust capture yet simple presentation.

An enhanced blog engine for console logging might have the following characteristics:

- Automatic entry of full date-time group, operator name (may have more than one operator working a position concurrently), and field for entering "source" of entry (e.g., voice loop, email, telemetry, etc.)
- Log entries would be very short synopses of results or issues, but would have "magic links" to underlying details. Such a link would be created by merely highlighting the desired portion of detailed source material (which of course may live in any of a number of mission systems) and dragging into the blog. By default, the detailed material content would be hidden, but could be viewed within the log entry or opened in a separate window, and just as easily re-hidden. The detailed material itself would not actually be pasted into the blog.
- Ability to handle graphics, video, and other media. Depending on the circumstances, linkage may be better than pasting.
- Pasting of messages from monitoring systems, e.g., Caution & Warning. (Could be automatic, or could notify operator of condition and ask if log entry desired. There could be interesting variations for supporting reduced staffing.)
- Support for speech-to-text conversion of voice loop audio when literal transcripts are desired.\
- Support for treating and/or displaying some threads as side-bar items – summarized in the blog, visible as needed, then hidden so the forest is not obscured by too many tree
- Viewable in real-time by appropriate parties other than the console operator, e.g., off-console personnel, typically from same team, but possibly from related teams or from supervisory positions. There might even be merit in having the log be visible to other real-time and/or back room positions, so they can be cognizant of what is in work.
- Ability to accept comments from appropriate external parties. Authority and responsibility for a position's activities always lies with the on-duty operator. However, a teammate who happened to be viewing the blog might have knowledge or insight that could benefit the real-time effort and/or be useful from a post-ops perspective. It is important to be able to capture such "in the moment" thoughts in the context that inspired them. One could have a very interesting discussion about when these comments should be visible and invisible, and to whom. Any provision for external comments must clearly identify them as such.

The notions of external viewing and/or comment capability introduced in the paragraph above could involve quite a stretch of operations philosophy. While console logs must fulfill their initial purpose, there could be tremendous value from a systems and/or lifecycle perspective in enabling logs to feed and/or receive information to/from other contexts. There is so much linkage in the things we do. We might as well take advantage of technology's burgeoning ability to capture it and navigate it so that we can gain deeper insight and make better real-time and off line decisions.

**Concept: Establish a main blog for a given control facility [ops-unique application]. See Figure 3.**



**Figure 3 – “Main Blog” for an Operations Control Facility**

In many flight control rooms, there is a main voice loop, typically named after the lead flight controller position in the facility, that carries voice traffic about the operation's "big picture" issues and decisions. Generally speaking, all controllers in that facility are required to monitor the main loop, and its not unusual for some external facilities listen in as well. For ISS, the FLIGHT (Flight Director) loop at MCC-H is monitored by all ISS control facilities around the world. Use of a Main Blog, similarly visible to "all", could provide a page for "all" to be on. Read and write privileges would be controlled similarly to talk and listen privileges for voice loops.

Characteristics of a Main Blog might be similar to those discussed in the position-specific blog concept.

The right-hand side of Figure 3 depicts Integrated and Split views of the Main Blog with respect to position-specific logs/blogs. Users should be able to switch back and forth between these views as best suits their need at a given time. The author believes that the Integrated View would be most useful to those working real-time issues, as

position-specific log entries could be seen in the context of Main Blog activity. Careful design of the interface would permit operators to work seamlessly on their position-specific or Main Blog entries and threads. The Split View seems to make sense for support work, e.g., the operator is not in the thick of here-and-now decisions, but needs cognizance of operational flow.

## B. Wikis

Like blogs, wikis eliminate the overhead of email headers and nested blocks of text, graphics, attachments, etc. The distinction, of course, is that reading a blog involves seeing each contributor's individual inputs in some sort of sequence, e.g., by time and/or by thread, while a wiki shows a convergent sculpture resulting from the group's Archiving of previous versions is automatic. The simplicity of the process from a human perspective is shown in Figure 4.

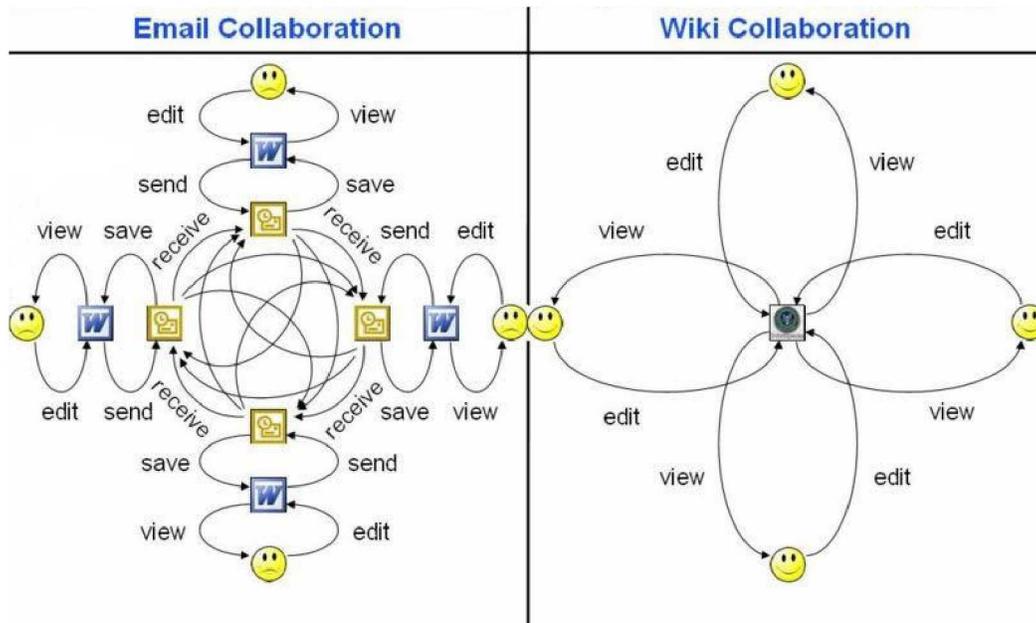


Figure 4 – Email Chain vs. Wiki

**Concept: Use wikis for maintaining uncontrolled and/or semi-formal documents that are internal to a team [nominal application]**

In any environment, wikis work well for encyclopedia functions – defining terms, explaining “how-to’s”, “gotchas”, and the like. Wikis produce more rapid convergence on “truth” than traditional methods of document circulation and review. Uncontrolled wikis could be used to gather/refine tidbits, musings, and issues for escalation to other forums. Console user guides and selected checklists might also be candidates. A defining characteristic might be that while there still needs to be an organized cognizance process, documents in this class do not require full-up configuration management.

Wikis may also be useful for working issues in a manner similar to the earlier “blogs instead of email chains” discussion. The cataloguing and access considerations mentioned there would also apply.

Some developers are working on a wiki-like system that could manage formal document evolution and/or Review Item Discrepancy (RID) processes. That could make life beautiful!

**Concept: Use wikis for periodic documents such as daily status reports and shift tag-ups [ops-unique application].**

Preparation of regular status reports often involves sending reports to a central position or person for integration into a finished product, which means someone ends up cutting and pasting (and perhaps losing a few tidbits). Group authorship eliminates the wasted motion. It might even be possible for certain information to be posted or updated automatically by a monitoring system.

It is not unusual for a shift to tag-up on the voice loops soon after handover. The trouble is that some team members may be working contingencies or otherwise be unavailable during the tag-up, so each position writes their own notes based on whatever they hear or do not hear. If voice loop archive playback is available, a position could review the tag-up, but this requires more time and would distract from here-and-now duties. If the team prepared a wiki in advance of the tag-up, everyone could get a basic sense of current activity and significant issues at a glance. The wiki could then be refined based on comments made during the live conversation.

### **C. Social Network Sites**

A major inhibitor to using SNSs at work is apprehension about being open with one's profile. This is quite understandable, given the free-for-all appearance of extremely popular sites like Facebook and Twitter and the images they conjure up. Using more closed environments such as (for NASA's situation) Spacebook, NASA Yammer, or an SNS embedded in a major engineering site should provide intimacy to encourage participation. Facebook-like SNSs have great potential for engaging in the "hall talk" that keeps us connected as people, which bolsters our capacity for technical discussion.

There could be valid uses for an application similar to Flickr, a SNS based on photographs, especially since users can assign "tags" to dynamically re-categorize photos, saving on the overhead of shuffling and re-shuffling through traditional online photo archives. The same concept applies to video storage and retrieval.

It is generally known that the original basis of Twitter was "In 140 characters or less, answer the question, "What are you doing now?" If that is all one does with the service, it stands to reason that traffic can easily become boring, especially if it is just people describing their daily doings. More value can be added by tweeting "Aha!" moments or appeals for help on questions/issues. These can be followed up with more detailed discussion via other social media, email, phone, or face-to-face meetings. The power of the technique is automatic notification of those who are following the tweeter who, in a workplace setting, have a common interest. This is especially true for Yammer, since a given user logon is restricted to a common email domain.

**Concept: Use Yammer to maintain a running operations "hall conversation" [ops-unique application]**

Example: At POIC, control center positions have email addresses with a very specific email domain that is much more narrowly defined than "@nasa.gov". Yammer activity within a domain this small (e.g.,) could be extremely fruitful. Why? This sort of group consists of approximately 300 flight controllers and facility support personnel filling about 20 functional positions with inter-related goals and concerns. The people also know each other reasonably well as friends. Yammer posts would probably appear in small clumps (initial post and a few replies, then other replies and/or threads beginning some time later), providing the intimacy of 2 to 5 people speaking casually, but the ideas would be accessible to all, across time (different shifts and duty days) and distance (travel to meetings at other centers). It would be good to let users identify yams (the Yammer version of tweets) by their position, name, both, or neither: both identity and anonymity have value.

## V. Overcoming Barriers to Concept Consideration and Implementation

The biggest obstacle to reaping the potential benefits of these tools and techniques crops up in most corporate cultures and across most topics. People and organizations often avoid investing the time and risk of learning methods that differ from the status quo because “There’s too much work that needs doing right now.” This phenomenon might be reduced if organizations budgeted work time for their members to spend some effort exploring and “playing” with alternative techniques outside of day-to-day activity. Professional athletes are given time to stretch and condition; engineers and console operators deserve no less.

In addition to individual efforts, exercises that involve trying things we might never do in real life could germinate desirable changes. For example, run a 2-hour simulation in which all transactions normally made by voice communication are handled via text chat or blog, then contemplate what types of messages could be more effectively handled in a similar manner. This could reduce both the amount of voice traffic required and the number of “say again” requests.

While exploration of new techniques can be somewhat free-wheeling, actual changes to the control room regime should be made with deliberation. A lot of resources and even human life may be at stake. While current processes may have room for significant improvement, they do work. In operations, better or best can be the enemy of “good enough”. The problem is that as data and demands increase, current methods may fall below the line of being good enough.

In some cases, transition to new methods can be eased by making the visual interface of the new product look similar to the old one - sometimes familiarity breeds comfort rather than contempt – then gradually morphing the interface for improved effectiveness.

## VI. Conclusion

Social media methods are in fairly broad use at NASA for public affairs. At least four sizable engineering support systems – ICE, NEN, ME KM, and AEON – have Web 2.0 and social media capabilities. NASA-centric Social Network Sites (Spacebook and NASA participation in Yammer) are evolving. An MSFC-sponsored introduction to basic social media concepts and tools is publicly available at <http://bit.ly/8rPon6>.

Social media can dramatically improve the density and organization of relevant information exchange among operations personnel.

For flight operations control centers, blogs have tremendous potential for improving efficiency:

- Position-specific console logs:
  - Ability to create and present very brief log entry with links and/or windows into underlying detail. This would reduce the time needed to create entries and vastly improve the ease of reviewing the log.
  - Automatically-generated threads would also help when tracing an issue or series of related events.
  - Possible speech-to-text conversion when literal transcription needed.
  - Automatic or semi-automatic inclusion of messages from monitoring and/or expert systems tools.
  - External comment capability could be useful for operations assistance and/or post-ops analysis
- Main blog for the control facility:
  - Features similar to those for position-specific logs:
  - Wide visibility, with write capability for many positions; central issues and decisions visible to all
  - One person’s entry may serve multiple viewers’ need; reduces divergence of multiple positions logging the same event in independent logs; perception conflicts surface instead of festering
  - Can post an entry after a voice loop exchange, as a prelude to one, or in lieu of one. Could provide a widget or other means of showing that viewers have read an entry of particular importance.

Wikis would be a good substitute for the email-chain method of working issues. Results of these discussions would still be processed via established planning and execution systems. Wikis could also be good for maintaining certain documents that do not require formal configuration management.

Social Networking, particularly Yammer, has potential for bridging time and physical presence gaps to create a highly inclusive “hall conversation” that yields insights leading to improved operations and morale.

While this paper has not addressed electronic and/or information security issues related to the use of social media tools, these should be manageable. Similar challenges related to new media have been solved in the past.

### **Acknowledgments**

The author thanks Eric Melkerson, Alan Johnston, and Cindy Grant of MSFC’s Mission Operations Laboratory, Aladin Beshir of the Huntsville Operations Support Center, with apologies to other colleagues and friends not named here, for their patient listening and responses to the author’s philosophical musings.

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- [4] Descriptions adapted from wikipedia.com, computerlanguage.com, thefreedictionary.com, campus-firewatch.com, engagedlearning.net.  
Wiki diagram from engagedlearning.net
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# Using Web 2.0 (and Beyond?) in Space Flight Operations Control Centers



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April 2010

# Flight Operations Control

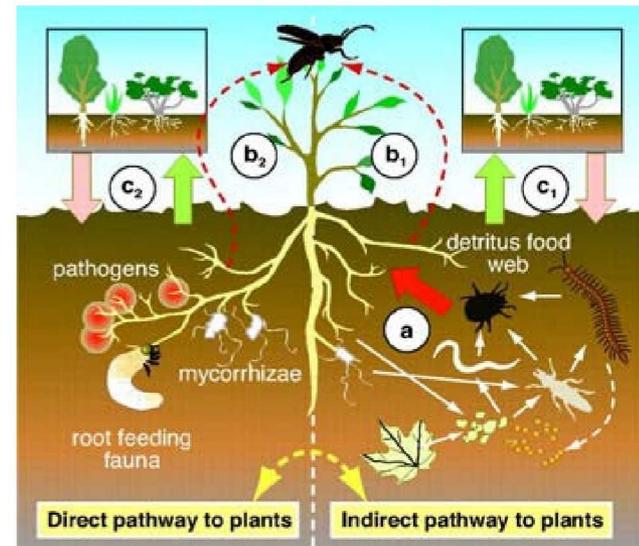


Social ...  
Say WHAT?

# What Does “Social” Mean?



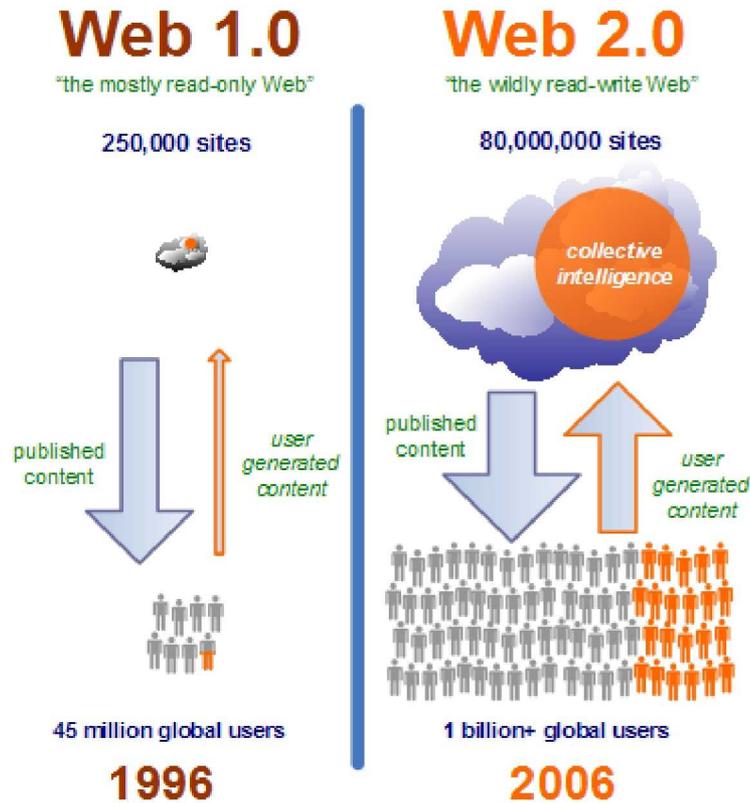
VS.



# Web 2.0 Definition – of Sorts

Web 2.0 – A Gravitational Core and its Resulting Solar System

# A Comparison



Emphasize services over content

Users manage data and how it reaches them

Promote online collaboration and sharing

Web 1.0 was commerce.

Web 2.0 is people

Web 1.0 and email are one-to-many.

Web 2.0 is many-to-many

# Why is Social Media Important? Part 1

Data	Fact without content
Information	Data presented in context
Knowledge	Understanding of what to do with information Enables sound decision making

People hold the knowledge!

(Technology assists)

# Why is Social Media Important? Part 2

## Social Media:

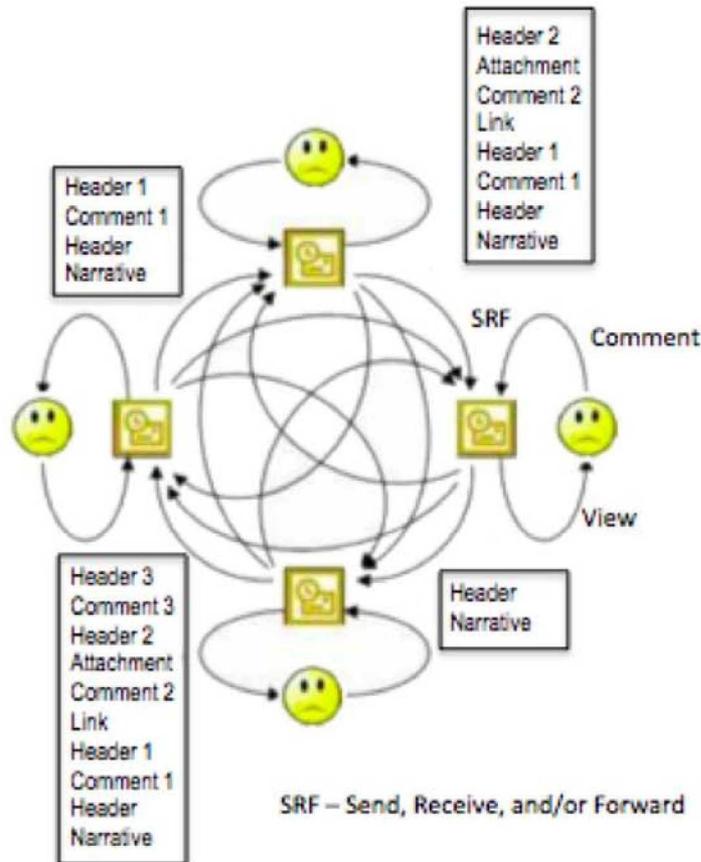
Enables and captures conversations across time and distance gaps

Introduces conversations to previously unknown parties

Multiplies collective knowledge, increases participation

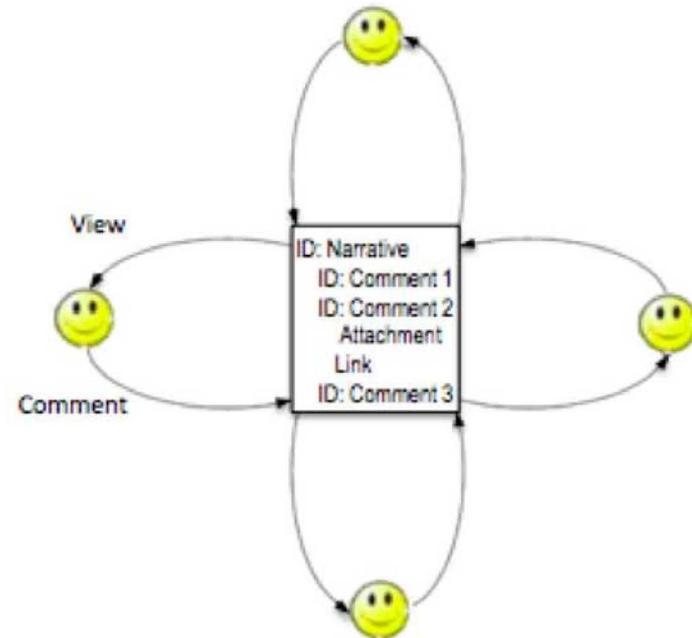
# Traffic Control

## Email Communication Thread



Participants update addresses and forward/reply manually.  
Message fragments easily added/deleted.  
Entire messages easily deleted, lost, or mis-filed.  
Inbox cluttered with multiple messages on same topic.

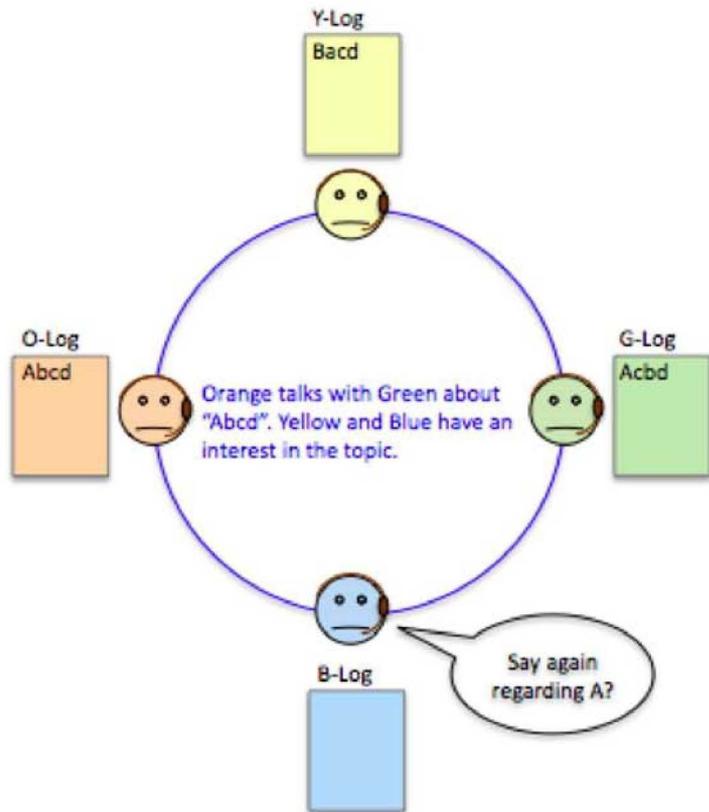
## Blog Communication Thread



Can configure blog engine to:

- Invite new participants
- Identify contributing participant, date, time
- Hide ID info to promote honest brainstorming
- Notify participants of changes by email, text msg, Twitter
- Participants can opt-in or opt-out of notifications.
- Deleting or omitting notifications doesn't lose access to content.
- Content stays in foreground, never lost among headers/fragments.

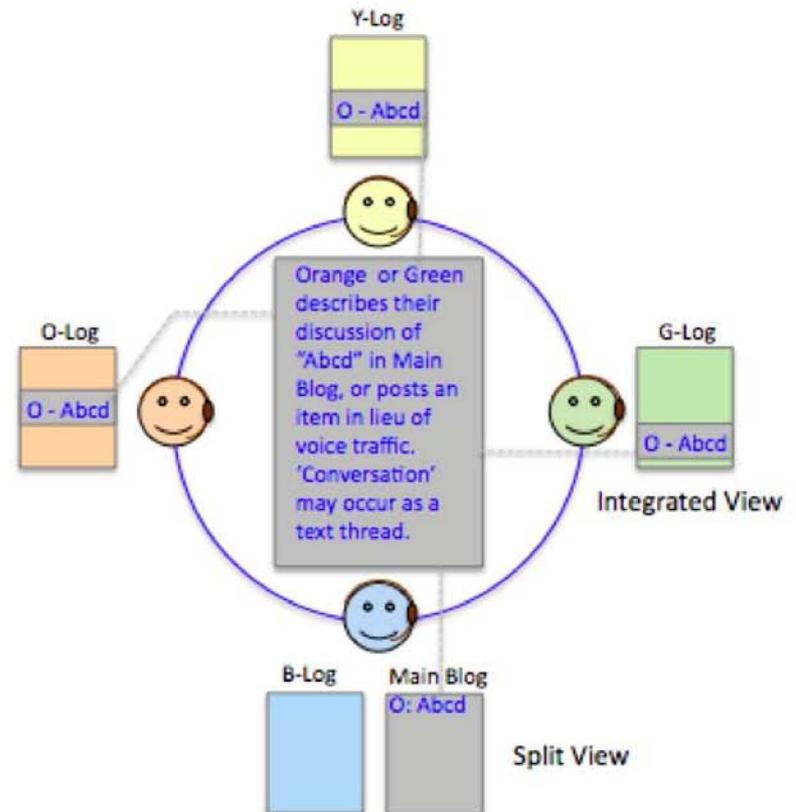
# Traditional Log-Keeping



## Position Logs Only

- Multiple parties create entries for a given transaction. Entries may diverge, but folks don't realize it because logs are independent.
- May have to ask for repeat or may miss content entirely (working other issue, off console, or conversation happened on secondary voice loop)

# A Social Boost

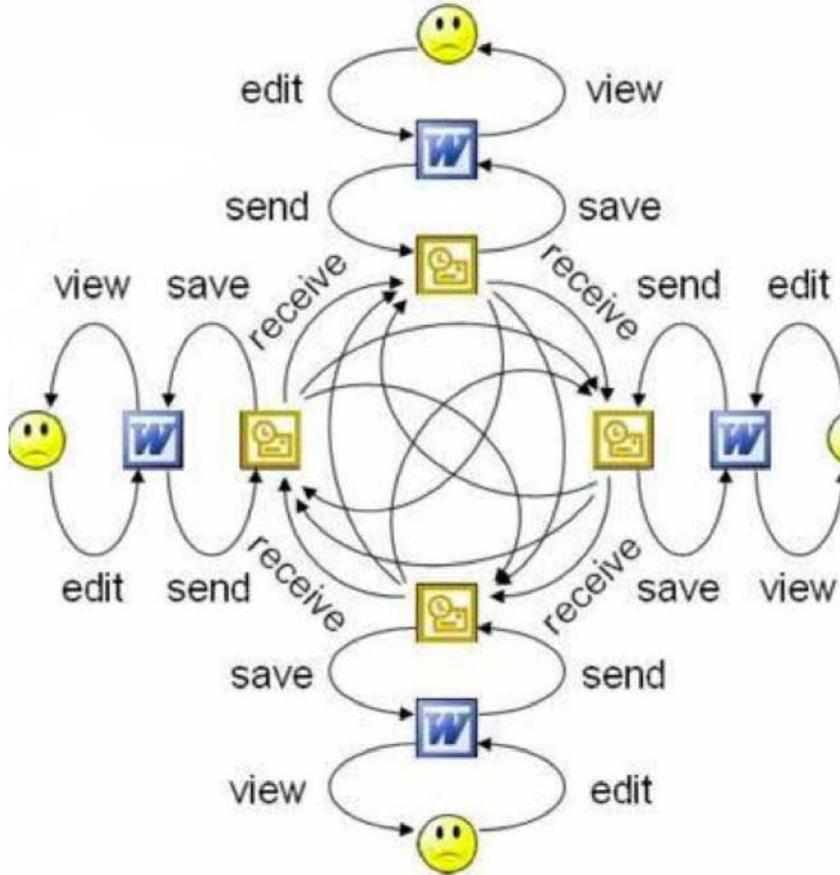


## Main Blog plus Position Logs

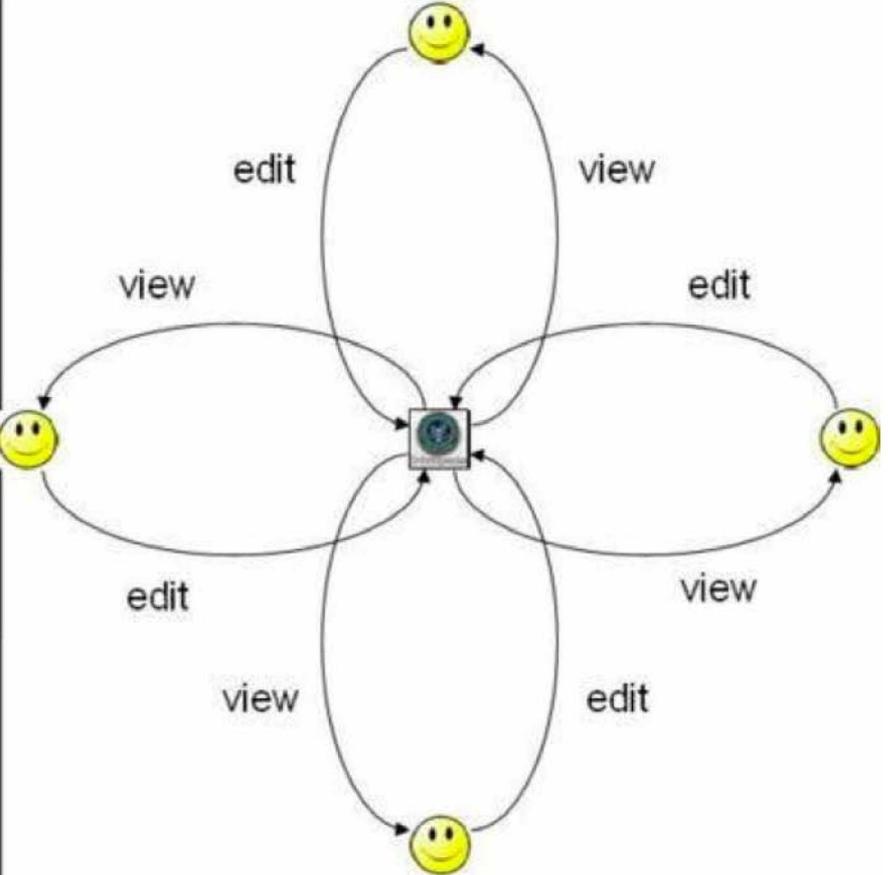
- Central ideas visible to all, with and/or without voice traffic
- Could provide widget to show who has read an entry
- "Comment" feature builds threads automatically
- Threaded and/or pure time-stamp views
- Blog entries should be brief, with "magic links" to underlying details and/or sidebar discussions

# More Traffic Control

## Email Collaboration



## Wiki Collaboration



# Yammer

Twitter-like Microblog/SNS

HOWEVER . . .

Not limited to 140 characters

Can add attachments

“Network” restricted to users in same email domain

(Other management options for the proverbial nominal fee)

# Overcoming Barriers to Implementation

We don't have time to try new methods.  
There's too much to do right now.



Individuals and organizations:  
Make regular time for exploring  
and playing, and guard it jealously.

Try things that probably won't work to prompt discovery of things that will, e.g., run a sim using text chat, blog, or sticky notes instead of voice traffic.

Explore techniques freely, but implement in control room with great deliberation. Better and best are often the enemy of good enough, but increasing data/demands can make current "good enough" methods drop below the line.

# Where We Seem to Be Right Now

Social media are in fairly broad use at NASA for public affairs.

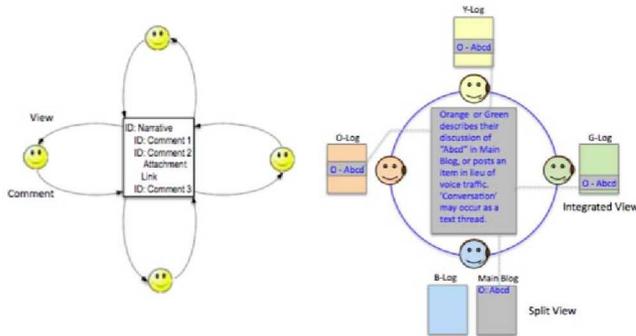
Individual Centers are conducting pilot projects to expand social media in the day-to-day workplace.

At least four sizable engineering support systems include some level of social media capability. Details in white paper.

Basic social media engines support applications suggested in this paper. Some mashups and/or specialized tools/linkages will probably be needed to bring them to fruition.

So, let's review some possibilities . . .

# Summary of (a Few) Possible Flight Ops Uses

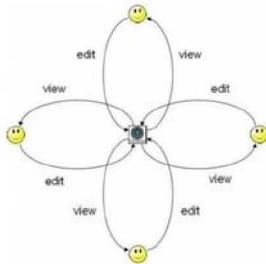


## Blogs

Replace email threads on specific issues

Position-specific console logs

Main blog for a given facility/function



## Wikis

Maintain uncontrolled/informal documents (e.g., handbook)

Periodic team-written documents (e.g., status/tagup)

## Social Network Sites

Yellow pages

Yammer – Use for a running “hall conversation”

With social media tuned to your needs and interests,  
you'll fish in relevance-infested waters!



Roger that.  
Way cool!