

# Wikis at Work: Success Factors and Challenges for Sustainability of Enterprise Wikis

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## ABSTRACT

We examined wiki use in a range of enterprise settings. We found many thriving wikis, but they were a minority of the thousands for which we obtained data. Even an actively used wiki can disappoint some important stakeholders. Careful stakeholder analysis and education may be crucial to successful wiki deployment. We identify a range of success factors, sources of wiki abandonment, and approaches to addressing the challenges. Some of our observations may extend to other social media.

## Categories and Subject Descriptors

H.5.3 [Group and Organizational Interfaces].

## General Terms

Management, Design, Human Factors.

## Keywords

Wiki, adoption, organization behavior.

## 1. INTRODUCTION

Enterprise document repositories grow rapidly, the pace of work quickens, and aging workers retire. When and how can wikis help organizations capture and organize knowledge for subsequent access?

Technology developed to archive and access institutional knowledge, such as the knowledge engineering and expert systems of the 1980s, rarely do well. They require considerable effort, encounter conflicting individual and disciplinary uses of terms, and top-down enforcement of effective use often fails. When information is retrieved, its currency and relevance is often uncertain. People in organizations often resort quickly to familiar human sources when seeking information [13].

The Dewey Decimal system used in libraries is a successful document management system, but it requires more overhead than most workplaces can provide. Weblogs can help manage project knowledge [9, 21, 25], but they are generally constrained to chronological, unrevised posting of information by one individual. Wikis are not as lightweight as blogs, but they avoid these limitations. They can be flexibly organized, promote multiple authors, and include a revision history. No special software is required for viewing, not much training is required to edit one, and employees are likely to be familiar with the concept through

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Wikipedia. Wiki projects were frequently undertaken in the environments we studied.

Enterprise settings present opportunities and challenges that differ from those confronting wikis elsewhere—educational settings or online public-access wikis such as Wikipedia and those on the Wikia platform. Large enterprises typically are hierarchically organized, with a complex array of competing forces elegantly described in organizational theorist Henry Mintzberg's account discussed in the next section [14]. The predominantly bottom-up character of wiki use is not a natural fit.

Enterprise wikis typically reside within a firewall. They are largely immune to spam and vandalism, a plus, but they can also be difficult for employees to access when not in the workplace. Large or mid-size enterprises have complex communication channels, repositories, authority figures, external constraints, and responsibility assignments. Their need to manage communication and information access affords opportunities for new technologies, but introducing one is inevitably disruptive for a time. Enterprises often undergo dramatic reorganizations, yet need a resilient, enduring information infrastructure. This does not preclude wiki use for limited-duration projects—indeed, this is a promising venue—but many wiki projects are undertaken with long-term knowledge management as a goal.

We collected quantitative data and conducted in-depth interviews in science, engineering, and technology companies ranging in size from a handful of people to over 100,000. We found extensive experimentation with several uses of wiki tools: single-contributor web pages used primarily for personal information management, team-based wikis used for small-scale collaboration, and enterprise-wide internal encyclopedias. We found some thriving wikis in a sea of discontinued sites. Not surprisingly, barriers to successful use that we identified were often absent in successful cases. However, even the most heavily used wiki that we found was threatened by a key stakeholder's lack of recognition of its value. Organizations are only beginning to understand this tool.

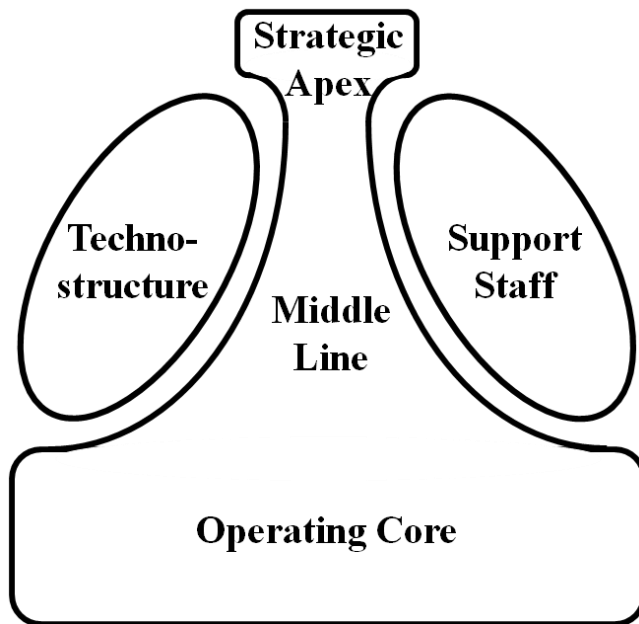
## 2. PAST WORK

### 2.1 Technology Adoption in Organizations

Many digital technologies are adopted by hobbyists and students first, with corporate use coming later—email, the Internet, instant messaging, and weblogs are examples. Younger employees who are familiar with a new technology see how to use it to work more efficiently or effectively, eventually overcoming resistance. Change almost always requires some effort, but today it is easier for businesses to introduce many new communication and information-sharing technologies. Networked systems are in place, applications can be acquired and installed with lower cost and effort, and most employees have computer skills.

Young individual contributors who have a relatively high need for informal, ad hoc communication and learning may see the value in new technologies; seasoned managers whose jobs involve coordinating activity and sharing highly structured information may see them as “ways that students waste time.” The different perspectives may be less a function of age than role, as elaborated in an elegant analysis of organizational behavior by Henry Mintzberg [14].

Mintzberg notes that most organizations comprise five distinct parts: (i) individual contributors who do the work; (ii) managers; (iii) executives; (iv) the technostructure responsible for designing work processes (policies, forms, workflows, etc.); and (v) the remaining support staff (Figure 1). Each part of the organization is organized and managed differently, and has a distinct view of the enterprise. This leads to very different uses of software tools by different organizational stakeholders [8].



**Figure 1. Five parts of organizations. (Mintzberg, 1984).**

People in each area vie for influence, and in different types of organization, different parts or roles take center stage. In a small organization, the executive typically plays a dominant role. In large divisionalized companies, middle management overseeing the divisions is central. In “professional bureaucracies” such as universities, the operating core, the instructors and professors doing the work of teaching and research, have unusual levels of authority and autonomy. In organizations with a strong focus on process, such as manufacturing, the technostructure is critical. Mintzberg also identifies “adhocracies,” such as a company pulled together to create a film, in which the support roles are crucial.

He outlines differences in outlook, focus, ways of structuring and measuring work, and other distinctions across the parts of an organization. This had limited significance for technology use when few employees were active users, but today most people in many organizations use some of the same applications.

We have observed significant differences in the uses of a range of communication and information sharing applications [8]. A feature useful to individual contributors may be rejected by managers; features useful to managers may be disliked by

executives, and so on. Why? Variables that systematically affect how different technologies are received include the proportion of time spent in formal meetings; the ability to delegate to tasks; whether an employee’s work emphasizes informal interaction, sharing of structured information (documents, spreadsheets, slide decks, etc.), or coordinating the activities of different groups of people; and the political sensitivity of work activities, which affects attitudes toward visibility and transparency. Of course the attitudes of IT professionals, an important support group, influence technology use in the enterprise, and technology is ever more central to the organizational processes comprising the technostructure.

We did not go into this study looking for role-based differences, but they emerged in interviews. Differences in outlook have consequences. A technology can be declared a time waster by managers before it has a chance to show its merits; conversely, inflated high-level expectations can lead to disappointment before a technology’s true value is established. A careful analysis of the goals and realistic possibilities for different organizational stakeholders is a good idea.

## 2.2 Wiki Use in Organizations

Organizational uses of wikis includes employee use of Wikipedia and other public wikis, external use of wikis that are designed for interacting with customers or vendors [23], and wikis created for internal use as an information repository, for project management, to communicate across groups, or other purposes. Our research focuses on the latter, but we consulted research on the other uses for contrasts and insights, to identify potential opportunities, challenges and behaviors to examine.

The growing literature on wiki use focuses primarily on public online wikis. It does not specifically examine their use in organizations—potentially a good research topic! A difference frequently noted is that vandalism is a problem on public wikis [16, 22], but not a concern on intranets where anonymity is not the rule [1, 3]. Other important distinctions include the greater availability of alternative communication channels for enterprise users, which is likely to lead to different coordination and conflict resolution patterns than those found for Wikipedia [10].

A major focus of Wikipedia research has been the emergence of incentive systems and governance based on participation and reputation [6, 11, 17]. In contrast to this bottom-up process, organizations other than startups have incentive, reputation, and governance structures already in place. Information accuracy, a major issue for public wikis [7, 19], plays out differently in organizations that have processes in place to address it. We find that such factors can complicate or alter the evolution of wiki use.

Most other studies of wiki use are in educational settings, specifically in classroom use [2, 6, 18, 26]. Schools and universities are workplaces, but have special characteristics—and not only that most users are young. Classroom wikis are used less by the employees (instructors and administrators) than the customers (students). A class wiki is typically intended to last for only 10 to 15 weeks. Enterprise wiki efforts are often in support of longer projects; even wikis used to support short-lived projects and events generally envision a repository that will be consulted.

The studies of educational settings provide insights and directions for exploration. Wikis used in classes share some features of use in startup companies, one of the venues we explored. Yet educational institutions have traditions and established routines

that create a potential for conflict, as in the case of introducing a technology into an existing enterprise. Forte [6] found that wiki use was discontinued in a high school class because it did not fit into existing practices for assessing and viewing student work.

Some small-scale studies of organizational use are reported, often based on interviews with several people or in one setting [4, 24]. They identify possible problems that mirror those reported for earlier knowledge management systems: lack of management support, data that is difficult to find or out of date, and software usability problems. An experience report describing wikis used in a law firm [5] for collaboration, information display, and personal use, although written by an upbeat evangelist, nicely identified some of the problems that we found and report here.

An interesting category is the successful use of wikis developed for serious project use in a research organization, with the involvement of researchers in design and management. They are a special case that provides valuable insights and examples. We cover several such projects here and return to them in the Results and Discussion section.

Danis and Singer [3] describe two years of use of a wiki designed to replace a tool that supported a research laboratory’s annual project proposal process. Similarly, Alquier et al. [1] describe the issues involved in migrating an existing relational database to a media-wiki based “collaborative database” involving integration with other tools. In replacing an existing major process or system, they had the advantage of mandated use of the tool. In contrast, none of the thousands of project wikis we examined were to our knowledge carefully designed. They were typically ad-hoc efforts to support ongoing projects or startup operations.

Phuwanartnurak [15] describes a wiki used with other tools for two software development projects in a university IT department. The projects were relatively short-term, staffed by relatively young and mostly wiki-savvy teams. Some of these users considered the need to refresh the wiki to see updates an impediment (following activity was slow, “not live”) and preferred an IM-like tool. Despite this the tool was used, and this case bears a resemblance to the startups in our study.

Majchrzak et al. [12] conducted a survey to determine whether wikis were being used in organizations and if so, for what. They recruited people from wiki-oriented listservs, so not surprisingly their 165 respondents mostly reported successful use, providing an affirmative answer to their first question: Are wikis sustainable? Respondents came from a variety of organizations. They reported that wikis worked better when directed at novel solutions or coming from sources already known to be credible. The authors segmented users into “adders” and “synthesizers.” They did not focus directly on challenges. This is useful data, but given that the vast majority of organizational wikis we encountered were dead wikis, it represents only part of the picture.

### 3. THE STUDY

We collected data from three very large companies, an online marketing firm recently acquired by one of them, and three software startups. The large enterprises were in the software, engineering, and pharmaceutical industries. At each site we conducted semi-structured interviews with employees involved in wiki deployment and use. The large software company was our principal source of data and the employer of one author. There, we had access to usage data from thousands of wikis hosted on two platforms on the company intranet (one was a FlexWiki

platform, the other was proprietary). We also subscribed to email distribution lists that focused on wikis and related technologies. Our study was one in a series that examine corporate use of social computing; it involved no specific hypotheses or expectations. Our intent was to see what if any patterns emerge from the data; in that sense the approach is that of grounded theory.

We will descriptively if unimaginatively identify the sites as MegaSoft, MegaEng, MegaPharm, MiniMark, MiniSoftA, MiniSoftB, and MiniSoftC. Table1 summarizes the roles of the people that we interviewed.

Company	People interviewed
MegaSoft	Individual interviews with each of the following: Six software developers, two software testers, two project managers, one test tool developer, one test lab engineering manager, one support and escalation engineer, one product planner, one program manager, one consultant, one director/wiki platform developer, one third-level manager, one MegaSoftPedia creator/developer, one legal counsel staff member Two separate group interviews with an IT team responsible for wiki platforms within the organization.
MegaEng	One group interview with 4-person IT team responsible for supporting collaboration technologies.
MegaPharm	One interview with the leader of IT team responsible for MegaPharmPedia.
MiniMark	One group interview with systems administrator, two developers, one project manager, and one vice president.
MiniSoftA, MiniSoftB	One interview with the founder/developer of two startups.
MiniSoftC	Individual interviews with one founding software developer, one new software developer.

**Table 1: Interviews**

Within MegaSoft, informants were identified through activity on internal email distribution lists and wiki servers, referrals from earlier informants, and by directly approaching stakeholders. We interviewed people about unsuccessful wikis as well as successful use. After two early informants identified one team wiki as a noteworthy success, we interviewed eight team members independently, one of whom did not consider the wiki a success. Informants external to MegaSoft were identified through contacts and referrals. We interviewed those who managed the wiki platforms, thereby seeing successes and discontinued use.

We asked participants about their experiences, their perceptions of wiki success and failure, the effects on work processes (if any), and any rewards for use. We examined relevant wikis prior to interviews and when possible conducted interviews in informants’ offices. IT support staff were interviewed in groups at MegaSoft, MegaEng, and MiniMark.

Following the interviews, we conducted a survey of over 4000 users of the internally-developed wiki platform that had been active within MegaSoft for over two years. The survey assessed motivations for wiki creation, the nature of the content, evolving use over time, and personal attitudes toward it and toward wikis in general. This platform was being decommissioned, so we inquired whether the wikis would migrate elsewhere and who would be responsible once the server was shut down. (One person we interviewed had undertaken, on his own, to inspect inactive wikis and convert any useful information he found to a new enterprise-

wide wiki.) We received 433 survey responses, as well as notification that 619 recipients were no longer at MegaSoft. (Platform and personnel turnover as factors in wiki management is discussed below.) We also obtained data from a 2007 survey of users of the FlexWiki platform that asked about the purpose, frequency of use, satisfaction, and plans for future use of wikis on the platform. It had been sent to 1500 users and received 300 replies. The surveys provided descriptive statistics about adoption, evolution, and attitudes toward wikis. Answers to open-ended survey questions were analyzed with the interview data.

#### 4. Results and Discussion

We assumed that anything built on a wiki platform was a wiki effort. Many of these constructs did not in the end exhibit key features of wikis, but when the initial intent is wiki creation, understanding it is part of understanding attitudes and behaviors around wikis in organizations.

We discovered many more wikis in this sense than expected, but most had soon been abandoned. IT teams at MegaSoft and MegaEng both reported high rates of abandonment; 66% of the MegaSoft survey respondents indicated that their wiki had not been used in the past six months. Some wikis had been casual experiments, but we found other sources of dissatisfaction.

Some executives saw wikis as a way to capture institutional knowledge or attract younger employees. Managers may see a wiki as “project dashboard”—where team status is updated and reviewed. These sources of management approval are steps toward getting platforms in place, but the activity we found was overwhelmingly bottom-up, driven by individual contributors. They saw wikis as a place to post or find useful information or answers to frequently asked questions, a place for knowledge that is usually shared informally, and not necessarily efficiently, because it was previously undocumented or inaccessible. In startups, where each new employee follows much the same learning curve, this is particularly useful. Wikis were also a place for team members to work out agreement on terminology or ways of describing an issue, to achieve what one participant described as “linguistic convergence.”

The simplest wikis supported personal information management by one user. These were effectively personal pages that the wiki tool enabled people to construct quickly, lacking collaborative input and use of history or talk features, but some owners initially intended for others to participate and found it useful to continue adding to the site, not knowing or perhaps caring if others consulted it.

MegaEng and MegaSoft had thousands of wikis intended to support small groups; 71% of MegaSoft wiki users reported this purpose. They supported communication within a team or among people with shared interests, such as responses to frequently asked questions, communicating about new company initiatives, or discussing special interests or hobbies.

MegaPharm and MegaSoft also housed efforts to create encyclopedic enterprise-wide information repositories, or *pedias*. Modeled on Wikipedia, these aimed to be comprehensive, internal sources of company knowledge. Both *pedias* were substantial, but did not yet span the company.

Each small business we studied had a wiki intended for all employees. These wikis exhibited the pragmatic characteristics of team wikis. Contributors knew one another, communicated heavily via other channels as well, included detailed information

of interest to only a few people, and did not strive to be comprehensive.

What challenges does a company adopting wikis encounter? As with any tool intended for broad use, there is a need to settle on a common platform. In companies that may opt to develop a company-wide *pedia*, there are issues to be resolved around the placement of information in team wikis versus the *pedia*. We saw signs of this, but will focus on three major challenges relevant to adoption and long-term sustainability that arose repeatedly in the interviews and open-ended survey comments. The quotations in the following sections are representative—but not exhaustive—examples. The three commonly occurring themes are:

- Aligning the expectations of managers and individual contributors
- Content organization and flexibility over time
- Positioning the wiki in an existing information ecology and corporate culture

Managerial (or executive) expectations can conflict with what successful wikis actually deliver. Ideally the initial vision should be aligned with plausible outcomes, and periodic reassessment could keep all parties apprised of benefits that are being realized. Wikis support flexible organization of content when created and soon afterwards, but early choices can cause difficulties as a wiki grows, evolves, or merges with another wiki. And given that established communication channels and sources of expertise will be disrupted, success may favor a newly-formed group or one with core enthusiasts who champion the wiki through early stages.

##### 4.1 Challenge 1: Aligning Manager and Individual Contributor Expectations

What did people expect of wikis? Were expectations met? Many executives and managers supported the idea in principle and envisioned how wikis could be useful, but their visions did not align with the ways that even successful wikis were used by the individual contributors who contributed most content. The mismatch between managerial vision and the practices of individual contributors is illustrated by a MegaSoft team we will call the Orbit team.

Orbit is a consumer software product with a 200-person development team. Its wiki was a grass-roots effort initiated by a tester. It was the largest team wiki we found, with hundreds of actively edited pages and scores of contributors. We interviewed seven users who considered it a strong success. They described saving time by reusing information and finding redundant processes between sub-teams. But from each informant we heard a complaint: The wiki was “going to weed.” Before leaving the Orbit team, a major contributor had regularly edited it for formatting, grammar, and other corrections. A project manager was then assigned to this role, but was later reassigned to other tasks. The wiki remained very active, but with no “gardener,” its appearance and consistency suffered.

As a result of hearing these complaints, we interviewed a manager who oversaw the team. From his perspective, the wiki had been a promising but unsuccessful venture. It was not a project dashboard. Some groups had excessive detail, others had little or no content, and yet other pages were outdated. The individual contributors created content to share information opportunistically, when it was efficient for them. They did not use it to document status; in fact, when a deadline approaches and a

manager is most interested in status, team members might have less time to update a wiki. This manager saw “raggedy” looking content and not the successes experienced by others, and had withdrawn the maintenance resources.

Complementing this were results from the survey. Managers were less likely to contribute content than developers and testers. A manager might envision a project management tool in which the activities of the groups that they manage can be inspected and drilled into efficiently, in real time, rather than in arduously extracted periodic reports. But managers we interviewed and who provided survey comments saw content that was not uniform, was out of date, and was often contributed by people who had left the organization. Some asked team members to put weekly status reports on a wiki and reported difficulties getting them to comply.

At MegaEng we were told that executives hoped to use wikis to record tacit knowledge of older employees before they retired. A MegaSoft program manager designing a wiki product said this was a major interest of external customers. But we saw no wikis used this way. Older employees most likely lack the incentives and skills for this. Danis and Singer [3] describe an enthusiastic executive whose project management goal differed from the wiki contributors’ goals and was not supported by their practices.

As we noted in the literature review, and consistent with Mintzberg’s organizational analysis, many technologies follow this pattern. Executives, managers, and individual contributors have different goals and experiences. They have different priorities and activity patterns. Aligning managerial expectations with plausible benefits could be the most critical step in introducing a wiki. Wikis appeal to managers because of the potential for flexibly organized information, but are more often used for ad-hoc communication.

#### 4.1.1 Disruption of Hierarchy

Middle managers can be caught between high-level management that supports wiki use based on an unrealistic vision and individual contributors who are excited by the wiki’s potential but do not anticipate disruptive consequences. At one of our sites, wikis had strong support from executives concerned about retirements and recruitment challenges. Some individual contributors were enthusiastic. The wiki platform team attributed the lack of rapid progress to resistance by what one called “the middle management ice age layer,” which two of them discussed:

*Team Member 1: To be fair, in the context of other large companies I would characterize (us) as having a more open culture than many other companies... but the practice and the tools that we have available aren’t pushing us as far forward as we would like to be.*

*Team Member 2: Part of the problem is that they [the leadership team] just don’t get it. The worst example is that when they started that wiki, it was called the culture of sharing... the first thing they did after setting up that wiki ...the first thing they did was lock down their attachments, in the culture of sharing.*

*Team Member 1: Each wiki customer can protect the space however they want. If they want it open, they can be big and have contributors from many walks of life if they want that. But primarily they’re locked down. It may not be because they decided that’s how they wanted to do it; it might be that they don’t know any other way. They don’t know the way to have everything open and they don’t, they haven’t gone*

*through the culture change to say it’s ok if someone you don’t even know is contributing something to your wiki....*

Executives may enthuse about the potential; middle management confronts the thorny information-access issues. For example, at MegaEng, even on-site vendors and contractors are not permitted to see certain information. Some projects involve classified information. Not all information can legally be released to foreign nationals, even those working for the company. Similarly, Danis and Singer [3] described a need to withhold from their wiki information that had been available to some users of the system it replaced, calling into question whether a wiki was the most appropriate tool.

Company culture can add another layer of complexity. In general, individual achievement is rewarded more than assisting others or reusing their work. Individuals are responsible for information accuracy, leading to issues with the core wiki concept of relatively open editing. Regulatory practices and the criticality of being able to retrieve certain records forced MegaEng and MegaPharm to employ heavyweight document management systems that coexist uneasily with wikis. Finally, a strongly hierarchic management style is not a natural fit for a technology promoting open collaboration that seems resistant to top-down adoption mandates.

## 4.2 Challenge 2: Content Organization and Flexibility

Early deployment choices can have profound downstream impacts. Contributors to team wikis mentioned time and again that seemingly arbitrary choices of how to organize information at the outset became suboptimal as a wiki grew in size and scope. Some teams did not see individual user differences in content organization as problematic, but some experienced conflict over data organization; what seemed logical to one person bothered other team members. Reorganizing information to be more useful was considered a daunting task because of technical difficulties, the sheer amount of information, and/or disagreement over what reorganization would be better.

One MegaSoft team attempt to merge multiple wikis was confounded by colliding page names and approaches to content organization. One person marveled that 1970s-era programming—global namespaces—lives on in the wiki universe. Arbitrary page names (“My Page,” “Issues,” “Policies”) seemed fine to someone at the outset, but hindered subsequent searches and meaningful reorganization, especially when links to such pages had been established. Although editing a wiki is not difficult, it does require “a little programming,” as one person put it; even at startups not all employees used them. And certainly wiki design benefits from a programmer’s perspective.

When a division reorganizes, a project ends, or people leave, a mature wiki does not easily evolve in step. Old content hangs around but is not updated, consuming resources and confusing those who come across it. Like stale Web content, outdated wiki content is difficult to manage. Some is useful only until a milestone is reached or an event occurs, other content remains useful. Problems increase over time. No one we interviewed mentioned “pruning stale content” as an activity that they engaged in. Closest was the MegaSoft employee salvaging information from inactive wikis on a platform destined for retirement by copying it into a pedia, and that task was simpler than wiki repair.

As organizations grow or change, challenges emerge for IT. The team managing a resource-consuming MegaSoft platform wanted

to remove wikis that were no longer useful. How could they identify stale content? If the wiki contributors no longer were employed by the company, they felt relatively confident. Otherwise, it was hard to know. Egli and Sommerlad's [5] report on wiki use in a law firm describes unfortunate consequences that ensued when a customer ended their relationship and asked for account information that resided in a wiki. Providing it for them in a useful format was difficult.

### 4.3 Challenge 3: Positioning a wiki in an existing information ecology and corporate culture

Wikis are generally introduced into an ecosystem of communication and collaboration technologies: email distribution lists, IM use, documents and document repositories, intranet sites, and hallway conversations. Some people may formally or informally be considered experts, gatekeepers, or points of contact for different information. A new channel will disrupt established practices to some extent, particularly a tool based on a fundamentally different participation style. A MegaSoft survey respondent commented:

*People often agree to use a wiki at the beginning of a project, but then resort to e-mail when they can't do something they already know how to do in a different way.*

We found that wiki sustainability was strongly dependent on enthusiasts who exhorted others to contribute. The person who maintained the MegaSoft FlexWiki platform remarked:

*It's hard to get started with something like this. You have to get a lot of content, you have to get people committed to it, you have to change their work patterns...it's hard. You have to generate value... It's important to think about people behind the scenes trying to grow and make the community successful... In the case of [the wiki server I managed] for the first year or two, I was really active in mailing lists and I put out new builds every week and there would be features and discussion about it. When you can engage and have things move and evolve with the community stuff happens...You can't just put it out there, you've gotta garden... You have to see what opportunities are right in front of the community that you can enable with a push.*

Pragmatic concerns may deter use. Several participants noted the negative consequences for wiki use of corporate network access policies that prohibited access from outside the firewall; in contrast, corporate email was available via web access.

#### 4.3.1 Wikis are Just One Option

Wikis are one of several available tools, and it was often unclear to people which are appropriate for particular tasks. The MegaEng IT team said that such questions are among the most common inquiries they receive. The manager of a large MegaSoft team remarked that he had no idea which tool to use when and would like more guidance. Another MegaSoft employee said:

*Wikis are one of many alternatives for hosting content, and while they provide unique benefits, there's insufficient differentiation between a wiki, collaboration through SharePoint, and the much hated email interchange collaboration. This is why I abandon wikis every time. Great in principle but insufficiently differentiated and difficult to motivate people to try something new.*

Some employees felt there were too many tools. One survey respondent wrote:

*The primary reason I don't use the wikis is that we have so much information to track across so many different sites that I simply can't keep track of them and forget they exist.*

#### 4.3.2 Uncertainty about Editing Others' Work

A key strength of a wiki is that anyone can edit it, but the novelty of this feature means there are few norms to indicate when it is appropriate. Many wikis had a single contributor. One described it as a web page that was easy to set up. Others reported that they intended for others to contribute, but none did. Potential contributors may not know an owner's true intent. Perhaps the owner is responsible for the information. Concerns over disrupting culture around ownership and accountability are also reported in [3, 6, 20].

#### 4.3.3 Wikis are Ill-suited for Some Tasks

For some tasks, wikis—in their current form—are not well-suited. In some industries, regulatory requirements preclude some wiki use. Regulations governing drug research documentation prevented some information from being kept on wikis at MegaPharm. Software developers at MegaSoft noted that formal software specifications were expected to be in a particular format that the wiki platform did not support.

Wikis do not support complex formatting and lack the professional polish of other reporting and presentation tools. Information “needing to look professional” was typically not created in wikis. Wiki content was seen as appearing too informal and messy to be presented to clients. Inclusion of diagrams and images also created issues. Said one wiki user:

*The thing I wish wikis had which is really hard right now is illustrations, pictures, stuff like that. Like say for example I want to include a Visio diagram. I have to take a picture of it, which is saving it as a jpg. Then I have to upload it to some file library and link to it... In some cases it's just easier for me to just go back to ASCII graphics [when making illustrations for the wiki], like drawing pictures using plus signs. It's kind of retro in a way because the tools are so bad.*

Enterprise wikis may need easier ways of integrating complex or alternative types of formatting, although this could conflict with their appealing simplicity.

#### 4.3.4 Where Wikis Worked

Where did wikis work well? Several characteristics accompanied successful deployments. Groups that were rapidly expanding, notably start-ups and those with a constantly-changing staff of contract employees, placed information for new employees in wikis. Although new employee guidance was not the only information in the successful start-up wikis, it was useful enough to sustain them. Groups with no pre-existing history of collaboration and tight schedules also embraced wikis as a way to quickly start sharing information.

We saw two striking, large-scale successful wiki-based collaborations at MegaSoft. Both represented exceptions to “business as usual” at the firm, where the norm for large projects is continuity of personnel and documentation, with planning for one version beginning before the previous version is released. Orbit, the product discussed previously, was different. After one release, the team had been disbanded. Three years later,

management quickly assembled an entirely new team to build another version. The old team had dispersed, many had left the company. Young engineers were hired. They had to literally reverse-engineer some of the existing product to figure out how it worked. Information-sharing was critical—often, as soon as someone figured something out, others could use it. With few document repositories or established experts, the team eventually embraced wikis, as described earlier.

The second case involved an established team that was given a new task. Upon returning from the winter holidays, a large software development team was ordered to drop everything and create detailed documentation required by a foreign government. The group had not created such documentation before and had to learn quickly. As one developer remarked:

*We had to go from 0 to 15,000 pages [of documentation] in 4 months, and it had to be written in a specific way. There was so much learning and decision-making that had to happen in such a short time. The best we could do was write it down in the wiki and hope that other folks making decision on the fly just write it down and get it recorded... We went from 0 people to 500 people overnight essentially working on this effort. So there's lots of people that need to know what's going on and no one has the time to try to...everyone had their own sort of day job so it takes a while to try to explain what you're doing to the other 499 people.*

These successful cases shared tight deadlines, no pre-existing work organization, and intense information sharing needs. They resembled startup efforts inside a large enterprise.

## 5. Conclusion

We explored where, how, and why people use wikis at work, focusing on the creation and use of wikis on corporate intranets in scientific and engineering organizations. We examined challenges in adoption and long-term sustainability that contribute to a high wiki mortality rate. These companies are relatively savvy adopters, yet they encountered significant challenges which could be even more pronounced in other settings.

We noted that management visions often do not match the benefits delivered by successful wikis. A wiki may not become the comprehensive repository of corporate knowledge that an executive hopes for, or even a manager's project dashboard, yet it may successfully support ad hoc communication needs within and across teams. Such mismatches between executive, managerial and individual contributor attitudes and practices are reported for virtually every communication and collaboration tool, yet always seem to come as a surprise. Wikis also impacted Mintzberg's other two organizational parts. IT, in the support role, had to support the evolution of wiki platforms and deal with problems of stale or inappropriately formatted content. MegaEng had federally mandated documentation requirements that conflicted with wiki use, an issue originating in policies overseen by the technostructure.

We identified limitations of current tools that impact long-term use, especially the difficulty of reorganizing information. These considerations are important given that many organizations are in early stages of experimenting with wikis. Early successes are often enthusiastically reported; problems that develop over months and years are not. Wiki technologies in wide use support initial flexibility but age into relative brittleness.

Bringing yet another technology for communication and information sharing into environments with established practices is initially disruptive. It is one more tool to learn to use, and if information is power, shifting to an open-access freely-editable information system will affect power balances. Startups and startup-like efforts in a large enterprise fared better, with no prior history and flatter organization.

Effects of unfamiliarity with the collaboration model inherent in wikis, including uncertainties about accountability are evident in enterprises just as they are in education settings [24], although they play out differently.

Wikis may be most successful in supporting newly established groups or short-term activities, which have few entrenched communication channels or resident experts. The successful wikis described in [1, 3] reached similar goals by a different path. They replaced existing tools, so short-term disruption was expected and use was mandated. Unlike almost every wiki we saw, theirs were the products of a development project, which insured resources for design, training, management, and evolution that were lacking in the thousands of team and project wikis we studied. Being driven as a research project can make a wiki exceptional, yet it can identify features that can contribute to success elsewhere.

For an established organization to adopt a wiki, there must be a shared conviction that change—which will benefit some more than others—will be worthwhile. Contributing usually requires effort from people who have other work to do. A small core of enthusiasts can seed content, but success may require participation by many people. Organizations that introduce wikis should consider incentives and rewards for participation, clear policies about editing permission, and processes for maintenance and conflict resolution.

Wiki tools will improve. Limitations on content organization and flexibility will fade away. Powerful visualization and editing tools may be required to enable wikis to evolve gracefully as projects change, people come and go, or an organization realigns. Wiki use is problematic when early decisions about structure, often made by one person, have a lasting impact. Tools that provide alternative views of content are needed.

Technology will improve. No doubt executive and management views of wiki potential will over time align with the benefits that can be realized in different settings. Social conventions and incentives will emerge and evolve to guide contributors, resolve disputes, and help manage wiki deployments in organizations.

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