Methods Research Report

Feasibility Study of a Wiki Collaboration Platform for Systematic Reviews

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Feasibility Study of a Wiki Collaboration Platform for Systematic Reviews

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Preface

The Agency for Healthcare Research and Quality (AHRQ), through its Evidence-based Practice Centers (EPCs), sponsors the development of evidence reports and technology assessments to assist public- and private-sector organizations in their efforts to improve the quality of health care in the United States. The reports and assessments provide organizations with comprehensive, science-based information on common, costly medical conditions and new health care technologies and strategies. The EPCs systematically review the relevant scientific literature on topics assigned to them by AHRQ and conduct additional analyses when appropriate prior to developing their reports and assessments.

To improve the scientific rigor of these evidence reports, AHRQ supports empiric research by the EPCs to help understand or improve complex methodologic issues in systematic reviews. These methods research projects are intended to contribute to the research base in and be used to improve the science of systematic reviews. They are not intended to be guidance to the EPC program, although may be considered by EPCs along with other scientific research when determining EPC program methods guidance.

AHRQ expects that the EPC evidence reports and technology assessments will inform individual health plans, providers, and purchasers as well as the health care system as a whole by providing important information to help improve health care quality. The reports undergo peer review prior to their release as a final report.

We welcome comments on the Methods Research Project. They may be sent by mail to Task Order Officer named below at: Agency for Healthcare Research and Quality, 540 Gaither Road, Rockville, MD 20850, or by e-mail to epc@ahrq.hhs.gov.

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Project Overview

The Agency for Healthcare Research and Quality (AHRQ) is interested in leveraging new collaborative technologies to improve communications within and between various programs within its purview. To investigate some possibilities, the ECRI Institute Evidence-based Practice Center (EPC) was charged with examining the feasibility of using a wiki to support the collaborative development of evidence reports, technical briefs, and systematic reviews by AHRQ's EPCs. A wiki is "a type of Web page designed so that its content can be edited by anyone who accesses it, using a simplified markup language," according to The Oxford English Dictionary. Wikis [1]could serve multiple purposes in the workflow for EPCs. In addition to serving as a mechanism for reviewing draft reports, wikis could be used in earlier stages of topic refinement and report development, such as in the developmental phases of key questions, inclusion/exclusion criteria, and search strategies. The wiki could serve as a collaborative platform for general methods development and methodology-related discussions and potentially could facilitate submission of topic nominations by partner organizations and public stakeholders.

At AHRQ's request, this study explores access, governance, and policy issues related to using a wiki for peer review of reports, and its feasibility and potential in the longer term as a platform for report publication, updating, and dissemination. It also explains technical and operational considerations involved with different types of wikis and addresses other points of interest, such as issues of Section 508 compliance.

This project was researched in 2008. Several approaches were used to gather material for this study. Systematic searches were conducted of bibliographic databases, conference proceedings, and digital repositories to identify publications of interest. Searches of the Internet were also conducted to identify grey literature and sample wikis. A case report based on an interview with representatives of the Agence d'évaluation des technologies et des modes d'intervention en santé (AETMIS), the government agency in the Canadian province of Quebec responsible for Health Technology Assessment, is included in Appendix D to this report.

Finally, we make recommendations on using a wiki for review of systematic reviews and other report-development activities based on our research and our use of the PBwiki platform while authoring this report. This tool is now available as PBworks (www.pbworks.com).

Introduction to Wikis

What Is a Wiki?

"A wiki is to a typical Web site what a dialogue is to a monologue."[2]

According to Ward Cunningham, the "father" of wikis, a wiki is the "simplest online database that could possibly work." Wikis are server-based online content management systems that ease creating, editing, organizing, and storing information for any user with Internet access. Users may freely create and edit Web page content using any Web browser, although some wiki sites function best using specified browsers such as Microsoft's Internet Explorer and Mozilla Firefox. Wiki allows inexperienced users to create Web content without knowledge of markup and programming languages—wikis support hyperlinks and use simple text syntax for creating new pages and crosslinks between internal pages on the fly. Many wiki applications now embed WYSIWYG (what you see is what you get) capability to ease the process even further.

One of the key characteristics of a wiki is its initial flat structure. Pages are easily created and are connected to each other via hyperlinks. This results in more of a web of nodes than a hierarchical structure which allows users to easily customize the wiki to meet the needs of individuals and projects. This makes wiki unusual among group communication mechanisms in that it allows the organization of contributions to be edited in addition to the content itself.

Wiki is also a philosophy about how users should go about editing content in wiki platforms[3] and working in a wiki requires users to shift their perceptions about documents and collaborative work. Wiki is generally considered part of Web 2.0. According to Choate,[2] the "term [Web 2.0] was coined in an effort to capture what was different about companies that survived the Internet bust of early 2000, and those that did not. As such, Web 2.0 is not a set of web technologies per se, rather, it is a set of attributes shared by successful Internet companies." These characteristics include user participation, geographic and organizational decentralization, use of links and hypertext (embedded links that transfer users to related content within or between documents/Web pages), and an emergent nature (e.g., the system arises out of the interactions of many contributors). In Web 2.0 applications such as wikis, emphasis is given to the dynamic nature of information. There is no final version of a document, just the current revision. This has an impact on the authoritativeness of published information. Users also need to shift their concept of authoring and ownership. As Guy notes, "The notion of ownership remains so deeply embedded in our society that many users still find it difficult to change things on another person's Web site."[4]

Another key attribute of wikis is the revision history that is created for each page. This history captures the full version of each revision plus the time, the author, and the specific changes made in that revision. Reversion to any revision is possible. This differentiates wikis from other groupware in which only the changes are saved. Another difference between wikis and other content management systems is "that content is put in the wiki during the project, not after the fact." This makes wikis more of an "active hub" rather than a "file cabinet."[5]

Potential Uses for Wikis at AHRQ

The initial scope of this task order focused on the feasibility of using wikis in the context of AHRQ systematic reviews. However, there are many ways in which the introduction of wikis could enrich communication and collaboration within the EPC community.

EPC Community of Practice

A wiki could help foster an EPC community of practice (CoP). Communities of practice are "groups of people informally bound together by shared expertise and passion for a joint enterprise ... people in communities of practice share their experiences and knowledge in free-flowing, creative ways that foster new approaches to problems."[6] Communities of practice differ from formal work groups, project teams, and informal networks in several ways. First, CoPs exist to benefit the members via knowledge exchange and exist as long as there is an interest in maintaining the group. Other collaborative groups exist to deliver a product or service, accomplish a task, or to collect and disseminate information related to a business or organizational goal. These groups may be formed by the organization and membership may be a job requirement. Wenger and Snyder[6] note some organizational benefits that accrue when members participate in CoPs. These include new ways of driving strategy, creating new lines of business, quicker problem solving, transfer of best practices, professional skill development, and new methods of recruiting and retaining group members. The EPCs don't fit neatly into any of these categories—they are independent organizations that are bound together through their individual commitments to AHRQ. However, the members of the EPC teams do share interests in topic areas that transcend individual reports, such as methodology and disseminating research results that could serve as the basis of these CoPs.

Central Hub for Methodology

The EPC program researches methodologies relevant to systematic review in addition to specific diseases, interventions, and diagnostic technologies. Providing access to methodology research in real time could provide valuable insight and cross-pollinate ideas between projects. This could easily serve as the core for an EPC CoP.

Connecting Related Topic Areas

A wiki could also be a useful way of linking AHRQ research across multiple categories. EPC projects could be linked with Centers for Education and Research on Therapies (CERT) and Developing Evidence to Inform Decisions about Effectiveness (DEcIDE) projects in complementary subject areas. Portions of separate EPC reports on similar subject areas could also be linked—the first example to come to mind is genetic testing. This topic is currently of great interest, and there are published and ongoing reports in this area, some of which are interrelated—at least three or four EPCs have previously or are currently assigned to work on projects addressing different aspects of genetic testing. Creating a topic-related forum would allow researchers from these different EPCs to share their experiences and easily communicate their "lessons learned."

Individual Sites for Project Working Groups

Example—Analytic Validity of Genetic and Laboratory Tests

Most EPC projects are collaborative efforts between the individual EPCs, AHRQ Task Order Officers, partner organizations, Key Informants, and Technical Experts. At present, collaborations are managed via e-mail, shared documents, shared Web conferencing (e.g., WebEx, LiveMeeting) and conference calls. Adding a wiki into this mix would simplify and reduce redundancy in these processes. However, collaborators will need to confirm that the application isn't blocked by their institutional firewalls at the onset of the project. The front page of the wiki would include a description of the project including background and context along with links to official documents such as the task order and to the other sections of the wiki. Other sections would represent different aspects of the project. For example, one section of the wiki would be focused on introducing team members, identifying their roles and areas of expertise, and specifying best methods of contact. Another would be dedicated to announcing events such as conference calls and stakeholder meetings and would lead the user to the minutes for these events. Detailed minutes or brief synopses linked to more detailed documents would be available from this page. This section would also provide content on meeting locations, hotels, travel, reservations, and other logistical matters. The technical section of the wiki would include content such as the key questions and analytic framework for the project, proposed search strategies and search reports, inclusion/exclusion criteria, and proposed statistical methods. Additional sections could be reserved for suggesting peer reviewers, reference lists, and evidence tables. Links could also be provided to TrialStat or other systematic review support sites.

The above examples are suggested internal uses of a wiki. Wiki may also be an efficient method of disseminating draft documents for public review. This could be accomplished by creating a separate section in the project wiki with less stringent access controls, or, by creating a separate wiki for the review stage and linking it to the project wiki. Other public uses could include topic solicitation and a structured feedback area seeking public input on more general areas such as best practices for disseminating reports, or determining how well the summary guides developed from the comparative effectiveness reviews are received by intended audiences.

Collaborative Authoring

Wikis work well for collaborative activities such as brainstorming, planning, and reviewing, but there is less evidence how well they function as a platform for authoring complex reports.[5,7-9] Wilder and Ferris wrote of their experience using a wiki to write about wikis. They note that "using a wiki to write a document destined for a linear publication was a futile exercise from the outset."[10] They found that working with hypertext in the flat wiki structure led them to forget elements necessary for traditionally published documents such as titles and abstracts. This may be a pitfall if a traditional approach is taken, however, there are alternatives to be explored.

One consideration is how many authors will be authoring the report and whether they will be working jointly, simultaneously, or sequentially. Noel and Robert comment on a number of approaches, including parallel writing, where authors work on their sections concurrently; sequential authoring, in which one author at a time works on a draft and passes the responsibility on; joint authoring, in which a group collaboratively authors a draft in real time; and a scribing approach, in which jointly created documents are entered into the wiki by a single author. They

consider awareness, which they define as "an understanding of the activities of others which provides a context for your own activity" crucial for successful collaboration.[11] Liccardi et al. discuss differences between group and individual authoring. They note that contributions from the different writers should be coherent together and that this requires an editor and enhanced functionality in software. They also found most users prefer parallel writing—either users work separately and occasionally upload their sections or write the entire sections separately and merge the sections with the document upon completion. These authors have developed the CoAuthoring Wiki-based System (CAWS) as a tool for writing professional papers.[12-14] Like Noel et al., they note that "it is important for people collaboratively authoring a document to be informed about the changes that have been made to the document between versions, when new parts are added to the document and by whom. Being aware of these changes helps the users to better understand the evolution of the document, to more easily cooperate with others and avoid possible conflicts." Problems with collaborative online authoring identified by these authors include:

- Communication degradation
- Misinterpretation of comments referring to specific sections
- Resolving conflicting suggestions for revision
- Poor tools for annotation
- Version tracking
- Update conflicts
- Awareness
  - personal
  - social
  - informal
  - group
  - workspace

The CAWS was designed to emulate face-to-face interaction and address the above problems. First, "instead of multiple pages the system comprises multiple document sections that form a complete document." Each document would have a front page that provides authors with an informal update on current activity and events. This enhances what the authors call "informal" awareness. "Personal awareness" is addressed through providing each author with a user page and requesting that they update it periodically. Users would also be able to designate their "status"—this would indicate whether the author could be disturbed and provides "social" awareness. "Group awareness" is addressed through a page which includes users' roles, responsibilities, positions on issues and statements, and status related to assigned goals. In addition to these pages, administrative tools enhance author awareness by linking discussions to an annotation system. Comments can be color-coded by commenter or by the type of comment (e.g., suggestion, proposal, request for discussion) to provide visual cues to users. Users can also specify which revisions will trigger an automated notification for them.[13] CAWS has been examined in two field studies involving undergraduates working on a group project and postgraduates collaboratively authoring a document. As a result of these studies, the authors plan to augment CAWS with an instant messaging system to provide more immediate communication. As of early 2009, this system is still under research.

Review and Editing

A number of practical issues need to be determined by the EPC community before structuring a wiki for peer review.

- Should the draft be posted as a document or should pages be created for the sections? Uploading draft documents to a wiki site allows document review without distracting reviewers from the content with a new editing environment. Taking this approach turns the wiki into a convenient centralized method of disseminating information while retaining access to review tools such as tracking changes. Encouraging reviewers to make their comments using structured wiki templates would add another layer of usefulness to the wiki. However, reviewers could upload their completed review documents to the wiki as well. Alternatively, the report could be available as one or more wiki pages. This would allow reviewers to make comments directly in the document (much as they would do using "track changes"). This would centralize comments from multiple reviewers and simplify the comment integration process. Guidance for reviewers could be provided in a Frequently Asked Questions (FAQs) section. Either of these approaches could decrease the time needed for this part of the review process since the authors would become aware of the reviewer's comments as soon as they are posted.
- If the reports are made available as wiki pages, should the formatting mirror existing AHRQ reports or should a more flexible wiki structure be used? Currently, the Web version of a comparative effectiveness review consists of a single html page with intradocument links for navigation. This could easily be replicated in a wiki, but it might be unwieldy for reviewers. Wiki pages could be created to represent different sections of the report (e.g., methods, results, evidence tables). One of the advantages of "Web 2.0" approaches is giving users easy means of personalizing content. In the context of the wiki, this includes adding tags to pages. If the entire report is in a single page, appending tags wouldn't be as useful. Breaking the report into different pages allows users to apply tags more specifically.
- Should reviewers use templates? Providing semistructured templates encourages contributions to wikis. For peer review and discussion of EPC projects, structured templates based on current peer-review forms and checklists could be generated. This ensures that all reviewers consider the same elements and should at least mirror current instructions for peer reviewers. Authors should have input on specific questions for each project.
- How do you create and manage time-limited review periods? The review period could start once reviewers receive their access, and periodic alerts could be generated advising reviewers when comments are due. Edit access can be removed at the end of the review period. Using a wiki for review would provide more transparency into the review process and let the EPCs know when their reports were actively being reviewed.
- Would the reviewers be able to see each others' comments during the review process? Could this introduce bias? Would it be better to provide each reviewer with their own draft page that they can both edit and comment on? This would facilitate replies to individual reviewers, but merging could be difficult at the end. Should a general discussion page be created where reviewers can interact after they've completed their review?
- Since wikis can be continually revised, how do you know when the reviewers' comments are final? A checklist page for reviewer signoffs could be created. The reviewer would

indicate on this page that his/her edits are "final," and a date and timestamp would automatically be provided.

- Do responses to reviewer comments on the talk page constitute a sufficient response to reviewers or are more formal replies required? Currently, disposition of comments is handled through documents with tables that list the reviewer's comment and the resulting action of the EPC. Wiki pages could be formatted in multiple ways to enhance this process. The table format could be retained if desired, but both the comment and dispositions could be linked to the relevant section of the report (or reports if the draft version will remain available).

Wikis can be easily edited, but it is difficult to link a comment to a specific statement within the text. MediaWiki and PBwiki are two wiki platforms that were considered for this pilot project. PBwiki creates comments at the bottom of the page, and MediaWiki creates a separate tab (namespace) for discussions. Can a unique identifier be assigned to each sentence or segment to improve this process? How would this be maintained? One proposed solution is Purple Numbers. This is software that produces HTML documents that can be addressed at the paragraph level. The software automatically creates name anchors with static and hierarchical addresses at the beginning of each text node and by displaying these addresses as links at the end of each text node. Using this approach, reviewers could specifically reference the subject of their comment regardless of the comment location. Purple Tools are available for developers to incorporate Purple Numbers into their applications.[15] Purple Numbers have been implemented as part of the government's COLAB Collaborative Work Environment.

What happens when multiple editors try to save an edit at the same time? Ignat et al. examined how MediaWiki handles concurrent saves and compares this with peer-to-peer approaches.[16] They found that in this circumstance the user who submits the edits first wins and the others fail. Nonwinning users are presented with two versions of the page—the one they tried to publish and the now-current revision of the page. The author can then determine whether the desired edits are still required and, if so, paste them into the new revision. There is no automated merging—users manually combine the parallel modifications.

Wikis are continually in flux—how do you make sense out of revision histories? Viegas et al. used history flow visualizations to study cooperation and conflict between Wikipedia authors with the goal of determining whether page edits are significant or if there are recognizable trends and patterns.[17] Their history flow visualization was designed to graphically show relationships between multiple document revisions. Contributors are each assigned a different color in the visualization, and the sections of revision lines are colored according to the original author. Sections that remained the same between consecutive versions are linked using shaded connections between corresponding segments on adjacent revision lines. The spacing of revision lines indicates the passage of time. The authors noted a number of patterns including what they termed "first user advantage" in which the original content on a page survives longer and experiences fewer modifications than later edits. They also noted that people tended to delete and insert text more frequently than moving text in an article. Many of the negative patterns noted in Wikipedia would not be relevant in the context of an inward-facing AHRQ wiki but would apply if an AHRQ wiki were open to the public and permitted anonymous contributions. These include different forms of vandalism, such as mass deletion of content and edit wars, in which two or more editors or groups alternate between versions of a page. These patterns should be taken into consideration when governance policies are established for a collaborative space.

Kittur et al. also address the issues of conflict and coordination in wikis, using Wikipedia as a specific example.[18] They point out that conflict in online communities is complex and is associated with positive values as well as negative. These include resolving disagreements, establishing consensus, clarifying issues, and strengthening common values. However, conflict does lead to more indirect work, which they define as "excess work in the system that does not directly lead to new article content." This includes discussion, user coordination, maintenance activities such as reverts to earlier revisions, and anti-vandalism.

Policy and Governance Issues

Access and User Roles

Access to content and functionality is linked to user roles/types in most wikis whether they are public or private. In Wikipedia, which uses the MediaWiki platform, there are three types of users: anonymous (identified by IP address), registered (create username and password), and SYSOP (site administrators). All visitors to Wikipedia can view, edit, and discuss articles as well as view the article history. Registered users can be automatically notified by setting "watches" on pages and "move" (rename) pages. Only users with SYSOP status can block users, import pages, control user rights management, and view deleted pages. Although these are the access levels available at Wikipedia, MediaWiki allows users to tailor different access levels to their needs.

PBwiki is another platform that offers varying levels of access that can be set at page or more general levels. Readers cannot make any modifications to the wiki but can add comments; however, administrators have the ability to disable commenting at this level. In addition to reading and commenting, writers can edit pages and revert pages to previous versions. They can upload files and create new pages, but they cannot perform any functions that can't be undone. Editors do have the ability to delete content irrevocably and can rename files, folders, and pages. Administrators have the highest level access and can rename or delete anything on the wiki, add/remove users, change permission levels, set page security levels, see hidden pages, and edit locked pages. PBwiki also allows administrators to grant higher levels of access on a page by page basis.

Access can be a contentious issue and according to Burrow can be a deterrent to participation for authors who "prefer to 'incubate' ideas before laying them before a group."[19] As a means of avoiding this issue, the author proposes a theoretical model based on an augmented form of hypertext that includes an additional data structure to provide access rules—essentially the system automatically creates and maintains access rules in response to browsing and editing of the hypertext. This would allow changes in page status from private to public as the page evolves. Burrow's hypothetical example isn't too different from AHRQ's EPCs. In this scenario, a funding body has been created to foster collaborative research. It funds research by teams that include two tertiary institutions and an industry sponsor. These teams collaborate on proposals and deal with information exchange at various levels of sensitivity. The access rules change over the lifetime of the hypertext, access rules differ across documents, and the outcomes of the collaborative process are recorded. According to Burrow, "the central idea is to represent the access rules of each document in order to model its progressive exposure." This would be desirable for AHRQ in that access could be set at the page level, a single namespace could be maintained for all participants, and participants would only see page names as viable links if they have access to the page.

Adoption and Usage

Creating a wiki may be technically easy, but ensuring widespread adoption and continued use is more challenging. Some widely recognized barriers to adoption and usage are uneven computer literacy and skills within the wiki community and an open philosophy that may be at odds with existing organizational policies and work habits.[7,20,21] Although the lack of established

methods for setting up wiki sites used to be a significant barrier, this is less problematic given the availability of hosting sites that don't require the same level of IT expertise or access. WYSIWYG interfaces and extensions allow users to create content without knowledge of wikitext, however, some claim that these interfaces lack the flexibility of coding with wikitext.

One major barrier is the concept of owning one's work. Syzbalski notes that "while a blogger has almost complete control over a blog's content, a wiki contributor relinquishes control over his or her words as soon as they are posted."[21] The lack of a single author or editor can harm the authoritativeness of the content—users have less faith in the authority of the document. This could be especially critical in areas such as systematic review, where readers must have trust in the accuracy of the analyses. Suh et al. comment that "social transparency and the attribution of ideas and facts to individual researchers is a crucial part of the scientific process." To capture this information, they created the WikiDashboard.[20] This MediaWiki extension is currently embedded in Wikipedia and aggregates and graphically displays edit activity for each page over a given time period. A list of topic active editors for that page is also provided. A similar dashboard has also been developed for user pages to track the activity of individual users. According to the authors this is one way to "increase accountability and social transparency by surfacing hidden editing information." They note that more work is required to distinguish between work that should be transparent and some work that rightfully should stay private.

On a practical level, in his Wikipatterns book and wiki, Mader has identified over 90 "patterns" that encourage or discourage wiki use. These patterns are broken into People patterns and anti-patterns that are based on behaviors of individuals and Adoption patterns and anti-patterns that are based on structural features and policies; each pattern page includes an explanation of the pattern, how it is used, methods of fixing the problems and examples. For instance, the 90-9-1 Theory pattern focuses on patterns of user participation. Ninety percent of users are readers who "lurk" without contributing, 9 percent of users contribute occasionally, while 1 percent of users are very active and make the largest contributions. Another important People pattern is that of a WikiGnome (also known as a WikiGardener). "WikiGnomes are important to the success of a wiki because their edits increase the value of everyone else's content." Making cosmetic edits, improving information flow and clarity, and fixing broken links are examples of WikiGnome edits. A sampling of the patterns is listed in the Figure D-1 in Appendix D.[5] Abstracts of case studies from the Wikipatterns book are presented in Appendix D.

Suvinen and Saariluoma examined wiki usability from a psychological perspective and provide a series of suggestions for wiki developers. One suggestion is to clarify concepts by providing clearly written explanations in "tooltips." They recommend distinguishing between the content, processes of content generation, and content use and explaining the purpose of a page in the first couple of paragraphs. On a functional level they suggest using page maps, distinguishing between links in side bars and menus, and identifying the differences between types of search functions if more than one is available. They recommend automating some functions such as creating an "add" button that would open a template for creating new information and hover functionality for tooltips. A detailed site map, demos, and a sandbox (a separate page dedicated to experimentation) also enhance usability.[22]

Essentially, creating a wiki with content that people want, that is easy to use, has well-defined policies, and is seeded with information and templates to provide initial contribution is more likely to succeed.

Governance

Internal Wiki Governance

According to the Web Governance Task Force, Web governance is "the structure of people, positions, authorities, roles, responsibilities, relationships, and rules involved in managing an agency's Web site(s). The governance structure defines who can make what decisions, who is accountable for which efforts, and how each of the players must work together to operate a Web site and Web management process effectively." Governance is also an issue within wiki communities. Butler et al. state that "...pursuing the 'policyless' ideal that wikis represent is a pipedream. Policy creation and maintenance is an important aspect of the work that must be done to keep the community running." They propose a conceptual framework for understanding the "nature and role of policies and rules within wikis" that include a number of perspectives.[23] First, rules and policies can be seen as rational efforts to organize and coordinate activity and can serve as control mechanisms. This assumes that rulemaking is a conscious intentional action intended to improve collective performance, including reliability and consistency, and that the group members have the same motivations and goals. The Wikipedia community distinguishes between policies and guidelines and policies are often enacted after they've been used in practice and recognized as a means of improving the speed, and efficiency of administrating the encyclopedia. Butler et al. note that rules and policies should be seen as competing, self-propagating entities (e.g., rules beget more rules) that adapt over time. Rules are a method of constructing shared group and individual identities—this allows potential participants to gauge the "goodness of fit" with their interests and expertise and determine whether they wish to contribute to specific efforts. Rules are also a way of sending internal and external signals about the scope and norms of the community and resolving conflicts.

Federal Government

Wikis are subject to the same regulations and limitations as other Federal Internet-based resources. The Webcontent.gov Web site provides a checklist for requirements and provides links to the specific sections within larger regulations. This list and a table of agency Web governance policies are included in Appendix A.

Governance within agencies can be complex. For example, at the Environmental Protection Agency (EPA), primary responsibility for the agency Web site rests with the assistant and associate administrators of the Offices of Environmental Information and Public Affairs. Each section breaks Web management into content and infrastructure areas and has separate management structures for each branch.

A Web council convenes quarterly with occasional face-to-face meetings. The council has created topical workgroups that include council members, workgroup members and other interested individuals. The role of the groups is studying specific issues and then reporting recommended actions to the Web council. EPA is migrating its Web site to a new agency Web content management system and has created a wiki to ease the process but it is inward facing and only available from its intranet.

Section 508 Compliance

- One of the most critical governance topics is Section 508 compliance. Section 508, an amendment to the Workforce Rehabilitation Act of 1973, requires that electronic and

> information technology that is developed or purchased by the Federal Government is accessible by people with disabilities. According to § 1194.22 of the Act (Web-based intranet and Internet information and applications) the 508 requirements apply to intranets as well as publicly accessible sites and seemingly would affect launching both internal and public-facing U.S. Federal wikis. Most wiki platforms are text-based and use tags extensively and would therefore not be a barrier to Section 508. However, input from AHRQ's Section 508 coordinators would be prudent for the initial design of the wiki. AHRQ's coordinators may be contacted at http://www.section508.gov/index.cfm?fuseAction=Contact AHRQ's accessibility notice is available at www.ahrq.gov/accessibility.htm

COLAB is a Collaborative Work Environment for intergovernmental communities of practice that includes a wiki. Section 508 compliance is briefly addressed in the ColabWiki Style Guide (http://web.archive.org/web/20080621215521/http://colab.cim3.net/cgi-bin/wiki.pl?WikiStyleGuide). The Guide states, "When users author content that involve nontext elements to convey information, like color palettes, images and graphics, multimedia presentations, image maps, tables, frames, and when making use of scripts, plug-ins, applets, forms and/or timed responses, they should take responsibility to ensure section 508 compliance, if it is so required... Wiki pages should generally have no problem with Section 508 compliance as the pages are essentially text based. In the case of images, which include links to compatible image elements (e.g., a link to a .png, .gif or .jpg file) as well, an embedded image shows up within the body of the page. To ensure compliance, users should properly caption such linked image elements."

In the context of Web pages, alternative text (alt text), which provides a detailed audio description of nontext content, is highly important. This is illustrated in a study by Buzzi and Leporini[24] in which they investigated barriers that blind users might encounter when accessing Wikipedia using a screen reader. Both authors independently accessed three types of Wikipedia-user interfaces using the JAWS for Windows screen reader. One of the authors is sighted and familiar with Wikipedia but a novice JAWS user while the other was blind from childhood and used the JAWS application daily. Wikipedia was chosen as the test site because of its popularity and tests were conducted using both the English and Italian versions.

Not surprisingly, graphical interaction was difficult while using a screen reader, and the blind user's mental model of the editing page didn't match the real layout exactly. Many of the obstacles encountered were related to links—too many of the links had missing or ineffective alt names, preventing the screen reader from translating all the useful information on the page. A lack of labels was also a problem; there are multiple search boxes on Wikipedia pages that are not labeled. Sighted users can understand their use from their placement on the page, but this is invisible to the screen reader and is not relayed to the blind user. Additional challenges to the reader were the table-based graphical layout and the lack of clear messages when zero items are retrieved by a search. The authors also found it difficult to apply formatting and style properties and select characters and symbols. The expectation of Web designers that users would have access to both a keyboard and a mouse while editing was another obstacle for blind users, who rely on a keyboard for performing all functions.

The recommendations made by the authors to improve usability of Wikipedia for screen readers are in line with the 508 compliance requirements. They recommend simplifying editing functions and clearly identifying content parts and search boxes. Detailed recommendations for

508 compliance Web-based intranet and Internet information and applications are available at: http://www.section508.gov/index.cfm?FuseAction=content&ID=12#Web.

Wikis That State They Are 508-Compliant

Apture http://wiki.apture.com/apturewiki/index.php/Is_Apture_Section_508_Compliant%3F

SamePage http://www.etouch.net/products/collaboration/features_508_compliance.html

Although they don't specifically tout 508 compliance as a feature, Atlassian notes multiple U.S. federal agencies are using the Confluence Enterprise wiki, available at: http://confluence.atlassian.com/display/DISC/Confluence+Section+508+Accessibility+Compliance - These agencies include EPA, FBI, and HHS.

Agency Section 508 Coordinator List

http://www.section508.gov/index.cfm?FuseAction=Content&ID=84

We recommend that AHRQ query these coordinators to determine whether they have wikis and how Section 508 compliance is managed on these sites.

New Web Content Accessibility Guidelines (WCAG) 2.0

(released 12/11/08) www.w3.org/TR/2008/REC-WCAG20-20081211/

Table 1. Web governance—sample Federal agencies

Agency	Specific Areas Subject to This Policy
Department of Education www.ed.gov/internal/wwwstds.html#iwg content last updated 11/20/08	ED.gov mission and information architecture Administrative roles and responsibilities Funding model and contract support Technical architecture and operations Content management Performance metrics
Department of Energy http://www1.eere.energy.gov/communicationstandards content last updated 6/14/2011	Web Project Management Guidelines • Content analysis • Domains and URLs • Maintenance plans • Process and approval for site development • Project charters • Web site publication priorities and schedules • Statistics Web Content Guidelines • Accessibility • Contact information • Content Quality Assurance (QA) • Copyright • Links • Maintaining content • Navigation and common terms • Page elements • Search optimization • Types of pages • Wikis and blogs (wiki guidelines are still under development)
Environmental Protection Agency www.epa.gov/webgovernance/ approved 3/12/07, last updated 1/7/2010	Content Infrastructure

Table 1. Web governance—sample Federal agencies (continued)

Agency	Specific Areas Subject to This Policy
Health and Human Services http://www.hhs.gov/web/policies/index.html current dates listed with each policy	Section 508 accessibility (6/21/01) Forms (6/7/06) Domain names (7/13/05) Web records (12/5/07) Persistent cookies (1/8/01) OMB policies (12/14/05) Logos
Housing and Urban Development www.hud.gov/library/bookshelf11/policies/wwwpol.cfm	General (Internet site, Web-based products, Hosted Web sites, Web-based applications, Participation in interagency Web sites) Coordination and approvals Web technologies Information services File creation, posting, and retention Emergency procedures Links Privacy Accessibility Web-generated e-mail Photos and graphics Discussions (chat) Webcasts Mailing lists Publication standards
International Trade Administration www.usa.gov/webcontent/documents/ITA_WGB_Charter.pdf Last updated 2/21/07	Vision and target structure for ITA Web presence Information infrastructure Corporate brand identity Establish and review ITA standards for Web sites, Web content, and Web-based applications Monitor and enforce compliance
National Criminal Justice Reference Service www.ncjrs.gov/ojpquality.html Last updated 4/3/07	Utility Objectivity Integrity Transparency Sound statistical methods Guidance does not pertain to: • Information limited to government employees, agency contractors or grantees • Intra- or inter-agency use • Responses to Freedom of Information Act (FOIA) requests • Correspondence with individuals • Press releases & public filings • Information related to subpoenas or adjudicative processes • Archival records disseminated via libraries or federal repositories • Information presented to congress that isn't also distributed publically • Internal manuals

Technical and Informatics Issues

What Types of Wikis Are Available?

Different types of wikis are available with a range of features but all are server-based. The server can be maintained by the user or by a hosting organization. There are a large number of open-source wikis, and even commercial products are frequently free for personal use. Enterprise wikis are a single framework for managing multiple wikis. These are designed for the easy creation and management of new wiki spaces under a single organizational umbrella. These systems can link into existing user account repositories which allow users to log in using their organizational logon and password information.[2] WikiMatrix is an online site that allows users to compare wikis on more than 90 features. Lists of these features are presented in Appendix B.

Most people are familiar with Wikipedia, the wiki-based collaboratively maintained free-content encyclopedia project. Wikipedia can be edited by anyone with Internet access. But this does not have to hold true for all wikis. Wikis can differ in their community structures in several ways. Wikipedia represents an all-virtual community in which membership is granted by virtue of participating in the community. But wikis can also reflect existing physical and hybrid communities. In these cases, there are elements that tie the members together outside of participating in the wiki. Examples of these communities would include people working for the same organization, people with shared goals, and working groups. Levels of access can be tailored to meet the needs of the community and can range from completely open access to participation by invitation only.

Semantic wikis have been proposed as a means of enriching links with meaning.[25-29] A detailed discussion of ontologies, modeling, and description logic is outside the scope of this report. However, Wagner et al.'s discussion of building semantic webs for e-government with wiki technology may be of interest. The authors note that government domains are very large and include much information created by heterogeneous distributed sources. This results in inconsistent terminology and information overload. They propose overcoming this by adding a logic layer or semantic infrastructure for meaningful organization. This semantic layer would be maintained separately from the content, which allows continued collaborative development by nontechnical users. In their proposed approach "...site developers ...annotate the Web pages with semantic markup, semantic links, and metadata so as to enable machines to follow the links and ideally to facilitate the integration of knowledge and information from many different sources." [27](). Semantic markup refers to a markup language whose name spaces, vocabulary and relationships are meaningfully definable. Semantic links are pointers between Web objects, which can be meaningfully interpreted because of their labeling elsewhere in the system and because they may have properties or methods associated with them. The metadata adds further well-defined, meaningful information so as to facilitate machine readability even more and to enable better Web analysis to furnish best results to citizen users." Semantic wiki platforms are under development and semantic extensions for commonly used wikis (such as MediaWiki) are available.

Uses for Wikis

Szybalski[21] describes the wiki as the "conceptual descendant of both online communication networks like Usenet and application software like the word processor." Given the wiki's ease of

access and its ability to foster collaboration, wikis have been used in many contexts, most of which involve project management and/or content creation and management.

Majchrzak et al[30] surveyed experienced corporate wiki users to determine whether wikis were considered sustainable and beneficial and to characterize contributors and contributions. They found that wikis were used for:

- software development
- e-learning
- project management
- posting information
- knowledge management
- communities of practice/user groups
- ad hoc collaboration
- tech support
- marketing/customer relationship management
- resource management
- R&D

Topic-specific wiki-based resources are also common. Medpedia,[31] a wiki-based medical resource that launched recently clearly lays out commonly accepted principles of wiki participation. According to the Web site:

> The goal of The Medpedia Project is to evolve a new model for how the world will access medical knowledge in the future. The specifics of the model will evolve over time, but Medpedia is founded on several principles that will remain:
>
> - Wisdom of the Many—Medpedia is an iterative environment where content is written, edited and constantly re-edited by an ever-larger group of editors. Hundreds of editors can read the articles and monitor changes using the "Recent Changes" pages. The model, therefore, is that incorrect information will be corrected quickly, and the overall accuracy of Medpedia will always be improving.
> - Collaborative—Medpedia gives consumers, medical professionals, and organizations/companies their own ways to contribute. Each has a role in the real world, and each can be effective in contributing to Medpedia. The tools and permissions for those contributions will evolve over time as the system matures.
> - Interdisciplinary—Medpedia is able to tap knowledge from all medical and health professionals, starting with physicians and Ph.D. researchers, but safely including anyone with expertise and motivation, including nurses, public health officials, social workers, etc.
> - Appropriate language—Medpedia provides a structured environment encouraging two types of content to emerge: "Plain English" pages for the layperson, and "Clinical" pages for medical professionals.
> - Transparent—All members must have a profile with their real names and must disclose any financial, personal, or professional affiliations that may influence their participation on Medpedia. Every change made to the site is attached to a member's profile, and every change is visible in the logs of the knowledge base.

- Self Service—Medpedia is a platform of free tools anyone can use. Medical professionals can use Medpedia as a knowledge-sharing and communications tool, a recruiting tool for research collaborators, a clinical referral network, an article-publishing network, and a way to develop their reputation in their areas of expertise. Organizations can use Medpedia as a communications tool for their members and to fulfill their mission. And anyone may use Medpedia set alerts to follow topics of interest, learn and collect knowledge, teach and share information and elevate the best medical information on the Web.
- Free, Web-based, Real Time—Due to the nature of the Web, improvements made on the Web site are immediately available worldwide for zero incremental cost."

In addition to corporate, academic and general public use, wikis have also been implemented for government use both within specific agencies and on the broader federal level. These will be discussed in more detail in the section on Government Wikis.

Best Practices in Wiki Design

Wikis are intended to be graphically simple, but there are still design principles that encourage adoption and facilitate use. The core of the "Wiki Way" is represented by the following principles:[27]

Open—Any reader can edit as s/he sees fit.

- Incremental—Pages can cite other pages, including pages that have not been written yet. Within wiki systems citing the page will cause it to be created.
- Organic—Structure and text content of the site is open to editing and evolution.
- Mundane—A small number of (irregular) text conventions will provide access to the most useful (but limited) page markup.
- Universal—Mechanisms of editing and organizing are the same as those of writing so that any writer is automatically an editor and organizer.
- Overt—The formatted (and printed) output will suggest the input required to reproduce it (e.g., location of the page).
- Unified—Page names are drawn from a flat space so that no additional context is required to interpret them.
- Precise—Pages will be titles with sufficient precision to avoid most name clashes, typically by forming noun phrases.
- Tolerant—Interpretable (even if undesirable) behavior is preferred to error messages.
- Observable—Activity within the site can be watched and reviewed by any other visitor to the site.
- Convergent—Duplication can be discouraged or removed by finding and citing similar or related content.

In Wikipatterns,[5] Mader provides a list of best practices for pilot implements and for broader adoption.

Pilots

- Establish a timeframe (~3–6 months)
- Make it representative. Ensure you choose groups that represent typical projects and activities. This enhances buy in and provides a cross-section for evaluation.

- Keep the pilot groups small so you can work closely with each one.
- Choose representatives from each potential user group.
- Determine whether you'll hand-pick participants or advertise.
- Wikis must have a purpose to be relevant.
- Set up basic rules or guidelines.
- Set up personal spaces for each participant (contact information, blog/personal URL, biography).
- Encourage users to create scaffolds (templates) for new pages.
- "Make it a magnet"—get people into the habit of looking at the wiki for their information. You can accomplish this is by emailing links to the content on the wiki rather than the content itself.
- "Be firm and think long term"—try to keep users from slipping back into old habits (e.g., e-mail).

For wider adoption, Mader recommends developing a wiki use policy and adds the following items to the list created for pilots:

- Don't make the policy too long to read in its entirety.
- Note the goal for the wiki.
- Note there needs to be a moderator for each space—this helps to nurture growth, maintain organization, and provide a point of contact. However, he cautions moderators to remember that the space is owned by the community first and foremost and resist controlling it.
- Consider information sensitivity. This includes determining the visibility of information and the level of confidentiality required. There should be disclosure policy posted within each unit.
- Use disclaimers—consider consequences of posting information and consider that it's not just what is said but how it is said.

Overall, he recommends taking a phased approach, explaining how the wiki will help users and offering training and user support.

Hohman and Saiedian[3] discuss methods of customizing wikis to enhance project management. In addition to core activities such as posting and authoring content, they suggest incorporating pages for the following elements:

- ***Rapid feedback areas***—These encourage quick turnaround on evaluation of work products and should involve both management and peers.
- ***Peer-to-Peer links***—The authors suggest three levels: upper management, project management, and developers. The goal is facilitating communication between groups by making it easy to know who to contact in the other groups. The information should include the easiest method of contacting each person.
- ***Role descriptions***—Explicitly defining user roles facilitates communication between nonpeers. The authors strongly suggest creating the role of Problem Solver—this would be a highly experienced team member who either knows most of the answers to questions about the project or knows where to find them. There should be one problem solver per team, and everyone on the team should know who holds that role.

- ***High-level reports***—Posting project status and progress reports with a broad focus can serve multiple purposes. These include providing context for upper management and developers, providing a backup means of communicating project-related changes and decisions to remote teams, and alerting group members when documents or other information needed for the next stage of the project become available.
- ***Face lists***—Posting photos and an organizational chart builds trust between groups and combats the feeling that "remote team members are unknown and easily disregarded partners."
- ***Project directory***—These pages should contain definitions for key terms and jargon as well as lay out the methodology for the project. It should also provide background and context for the project.
- ***Business rules and policies***—These pages should contain links to formal documents and list rules and policies that are not defined more formally.
- ***Semantic wikis***—The authors suggest using two levels of semantic data (applied in the form of tags). The first level would be project oriented. For example, a Gantt chart for resource allocation would be labeled with a scheduling tag while schema planning notes would be labeled with an architectural planning tag. The second level of semantics would be chosen by the users. The authors note that while semantic tags are useful adjuncts for wiki content, they should be optional to prevent discouraging users from adding content.
- ***Light constraints***—According to Di Iorio and Zacchiroli,[32] wiki editing involves implicit rules that are exemplified by the editing practices of wiki users. Heavy constraints are "constraints that wiki pages must satisfy at any given instant to be practically useful." They note the need to code wiki pages so that they can be parsed by the wiki engine as an example of heavy constraints. Light constraints can be "(temporarily or not) violated, without inhibiting proper wiki runtime behavior." Light constraints typically encode community best practices and domain-specific requirements. They apply to the content itself rather than metadata or URLs and in some cases can be achieved using templates. The authors note several areas where this can help contributors and enhance consistency across the wiki. These scenarios include verifying spelling words, providing guidance for managing intra-wiki links, and creating a standard user profile that becomes available when contributors join the wiki community. They note that nonadherence to the constraints shouldn't prevent contributors from saving their content, but should be noted for reference. A user role of "Tailor" is suggested by both Hohman and Di Iorio—only users with a Tailor designation would be able to edit the rules for the constraints.[3,32]

Government Wikis

National Library of Medicine (NLM)

Dan Wendling, a member of the NIH Work Group, was interviewed by members of the ECRI Institute EPC in October 2008 to discuss the implementation of a wiki at NLM.[33,34] NLM has launched a pilot wiki on a commercial enterprise wiki platform (Atlassian's Confluence) with access limited to staff only. Although the NLM team considered using the open-source MediaWiki platform, they eventually chose the commercial system because they believed it requires less behind-scenes processing, and they felt their use case would be better served using an enterprise system which could provide multiple spaces with different permissions for viewing, editing, adding, and deleting content. The goal of the wiki was enhanced idea sharing, marshalling and presenting facts, and providing word processing within a browser. The initial steps involved policy and standards development and creating user roles. The group decided on three levels of usage: readers, participants, and administrators. The pilot wiki "went live" in May 2008 with 20–30 different spaces. Eight hundred staff members have access to the wiki, but only 80 were specifically told of its existence. Within 6 months after the launch approximately 200 staff members have viewed pages, and there are approximately 30 active users. The initial launch did not include user training but, according to Wendling, they are now rethinking this approach and are considering physically gathering users for training sessions and providing more FAQs.

NASA

The NASA wiki hosts the Federal Knowledge Management Working Group (KMWG) wiki, which brings together initiative-based and action groups within the Federal Government.

COLAB

The Center for Intergovernmental Solutions is the "U.S. government organization whose primary mission is to bring public-sector leaders together to share information, knowledge, and experience in leveraging best-practices to improve services to citizens." COLAB provides the workspace and tools for this endeavor. It is a collaborative work environment hosted by GSA Intergovernmental Solutions that includes a community portal, forum, and shared document repository as well as a community wiki. It currently hosts 30 intergovernmental communities of practice.

Intellipedia

Intellipedia is a wiki for the U.S. government intelligence community and was originally hosted by the Central Intelligence Agency. It is now managed by the Office of the Director of National Intelligence. The pilot version of the wiki was announced to the intelligence community in April 2006 and is open to anyone with a government email account. It is used by analysts, working groups, and engineers within the intelligence community. This wiki is not open to public access; however, as of 2008, there have been more than 1.5 million edits submitted by more than 35,000 registered users.[35]

Recommendations

Is There a Place for Wikis in the AHRQ EPC Program?

There are a number of ways that wikis could enhance collaboration for the EPCs without adding undue burdens. The most easily implemented use for a wiki would be establishing Communities of Practice based on methodologies. The EPC Librarians' Working Group might be a good group to pilot such a project—a central repository for resources and search strategies could be very beneficial and information professionals tend to be more comfortable with online platforms than some other user groups. The ECRI Information Center began using an informal wiki for this purpose after researching wikis for this project.

"Homepages" for ongoing EPC projects would be another useful early implementation of wikis. Although wikis can foster new forms of online collaboration they can also serve the same purpose as other Web sites, making information available to users with access privileges through any Internet connection. Wiki access could be provided to all contributors to the project and serve as a hub for meeting minutes, project documents, and other materials without support from an IT department. Users could contribute to more collaborative areas of the wiki as they become more comfortable with the technology.

Using a wiki for report authoring and review is a tantalizing prospect. There are many benefits of having a centralized single version of a document that represents the entire document history, including input from various authors and reviewers. However, as was pointed out earlier in this report, wiki technology is not sufficiently developed yet for authoring and reviewing reports on this scale. If AHRQ chooses piloting a wiki for collaborative authoring and review, an EPC representative should contact Liccardi et al.[14] to discuss the possibility of piloting the CAWS system, discussed in the "Collaborative Authoring" Section. Implementing wiki-based authoring and review would also require expert wiki users familiar with AHRQ processes to develop templates and training materials.

This white paper was partially authored using the PBwiki platform. PBwiki is a WYSIWG application and we did not add extensions to increase functionality. In many ways it was useful, including easy access to abstracted information from articles, easy dissemination amongst the workgroup, and universal access via the Internet. However, the flat structure did lead to some disorganization, which improved when tags were added to categorize the information. The wiki version of this white paper will differ in format to leverage the benefits of hyperlinks.

Selecting a Wiki

If AHRQ does decide to incorporate wikis, the choice of wiki platform should be carefully considered. There are many issues associated with selecting a wiki and there is an ever-increasing variety of wikis to choose from. Questions that might be asked when selecting a wiki platform for authoring and review could include:

- Can you put a lock on a page so only one user can revise at a time?
- If you allow simultaneous editing how does the wiki handle conflicts?
- Does the platform allow internal comments?
- Does the platform distinguish between minor (e.g., spelling) and more substantive changes?
- Are the pages equally readable in both edit and reading modes?

- Can weights be assigned to input by different reviewers?
- How does it accommodate the massive amount of data generated in systematic reviews?
- Can the platform be customized for statistical analysis?

Additional elements for consideration are the system infrastructure requirements, the level of maintenance required by the system and cost. Identifying workflow and sociocultural elements should be part of the decisionmaking process as well. Lists of comparable specifications are provided in Appendix B. Sites such as WikiMatrix and the Wikipedia Comparison of Wiki Software page help potential users to evaluate wikis on multiple dimensions; WikiMatrix currently contains data on 118 wikis and lists MediaWiki, DokuWiki, PmWiki, TWiki, and PhpWiki as the most frequently compared wikis.

In 2006, the Office of the Chief IT Architect of the National Institutes of Health (NIH) convened a working group to investigate the best application of wikis for NIH enterprise. The group was charged with developing and issuing a Request for Information for wiki solutions, conducting market research analyses, examining Federal and agency-specific governance guidelines, determining wiki best practices, surveying the NIH population for current wiki use, and reviewing existing wiki sites within the government. Members of the working group were drawn from departments across NIH. The group's final report was published in June 2006.[36] (See NIH_Wiki_Final_Report.pdf)

Despite concerns with the effects wikis might have on productivity and the potential degradation of the reliability of posted information, the group found that wikis foster and support collaboration within and across organizational groups in a wide range of situations. Some specific benefits were a broader sense of ownership and greater participation, wider access to content, and distribution of workload. This resulted in project completion with shortened timeframes and more efficient workflow. The ease of customization, agile and lightweight interfaces, and interactive and dynamic nature of the tools were noted as elements of this success.

The Working Group reported a number of issues relevant to AHRQ that remain unanswered:

- Should relationships be established between internal wikis? If so, how should these relationships be defined, implemented and maintained?
- Wikis should have determined and finite life cycles. Are there any archiving requirements or mandates?
- How should the Freedom of Information Act (FOIA) be interpreted in the context of a wiki?

Although the group did not recommend a specific technology, it did make recommendations for internal and external uses of wikis for the NIH enterprise, some of which are also applicable for AHRQ. These were:

- The wikis should be behind the agency firewall.
- The wikis should be accessible through AHRQ's Clinical Information Web site.
- The content should be indexed and searchable.
- A library of predetermined templates should be developed.

Before moving forward with a wiki project, AHRQ should investigate its current Web governance policies and identify personnel that could contribute to the wiki selection process. The EPCs also need to decide whether they wish to create a network of wikis within the umbrella

of an enterprise wiki system or create a series of independent wikis which could be connected via hyperlinks. In either case, since several HHS agencies are using the commercial Confluence enterprise wiki, it would be useful to contact them to determine what informed their decision on this platform. It would also be advisable to determine whether HHS is planning standardization on a wiki platform.

This literature review reveals numerous ways in which wikis could enrich the EPC community and processes. The next step should be discussion of issues identified in this report amongst the broader EPC community with the goal of launching Community of Practice and project-specific wiki pilots.

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Appendix A. Requirements Checklist for Government Web Managers

"The Federal Web Managers Council has developed this comprehensive self-assessment 'checklist' to help you assess how well your agency meets federal Web site requirements. It's based on current laws and regulations, OMB Policies for Federal Public Web sites, and other directives that pertain to federal public Web sites.*

To meet the requirements, agencies should be able to answer 'yes' to the questions below.

- ***E-Government Act of 2002***: Does your site comply with policies and standards to implement the E-Government Act of 2002, Section 207(d)?

  Source: E-Government Act of 2002 http://www.gpo.gov/fdsys/pkg/PLAW-107publ347/content-detail.html

- ***A-130***: Does your site comply with OMB Circular A-130, Management of Federal Information Resources?

  Source: OMB Circular A-130: Management of Federal Information Resources http://www.whitehouse.gov/omb/circulars_a130_a130trans4

  See also: Major Implications of A-130 for Federal Web Managers http://www.usa.gov/webcontent/documents/a130summary.pdf

  (PDF, 103 KB, Jun 2005, requires Adobe Acrobat Reader)

- ***Approved Domains***: Is your URL a .gov, .fed.us, or .mil domain?

  Source: OMB Policy, Section 6 http://www.usa.gov/webcontent/reqs_bestpractices/omb_policies/domains.shtml

- ***Agency Sponsorship***: Do you provide 'clear and unambiguous public notification of the agency's involvement in or sponsorship' of your Web site?

  Source: OMB Policy, Section 6 http://www.usa.gov/webcontent/reqs_bestpractices/omb_policies/domains.shtml

- ***Linking Policy***: Does your Web site have a linking policy for how you link to other sites, including 'management controls for linking within and beyond your agency'?

  Source: OMB Policy, Section 3 http://www.usa.gov/webcontent/reqs_bestpractices/omb_policies/linking.shtml

- ***Disclaimers:*** Does your site have appropriate disclaimers and 'clearly identify the limitations inherent in the information' that is provided on your site or on sites you link to?

  Source: OMB Policy, Section 3 http://www.usa.gov/webcontent/reqs_bestpractices/omb_policies/linking.shtml

- ***External Links Review:*** Does your site have 'reasonable management controls to assure external links remain active'?

  Source: OMB Policy, Section 3
  http://www.usa.gov/webcontent/reqs_bestpractices/omb_policies/linking.shtml

- ***Required Links and Content***: Does your site include 'mandatory links and post (or link to) the [required] information on your principal Web site and any known major entry points'?

  See Required Content and Links page for complete list

  http://www.usa.gov/webcontent/managing_content/organizing/links/required_links.shtml

  Source: OMB Policy, Section 3
  http://www.usa.gov/webcontent/reqs_bestpractices/omb_policies/linking.shtml

- ***Advertising:*** Have you ensured that your site is 'not used to advertise for private individuals, firms, or corporations, or imply in any manner that the government endorses or favors any specific commercial product, commodity, or service'?

  Source: .gov domain registration program guidelines
  https://www.dotgov.gov/portal/web/dotgov;jsessionid=CBjCTzGhTK1pybGD1KBsXNvyXXSvkyJWGp7sJsTL0DT88HW2zLZp1Z8WhQYSLhTDv1qsQ9xfLp4797mL02p9RVDndnpGwfBQSHqhK19R31hvb4Xn7j8pJwLTPVpNBnrC!-1424553105!1316177626810

- ***Communication with the Public***: Have you established and maintained 'communications with members of the public and with state and local governments' to ensure you create content that meets their respective needs?

  Source: OMB Policy, Section 4
  http://www.usa.gov/webcontent/reqs_bestpractices/omb_policies/communication.shtml

- ***Privacy Policy***:
  - Does your site post a 'Privacy Act Statement' that tells visitors the organization's legal authority for collecting personal data and how the data will be used?
  - Does your Web site have 'a link to your privacy policy from:
    - your principal Web site;
    - any known, major entry points to your sites;
    - any Web page that collects substantial information in identifiable form.'
  - Does your site conduct privacy impact assessments?
  - Does your site translate privacy policies into a standardized machine-readable format?

  Sources: OMB Guidance for Implementing the Privacy Provisions of the E-Government Act of 2002 (See Section 3D) http://www.whitehouse.gov/omb/memoranda_m03-22

E-Government Act of 2002

http://www.gpo.gov/fdsys/pkg/PLAW-107publ347/content-detail.html

- ***Security***: Does your site comply with Section 207(f)(1)(b)(iv) of the E-Gov Act of 2002, which requires organizations to have security protocols to protect information?

  Source: E-Government Act of 2002

  http://www.gpo.gov/fdsys/pkg/PLAW-107publ347/content-detail.html

- ***Accessibility (Section 508)***: Does your site comply with the requirements of Section 508 of the Rehabilitation Act (29 U.S.C. 794d), designed to make online information and services fully available to citizens with disabilities?

  Source: Section 508

  http://www.usa.gov/webcontent/reqs_bestpractices/laws_regs/accessibility.shtml

- ***FOIA***: Does your site comply with existing laws and directives that relate to the Freedom of Information Act (FOIA)?

  Source: FOIA

  http://www.usa.gov/webcontent/reqs_bestpractices/laws_regs/foia.shtml

- ***Information Quality Guidelines***: Does your site comply with section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554, 'Guidelines for Ensuring and Maximizing the Quality Objectivity, Utility, and Integrity of Information Disseminated by Federal Organizations'?

  Source: Information Quality Guidelines

  http://www.usa.gov/webcontent/reqs_bestpractices/laws_regs/info_quality.shtml

- ***Access for People with Limited English Proficiency***: Does your site provide 'meaningful access' to government information and services for people with limited English proficiency?

  Source: LEP Executive Order

  http://www.usa.gov/webcontent/reqs_bestpractices/laws_regs/languages.shtml

- ***Paperwork Reduction Act***: Have you received OMB approval before collecting information from the public (such as forms, general questionnaires, surveys, instructions, and other types of collections)? And do you display the current OMB control number?

  Source: Paperwork Reduction Act

  http://www.usa.gov/webcontent/reqs_bestpractices/laws_regs/paperwork_reduction.shtml

- ***Government Paperwork Elimination Act (GPEA)***: Do you use electronic forms, electronic filing, and electronic signatures to conduct official business with the public, whenever practicable?

  Source: GPEA

  http://www.usa.gov/webcontent/reqs_bestpractices/laws_regs/gpea.shtml

- ***Web Records***: Does your site comply with existing laws and regulations related to the management of public Web records?

  Source: Web Records
  http://www.usa.gov/webcontent/reqs_bestpractices/laws_regs/web_records.shtml

- ***Digital Rights and Copyright***: If your organization uses or duplicates information available from the private sector as part of an information resource, product or service, do you ensure that the property rights of the private sector source are adequately protected? (These protections apply to any material posted to federal public Web sites, such as documents, graphics, or audio files.)

  Source: Digital Rights and Copyright
  http://www.usa.gov/webcontent/reqs_bestpractices/laws_regs/copyright.shtml

- ***GPRA*** : Have you made your annual performance plans 'readily available to the public' via your Web site?

  Source: GPRA

  http://www.usa.gov/webcontent/reqs_bestpractices/laws_regs/gpra.shtml

- ***Restrictions on Lobbying***: Does your site comply with existing laws that prohibit federal public Web sites from being used for direct or indirect lobbying?

  Source: Restrictions on Lobbying
  http://www.usa.gov/webcontent/reqs_bestpractices/laws_regs/lobbying.shtml

- ***Priorities and Schedules for Posting Content***:
  - Have you created an inventory of content that all targeted audiences need or want? (The inventory should identify categories of information, such as press releases, publications, and budget documents – not specific documents.)
  - Have you determined a schedule for posting additional content in the future?
  - Have you incorporated this requirement in management plans?
  - Have you posted the inventory, priorities, and schedule for posting additional content on your Web site, for public comment?

  Source: Priorities and Schedules
  http://www.usa.gov/webcontent/reqs_bestpractices/laws_regs/priorities_reqs.shtml

- ***Search:*** Does your agency's principle public Web site and any major entry point include a search function? (exception may be smaller Web sites)

  Source: OMB Policies, Section 5
  http://www.usa.gov/webcontent/reqs_bestpractices/omb_policies/search.shtml

*Important Note: These requirements apply to executive departments and agencies and their public Web sites. Some requirements may not apply to Intranet Web sites or to judicial or legislative agencies, as specified in each individual policy, law, or other directive.

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Appendix B. Elements That Can Be Compared Using WikiMatrix

- **General Features**
  - Author
  - URL
  - License Cost/ Fee
  - Intended Audience
- **Security/Anti-Spam**
  - Page Permissions
  - ACL
  - Host Blocking
  - Mail Encryption
  - nofollow
  - Blacklist
  - CAPTCHA
  - Delayed Indexing
- **Development/Support**
  - Commercial Support
  - Issue Tracker
  - Mailing List
  - Support Forum
  - IRC Channel
- **Common Features**
  - Preview
  - Minor Changes
  - Change Summary
  - Page History
  - Page Revisions
  - Revision Diffs
  - Page Index
  - Plugin System
- **Special Features**
  - Unicode Support
  - Right-to-Left Support
  - Interface Languages
  - Email notification
  - Comments
  - Categories
  - Namespaces
  - Page Redirection
  - Conflict Handling
  - Search
  - Structured Data
- **Links**
  - CamelCase
  - Freelinks
  - Backlinks
  - InterWiki
  - SisterWiki
  - Image Links
  - Windows Shares
  - Page Redirects
- **Syntax Features**
  - HTML Tags
  - Math formulas
  - Tables
  - CREOLE support
  - Markdown Support
  - Textile Support
  - BBCode Support
  - Emoticon Images
  - Syntax Highlighting
  - Footnotes
  - Quoting
  - Internal Comments
  - Custom styles
  - FAQ Tags
  - Scripting
  - Content Includes
  - Feed Aggregation
- **Usability**
  - Section Editing
  - Page Templates
  - Double-Click Edit
  - Toolbar
  - WYSIWYG Editing
  - Access Keys
  - Auto Signature
- **Statistics**
  - Recent Changes
  - Wanted Pages
  - Orphaned Pages
  - Most/Least Popular
  - Recent Visitors
  - Analysis
- **Output**
  - HTML
  - CSS Stylesheets
  - Printer Friendly
  - Mobile Friendly
  - Themes & Skins
  - RSS Feeds
  - ATOM Feeds
  - Abbreviations
  - Auto-TOC
  - Raw Export
  - HTML Export
  - XML export
  - PDF Export
- **Media and Files**
  - File Attachments
  - Media Revisions
  - Embedded Flash
  - Embedded Video
  - Image Editing
  - SVG Editing
  - MindMap Editing
  - Media Search
- **Extras**
  - Calendar
  - Image Galleries
  - Forums
  - Blogs
  - Ticket System

Appendix C. Recommended Reading

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Appendix D. Case Study: Community of Practice Based on a Wiki

The Agence d'évaluation des technologies et des modes d'intervention en santé (AETMIS), the Canadian government agency in the province of Quebec responsible for health services and technology assessment, decided to look into using a wiki to share information about their research projects about three years ago. Most researchers are on contract and are far-flung, working at home approximately three days a week. "We have developed a community of practice based on a wiki," says Reiner Banken, M.D., Deputy Director of AETMIS. The wiki helps researchers and staff members think together about their shared interests and research in their community of practice.

Communities of practice are "groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis".[6] A wiki provides a way to create, nurture and sustain an intellectual community of this nature without its members ever physically coming together by providing them with an asynchronous electronic meeting space.

For its meeting space, AETMIS chose TikiWiki, an open-source, Web-based application. According to the Open Source Initiative, "Open source is a development method for software that harnesses the power of distributed peer review and transparency of process." (Available at: http://www.opensource.org/). Currently, TikiWiki is actively developed by a large international community, and "can be used to create all sorts of Web applications, sites, portals, knowledge base, intranets, and extranets." (See the TikiWiki Fact Sheet, available at: http://info.tikiwiki.org/Fact+Sheet).

AETMIS uses TikiWiki as a wiki-based intranet/extranet. The agency found that this platform has the "great advantage of a very well developed system of permissions for accessing pages, and we are using this system to create collaborative workspace for researchers," says Banken. AETMIS also uses TikiWiki as the platform for the INAHTA/HTAi glossary [The International Network of Agencies for Health Technology Assessment/Health Technology Assessment International (HTAi)]. The agency used TikiWiki as a project management and information sharing tool for organizing the HTAi 2008 meeting. Currently AETMIS is working with TikiWiki developers on bibliographic database tools and mind-mapping applications. As TikiWiki is open source, all developments become part of future releases.

The AETMIS staff learned to use TikiWiki by pairing up staff members and having the more computer-savvy staff (regardless of age) teach the staff members who were less experienced with using computers to use the wiki. This process took time, but eventually staff members adapted to the wiki. Initially, AETMIS began with an intranet, but now the agency has an extranet so that external researchers can also participate in the community of practice, and exchange information and ideas. Now researchers are beginning to collaborate on writing.

"The fundamental elements of a Community of Practice are: a domain of knowledge, a community of people and shared practices. Wikis can be seen as a supporting technology for a Community of Practice: they enable users to discuss around a page representing a concept, they adapt to situations in which knowledge changes quickly, and they do not impose any extra overhead on those who want to contribute."[37]

Going forward, Banken says, "We plan to use the wiki to interact with stakeholders on research projects. Our reports should make sense to all of the stakeholders involved. It's very difficult to involve all of our stakeholders in the process. The wiki is another tools that we can

use making our work transparent to them, helping them understand what we do, and involving them in our work."

Screen shots and additional information are available at Wiki at AETMIS.

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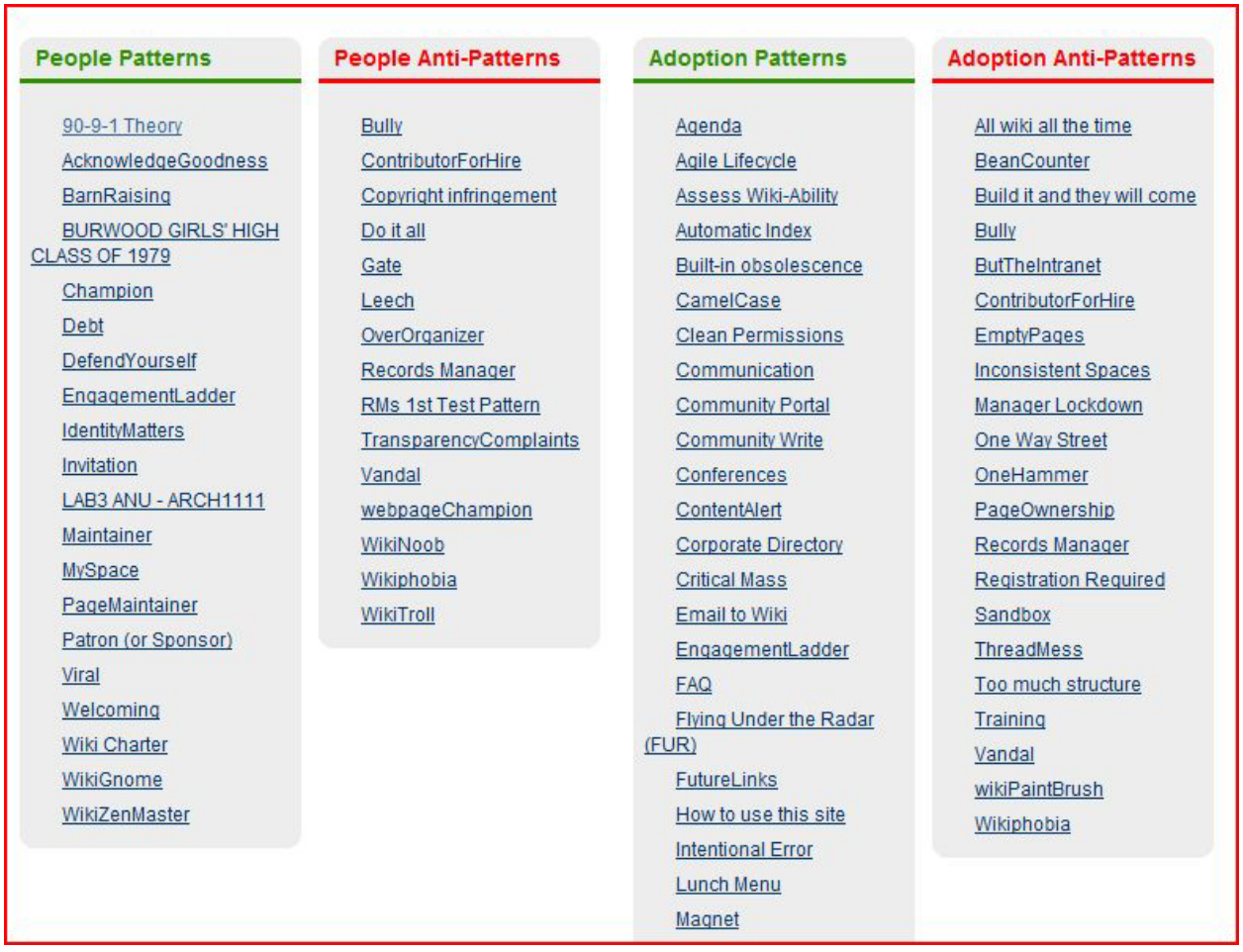
Listing of Patterns and Abstracted Case Studies from WikiPatterns[5]

Figure D-1. Selected WikiPatterns



Source: www.wikipatterns.com/display/wikipatterns/Wikipatterns

Table D-1. Abstracted case studies from WikiPatterns

Organization	Reason for Using a Wiki	Type of Wiki	How is it being used?	Outcomes & Changes
LeapFrog Interview was conducted 3 months before widespread corporate rollout www.leapfrog.com pp. 17-23	Info management system for product ideas, tracking concept development & improve collaboration	Commercial enterprise wiki (sounds like Confluence) Private	Gave it a human name—Emma Emma Support Emma Users Group Separate wiki spaces: • personal • project • organizational group • site-wide FAQ system • collective knowledgebase • site framework Tools that have evolved: • "About" boxes for each space • Source code repository • dashboards • employee blogs • innovation spaces Not the end application for all information	More unity—tears down walls between functional groups working on the same project emphasis shifted from presentation aesthetics to information creation and distribution Emma has entered corporate lexicon increased ease of information access and transparency
Johns Hopkins University www.jhu.edu pp. 37-39	Creating new student information system. Needed to communicate with project participants and stakeholders while reducing the volume of e-mail.	Commercial enterprise wiki Private	Knowledgebase Document repository Employee blogs Departmental intranets Task force collaboration	Increased transparency Increased trust between project members and stakeholders Ideas are posting ideas and quickly receive comments, elaborations, invalidations, etc.
Sun Microsystems http://wikis.sun.com pp. 61-62	Content sharing and collaboration	Readable by anyone—edit access for anyone with a Sun online account who has requested and been granted permission. Employees have global write access, outside users only have access to the pages that they've requested access to.	Collaborative creation of documents	Pages have been created for a variety of work and social-related topics.

Table 2. Abstracted case studies from WikiPatterns (continued)

Organization	Reason for Using a Wiki	Type of Wiki	How is it being used?	Outcomes & Changes
Red Ant www.redant.com.au pp. 75-79	Organization uses a central edit model. flexible communication both within company and with clients	Commercial enterprise wiki	Documenting meeting notes Client access to designs & prototypes Links to staging versions Present feedback and stats analysis in real-time Create filtered views of information Summary - WIP page	Stronger communication internally and externally Centralized data saves time Empowers team members
Center for Scholarly Technology - USC Jude Higdon pp. 81-85	Intra- and inter-class communications	Enterprise wiki	Pilot expanded to 40 instructor-led projects involving more than 1,000 students Grad students in master of public policy program conducted research on insights into redeveloping urban areas devastated by natural disasters. Wiki was used in redesign ideas for 9th Ward in New Orleans Collectively generated knowledgebase on the history of the evolution debates Managing multisemester collaborative projects Platform for collaborative writing assignments	Increased instructor interest in creating nontraditional writing and collaboration assignments. Only 1 of the 40 projects ended early
JavaPolis Conference & Community (Belgium Java Users Group BeJUG) www.javapolis.com pp. 101-102	Planning tool for large conference. Allows companies to update their own partner page, speakers to add or edit bios and abstracts, and updating the conference schedule and program.	Self-hosted JAVA wiki using Resin Web server and MySQL database	Conference Web site Schedule of events, information on speakers, partners, sponsors & news	Overcame initial skepticism. More community collaboration in voting, comments, and content updates
Chordiant Software Jeff Calado, Release Engineering Manager pp. 103-105	Centralize information and enhance access	Self-hosted commercial enterprise wiki	Space for each team and each project Posting meeting notes and specs Created email account for the wiki and added it to the project email group. Emails are automatically downloaded to the project site for archiving.	Centralization of project information Expectation that people will take relevant information from their heads and share it on the wiki. Decreased learning curve for new employees and increased consistency in the training process. Improved knowledge and skills of broader team

Table 2. Abstracted case studies from WikiPatterns (continued)

Organization	Reason for Using a Wiki	Type of Wiki	How is it being used?	Outcomes & Changes
Kerrydale Street Celtic Football Club www.kerrydalestreeet.com fan club for a Scottish football team pp. 117-119	Co-op fans to build the "ultimate" fan site	Free consumer-oriented hosted wiki service	Comprehensive guide to Celtic FC	Rapid site growth Site returned in first page of Google searches for the team
National Constitution Center Constitution Day Education Nonprofit organization Tom Hillhouse pp. 127-128	Community-oriented content management system.	Commercial enterprise wiki	Permission-based Structured metadata Template based design	Task distribution Empower users
Creative Digital Industries Mapping Project - Queensland University of Technology http://wiki.cci.edu.au/display/NMP pp. 129-139	Cutting through bureaucracy which was functional for large groups but not for small mapping project. Enhance collaboration for cross-disciplinary global project Goals: Encourage & facilitate discussion and agreement regarding approaches to taxonomies and strategies Forum for sharing info Harness knowledge and "willingness to participate" Asynchronous communication	Confluence enterprise wiki	Established 4 levels of access: Anonymous public - can view entire site but cannot edit or comment Self-enrolled researchers and practitioners - see, edit, & comment on most parts of site. Add & edit pages and forums. Project partners, contractors & consultants - same as researchers but can also access the project administration area Project Administrator - manages user logins, authority levels, page and global access Still in first generation of usage. Plans for second generation: Infrastructure for delivering eResearch services Citation management Networking "sandboxes"	Benefits projects with a high coordination requirement (such as RFPs) within a relatively short time frame. Allows researchers to take direct control of the publishing and communication with their collaborators and community with a minimum of distraction