

Teaching case

Employing Wiki for knowledge management as a collaborative information repository: an NBC universal case

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Abstract

The Web 2.0 era is nourished by the emergence of collaboration-conducive web applications, such as blogs, social networks, and wikis. Among these, Wiki has particularly revolutionized the way information is created and shared within a wide variety of organizations, such as educational institutions, research centers, and business enterprises. The technically undemanding nature of Wiki alleviates the burden of mastering cumbersome or complicated technologies, thereby encouraging personnel to share and archive valuable tacit knowledge with other members of the organization. As a result, Wiki helps mitigate the reluctance of members to share knowledge, resolving one of the most pronounced challenges in managerial efforts to capture, transfer, and store knowledge for the firm. This case study presents the inception of a wiki by the NBC Universal Software Engineering and Delivery Team and the expansion of the wiki to other departments in the firm, in particular to Peacock Productions, which specializes in programming of documentary TV programs. The Peacock Productions case demonstrates that Wiki can be a powerful tool for managing knowledge in business corporations, which must adapt quickly to changing market demands.

Keywords: Wiki; Web 2.0; user-generated content; social media

Introduction

After the dot-com collapse in 2001, the Internet began to take on a new shape and a different purpose. Recognizing this imminent change but not quite knowing what it would be, Tim O'Reilly from Media Live International held a conference to address the future of the Internet. There the term 'Web 2.0' was coined, signifying the shift of the Internet from a collection of stand-alone websites to a system of inter-linked platforms in which multiple sites are connected to one another (O'Reilly, 2007). The term also refers to the interactive, user-driven atmosphere where users build inter-personal relationships and communities for collaboration, knowledge sharing, project management, and project development.¹ While the Web 1.0 era was characterized by static, one-way communications,

the Web 2.0 era is a highly dynamic, democratic, and collective environment where users both consume and contribute.

The Web 2.0 era is nourished by the emergence of collaboration-conducive web applications, such as blogs, social networks, and Wiki (O'Reilly, 2007). Among these, Wiki, the Hawaiian word for quick, has perhaps most profoundly revolutionized the way information is created and shared. Wiki is defined as 'a freely expandable collection of interlinked Web pages, a hypertext system for storing and modifying information – a database where each page is easily editable by any user with a forms-capable Web browser client' (Leuf and Cunningham, 2001: 14).² Wikis have been revolutionary in a wide variety of

institutional contexts, including educational institutions, research centers, security agencies, and business corporations (Raman, 2006). In schools, wikis provide students with access to collective knowledge created by other students and teachers, thereby changing the way students perform homework assignments and group projects; consequently, the publication and distribution of textbooks are expected to undergo a drastic transformation (Forte and Amy, 2006). Enterprises that rely heavily on employees with high intelligence and hands-on experience – NASA, Northrop Grumman (security agency), the CIA – have also benefited from the increasing use of wikis. Businesses have also been quick to recognize the value of Wiki. Some of the largest corporations, such as Google and IBM, use wikis to manage daily operations, disseminate information among employees, and enhance communication with customers.

That these large corporations have successfully implemented wikis testifies to the benefits Wiki can provide to a business. The foremost of these benefits is that anyone can use one, even the non-technology-savvy. No programming experience or technical jargon is required. With a little effort, one can create or edit a number of intertwined web pages using a simple markup language. Each page is linked, so anyone can easily refer to other pages and contribute anywhere they want. Alleviating the burden of learning cumbersome technologies, the ease of use, accessibility, and flexibility of Wiki encourage people-in-the-know to share and archive their knowledge and experience. Wiki also enhances the efficiency of information exchange; messages that require the attention of specialized personnel can be posted and responded to in one simple interface platform. These knowledge sharing attributes in turn foster a culture of cooperation and a sense of community, which is a catalyst for further knowledge sharing.

The wide acceptance of wikis and their potential business benefits have spawned a number of case studies conducted in diverse institutions, ranging from knowledge-intensive firms to government agencies (Boulos et al., 2006). However, few studies examine the use of wikis in business corporations with fluid and dynamic organizational structures. Fluid structures impose a serious challenge to the deployment of effective knowledge management systems because personnel who possess essential knowledge are constantly joining and then leaving the organization, limiting managerial efforts to capture and transfer this tacit knowledge for the firm. This is a common problem for companies in the media and entertainment industries. Because the demand for entertainment content fluctuates seasonally and in many cases unexpectedly, due to the fickle tastes of viewers, many of these companies maintain a lean payroll, and at peak times supplement personnel by hiring freelancers and short-term contractors. This constantly changing structure inhibits the cultivation of

collaboration and knowledge sharing among employees. Nonetheless, sharing of experience, insight, and know-how is critical for successful inception and production of programs capable of attracting an audience in an environment inundated with entertainment and media choices. Few knowledge management tools, however, are known to be successful in creating, transferring, applying, and storing such tacit knowledge (Alavi and Leidner, 2001). We seek to demonstrate how Wiki fosters a culture of collaboration, thereby enabling the sharing of tacit knowledge in a highly fluid and dynamic organization. Toward this end, we choose NBC Universal as a case study, which will be organized as follows: we first define what Wiki is and summarize its benefits to business organizations. Next, we describe the inception of a wiki in the NBC Universal Software Engineering and Delivery (SED) Team and the expansion of this wiki to other departments. One of the departments that adopted the wiki is Peacock Productions; the Peacock wiki case demonstrates with great acuity Wiki's potential to enhance knowledge sharing among employees.

Wiki: collaborative information repository

What is Wiki?

In 1994, Ward Cunningham invented Wiki as an online database with a basic set of rules for creating and editing sharable content. Nowadays, a number of groupware packages are available to download from the Internet to create wikis, for little or no cost. Wiki is 'a combination of CGI script and a collection of plain text files' that enable users with little technical experience to create Web pages.³ When a user clicks an 'Edit' link on a wiki page, the script sends the raw text file in an editable form to the user's browser, permitting the user to change the textual content of the page. When the user presses the 'Save' button, the script sends the changes to the wiki server where the existing text file is replaced with user-changed version. If a user requests a wiki page to see, the script collects the pertinent text file, converts the marked-up text into HTML, creates hyperlinks for certain user-chosen words, puts this information in a page template, and finally sends the result to the user's browser. Some wikis store the history of past edits, entries, modifications, and deletions.

Wagner (2004) recognizes that certain knowledge management tools are characterized by technical simplicity and calls them, 'conversational knowledge management tools.' These tools facilitate discussion among individuals and foster online communities founded on common interests, topics, and practices (Wagner, 2004). Examples include video and audio conferencing, blog, forum, and Wiki (Wagner, 2004). The advantages of conversational knowledge management tools are as follows (Table 1).

Table 1 Advantages of conversational knowledge management tools (Wagner, 2004: 266)

- Economical and technically undemanding: Little more than a listserv or a (freely available) web-based discussion forum is required
- Fast: The only time taken is for one person to post a question and for others to post or email a response
- Useful for creating *ad-hoc* knowledge: These tools are particularly applicable for environments where the knowledge is not centralized but resides in multiple owners in a geographically dispersed team

Table 2 Other conversational knowledge management tools

Blogs	<ul style="list-style-type: none"> ● Typically limited to one author ● Provide knowledge and viewpoints on array of issues, or on a single idiosyncratic one ● Often convey bias perspectives ● Feedback is limited to a comments section, which is often controlled by the author to reflect his or her own opinions and can digress from the topic
Forums	<ul style="list-style-type: none"> ● More flexible and impartial than blogs ● Information sharing is conversational and very informal ● Various users edit and comment on an array of topics ● Inaccurate posts cannot be edited by other users ● Forum posts are often difficult to locate, because they are frequently archived

In terms of their capability to foster discussion and collaboration, other conversational knowledge management tools compare unfavorably to Wiki. Blogs are a popular information sharing platform, with famous blogger personalities ranging from Fortune 500 executives to gossip guru Perez Hilton. But blogs are typically limited to one author providing knowledge and opinion on either a particularly narrow niche or a vastly disparate array of issues, and blogs often convey deeply biased perspectives. Meanwhile, feedback on blogs is limited to a comments section, and while useful as a brainstorming tool with sequential postings, they are often controlled by the author to reflect their own opinions and can digress from the topic. Forum-style websites offer more flexibility and impartiality than blogs, but information sharing on forum sites is usually conducted through very informal, unregulated discourse. Inaccurate forum posts cannot be edited by other users, and posts are often difficult to locate because they are so frequently archived. Table 2 presents a summary of the differences between these alternative information sharing tools.

The rewards and risks in the context of business use

Wiki provides unprecedented advantages to business, in particular a powerful yet flexible collaborative communication capability (Wagner, 2004). Table 3 summarizes the advantages and disadvantages of Wiki.

Wiki content is generated and regulated by all of the group's members. This self-governed content-creation reduces the cost of maintaining effective knowledge management. In addition, Wiki consolidates data in a central location, reducing the time and effort required for collaboration across various functional areas and by users in geographically dispersed locations. For instance, by centralizing data, Wiki helps reduce data redundancy and eliminate outdated and inconsistent data, a problem often caused by frequent email exchanges on a person-to-person level (Morris, 2007). Using a wiki consistently, users can reduce their email volume by up to 30% (Majchrzak *et al.*, 2006). Lastly, a wiki acts as a knowledge base for users to share new ideas, take faster action on these new ideas, and improve their job performance (Hasan and Pfaff, 2006). Specifically, Wiki provides employees with resources to resolve problems as soon as they arise, with chances to receive peer reviews, and to acquire the acknowledgement and esteem of the management. As a result, employees suffer less frustration and enjoy more satisfaction with their

role in the organization, while companies benefit by retaining key personnel and saving information that would have otherwise been lost as a result of frequent employee turnover.

However, Wiki has several potential drawbacks. The open access and editing ideals on which wikis were designed open the door for potential security issues (Bean and Hott, 2005). With improper oversight, open editing leaves the system susceptible to Internet attacks (viruses, worms, SPAM, etc.). Moreover, the complete disclosure of knowledge may prove too problematic for companies that rely heavily on confidential documents. To alleviate these risks, wikis are often monitored to ensure that inappropriate language, spam, and incorrect or inappropriate content are not allowed. In addition, a wiki grows and evolves as the number of its users and contributions rise. While this maturation significantly enhances the value of the wiki, it also means that a wiki may evolve in a more chaotic manner than was originally intended (Bean and Hott, 2005). Another shortcoming of Wiki is that it represents the collective perspective of the group that uses it. Wiki has a collaborative bias: over time, the values, perspectives, and opinions of users can become embedded in a wiki and difficult to spot. Wiki is well suited to reflecting current thoughts but perhaps less effective as a means of obtaining unbiased perspectives on rapidly evolving topics. Lastly, as Wiki is democratically self-governing, in certain cases its lack of hierarchical supervision or a support team to address any potential issues that may arise may prove problematic.

Many firms have adopted wikis for collaboration with clients and for management of major projects.⁴ Among these is Pixar, the producer of several Academy Award-winning animated films. Pixar used a wiki to coordinate the development of new computerized animation tools for the film 'WALL-E' released in 2008. Also Red Ant, a web design and development firm based in Sydney, Australia uses a wiki as the central base for collaboration among employees and customers. Designers at Red Ant draft a prototype of the website and then post it on the wiki to solicit feedback from both co-workers and clients. Co-workers reply to the posted message in various forms (e.g., hyperlinks, image files, emails, etc.) to comment and/or suggest better solutions. The clients also add comments on the page. This collaborative workflow has proven to be a tremendous competitive edge for Red Ant. Sony Ericsson is yet another example; a team developing applications using the Java ME application platform and a

Table 3 Advantages and disadvantages of Wiki for business use

Advantages	<ul style="list-style-type: none"> ● Wiki content is created, verified, and updated by users: <ul style="list-style-type: none"> ○ The self-governed content-creation reduces costs for maintenance ● Wiki consolidates data in a central location: <ul style="list-style-type: none"> ○ Lowers the costs for communications and collaborations across various functional areas and in geographically dispersed teams ○ Eliminates data redundancy ● Wiki facilitate knowledge sharing: <ul style="list-style-type: none"> ○ Provides employees with chances to receive peer review and to gain recognition from the management ○ Retains tacit knowledge of key personnel
Disadvantages	<ul style="list-style-type: none"> ● Potential security issues ● May evolve chaotically ● Can be ineffective when there is a lack of consensus ● Potential lack of supervision and support if problems occur

Symbian/UIQ3 pen-based interface used a wiki to exchange ideas about how these two technologies are used in Sony Ericsson phones. Lastly, Carbon Five, a firm based in San Francisco and Los Angeles that develops web enterprise applications, uses a wiki for both communication among employees and for collaboration with customers. At Carbon Five, the wiki functions as a platform where the client and the development team collaborate on projects.

Case study: a Wiki at NBC Universal

A wiki has been implemented at NBC Universal along the following time line presented in the appendix.

The rise from obscurity

The NBC Universal wiki started as grassroots movement within the walls of the company's IT department in 2005. The SED team was in desperate need of a collaborative communication tool for geographically dispersed programmers. With programmers in multiple locations, including the east and west coasts of the United States, India, and Mexico, the SED team prioritized effective communication. Their existing system, Support Central, was failing. An application developed in-house specifically for General Electric (GE) (NBC's parent company at that time), Support Central was designed and custom-built for GE as the backbone for workflow and collaboration management.⁵ At GE, Support Central digitized business processes and enhanced knowledge sharing. But at NBC Universal, Support Central did not provide the necessary functionality for the SED team's communication, for many reasons. First, rather than allowing everyone to contribute equally, Support Central gave only a limited set of people the privileges to publish. Second, it had limited search features and a cumbersome user interface in general, incapable of supporting content sharing across various crucial formats (text, images, PDFs, uploaded files, video, etc.). These constraints inhibited the SED team members from discussing, creating, and analyzing content. A more serious challenge was that Support Central was not suited for NBC Universal's organizational culture and business processes. As mentioned previously, Support Central was custom-built for GE, which has a uniquely defined organizational structure and concrete processes. In contrast, NBC Universal is a media and

entertainment company that has a very dynamic organizational structure and flexible processes. Therefore, Support Central had inherent limitations as a support system for NBC Universal, not to mention the SED team for which interactive communication was especially imperative. Due to the functional limitations and the organizational misfit, the SED team members hardly used Support Central.

This feature-poor document management system wasted the SED team's time, as transferring knowledge from person to person was an unnecessarily belabored process. 'Prior to the wiki, our most widely used knowledge management tool was email. It left a lot to be desired,' said Bill Endow, head of the SED at the time. The SED team needed a knowledge management tool that would allow quick and easy knowledge capture, transfer, and update in a variety of formats.

The birth of a Wiki in the SED team

One of the SED team members suggested a wiki as a solution for exchange of ideas and internal communication. At that time, Wikipedia was gaining momentum with its growing popularity, and the overall Wiki concept was gathering mindshare at the peak of the Gartner Hype Cycle. Bill Endow, then the head of SED team, accepted the suggestion and decided to employ a wiki as the primary information repository within the team. This move marked the beginning of transition at NBC Universal to a wiki community rooted in easy communication and open collaboration among programmers geographically dispersed across multiple locations. Table 4 lists the SED team's specific knowledge sharing objectives for the wiki.

Next, Bill Endow went searching for the right wiki application. At NBC Universal, there are clear distinctions among documents handled by different divisions. Because many wikis provide no systematic mechanism to organize documents, Endow looked for a wiki application that supported the creation of hierarchy to categorize documents into appropriate groups. Simply put, many wiki applications available that time were more like keyword search engines as opposed to systematic information management tools. Endow discovered Confluence, produced by the Australia-based company Atlassian, an application capable of providing the desired hierarchical structure

Table 4 Knowledge sharing objectives for the Wiki project

Department-wide communication	<ul style="list-style-type: none"> • Make transparent the IT department's organizational structure, goals, and charter • Share best practices and documentation of all types with an all-inclusive audience • Share information in an accessible and useful form • Help employees and contractors share specific technical knowledge vital to projects currently in execution
Quality assurance	<ul style="list-style-type: none"> • Provide a searchable real-time reference manual for QA engineers to help reduce the long delay previously required to upload and disseminate a new resource, and to help advertise and maintain standards by making them transparent and accessible • Share functional QA process overview to educate people on test planning and to ensure that entry criteria (use cases, functional specifications, etc.) meet quality standards for test preparation
Processes and tools	<ul style="list-style-type: none"> • Share tool overviews, links to tutorials, and best practices gathered by tool users • Share templates and example documents for various deliverables. Help answer questions such as, 'What is included in a good Vision Statement?'
Resource allocation	<ul style="list-style-type: none"> • Share resource allocation process overview to educate people on the steps necessary to engage with the Resource Allocation group • Provide an entry point to the Resource Allocation process – a guide to specific next steps
Software architecture	<ul style="list-style-type: none"> • Share software architectural design process overview with design engineers, software architects, software engineers and so on to help teams successfully design their applications • Share templates and example documents for various software architecture deliverables • Share architecture tool overviews, links to tutorials, and best practices gathered by tool users
Software engineering	<ul style="list-style-type: none"> • Share various best practices pertaining to all of the above processes and areas of the department

while also providing a powerful search engine; both of these key features were absent from Support Central and from many wiki alternatives. Confluence had become the market leader for stand-alone enterprise wikis. Also, its subscription fee was reasonable: a one-time initial cost of approximately US\$12,000 to purchase the software plus US\$6000 per year for maintenance. For these reasons, Bill Endow and the SED team chose Confluence Wiki and implemented it on Oracle 10g RAC, running it on Red Hat Enterprise Linux on HP servers. More specifically, the team set up two servers to run the wiki platform: one a software server to display the wiki pages and the other an oracle database server to deal with structure and content, as well as user information and history. In addition, the SED team built a small storage unit to act as a file system to hold all attachments and non-text documents.

In 2007, the wiki was finally in place, but two technical problems were quickly identified. First, while the SED team had integrated Confluence into its single sign on infrastructure via a lightweight directory access protocol interface, the authentication process was not integrated into NBC's network software. Confluence Wiki required users to log into the NBC network with their employee IDs and passwords prior to granting access to the wiki, to verify their identities. This verification phase was slow and often malfunctioned, blocking legitimate users from accessing the wiki. Second, the particular version of the Confluence Wiki application in use at that time was still in an early stage of development, and hence had several lingering glitches that caused annoying delays in contributing, modifying, and updating content. The SED team and Atlassian collaborated to resolve these problems. By the end of 2007, the user verification process had been streamlined and the NBC wiki was performing smoothly and speedily.

Expansion throughout the NBC Universal

With the two problems solved, the wiki was ready to grow for use above and beyond that of the parenting SED team. An unexpected event prompted the expansion. In December 2007, NBC Universal IT department began a major reorganization, which was expected to affect approximately 800 staffers and contractors. The IT department needed a flexible collaborative communication tool for such a massive reorganization. Bill Endow suggested that the IT department use the wiki. Impressed by the wiki's flexible yet powerful features, the IT department leaders decided that this little known tool previously used only within the SED team would become the nerve center for all information related to the reorganization. All department heads would be required to create wiki pages recording their organizational structures and other relevant information for reorganization, such as mission statements, team biographies, service catalogues, and standard operating procedures. In January 2008, the new and improved wiki was rolled out, and its usage increased by ten times overnight. As the number of users grew, the wiki started to generate buzz around the company. People began to discover the wiki's enormous potential for improved knowledge management. For instance, the Nightly News graphics department and a division of IT called Dot Media began using it to track workflow. 'The wiki helps us capture knowledge at its source, with the individual knowledge worker, in real time, as ideas occur to them,' added Bill Endow.

As the wiki grew and attracted more traffic, it reached a new phase of maturity. Because the data center utilization rate had increased so much, the wiki's capacity needed to be expanded. However, the high projected cost of this expansion was a serious problem in 2008, when the entire nation was under a severe recession. Data center expansion

can easily cost tens of millions of dollars, so NBC needed the expansion to be done cheaply. Compounding the problem was the fact that data center expansion has the potential to interrupt the continuous availability of services. Careful capacity and scalability planning were required to keep the wiki running smoothly, without running the company into debt. The solution was to move the wiki to a virtual server: a virtual server would allow the expansion investment to be maximized quickly and efficiently, facilitating the flexible development of the wiki contingent upon its usage. By 2009, the wiki had been moved to the virtual server, upgraded to the latest version of Confluence Wiki (Version 3.1), and was ready for company-wide utilization.

The Peacock predicament

The preceding SED team case demonstrates that the wiki is a useful tool for internal communications, as well as for central information storage during a period of departmental reorganization. The following case of Peacock Productions, a division of NBC News, illustrates that Wiki can be a powerful medium for collecting, transferring, and storing both explicit and implicit employee knowledge in an organization with a fluid structure.

Peacock Productions (<http://www.peacockproductions.tv/>) produces a variety of television programming and content, both internally and externally, for various network and cable channels. More specifically, Peacock produces long-form documentaries, live specials and event coverage, and reality/docu-soap series. Examples include *American Character along Highway 50* with Tom Brokaw (USA), the *McVeigh Tapes: Confessions of an American Terrorists* (MSNBC), *Intervention In-Depth* (A&E), *Disappeared* (Discovery ID), *Storm Stories* (The Weather Channel), *Secrets of the Secret Service* (Discovery Channel), and *Criminal Mindscape* (MSNBC).

Like that of any other production department, Peacock's workload fluctuates unforeseeably depending on season and viewership. To build an agile organization adaptable to fluctuation, Peacock keeps a lean payroll in ordinary times and expands and contracts with supplementary freelancers when the demands for programs increase. More than 100 people could be working for Peacock at any given moment, although its core staff comprises only 40. In addition, its business processes little resemble the structured routines often found in the manufacturing sector, because producing TV programs requires creativity, originality, and adaptability to changing viewer preferences. Also, many employees are frequently on the road to shoot scenes, meet interview subjects, and develop talents and stories. These unique organizational structures and business processes pose serious challenges to Peacock's knowledge sharing efforts. Peacock employees need to keep their fingers on the pulse of current affairs in order to develop eye-catching programs and polish their filming and producing skills. When asked if there is a need for knowledge sharing, a senior producer said, 'Well, that's a lot, actually. I need to see how the other senior producers are running their shows.' An assistant producer at Peacock says, 'I like to learn more about the way other people approached doing the same job because it is a job that's very subjective no

matter what you are doing as a producer, so just sharing information about how to produce the best program and content possible [is vital].'

Despite awareness of these knowledge sharing needs, Peacock did not have a centralized database or information repository to meet them. In fact, Peacock was using a number of fragmented, isolated, and antiquated legacy systems for information storage and retrieval, such as Support Central and iNews. As mentioned in section 'The rise from obscurity,' Support Central was hardly used in NBC Universal due to its misfit with NBC Universal's organizational culture and business processes. Peacock staff used Support Central only for limited administrative purposes, such as placing work orders and requesting reimbursement for expenses, and rarely used Support Central's communication and knowledge sharing features. iNews is a news room computer system that displays breaking news in real time and is used by major news organizations, including NBC News, CBS News, and ABC News. However, while iNews was useful for keeping tabs on breaking news, it was not geared for long-form documentary programming, Peacock's primary genre.

These inept and fragmented systems were worsened by poor governance. There was no structure to establish who could or should enter information. As a result, no one entered information, leading to a severe inaccuracy and inconsistency of data. Peacock employees could not find information to answer routine questions, from those relating to daily operations (e.g., Where do I submit my expenses? How do I fill out my time card?) to those relating to production and programming (e.g., What is the best location to film an interview?). The only way to obtain information was the individual's personal connections. The employee searching for answers had to first find the right person to answer the question and had to wait until the right person became available – and willing – to answer it. To make matters worse, only about 40 core staff could be depended upon to be around to answer questions, and these people were outnumbered by newly incoming freelancers and contractors in search of answers. As a result of this pandemonium, experienced staff members were inundated with endless phone calls and emails from new employees and freelancers asking routine and repetitive questions. As Peacock expanded and more people joined the division, the demand for information grew drastically, costing the company significant skilled manpower. Time that the core staff was supposed to be investing in developing and producing content was directed to answering mundane questions. 'Before the wiki, information sharing at Peacock Productions was extremely *ad-hoc* and completely disorganized,' said Danielle Bibbo, the Director of operations.

Peacock's adoption of the Wiki

Danielle Bibbo suggested that the division establish a central information repository where important knowledge could become documented and readily accessible by any Peacock employee. The repository would allow new employees to find relevant information quickly and the experienced staff members to focus on their core tasks rather than answering routine questions. Bibbo launched

a task force in search of possible alternative applications to build a repository. The requirements for the new application were three-fold. First, the application had to be easy to use. Many NBC staffers are not technology savvy and would not want to use an application that is complex. Also, many freelancers and daily contractors would not want to invest their time learning a complex system they may not use when they leave Peacock. The task force team, therefore, needed to find an intuitive application that employees could log onto and immediately know how to use. Second, the application should not require extensive maintenance and support from the IT department. Peacock's technical support division was already overloaded with requests for technical support for programming operations. Lastly, the application needed to be cost effective because, like many other companies in 2009, NBC Universal was feeling financial pressure due to the worst economic downturn since the Great Depression.

By this time, the Confluence wiki developed by the SED team started getting traffic around NBC (see section 'The birth of a Wiki in the SED team') and caught the attention of Bibbo's task force. The wiki seemed to fulfill all the requirements: it was easy to use, interactive, required little maintenance effort, and was cost-free to deploy because the SED team had already made the initial investments and completed the implementation. The task force decided to adopt the wiki. Setting it up was instant and effortless because the wiki was already completely developed and fully functional. The technical platform for sharing information was ready.

Constructing the knowledge base on the Wiki

Setting up the wiki application technically was instant and costless. Establishing the knowledge base required more intensive effort. The task force needed to collect employees' valuable knowledge, and they devoted the next 10 months

to accomplish this. The first step the team took was to carefully analyze Peacock's business processes and workflow based upon its organizational structure (Figure 1).

Peacock consists of three divisions: development, production, and support divisions (divisions that provide support to Peacock but they are not under direct control of Peacock). First, the development division does not have clear sub-divisions; it is instead led by groups of developers in three locations: New York, London, and Los Angeles. Second, the production division consists of operations and editorial. The operations division provides assistance to the editorial division, which is in charge of producing programs. The operations division consists of technical operations and finance and strategy. The editorial division also does not have clear sub-divisions, but is led by several senior producers, each of whom oversees a team of producers, associate producers, assistant producers, and freelancer producers and daily hire editors. Externally, Peacock received support from other NBC Universal divisions, including talent management, business affairs, legal, finance, and human resources.

Next, the task force team asked the heads and senior producers that oversee internal teams to provide content to be displayed on the wiki. The task force team chose to contact the heads and senior producers because they know the best practices in the corresponding fields. Although approached by the task force team initially, the heads and senior producers were not required to make extensive contributions, though they could if they wanted. They had the autonomy to choose the type and depth of content they wished to contribute. Surprisingly, the managers responded to the requests with alacrity. The managers assembled and contributed not only explicit and procedural information, but also 'insider information,' tacit knowledge that had previously only been shared on personal levels. For instance, a senior producer could share his or her review of filming equipment: 'This camera is good for

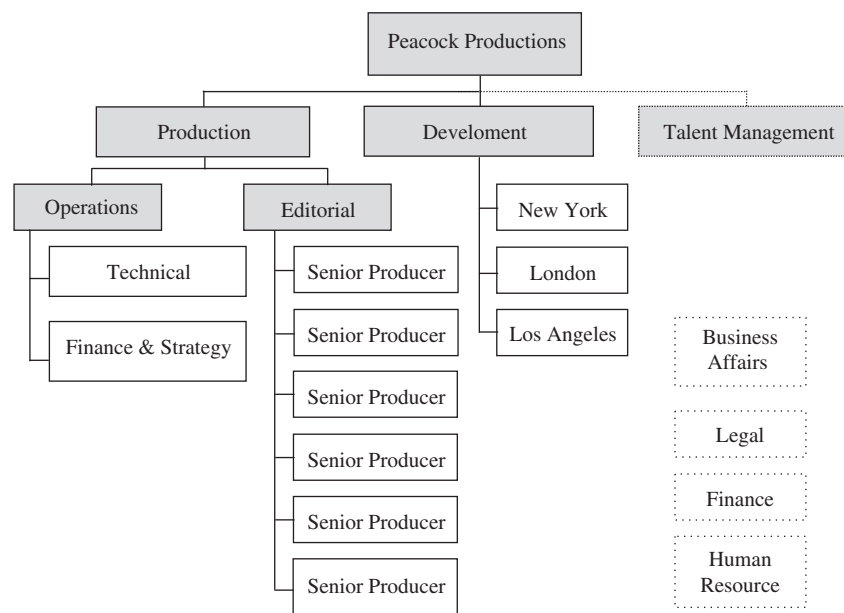


Figure 1 Peacock Production organization chart.

Note: Dotted borders indicate external departments.



Figure 2 Peacock Productions Wiki – homepage.



Figure 3 Peacock Productions Wiki – information about filming equipment.

filming in daylight situations while not strong in low light conditions.’ A senior producer recalled this experience: ‘Because we have been down the road, you know every project has its thing where [an issue] comes up and yet you can’t predict it ... How you do that is a very good thing to have. I remember re-writing [those] things What do I do from beginning to end? What do I need to know? What are the expectations of a producer who walks in?’ The managers were excited to have a medium (i.e., the wiki) via which they could share their knowledge and help their team members. One manager, when asked what motivated him to contribute to the wiki, said, ‘I feel proud that we’ve got this tool that works for us that other people don’t have ... Making people self-sufficient is one of the most important things for me about the wiki.’ Another reason for this enthusiastic response may be that the managers and senior producers could now redirect redundant questions to the wiki so that they could focus on their core tasks:

‘I don’t always have the time to explain things to everyone, so it is really nice to have the wiki.’

Lastly, the task force involved the support divisions to include company policy and legal matters. These support divisions, such as legal, finance and human resources, participated as ‘guest contributors.’

Due to the eager contributions, the task force team gathered 145 pages covering 240 topics. In February of 2010, the wiki was finally launched as the central information repository. The wiki is the complete guide to the unit that Peacock had long sought after. Within days the wiki was gaining incredible momentum; after just a few months of use, the wiki had collected over 1300 visits and more than 5000 clicks. Today, employees at Peacock Productions are using the wiki for a wide variety of purposes, such as to brainstorm ideas, make suggestions, and, of course, to find information necessary for their job. Screenshots of the wiki are displayed in Figures 2 and 3.

Table 5 Cost-saving by the use of Wiki (from 8 February 2010 to 20 March 2010)

Page clicks	4052 page clicks on the site
Average time spent on a page	39 s (per page)
Average cost per second per employee ^a	US\$0.02
Average time spent to acquire information BEFORE the wiki ^b	On average, people spent 4 min searching for or asking about the information
Average time spent to acquire information AFTER the wiki ^c	On average, the same information can be found in 39 s
2010 projected yearly savings (estimate ^d)	4 min of time before Wiki (240 s) compared with 40 s of time after Wiki Time Saved = 200 s US\$0.02 × 200 s = US\$4 For each visit to the wiki, we save US\$4 US\$4 × 4052 clicks = US\$16,208 saved in 2 months (8 February–30 March) Projected yearly savings estimate = US\$97 248

^aCost refers to labor costs in the form of salaries and wages paid to long-term staff and short-term freelance employees of Peacock Productions. The average cost per second per employee was calculated as follows: (1) A weekly salary (based on blended salary rates determined by the budgeting department) was assigned to each of eight positions in the unit – Senior Management, Production Management, Producer, Associate Producer, Assistant Producer, Production Assistant, Support Staff, and Other (secretarial, etc.). (2) The weekly salary of each position was then multiplied by the number of people who occupied that position. (3) The weekly subtotals for each position were then added to derive a weekly total for the unit as whole. (4) A per second rate per employee was then calculated for the entire unit based on a 40 h work week.

^bTime saved varied depending on topics of interest.

^cThe statistics are obtained from the Peacock workforce survey administered in March of 2010.

^dThis is a conservative estimate based on the assumption that the number of users will remain constant after 2 months.

Benefits and risks of the Wiki at Peacock

This deployment of the wiki brought in a number of benefits to Peacock. First, it provided an opportunity to create new sources of information by leveraging small contributions from a broad community of motivated, self-selecting contributors. When employees see an entry that is outdated or incorrect, they use the 'comment' feature on the wiki or simply email the task force to report the inaccuracy and to provide accurate information. An assistant producer who contributed to the wiki said, 'There are instances where I thought other people might be interested in information that I had so I added it to the wiki. Also I've made suggestions about information that's come my way so that I could share it with the rest of the staff.'

Second, the wiki increased Peacock's operational efficiency. The wiki eliminated countless unnecessary meetings, conference calls, mass emails, and it redirected employees with basic questions to a ready resource for answers. 'The wiki has dramatically increased the efficiency of our unit and has enabled Peacock Productions to run more smoothly. Since implementing the wiki, people are able to easily find the information they need without wasting valuable time,' says Danielle Bibbo.

As a result, it helped the organization achieve lower operational costs while enhancing the quality and level of service. On average, staff at Peacock Productions used to spend 3–5 min searching for information prior to the roll-out of the wiki; the staff now spends roughly 39 s to do the same on the wiki. The implementation of the wiki provided Peacock Productions a projected annual savings of approximately US\$100,000 for 2010. Table 5 presents projected yearly savings.

Despite these significant benefits, the wiki is facing a few important challenges. First, NBC has had to limit access privileges by granting access only to employees who can log into the NBC intranet because proprietary information cannot be shared with external users. For this reason, the wiki is not realizing its maximum potential to gather valuable input from external contributors, including clients. Second, the wiki does not allow individual employees to post new messages or initiate a new threads themselves, while the wiki does allow them to comment on existing posts. This constraint does not mean that individual users are banned from posting new messages, it just means that individuals are required to go through a moderator, who solicits content from users, reviews it, and verifies that the content adheres to the organizational policy. Research says that knowledge management tools with proper verification processes lead users to contribute more than the tools without any moderation processes (Durcikova and Gray, 2009). This is because the verification processes ensure the quality of postings and increases the credibility of sources (Alavi and Leidner, 2001). Lastly, the wiki has yet to be integrated into other knowledge management tools at Peacock, including Support Central, iNews, and LifeCycle (a newly developed system that records the histories of shows produced by Peacock). Each tool supports different functions, likely causing confusion and increasing inconvenience among end-users. Peacock is currently trying to integrate the wiki and LifeCycle into a one-stop knowledge management tool.

The future of Wikis at NBC

The wiki's success at Peacock Productions has impressed NBC Universal executives, who are in turn planning to

expand it throughout the organization. Senior NBC News Management suggested that wikis should be implemented throughout the News Division as a tool to guide employees through the Comcast/NBC Universal joint venture. The wiki currently has 900 users with 300 active users. By the time wiki use spreads to all the employees of NBC Universal, the wiki will have approximately 17,000 employees as opposed to 900 current users. To accommodate a sudden increase in traffic, the NBC IT team must find a more scalable way of supporting the wiki. Also, NBC Universal needs to create an attractive platform for users to contribute and to use the resources available on the website with ease. NBC Universal also needs to make sure the wiki integrates well with other applications (e.g., Microsoft Office suite) and knowledge management tools currently in use. Lastly, because the workforce has become increasingly mobile, Peacock Productions has rolled out a downloadable version of the wiki for blackberries and has also discussed the possibility of creating a wiki iPhone application.

Conclusion

The dynamic environment of Web 2.0 has generated significant benefits for business, including the creation of a global market space, a wealth of accessible information, and time and cost savings. Key benefits of Web 2.0 tools include the potential to serve as a central repository for information and to provide access to multiple contributors. The NBC Universal case highlights the increasing importance of Web 2.0 tools such as Wiki to solve critical communication disconnects, time drains, and information accessibility impairments within a firm.

This case study shows how a wiki was developed by the NBC Universal's SED team, expanded to other divisions, and enhanced knowledge sharing in Peacock Productions, a division of NBC News. The idea of a wiki was inceptioned by the SED team, which had been looking for ways to enhance communication and collaboration among programmers dispersed in multiple locations. Wiki allows anyone to contribute interactively and flexibly because of its technical simplicity; therefore, the wiki allowed the SED team programmers to ask questions, provide solutions, and consolidate the solutions that had previously been discussed in one central repository. Our analysis also shows that a wiki, when its capacity is carefully planned and managed, can expand to support communication on an even larger scale. The wiki served as a central information repository for the NBC Universal IT department's reorganization. NBC Universal department posted their organizational structures and relevant reorganization information; the IT department used this information to provide customized and prompt assistance to all the departments. Again, the wiki's interactivity, technical simplicity, and accessibility were crucial for the IT department's reorganization processes.

The success of the wiki drew attention from other departments in NBC Universal, including Peacock Productions, which soon after adopted the wiki as a knowledge management tool. Peacock has dynamically changing structure and business processes, which make it difficult to capture and consolidate knowledge for the firm. Yet, Peacock needed an effective tool to facilitate knowledge sharing, an activity critical to the TV production business.

The wiki successfully steered key personnel to knowledge sharing and became the central knowledge base on which everyone can add, modify, and correct the content on the wiki, creating a valuable collective knowledge resource. The benefits of the Peacock wiki include capturing and transferring explicit knowledge (e.g., administrative procedures) and implicit knowledge (e.g., how to develop and produce better programs). The documented explicit knowledge increased operational efficiency and subsequently led to substantial cost reductions. The archived implicit knowledge prepared assistant producers and freelancer staff to produce better programs. The enhanced knowledge sharing in Peacock is expected to result in higher-quality programming and increased viewership in the long run.

Both the SED team and the Peacock Productions cases demonstrate the importance of project leadership. The wiki would not have been inceptioned without the foresight of the SED team members and the leadership of Bill Endow, who perfected the system and resolved all the technical glitches to make it ready for the enterprise-wise expansion. Also, the Peacock task force, at the insistence of its leader Danielle Bibbo, invested 10 months expanding the knowledge base despite many setbacks. Wikis promise successes only when their technical advantages (e.g., ease-of-use, flexibility, and interactivity) are coupled with managerial foresight of a Bill Endow and persistent drive of a Danielle Bibbo.

Throughout the world, businesses constantly strive to improve efficiency and effectiveness in order to attain increased profitability and greater success (Laudon and Laudon, 2006). As technology continually changes, adaptation is essential to any business model. Achieving operational excellence is vital for any firm's success, not to mention its survival. Wiki allows employees to work efficiently together across different time zones and on continents. Employee collaboration brings a company one step closer to operational excellence. In addition, wikis enable companies to cultivate the culture of collaboration upon which they can be more productive and provide greater value to their customers. While a key function of Wiki is its ease of use, it is collaboration that gives a wiki its true value: individually you can be good, but collectively you can be great. By encouraging sharing of tacit knowledge, firms will be able to achieve operational excellence, improve employee performance and customer satisfaction, and ultimately achieve competitive advantage.

Notes

- 1 Parise, Salvatore, 'Marketing: The Secrets of Marketing in a Web 2.0 World,' *The Wall Street Journal*, 15 December 2008.
- 2 Following Raman (2006), the authors differentiate between the terms, 'Wiki (uppercase W)' and 'wiki'. The former is used to describe the concept or refer to the technology in general; the latter is used to refer to a particular application of the technology.
- 3 EduCause Learning Initiative, July 2005, <http://www.educause.edu/ir/library/pdf/ELI7004.pdf>.
- 4 <http://www.elevatorview.com/2008/01/08/7-effective-wiki-uses-and-the-companies-that-benefit-from-them/>, last accessed on 23 January 2012.
- 5 <http://www.zdnet.com/blog/collaboration/ges-enterprise-collaboration-backbone/126>.

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About the authors

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Appendix

Table A1 A timeline of events for the Wiki implementations

<i>Time</i>	<i>Developmental phases</i>	<i>Scope and reach</i>
2005–2006	<ul style="list-style-type: none"> ● Bill Endow, former head of SED Team at NBC, initiated a wiki development project ● Confluence chosen as the wiki application 	<ul style="list-style-type: none"> ● Developed for intra-divisional communications within the SED Team, whose employees worked at geographically dispersed locations
2007	<ul style="list-style-type: none"> ● Confluence wiki launched ● Soon, problems arise when integrating the wiki with NBC's existing network software, and several lingering glitches were found 	<ul style="list-style-type: none"> ● Minimal traffic was received even from the SED Team due to these problems
December 2007	<ul style="list-style-type: none"> ● NBC's IT department reorganized to be aligned with business units ● Wiki selected as the nerve center for all information related to the reorganization of NBC IT department 	<ul style="list-style-type: none"> ● All department heads were required to create a page in the wiki with their organizational structures and relevant information ● The wiki started gathering traffic from other departments outside IT
January 2008	<ul style="list-style-type: none"> ● The new wiki, improved and redesigned to be the nerve center for the reorganization, launched 	<ul style="list-style-type: none"> ● The wiki's usage increased ten times overnight
2008–2009	<ul style="list-style-type: none"> ● The wiki reached the next level of maturity where it required careful scalability and capacity planning to ensure continuous availability of services ● As a part of capacity planning, a decision was made to run the wiki on a virtual server ● The updated application, Confluence Wiki (Version 3.1), was adopted for company-wide utilization 	
2009	<ul style="list-style-type: none"> ● Peacock Productions, a division of NBC News, was in dire need of a knowledge management tool ● Danielle Bibbo, coordinating producer in Operations, suggested that the division establish a central information repository ● The wiki developed by the SED team suggested as a solution ● For the next 10 months, information to be shared in the wiki was gathered and the content was created 	
February of 2010	<ul style="list-style-type: none"> ● The Peacock wiki was finally launched as the central information repository 	<ul style="list-style-type: none"> ● Peacock Productions employees were the main users of the Peacock wiki
Future	<ul style="list-style-type: none"> ● NBC News, one of the largest division of NBC Universal, plans to adopt the wiki ● NBC IT team must find a more scalable way of supporting the wiki to accommodate a sudden increase in traffic 	<ul style="list-style-type: none"> ● The next phase is to grow the user base by marketing the wiki throughout the organization and by raising company-wide awareness through education and training ● A downloadable version of the wiki for blackberries and a wiki iPhone application is being discussed