Enhancing situational awareness by exploiting wiki technology

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0. Abstract

A wiki site is a web site on which it is possible for anyone to create and edit content using an ordinary web browser. This enables easy information sharing and encourages users to contribute and share responsibility for a common knowledge base. A good example of the power of the wiki technique is the web-based free encyclopedia called Wikipedia, which currently contains around one million articles, contributed by people all over the world. In this work, we detail a number of example scenarios where the robustness and simplicity of a wiki would be highly beneficial for structuring and sharing information within the context of command and control. The examples range from every-day multi-agency collaboration to crisis management and military operations. We also describe our current work on implementing a military wiki, called MilWiki KB, and discuss a number of possible extensions that would further enhance the usability of the wiki.

1. Introduction

A currently very important aspect of command and control is the increasing demand for collaborative capabilities. This has lead to equally increasing demands on technology for information sharing. The development of such technology is often complicated and expensive, hence reuse of off-the-shelf products (where applicable) is desirable. In this paper we discuss the potential of using wiki technology for enhancing civil and military situational awareness.

The wiki software is a system that enables users to collaboratively create and edit web content directly, using a web browser. The content is usually stored in a relational database, which is run on one or more web servers. Unlike other content management systems aimed at collaboration, which are often focused on documents (*e.g.*, Office documents like Word and Excel) and how to organize them in folders, the wiki system is completely focused on the content itself.

The first wiki system, WikiWikiWeb, was created by Ward Cunningham in 1995 [17]. Today many implementations exist, varying from simple hacks to full featured content management systems, *e.g.*, UseMod, TWiki, MoinMoin, PmWiki and MediaWiki [15]. Most wiki systems have built-in version histories containing a complete history of changes for all the pages in the wiki. This makes it easy to revert to a previous version of a wiki page in case of vandalism[1]. Some wiki systems (*e.g.*, MediaWiki) contain a page listing recent changes, *i.e.*, a site-global change history. Thus, it is easy for a user to determine what pages that have new information on them.

The most well known wiki site is the web-based free encyclopedia called Wikipedia [14]. The Wikipedia project started in 2001 and currently (1 March 2006) the English edition contains about one million articles, contributed by volunteers from all over the world. The speed with which the encyclopedia grows is exceptional. At the time of the first abstract submission for the CIMI conference in mid November 2005, the number of articles was 800 000. This means that another 200 000 articles have been produced in less

[1] Vandalism in this case refers to any changes of an article made in a deliberate attempt to reduce the content quality.

than three months. However, the great number of Wikipedia authors and their varying degree of expertise, ranging from subject matter experts to novices, raise important questions about the quality and credibility of its information. The reason behind the success of the Wikipedia, its complete openness, is also its vulnerability as it enables vandalism and the spread of doubtful information. To handle these issues, Wikipedia has a number of volunteer administrators that do their best to maintain quality and prevent sabotage by expelling vandals. In a recent study, a selection of Wikipedia articles was compared to their counterparts in the highly respected Encyclopedia Britannica [8]. The average number of errors in the Wikipedia articles was found to be four, to be compared with three in Britannica. This shows that the constant review of thousand of users can be compared to that of a few paid experts. However, even if the Wikipedia comes close to a traditional encyclopedia regarding some quality aspects, its major benefit lies in the speed with which articles are updated and new knowledge is included.

The wiki encourages information sharing by letting everybody take equal responsibility for the information published. This openness obviously can lead to misuses of different kinds. However, the versioning techniques used for handling these problems in, *e.g.*, Wikipedia, are working surprisingly well for standard applications. In a command and control context, though, where the reliability of information can be crucial, additional techniques and methods have to be developed before the wiki can be utilized to its full potential.

In section 2 we outline our current work in developing a prototype for a military wiki knowledge base. An important feature of this prototype is the possibility to include geographical links to maps. Section 3 describes two usable extensions of the wiki for use in a command and control context, quality marking and interconnection of multiple wikis. To illustrate the use of these extensions, section 4 includes two example scenarios. Section 5 is devoted to semantic capabilities in wikis, and how this can increase information utilization in the future. Finally, some conclusions and directions for future work are presented in section 6.

2. The Milwiki Knowledge Base

One of the major benefits of the wiki concept is its ability to allow a large number of authors to collaboratively produce articles. These authors can be distributed within an organization or geographically. This is a great strength which enables a large amount of information to be gathered and structured in a relatively short period of time. Another important aspect of the wiki concept is that a reader that discovers an error on a page can immediately correct it. This means that there is constant review and update process, which makes it easier to maintain an updated knowledge base.

In most command and control situations, the basis for good situational awareness is knowledge about the physical positions of the objects of interest. Hence, tools for decision support commonly include maps. To fully exploit the powers of a wiki system in a command and control context, it is necessary to be able to connect wiki content to geographic locations [18]. This feature is called *geo-referencing*. For example, information about a factory should be connected to its geographic location in a machine interpretable way, thus enabling presentation on a map.

We are currently developing a prototype of a military command and control wiki knowledge base, called MilWiki KB (the Military Wiki Knowledge Base). The purpose of the MilWiki KB is to study how a wiki system can be used for knowledge management in everyday use across hierarchies and boundaries in a military organization. The prototype system will be used in Demo 06 Vår, an experimental exercise of the Swedish Armed Forces. To encourage usage of MilWiki KB as a source of information during the

exercise, the database has been filled with background information on the exercise scenario. The users of MilWiki KB can then continuously update this knowledge base, as more information is acquired.

Technically the MilWiki KB prototype is implemented as an extension of the MediaWiki software [5]; support for geo-referencing builds on a special GIS-extension [6]. By adding a specialized *geo-tag*, the user can link a wiki page to a coordinate. The geo-referencing feature will make it possible to generate lists of wiki pages that are geographically near the current wiki page.

Another extension implemented in MilWiki KB is the support for displaying embedded maps. By typing a specialized map-tag on a wiki page, a map is included in the article. The functionality is similar to inserting an image on a wiki page, but instead of entering a reference to an image, the coordinates for the map is entered. The coordinates for two opposite corners are sufficient for specifying a geographic region. Various types of coordinate systems can be used as input, *e.g.*, geodetic (latitude, longitude) or projected (RT90, UTM, etc) coordinates. Generation of maps that can be visualized in a web browser is done by a dedicated map server, which delivers an image of a specific geographic region. While a map alone is very useful for presenting geographical information, combining this with geo-referencing of wiki pages makes an even better user presentation possible. By enabling this feature, geo-referenced wiki pages can be shown as markers on a map. These markers are also back-links to the corresponding wiki page. Figure 1 shows this feature in action, where each of the cities being marked at the map exist as a separate wiki page.

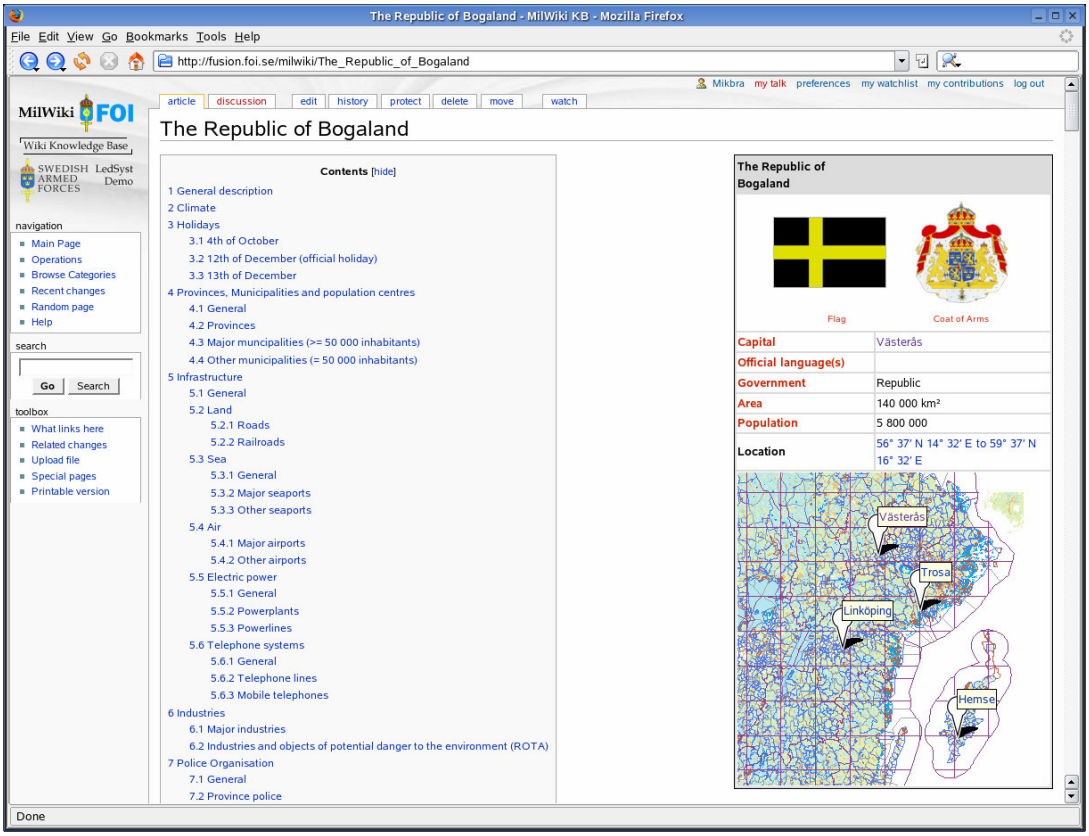

Figure 1. Screen shot of the MilWiki KB with a map containing back-links to cities in the area.

3. Technical extensions

In the wiki knowledge base concept the right to read and update information should be pushed out in the organization. Instead of having a top-down approach where information is only sent through the command chain, a more direct way of information sharing is possible where the grass roots of the organization can collaborate with reduced need for a hierarchy to communicate through. However, it can be argued that allowing many authors will lead to reduced quality. Although this issue can be addressed by the constant review of all of the users of the wiki, some kind of information quality marking is still needed. Another issue is how to interconnect wiki knowledge bases belonging to different organizations to each other in order to allow broader information sharing and collaboration. In the next two sections the concepts of information quality marking and wiki interconnection are described.

Quality Marking

Information quality marking is similar to what advanced concurrent versioning (*e.g.*, Rational ClearCase) [9] systems provide to software developers. A software developer can request the stable branch for most of the source code while getting the experimental branch in another part of the software project. In a similar manner, but without branches, wiki pages could be marked with a quality label. This quality marking could then be used to filter out the correct version of a wiki page based on the information quality demands of the user. Since the quality filtering is a trade-off between quality assessment and information freshness, a wiki user may have different quality demands in different information domains. For instance, a medical doctor might choose to have the newest, and thus somewhat preliminary, information in the medical information domain since he/she has the knowledge to determine the validity of the information him/herself. In other domains, he/she may choose to have higher quality, thus relying on quality assessments performed by domain experts. Figure 2 shows an example of filtering on quality markers.

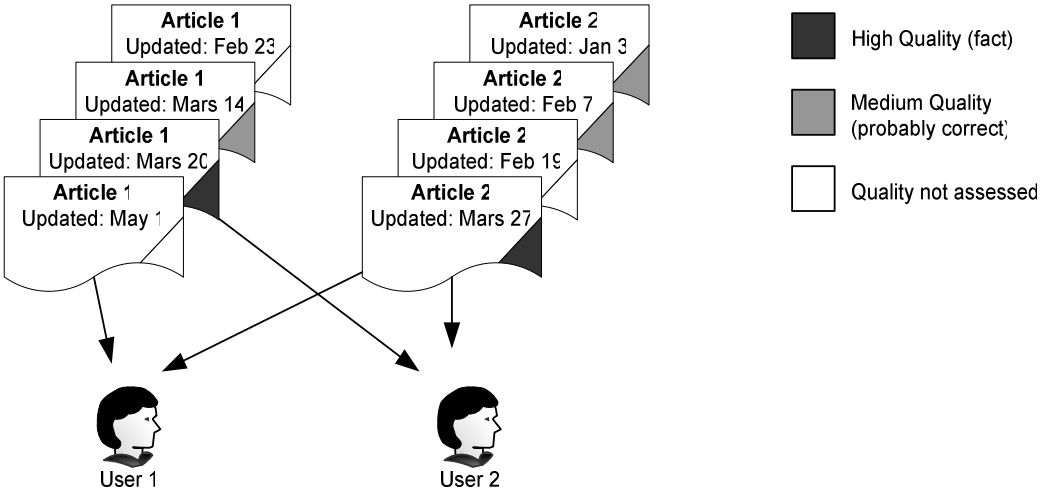

Figure 2. Quality filtering gives different users different views of the content. User 1 has lower quality demands on article 1 and automatically gets the newer available version.

To ensure that the quality marking can be trusted, setting these quality markers in the wiki should be restricted to certain users. Users with expertise in a certain domain may have the authority to set the quality marker up to highest quality of content in that

domain. Other users may only have the authority to set a medium quality marker. Using these techniques, user trust in the wiki-content can be reinforced.

Wiki Interconnection

Wiki is a great tool that enables collaboration within an organization or community. However, if multiple organizations need to share information with each other, their wikis should be connected. Currently there is no easy way of doing this. Generally, searches across several wiki sites have to be done manually at each wiki and links between wiki sites do not have the same support as internal links. Many ideas on how to overcome these problems have been introduced [4]:

- **Sister wiki** is a related wiki site.
- **Inter wiki links** are links between sister wikis with back-links and page existence detection. Current implementations [7] are more or less "syntactic sugar" with only a simplified way of entering an external link (simple hypertext link).
- **Inter wiki search** is the concept of searching through all sister wikis automatically when a search is initiated on one of the wiki sites. Experimental versions exist today [13, 16].
- **Near links** are internal wiki links that are automatically redirected to a sister wiki page if the page does not exist on the original wiki site but can be found on a sister wiki site. The link is pointed to the first sister wiki site that has content for the link.
- **Twin links** are related to near links. They are lists of links from one wiki page to sister wikis when the page title also exists on the sister wikis.

When these concepts have been implemented in a wiki system, organizations and communities can truly start to connect and share information in their wikis.

When interconnecting wikis across different organizations some security issues arise. A wiki is mainly usable when the focus is sharing information among its users. This is often contradictory with the way that secret information is handled (*e.g.*, sharing is restricted). The situation can be handled by using two wikis, one for open information and one for restricted information. These two sites are then interconnected in a one-way manner. The open wiki is unaware of the restricted one while the restricted wiki has set up the open wiki as a sister wiki with all the features like inter wiki links, inter wiki search, near links and twin links. Of course, back links will not be permitted in this case.

4. Example scenarios

Below we give two example scenarios where a wiki would be highly beneficial for structuring and sharing information. The first example is aimed at civil crisis management and points out how quality marking could be used. The second example is a military scenario stressing wiki interconnection as an enabler for information sharing between different organizations.

In a large-scale civil crisis scenario, *e.g.*, a natural disaster or terrorist attack, there is an urgent need to collect information for building an as good as possible situation picture. Considering the inherent chaos of such situations, it is not expected that normal sources and paths of information will function optimally. However, as has been registered during several recent major disasters, information may find other paths. During the July 2005 London bombings, the public used blogs and photo sharing applications on the Internet to share their observations and experiences [3]. In less than half an hour after the first bomb exploded, the page "7 July London bombings" was created on Wikipedia and then

continuously updated with more information and links to other relevant sources. Similar information posting behavior also appeared during the aftermath of hurricane Katrina, which caused catastrophic damage along the southern US coastline in August 2005 [2].

A non-public wiki for this sort of on-the-fly information gathering could be valuable to authorities trying to create a picture of a situation. In order to guarantee the quality of information, the editing should be restricted to a community of trusted users, scanning Internet and other media for news. Alternatively, editing could be allowed for everyone and a quality marker approach is used to ensure the quality of the information.

In military operations other than war (MOOTW), armed forces often arrive late to the conflict area in comparison to other organizations. It is easier for NGOs (non-governmental organizations) to act quickly on humanitarian disasters than it is for the UN to reach a consensus and send military forces. Therefore, the NGOs on site could be used as sources of information in the IPB-process (Intelligence Preparation of the Battlefield) of the armed forces. If the knowledge and experience these organizations have gained during their activity in the area are collected in a wiki knowledge base, information access can be (at least technically) accomplished by using interconnected wikis. In this way, the armed forces can gain knowledge about the religious and ethnical background as well as the current status of the humanitarian situation in the area. The information is presented directly in the knowledge base of the armed forces. As time goes, the armed forces will build up a wiki knowledge base on their own based on their own experiences in the area. Missing pieces of information are still automatically filled in with information from other sources (*e.g.*, by using twin links, near links and interwiki search).

This knowledge base, together with the sister wikis of the NGOs, can be used to collect the current knowledge about the conflict area so that new personnel can catch up as they arrive.

5. Semantic wikis

The increasing popularity of the wiki concept proves its usefulness as a tool for collaboratively creating web documents. However, since the product of a wiki collaboration is text in natural language, it is only suitable for other *people* to read; support for machine interpretation is poor. To deal with this problem, a number of ongoing research and development projects aims at introducing explicit semantics in wikis. This is in line with current efforts in developing the Semantic Web, an extension of the World Wide Web where the content of web-pages are given meaning through the use of standards, markup languages and related processing tools [10].

The first step towards creating a semantic wiki is to give meaning to the links between pages. Consider a page describing the life of Shakespeare. The page might contain a link to a page about Stratford-upon-Avon, Shakespeare's place of birth, and to a page describing the play Hamlet. In a normal wiki there is no difference in interpretation between the two links, they simply connect the different pages. In a semantic wiki the links are labeled, often using RDF (Resource Description Framework), a language for expressing triplet relations in the form of subject, predicate and object. The subjects and objects in a wiki are the interlinked pages and the predicates are expressions describing the kind of relations. In the above example, the subject would be the Shakespeare page, the object either the page of Stratford-upon-Avon or Hamlet, and the predicates *bornIn* and *authorOf* respectively.

This kind of tagging enables a computer to process the added link information and lays the foundation for more advanced querying of the wiki content. For example, it will be possible to ask the wiki for a list of all persons (included in the wiki) born in Stratford-upon-Avon, or when reading the Hamlet page, to ask for other works by Shakespeare.

Pages containing lists with dynamic content can be updated automatically instead of manually as is done today in for instance Wikipedia.

In the context of a command and control knowledge base, the semantic features can enhance situational awareness. Advanced queries will be based on semantic concepts rather than keywords, improving the precision of the information access. For example, in a military scenario, it will be possible to ask for all friendly units participating in a certain mission in a certain region. In an intelligence scenario, one can perform queries like "give me all pages related to a certain person or his/her family".

One of the major points of criticism of the Semantic Web is the question of how to make people and companies tag their web pages. Even if the mark-up process can be made relatively simple, the amount of time to perform the tagging will be considerable. Without any incentives, there is a risk that the glories of the Semantic Web will remain a dream. However, the designers of the Semantic Wikipedia believe that the large and devoted community of Wikipedia authors will manage the task of tagging the Wikipedia [11]. Similar arguments can be found in [12], which discusses the possibility of semantic management of very large governmental web sites using wiki technology. People in certain positions and with certain skills are organized into communities of interests, each of which will be responsible for continuously tagging a designated part of the site. Many authors sharing the burden of administrating the information will be the mechanism enabling large-scale semantic knowledge management.

6. Conclusions and future work

In this paper, we have described how a wiki knowledge base can be utilized for enhancing situational awareness in both civil and military command and control scenarios. A number of possibly useful extensions were also introduced, such as the already implemented geo-referencing tagging, and the quality marking and wiki interconnections. We believe that these extensions together with the simple but powerful principles of wiki collaboration can constitute the foundations for a knowledge base system that is useful, robust, easy-to-use and affordable.

In the FOI project TMDI[2] we will continue to study these issues. We also have plans to introduce text-mining capabilities to be able to infer relations between wiki pages automatically and use it to improve the knowledge structures. Text-mining could also be used to construct semantic relationships in a semantic wiki.

7. References

[1] Berners-Lee, T., Hendler, J., & Lassila, O. (2001). The Semantic Web. Scientific American, http://www.scientificamerican.com, accessed 2006-01-13.

[2] Katrina blogs. http://www.bloggersblog.com/hurricanekatrina/.

[3] London bombings. http://www.boingboing.net/2005/07/07/photos_related_to_lo.html.

[4] Meatball Wiki Interwiki, http://www.usemod.com/cgi-bin/mb.pl?InterWiki

[5] MediaWiki, http://www.mediawiki.org

[6] MediaWiki:gis, http://meta.wikimedia.org/wiki/Gis

[7] Meta Interwiki Linking, http://meta.wikimedia.org/wiki/Interwiki_link

[8] Giles, J. (2005). Internet encyclopaedias go head to head. Special Report, nature.com. http://www.nature.com/news/2005/051212/full/438900a.html

[2] TMDI – Teknik, Metodik och Demonstrationssystem för Informationsfusion, Avd. Ledningssystem

[9] Rational ClearCase, http://www.ibm.com

[10] Semantic Web, http://en.wikipedia.org/wiki/Semantic_web

[11] Völkel, M., Krötzsch, M., Vrandecic, D., & Haller, H. (2006). Semantic Wikipedia. Submitted to WWW2006.

[12] Wagner, C., Cheung, K.S.K, & Ip, R.K.F (2006). Building Semantic Webs for e-government with Wiki technology. Electronic Government, Vol. 3, No 1, 2006.

[13] InterWiki Title Search, http://www.dairiki.org/interwiki/search.php

[14] Wikipedia. http://www.wikipedia.org.

[15] Wikipedia, List of wiki software. http://en.wikipedia.org/wiki/List_of_wiki_software

[16] MetaWiki Search, http://sunir.org/apps/meta.pl

[17] WikiWikiWeb, http://c2.com/cgi/wiki

[18] Whitt, L. (2005). SmartCOP – the fusion of collaborative workspaces and the Common Operational Picture. In proceedings of the 10th ICCRTS, 2005.

8. Biographies

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