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The Transformation of the Web: How Emerging Communities Shape the Information we Consume

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Abstract: To date, one of the main aims of the World Wide Web has been to provide users with information. In addition to private homepages, large professional information providers, including news services, companies, and other organisations have set up web-sites. With the development and advance of recent technologies such as wikis, blogs, podcasting and file sharing this model is challenged and community-driven services are gaining influence rapidly. These new paradigms obliterate the clear distinction between information providers and consumers. The lines between producers and consumers are blurred even more by services such as Wikipedia, where every reader can become an author, instantly.

This paper presents an overview of a broad selection of current technologies and services: blogs, wikis including Wikipedia and Wikinews, social networks such as Friendster and Orkut as well as related social services like del.icio.us, file sharing tools such as Flickr, and podcasting. These services enable user participation on the Web and manage to recruit a large number of users as authors of new content. It is argued that the transformations the Web is subject to are not driven by new technologies but by a fundamental mind shift that encourages individuals to take part in developing new structures and content. The evolving services and technologies encourage ordinary users to make their knowledge explicit and help a collective intelligence to develop.

Keywords: Collaborative Work, Community Building, Self-Organisation, Emergence, Information Systems, Web-Based Applications, Wikis, Blogs, Podcasting, File Sharing, Social Networks.
Categories: H.3.4, H.3.5, H.3.7, H.4.3, H.5.1

1 Introduction

The World Wide Web has grown into a truly world-wide computer-based media network. Previously, most information was, by and large, offered by professional information providers such as companies advertising their products and services, organisations or news services. In addition, private users on the web had the option of establishing personal homepages as well. However, technological obstacles—complicated tools, lack of infrastructure and technical background knowledge—prevented many users from producing web-pages (e.g., [Lindahl and Blount 2003]).

The infrastructure of successful corporate web-sites often relies on content management systems. These environments take their organisational structures from traditional media such as newspapers or television channels, where authors, editors, an editor-in-chief, etc. are in charge. Hence it can be argued that, to date, the Web has mapped structures from the physical world to the hypertext domain. It has not been able to deliver other qualities than traditional media; the World Wide Web has been far from being interactive, and users rarely had a chance to *participate.*

Recently, however, the Web has undergone changes. Although it has gone partly unnoticed, these transformations are profound as they give ordinary users ability to get more involved in the content creation process. As a result, community-driven initiatives such as blogs, wikis and podcasts have emerged.

This paper gives an overview of a number of popular community-based technologies and services. The following sub-sections detail the nature of self-organising systems and briefly outline current developments on the Internet. Section 2 introduces blogs, a form of web-based journals. The subsequent sections address wikis, types of collaborative content development systems, and two particular instances of wikis: Wikipedia and Wikinews. While blogs and wikis allow communities to generate mainly textual content, podcasting addressed in section 6 introduces a way for users to distribute audio content. Section 7 discusses file sharing tools including Flickr used by communities for sharing documents such as photos. In section 8, social networks as communication and meeting platforms for communities and friends are presented. The last section of this paper discusses the impact of the services introduced and gives an outlook on further developments.

1.1 Self-Organising Structures

Oftentimes it seems to be necessary to introduce hierarchies in order to make large amounts of data and complex structures manageable and comprehensible. Hence most information systems, as computer-based environments or systems in the engineering sciences in general, have hierarchical structures. Examples are filesystems, web-sites, newsgroups and e-Mail systems.

Daily life, however, has numerous examples of systems that do not have a clearly defined hierarchy and follow the rules of organised complexity that may yield emerging structures (e.g., [Johnson 2001]). Examples include the formation of neighbourhoods and cities, the growth of plants, and the natural balance of ecosystems.

Probably the most prominent examples of self-organising systems, however, are ant colonies (see [Gordon 2000; Gordon 1999]). Although every colony has its queen, the term queen is misleading because she is not a leader of the colony. The ant queen lays the eggs, but she does not communicate any particular orders to the workers. They communicate with each other using a vocabulary of about ten to twenty pheromones. In addition to this, they are believed to have a small set of "built-in" rules they follow in order to be able to complete tasks including building a nest, protecting it, and foraging.

Every ant starts the day with a particular task such as collecting food. When many foragers return to the nest with food, ants performing other tasks will also start foraging. ("Today is a good day for collecting food.") When, on the other hand, many foragers return without food, the ants in the nest will continue doing their current

work, and foragers will, for instance, go back into the nest and remain idle. ("Today is not a good day for finding food, try again tomorrow.")

Although these simple decisions foragers make might not be ideal, and individual ants make wrong decisions, the large number of ants in colonies assures that decisions are ultimately correct. This can be explained as a variation of the principle of evolution that holds true for a sufficiently large amount of time and a critical mass of individuals (e.g., [Rechenberg 1973]).

Another remarkable aspect of ant colonies is that they change their behaviour over the course of generations. Foragers of a three or four year old colony, for example, are likely to fight over food with ants from neighbouring colonies. In contrast to this, ants of older colonies will steer clear of foreign foragers on their encounters. On subsequent days, foragers will avoid the corresponding region altogether and attempt to find food in different areas.

This change in behaviour is particularly astonishing since, apart from the queen, ants do not live for more than a year. The ant queen, however, is unable to pass any knowledge on to the workers. Although the behaviour of single ants seems to remain unchanged, the entire colony becomes more mature towards the end of its lifetime.

1.2 Recent Developments on the Internet

Technological advancements in recent years have yielded systems with entirely new qualities. Although similar applications have existed in the past, the new developments have amalgamated distinct features of their "precursors" and enable entirely novel applications.

The common characteristic, which all these systems share, is that the approach is "bottom-up" rather than "top-down". This means that in these environments content and structure are not determined by professional, corporate information providers. Both content and structure are defined by the individuals of the community. This facilitates self-organisation in these systems and makes the emergence of advanced structures possible. The result is a system where the knowledge of the community is "larger" than the sum of knowledge and experience of all individuals.

For this approach to work, a critical mass (of users in the community) is required (e.g., [Andrus 2005] and [Rechenberg 1973]). This requirement can be seen as an analogy to ant colonies. Individual ants may be unable to build a nest and defend it, may be incapable of providing all fellow-ants with food, etc. With a large number of ants, however, they become more than their sum—they form a community, an ant colony.

2 Blogs

Weblogs, often simply called blogs, are web pages that contain newsgroup-like articles in a chronological order with the newest article listed first. Postings to blogs are frequent, typically once a day. They are usually produced by one author or by a small group of authors and are open to the public for reading. Both in style and content, blogs resemble a cross between diaries, newsgroups, newspaper editorials, and hotlists where owners write down information important to them on a regular basis (see [Blood 2002]). Blogs are, however "owned" and maintained by a single

person or group of users. They are not open to the public for authoring, and there is no well-defined publishing process as in newspapers (e.g., [Herring et al. 2004]).

Blog entries frequently cite a current event such as a law recently passed, a news story, or the release of a new product. Individuals write comments and their opinion on the event in their blog. Hence, blogs are usually opinionated and reflect the author's views on certain topics.

2.1 Types of Blogs and Applications

Basically, two major sorts of weblogs can be distinguished: diaries or personal journals and filters. Journals amount to approximately seventy percent of all blogs, and filters to about ten to fifteen percent ([Herring et al. 2004]).

In the first class of blogs, authors keep readers informed on their work, a social life, they posted holiday photos, etc. The first diary-style weblog believed to have been published was started by Justin Hall, a college student, in January 1994 (e.g., [Pollock 2001]). He employed it to keep people informed about his daily life. Nowadays, for many users, weblogs are a replacement for homepages because they can be used in similar ways but are easier to maintain.

Filters are collections of links to external web-sites that are supplemented with abstracts or brief comments on the contents of the corresponding page. They are usually dedicated to particular topics that can be as diverse as computer hardware, politics, or the war in Iraq. One of the best-known filter style blogs is Slashdot, a web-site focusing on technology ([Slashdot 2005]).

Slashdot has a large number of authors, and hundreds of new articles are added every day. This was a potential problem for readers because it is hard to find out which articles are interesting, and almost impossible to read all new articles. Therefore Slashdot introduced a rating system: every entry in the blog is rated by readers of the blog. At the same time, readers can choose to have only articles with a certain average rating displayed. Thus, the community of readers determines which articles are significant and hence is capable of establishing a sort of quality control.

Blogging technology is employed in both professional and personal areas. Companies, for instance, make use of weblogs in order to keep employees informed about new products and strategies or on the progress of projects. Furthermore, they are a means to foster cooperation between various departments (see [Treese 2004]). Such blogs are usually only available within the network of the company and not publicly accessible. Authors are frequently project leaders and heads of departments.

2.2 The Blogging Community

With several free tools and services available on the Internet, basically anyone can set up their own blogs relatively easily (e.g., [Blogger 2005]). Hence, readers can also comment on other authors' blog articles in their own blogs. This network of more or less loosely interconnected weblogs is called *blogosphere.*

Connections among various blogs are a type of community-building that becomes possible through a set of technologies including permalinks, trackback and RSS feeds (see [Efimova and de Moor 2004]). A *permalink* is a persistent URL to a single posting in a weblog. When author *A* refers in her article a_A to an article a_B by author *B,* a permalink to a_B can be used. If the blogs are *trackback*-enabled, a link from a_B to

a_A is appended to a_B. Thus, a_A and a_B are linked bidirectionally, and authors of cited articles are informed about their content being used (cf., [Maurer and Tochtermann 2002] and [Bharat et al. 2001]).

RSS (RDF Site Syndication, [RSS 1999; RSS 2001]) is a relatively uncomplicated way for users to find out about the most recent changes on a blog, or a web-site in general, in a given period of time. The *RSS feed* for a site presents a list of changes and additions that typically contains the title of an article, a short summary and the URL to the full entry.

2.3 Advantages and Drawbacks of Blogs

Weblogs are an easy way for users to express themselves on the Web and are a valuable tool for companies and organisations to communicate information to employees. Critics, however, claim that they are essentially nothing new (e.g., [Herring et al. 2004]). Hotlists, discussion forums, and "what's new" pages have existed before; however, their usage was more complicated than writing an entry for a blog.

Blogs are sometimes perceived as authoritative works—which they are not. Their contents may be flawed due to a bias. Depending on the purpose of the blog, this can be an advantage or a shortcoming. In systems where a blog is utilised in order to give users the opportunity to comment on articles on a web-site, for instance, opinionated entries can be of value to other readers. Filter-style blogs, on the other hand, offer links to external information complemented with comments. In this case, biased comments are undesirable.

When analysing the blogosphere technological drawbacks of HTTP and HTML become obvious. Permalinks become necessary because it is not possible to identify and locate information at the required level of detail. Since the Web merely implements unidirectional links a technology like "trackback" has to be introduced (cf., [Kappe 1995]). The Web is a passive media that provides content on request; it cannot inform users whenever an existing document is altered or a new page is added. Therefore RSS is employed in order to notify users of new or modified content.

Blogs are usually not used by themselves but in conjunction with several other technologies ([Efimova and de Moor 2004]). Most frequently, they are combined with e-mail and instant messaging for "out-of-band" communication or wikis (see below). From this perspective, weblogs are a new sort of media that is complemented with various other technologies.

3 Wikis

The term *wiki wiki* is Hawaiian for "quick" and reflects Ward Cunningham's intent to create a concept that makes rapid development and organisation of web-pages possible (see [Leuf and Cunningham 2001]). The first wiki was started in 1995 as a collaborative authoring environment (see [WikiWikiWeb 2006]). Wikis in general are self-organising web-sites, where anyone on the Internet can edit existing pages and add new documents any time they wish. This means that every reader can instantly become an author.

This characteristic is interesting because initial authors of articles allow other users to edit "their" content. The fundamental idea behind wikis is that a vast number of users read and edit the content, and therefore errors will be found and corrected. Although modifications to the original article can introduce errors, the principle of evolution determines that in the course of time, after a number of changes, the document will become complete (cf., section 1.1).

The aim of wikis is to reach an agreement among the authors. Through the iterations an article undergoes, and the numerous editors, the content is generally agreed upon. For the same reason, wikis tend to be unbiased, which differentiates them from blogs.

3.1 Technical Aspects of Wikis

From a technical perspective, a wiki is a web-based content management system (CMS) for generating web-pages that can contain text, images, sound and similar media objects as well as hyperlinks to internal and external resources. Unlike a regular CMS, wikis usually do not contain sophisticated rights management. Thus apart from a few users with administrative privileges, every user in the system has the same permissions.

When the content of a page is modified a wiki-specific source code has to be employed. The complexity of this markup language determines, for example, if the wiki can be used to display tables, mathematical formulas or different fonts. The visual design of the wiki articles is determined by HTML templates that define the placement of the content on the page, the font to be used, etc. When a wiki page is requested by a user the content entered using the wiki-specific markup is translated into HTML code and is inserted into the template. Thus, a conventional HTML page with a pre-defined design is sent to the client.

The articles of a wiki are stored in a database. However, not only the most current versions of articles but their entire history is retained. Therefore wikis inherently provide version tracking, and users can have access to a list of recent changes of a given page. Moreover, the differences to a previous version of an article can be pointed out.

3.2 Application Areas

The concept of wikis is applied in numerous fields, from learning environments to documentation systems. Many companies including computer businesses and car manufacturers offer online documentation and help for business customers and consumers. Traditionally, these support databases contain information provided by engineers and customer support. Other valuable information such experiences with the actual product gathered by users are handled in discussion forums.

With wikis, engineers could provide the first version of a product description, and users could modify the initial content and append complementary information when needed. This approach can make documentation systems much more effective since the essential description of a product, for instance, is available in a single document. The information can be kept up-to-date by the user community, and new developments such as the influence of a new operating system on an existing software product can be dealt with potentially more effectively. Discussions about topics such

as the usability of the product can take place in forums or blogs attached to articles in the wiki.

Another area in which wikis are successfully applied are "knowledge bases" used in companies and organisations for internal communication and documentation. In such repositories information needed for doing everyday business but also information on competitive products, on the use of technologies, etc. can be retained. With wikis not only a small group of editors but everyone can contribute even small portions of information to articles in an uncomplicated way. When a programmer, for instance, finds a more effective solution to a problem, she can add it to the corresponding article in the wiki, and the result is available to other programmers immediately.

A research project conducted by the CIA suggests a similar concept (see [Andrus 2005; Tomlin 2005]). Intelligence officers collecting data could insert their information into a wiki and thus make it available to the entire organisation. Since an editor does not have to approve the content, the information can be offered faster, and actions such as re-structuring of articles can be performed more easily.

Many state-of-the-art learner-support systems make extensive use of digital libraries. In most cases, the information in these libraries is authored by teachers, lecturers, and professional information providers. More recent projects, however, rely heavily on the students who generate content as part of their homework or lecture. Although the first version of the digital library will most likely be rather imperfect, subsequent versions—after a few iterations, after a few semesters—will become more and more complete. An example is a wiki that is used by university students of structural engineering to create an online library of lecture material for reinforced concrete construction science ([Ebner and Zechner 2005]).

Further examples for wikis are Wikipedia and Wikinews presented in sections 4 and 5. Wikipedia, by far the largest wiki in use today, is of special interest because phenomena of large-scale communities can be observed (source: [Wikimedia 2006a]).

3.3 Benefits and Shortcomings of Wikis

Similar to ant colonies, wikis are self-organising systems with a large number of individuals at work (cf. section 1.1). As ant colonies manage to succeed in tasks such as foraging and building nests, wiki communities can successfully author content and create organisational structures.

The fact that basically everyone on the Internet can contribute to wikis in an uncomplicated way makes them more flexible than static editor-based web-sites. Content can be created and published by users easily and, unlike regular web-sites, without profound technical background. In addition, features such as easy and open access as well as version control make them particularly well suited for collaborative work.

Users being both readers and authors at the same time is one of the strengths of wikis but also one of their major drawbacks. Although the wiki concept makes the development of content highly flexible and a system versatile, it makes maintaining high quality standards for entire wikis almost impossible. Since basically everyone with access to a wiki can modify its content, the credibility of the information provided can be questioned. Users might inadvertently add incorrect information to a page in a wiki, and readers might mistake the content provided for reliable.

Vandalism is also a problem experienced in wikis: wrong data, advertisements, defamatory content are inserted deliberately, existing content is deleted, etc. Although acts of vandalism are usually found and corrected relatively fast they are pestering communities and can impede the authors' motivation to contribute to the system.

After a period of time and several evolutionary cycles, single articles in wikis usually become authoritative, and their level of accuracy and completeness is high. This does, however, not mean that the wiki as a whole becomes authoritative, which might be confusing especially for users not fully aware of the wiki concept. Further issues related to the wiki concept are discussed in section 4.2.

3.4 Counter Measures

The open access to the content in wikis is one of their disadvantages, particularly when the information presented is critical. Therefore a distinct form of wikis with various levels of permissions is proposed, while the core features of the concept remain unaltered.

For users on the highest level, the "hierarchical wiki" can be used in exactly the same way as traditional wikis, i.e., these users can edit any section in any article. Users on lower levels, however, may only modify parts authored by users on the same level or on lower levels but not portions of text, for instance, written by users on the highest level. Users on the lowest level can only edit information initially authored by users of this level.

The key for making such a system successful is to restrict the majority of all users to the lowest level. While a few users in higher level groups supply essential information, start new articles, and work actively on maintaining quality standards, the large mass of users work only on the actual development of content.

This approach makes it possible to have the most important information provided by high level users, whereas supplementary information is authored by writers on lower level. An example is a product-related wiki, where engineers as high-level users publish a user's manual, and consumers add their experiences or information on the use of the product. Although consumers can add new information and can alter pieces of content authored by other low-level users, they are not capable of modifying the content provided by the engineers.

Potential further application areas for hierarchical wikis include the communities around intelligence agencies (see [Andrus 2005]). One of the main processes in these environments is gathering pieces of information. As soon as new information becomes available it can, for instance, be inserted into an existing article in a wiki by the officer of the intelligence community. While the majority of the article can be edited and viewed by everyone of the community, certain parts might be confidential and only be viewed by members of higher levels. Yet other sections such as the "core" of the article might only be edited by users on the highest level.

4 Wikipedia

The tradition of trading knowledge in the form of professionally authored encyclopaedias goes back to the 17th and 18th centuries. This is in stark contrast to Wikipedia, where articles are neither written by acknowledged experts nor are they

reviewed by editors. Wikipedia could be coined "the people's encyclopaedia". It is a free, wiki-based encyclopaedia that anyone can edit. Every user is reader, author, and editor at the same time ([Wikipedia 2005a]).

The success of Wikipedia builds on the tight involvement of the users, the sense of the community, and a dedication to developing a knowledge repository of unprecedented breadth and depth. The project is growing rapidly: from its founding in 2001 until December 2005, Wikipedia has been established in more than 200 languages with more than 2.5 million articles. The largest editions are the English one with about 980,000 articles and the German one with almost 330,000 articles (source: [Wikipedia 2005b]).

4.1 Advantages of Wikipedia

The concept and architecture of Wikipedia make it much more flexible than a print version or an edited online version of an encyclopaedia. When events like the Olympic games, for example, take place the most current results are published just minutes after they become available. These articles are sometimes even complemented with tables, photos and links to external resources.

The main argument against the Wikipedia project is that with an open editing process the correctness of the information provided cannot be guaranteed. However, a recent study conducted by Nature shows that, in terms of accuracy, science articles in Wikipedia are fully comparable with corresponding information in the Encyclopædia Britannica (see [Giles 2005; Britannica 2005]). Both encyclopaedias contain a number of misinterpretations of concepts, omissions, misleading statements, and factual errors.

Wikipedia is probably doing comparatively well because it endorses guidelines to ensure that articles are written in an objective and unbiased way. One of the main policies for writers is the "neutral point of view". It urges authors to write content from a neutral perspective so that "ideas and facts [are presented] in such a fashion that both supporters and opponents can agree" (from [Wikipedia 2006a]).

4.2 Drawbacks of the Approach

Despite all guidelines, the concept of Wikipedia is prone to a number of complications. This section presents selected problems that can be observed frequently (see also [Denning et al. 2005]). They are most likely not only to be encountered in Wikipedia but in any wiki with many articles and users.

4.2.1 Quality and Authority

Encyclopaedias and dictionaries are typically reference works. They are used by researchers, librarians, students, journalists, etc. in order to obtain precise definitions and explanations. Since articles in Wikipedia are written by a large number of users, and currently mechanisms to approve the expertise of authors or to verify the reliability of content do not exist, the quality in Wikipedia is not equal for all articles. Therefore it can be precarious to use Wikipedia as a sole source of reference. An editor of the New York Times has even warned the journalists of the newspaper to use Wikipedia with caution (see [Ingrassia 2005]).

The Wikipedia initiative is aware of the problem of a lack of quality, but instead of having articles approved by experts, a peer review and rating mechanism is favoured (e.g., [Giles 2005]). The "article validation feature" due in January 2006 will allow users of the encyclopaedia to assess the quality of articles (see [Wales 2005; Wikipedia 2006b; Wikimedia 2006b]). Since the mean value of all ratings for a given document version indicates its quality, it will be easier for readers to judge whether to trust the information provided by Wikipedia or not.

4.2.2 Background and Balance

Wikipedia has several policies in place to ensure, for instance, that articles are unbiased (see section 4.1). However, even if an article is written in compliance with the "neutral point of view" the varying cultural, social, national and lingual backgrounds can have an enormous influence. Hence, content in Wikipedia can only be as professional and balanced as its authors and their demography are.

On February 5th, 2005, the English article on the American chess player Paul Morphy, for example, had 5,466 words, contained a photo, citations and references to external resources. In contrast to this, the German version consisted of only 290 words and did not offer any additional information. This example shows, on the one hand, that Paul Morphy is an important person for Americans. On the other hand, it distorts reality and creates an imbalance in that it emphasises "local heroes".

Edited encyclopaedias meet imbalance and bias by introducing guidelines for the creation of content. The length of articles or the number of references to external sources, for instance, might be limited. These measures make it possible to create articles in a given "class" with the same structure and similar volume (e.g., [Korica et al. 2006]).

In Wikipedia, disproportionate weight is given to topics such as controversial scientific matters, disputed hypotheses, science fiction, and conspiracy theories. It is beyond the scope of this paper, but it should be investigated how popular these topics actually are, and what kind of users are involved in their writing.

4.2.3 Sensitive Information and Privacy

Incorrect information in Wikipedia articles is particularly problematic when sensitive information is covered. A recent, startling example is the case of John Seigenthaler. An anonymous user published a biography for Seigenthaler on Wikipedia. It related him to the assassinations of John F. Kennedy and his brother and accused Seigenthaler of collaboration with the Soviet Union in the 1970s (see [Seigenthaler 2005]). An intense discussion followed and as a consequence of the Seigenthaler case, the creation of new articles is restricted to registered users only, i.e., anonymous users are not able to start new articles. Becoming a registered user is, however, not complicated, being only a matter of several minutes.

Although defamatory content can cause much harm, sometimes incomplete articles and articles with deliberate omissions are just as bad. If an article states that an author has written books *A* and *B* but does not mention that the same author has written another five books it leaves the impression that only two books were written. In some cases, however, correct but controversial information is published, and the person concerned wishes to have it corrected or removed. Daniel Brandt, privacy

activist and critical of Wikipedia, wanted to have the Wikipedia article on him removed (see [Brandt 2005]). After a lengthy, sometimes provocative discussion, Daniel Brandt was blocked from using Wikipedia, and his article was not removed.

4.2.4 Wiki-Related Phenomena

Malicious modifications of articles, including the deletion of information, appending incorrect or inappropriate content, insertion of vulgarities and the insertion of advertisements, happens occasionally in Wikipedia. Research shows that these acts of vandalism are often repaired within only a few minutes after they occur (see [Viégas et al. 2004]). Spiteful deletions, in particular, are reverted very fast.

Another example of something that is common to wikis in general are "edit wars": a number of paragraphs of articles are repeatedly inserted and deleted or modified and reverted by two users or groups of users. Most likely this is a social problem, where two parties are unable to reach a consensus over a piece of content. Usually such a dispute is ended by a democratic vote that is attached to the article.

4.2.5 Awareness of the Concept

Although in theory everybody can edit articles, only a small percentage of users actually do—even though they probably know that the content is incorrect or incomplete. Some users might not even be aware that Wikipedia is not an edited work and that basically every reader can edit the content provided. This is true especially for users that are relatively new to the Internet and are directed to Wikipedia by search engines such as Google.

If users are not acquainted with the underlying concepts of Wikipedia they do not know that the content may not be authoritative. However, even if users do not rely solely on the information provided by Wikipedia and do consult other resources, the content provided might be identical because several services including Answers.com retrieve information from Wikipedia ([Answers 2006]). Thus we could have the situation where misinformation originating from Wikipedia is used as a basis for a new piece of work, utilised by Wikipedia authors to argue for the incorrect information in the encyclopaedia.

4.2.6 Volume of Wikipedia

The number of articles is not necessarily a yardstick for the completeness of the encyclopaedia. Wikipedia with approximately 900,000 articles has far more articles than the Encyclopædia Britannica with about 120,000 articles ([Britannica 2006]), but it also contains many articles about movies, rock groups, etc. These kinds of articles are not usually part of a general encyclopaedia but of more specific works. Although it can be seen as an advantage that detailed articles on a very wide range of topics are present in a single encyclopaedia, it is sometimes cumbersome (cf., section 4.2.2). In a general encyclopaedia an article on The Beatles, for instance, is not expected to exceed more than a few paragraphs in length. In Wikipedia, however, the corresponding article is several printed pages long and includes a complete discography, a history and a set of photos of the band, etc. Thus, the Wikipedia article might be better suited for a specialised encyclopaedia on pop music.

These differences make it hard to compare Wikipedia to a traditional encyclopaedia. On the one hand, the topics covered by Wikipedia vary greatly, and it might have to be compared to a set of specialised encyclopaedias. On the other hand, articles in Wikipedia are sometimes much longer and more detailed than corresponding information in a conventional encyclopaedia or dictionary. We believe that Wikipedia is likely to become a new type of encyclopaedia incommensurable to existing ones.

5 Wikinews

Most community-based news services on the Web reverse the order of the traditional publishing process. In conventional publishing, a board of editors selects a set of stories from the vast amount of information produced every day. The number of stories is usually determined by the volume of the newspaper, by the time available for a TV or radio programme, etc. By contrast, community-based news providers make every piece of news accessible, and filtering techniques such as filter-style blogs are employed to present only relevant articles to the consumers.

5.1 Goals of Wikinews

In November 2004, Wikinews, a community-based, participatory news project linked to Wikipedia, was started ([Wikinews 2006a]). Wikinews is not only a news provider but a journalistic service. The aim is to publish complete news stories and to act as a counterpart to commercial news agencies such as Reuters and United Press (see [Wikinews 2006b]). Neither does Wikinews offer only news headlines with short abstracts like Slashdot does, nor is it restricted to a specific topic or does it present an opinion in its articles as services such as Indymedia does (see [Slashdot 2006] and [Indymedia 2006]). Instead, Wikinews articles are written conforming to Wikipedia's "neutral point of view" guideline.

As a news service where everyone can contribute information, it has to potential to have an impact on the information made available to consumers. Content that might not be relevant enough to be presented by large news providers or information deliberately suppressed by mainstream media can still be made available on Wikinews. Especially in countries where freedom of speech and freedom of press are restricted Wikinews can become an important service.

5.2 The Relationship between Wikinews and Wikipedia

Both Wikinews and Wikipedia build on the same concept and infrastructure, and both share the same benefits and disadvantages. Wikinews however takes a different approach to the publication of information. While Wikipedia articles are usually open for editing any time, stories in Wikinews are set "read-only" after editing has been completed and their content has been approved by the community. After editing has finished, a permanent and stable version of the articles is archived in the system.

This means that the convergence criteria applied in Wikipedia is not valid for Wikinews. Wikipedia articles are typically long-lived, therefore the probability to achieve completeness and accuracy is higher because the more time available, the

more readers will access an article, and the more likely it is that errors will be corrected. Such an approach cannot be taken for news sites since news need to be published quickly—otherwise it will be obsolete. Therefore information edited on Wikinews has to reach maturity rapidly, which is not always successful and sometimes results in rather short articles.

5.3 Success of Wikinews

Up to the 19th of January, 2006, 4,065 articles were published on the English edition of Wikinews, i.e., on average about nine or ten articles were produced per day (source: [Wikinews 2006c]). This makes Wikinews not nearly as successful as Wikipedia. One of the reasons might be the directive to write articles from a neutral perspective, without bias and opinion. In our opinion, this makes Wikinews monotonous to read. Also articles are often collections of news and different views on a given topic gathered from various mainstream news providers (see [Bruns 2005a]).

One reason for the limited success of Wikinews might be the fact that there is no way of commenting on news articles within the Wikinews system. Although it is possible to attach discussions to Wikinews articles ("talk pages") these postings are strictly confined to discussing details on authoring. Once a Wikinews article is completed, however, users cannot debate its content or add complementary information. In contrast to this, the popularity of blogs and Slashdot-like news services is *based on* the comments added by readers. In these systems, views on a news article shared by readers are sometimes more enlightening and more important than the actual news item because they can offer a different perspective on the story, details on the topic, related information, etc. This type of commentary is not permitted in Wikinews. As one of the administrators of the system explains, "It's deliberate – opinion or commentary is banned. There are enough blogs already." (from: [Bruns 2005b]).

6 Podcasts

The expression *podcasting* is a combination of two terms: iPod, a popular MP3 player, and broadcasting. The word appropriately describes the nature of podcasts. On the one hand, they offer audio content that can be listened to on demand—like music on an MP3 player. On the other hand, it is a system that provides content resembling radio programmes.

Podcasting basically means blogging audio content, where the content producers post audio content regularly on a server in the MP3 audio format (just as users post short articles on blogs). In a fashion similar to readers using RSS feeds to stay informed on the most recent articles on a blog, podcasting allows users to subscribe to various audio content producers. Each podcast offers a list of audio clips that are available for download complemented with metadata such as a brief description of the actual content. By subscribing to several podcasts, users are able to accumulate material from numerous sources. The content, however, is only retrieved on the users' request, hence podcasting can be seen as an "audio on demand" service (e.g., [Biever 2005]).

Topics covered by podcasts range from music and cultural programmes, mainstream entertainment, business, politics, science and technology, and travel to religious programmes. Podcasts are typically either person-centred or dedicated to specific topics. "Personal" podcasts are usually produced and published by a single person and offer the person's views on a various subjects, present the person's favourite music, etc. Podcasts geared to particular topics are often created by a small group of users and contain a selection of separate "stories". Examples are news programmes, regular discussions on political topics, or science-related shows such as the Nature podcast (see [Nature 2006]).

6.1 Use of Podcasts and Application Areas

In September 2004, the concept of podcasting started to take off. The initial idea was to offer anyone on the Internet a platform for publishing their own radio show. Soon a large number of amateur shows emerged, one of the favourite shows being *"Daily Source Code"* by Adam Curry, one of the earliest adopters of podcasting (e.g., [Pod411 2006; PodStats 2006]). Although the target group were amateur users, and the largest proportion of podcasted content is still produced by amateurs, the technology was soon also employed by professional content providers.

Nowadays podcasting is, for instance, applied in education in order to enable distance learning or simply to provide the possibility of listening to a lecture again (e.g., [Downes 2006]). Even organisations such as Duke University or the Washington College of Law fully endorse podcasting technology. Both universities make a range of content, including lectures and discussions, freely available in podcast format (see [DukeCast 2006; WCL 2006]). Moreover, podcasts can also be offered as supplementary material to the proceedings at conferences. Two workshops of the IEEE Symposium on High Performance Interconnects, for example, can be downloaded freely as podcasts (e.g., [HotI 2006; IEEE 2006]).

6.2 Similar Technologies

The idea of publishing audio content using blogging technology can also be applied to other types of media such as photos or video content. With *photocasting,* for example, users can share and distribute their photos using an RSS feed. This enables uses such as photos diaries or sharing entire photo albums with friends on the Internet. With the required functionality being included in popular applications such as Apple's iPhoto, photocasting can be expected to become a fashionable technology among users (see [iPhoto 2006]).

Videocasting, sometimes called *vodcasting,* applies the blogging concept to video content. Vodcasting is, in fact, an acronym, where "vod" stands for "video on demand". With vodcasting, content producers can create video clips and inform users about new episodes using RSS feeds. Consumers subscribing to a vodcast have access to a list of video clips that can be played at the users' request. Vodcasting can include both downloadable video files and content streamed from a streaming video server.

The technology receives attention from various business areas. Recently, German car manufacturer BMW, for example, made a videocast available for presenting new products and disseminating interviews (see [BMW 2006]).

7 File Sharing Tools

For most readers, maybe, file sharing has a negative connotation. It is often synonymous with downloading music and movies illegally from the Internet and with distributing pirated digital content. Napster and Kazaa are popular examples for tools that let users share files (mostly illegally) over the Internet. However, lately also legal peer-to-peer file sharing networks have evolved (see [Rodriguez et al. 2005]). The BBC, for instance, has started a service, based on file sharing technology, for the legal dissemination of TV shows (see [BBC 2006a]).

Recently, a new type of file sharing has emerged. This class of systems are web-based, offer users a private space to store their documents and a public space for sharing files with other users, as well as helping them to organise their information. The prime example of such an application is Flickr, a portal for managing and sharing photos (see [Flickr 2006]).

Flickr lets users store, organise, and share photos. Users can upload their photos to a server, add comments and leave notes inside pictures. The key element in the system, however, are arbitrary tags attached to photos (e.g., [Weiss 2005]). These tags represent loose metadata and are utilised to describe the content of the photo. A photo depicting a tree can, for instance, have the tags "tree", "my holidays in Iceland", and "winter". When users search Flickr for "winter", the photo of the tree is part of the results. Users can also browse the photos in Flickr. For every photo displayed the tags defined by the author are shown. Instantly, users can have all images in the same "category" presented (i.e., pictures with the same tag).

Flickr is a self-organising community where the system does not tell users how to tag their photos or impose any structures on the organisation of content. This approach is in contrast to the conventional way of generating metadata. In traditional "editor-based" systems, professionals assign metadata based on a well-defined taxonomy and a set of guidelines (e.g., [Mathes 2004]). In Flickr, however, the choice of tags is entirely up to the user. Although this concept lowers the barriers to entry and is a major incentive for people to store their content and metadata in the system, it raises the problem of ambiguity. Since there are no formal taxonomies users can use ambiguous terms and synonyms when tagging photos. The tag "apple", for example, can stand for the fruit or the computer manufacturer. On the other hand, there are several synonyms for Apple computers including macintosh and mac. As the examples illustrate, the free-form taxonomy can sometimes make it difficult to find the desired content.

The content in Flickr is largely published under a Creative Commons license (see [CC 2006]). With this type of license content is freely available while protecting the owners' copyrights. Therefore Flickr is an increasingly attractive resource for web designers, publishers, etc.

8 Social Networks

In 1967, American psychologist Stanley Milgram conducted the "small world experiment", in which he sent letters to sixty volunteers in Kansas and asked them to forward the envelopes to a specific person in Massachusetts—by hand and through

friends or friends of friends. The letters that reached the addressee were, on average, relayed by five to seven people. This is seen as an empirical proof that arbitrary people in our society are related to each other through friends and friends of friends (see [Milgram 1967]).

The small world hypothesis based on Milgram‘s findings states that the number of personal acquaintances needed to connect two random persons on the planet is small. The hypothesis led to the expression “the six degrees of separation”, meaning that any two random persons are associated with each other by a chain of about six individuals. The “six degrees of separation” is one of the underlying concepts of social networks on the Internet.

Social networking services offer friends a space where they can maintain their relationships, chat with each other and share information. Moreover, they offer the opportunity to build new relationships through existing friends. On the first use of the system, users are required to submit a profile containing personal information such as their name, date of birth, and a photo. The personal information is made available to other users of the system, and is used to identify friends on the network and to add them to a list of contacts. In most systems, users can not only view their friends but also second degree friends (friends of their friends). Some networks follow an “invitation only” approach. Hence, every person in the system is automatically connected to at least one other person.

Examples for common social networks are Friendster with about 24 million users, MySpace with about 41 million users, and Google‘s Orkut with about 12 million users (see [Friendster 2006; MySpace 2006; Orkut 2006]). In addition to these general-purpose networks, specialised services have evolved in order to establish a community of like-minded individuals. OpenBC, for instance, is a professional networking service that attempts to create a web of trusted experts and business partners (see [OpenBC 2006]).

8.1 Large Communities

When communities grow larger, self-organisation tendencies emanate, and frequently sub-communities covering more specific topics or smaller groups of friends are established. Several services including Orkut facilitate creating new sub-groups as a core functionality of the system. In these smaller communities users chat, have lively discussions in dedicated forums, and exchange pictures and other documents (e.g., [O’Murchu et al. 2004]).

The formation of smaller groups within a large collective can probably be described with the rule of 150. This axiom refers to the social channel capacity, the ability of the human brain to relate factual, emotional, and social details to people. A series of social studies show that the average person can remember these features for approximately 150 individuals (see [Dunbar 1993]). Psychologists explain this characteristic by using the evolution of human societies: early settlements did not comprise more than 100-150 people, and therefore the brain developed only to the point where it was able to store the information on all people in this social network. Thus, a “genuine” social network is limited to about 150 people.

8.2 Technical Aspects

Most popular social networks in use ask users explicitly for personal information (e.g., [Adamic et al. 2003]). Hence users fill out profiles and provide personal data as well details on their likes and dislikes. As mentioned above, users add their friends manually to the list of contacts. So the social network is generated manually, which usually results in a high accuracy of the connections made.

A system that forms a large social network without the users' explicitly knowing it, although users provide the required information voluntarily, is Skype. Skype is a provider of free internet telephony (see [Skype 2006]). Every user in the system has a user profile that can contain the name, address, phone number, e-mail address, a photo, etc. When person A wants to call person B, usually the profile of person B is added to the contacts of person A. Calling a person is a strong indication of a personal or professional relationship. Thus, the information stored in Skype represents a large, manually generated social network.

An alternative approach to manual generation relies on fully automatic creation of networks. E-mails of a group of users, their postings in newsgroups and blogs, links on their homepages and similar resources are analysed. An e-mail from user A to user B, for instance, indicates a connection between users A and B. In the same way, a follow-up by user B to a newsgroup posting by user A can be interpreted as a (weak) relation between the two users (e.g., [Kautz et al. 1997]). All connections detected by the generative algorithm are accumulated and utilised to form a graph of weighted edges between "user nodes". Edges whose weight is over a given threshold correspond to the connections in the network to be generated. The advantage of this method is that it does not require user interaction. Moreover, it is capable of unveiling connections that might otherwise have remained implicit or hidden. The drawback is, however, that automatic generation of the network cannot be as precise as manually adding contacts. Furthermore, a fully automated process is usually not able to collect the personal data provided by users.

Automatic generation of a type of "social networks" is also possible for services such as eBay or Amazon. In eBay, for instance, information is retained on who bought from whom, which buyer rated which seller, etc. This information can be used to generate a network of weighted connections, where the weight depends on positive, neutral or negative ratings between buyers and sellers. In Amazon, users' buying a book, writing a review or giving a recommendation for a book imply that they have an interest in the author or the topic. Although this data does not form a traditional social network, it can be interpreted as a social structure in the broader sense. On the one hand, clusters of users with similar interests are formed, and clusters and users are connected with each other; a friendly contact and direct communication among users is, however, not possible.

8.3 Use of Social Networks

The obvious aim of social networks is to give users a way to stay in touch with friends, colleagues, and acquaintances. Services such as OpenBC also let users browse through their contacts and second degree contacts (contacts of contacts). Additionally, users in OpenBC can search for people with certain skills or other attributes. When an appropriate person is found, the chain of contacts to this person is

displayed. Thus, users can, for example, ask their friends and friends' friends on the person's qualification.

Potentially, one of the biggest application areas of social networks might be personalised searching on the World Wide Web (e.g., [Freyne and Smyth 2004]). Whereas today's search engines provide largely anonymous or uncredited information, future versions might highlight or recommend web pages created by recognised or familiar individuals. The integration of search engines and social networks could also enable queries such as *"Has any of my acquaintances been on holidays in New Zealand?"* or *"Recent articles on hypertext authored by people associated with Ted Nelson"*.

It should be noted that real concerns regarding the privacy of members of social networks exist. Information on consumers that privacy activists have been trying to protect from companies are nowadays provided willingly by inexperienced users. The detailed personal information stored in user profiles, for instance, could be utilised to send disseminate personalised fraudulent advertisements, automatically sign users up to services matching their profiles or even sell the personal data to third parties. Moreover, the service providers have the ability to monitor and store the information communicated among users and make use of ideas expressed and data transferred during users' discussions (e.g., [Orlowski 2004]).

8.4 Other Community-Based Networks

Although not directly associated with social networks, this section introduces three community-based networking services: del.icio.us, Furl, and Eurekster. del.icio.us is a social bookmarking and classification service that enables collecting and sharing favourite web pages (see [del.icio.us 2006]). Users can add bookmarks of web pages to del.icio.us, attach tags or keywords and choose if it is to be publicly available or private. The keywords assigned by users are used for non-hierarchical categorisation of the bookmarks. Hence, clusters of bookmarks for various topics are created in the system. When users access a bookmark, they can also look at the public bookmarks of users that have the same web page in their portfolio. Moreover, users can search for "similar" pages—bookmarks that share certain keywords or are in the same bookmark cluster (e.g., [Millen et al. 2005]).

Furl, a similar service, takes the concept a step further and stores bookmarked articles in an internal database (see [Furl 2006]). Thus, users can create their own "Personal Web" that only contains the pages they store. As in del.icio.us, pages can be private or publicly accessible. In addition to keywords users can also assign topics, give ratings and attach comments to pages. Furl also creates an index of all documents stored in its database and offers full-text search functionality.

Both Wikipedia and services like del.icio.us are employed by some users as an alternative to conventional search engines such as Google. Wikipedia is a good starting point for many topics, since it can give an overview of a topic and frequently offers manually selected links to more detailed resources. Similarly, a query in del.icio.us yields a number of web pages that have been selected by users as one of their favourite pages on the Web. Although Google's search and ranking algorithms are very sophisticated and mostly offer relevant results first, they are currently unable to offer documents that were evaluated and chosen by individuals.

Eurekster is a collaborative search engine whose concept is a blend of social networking and social bookmarking (see [Eurekster 2006]). People sign up to the system and form communities of users with similar interests. When a user searches the Web, information on the query and the documents actually chosen from the result are stored in the system. These data are used in order to introduce a prioritisation of topics within the community and perform a ranking of relevant articles within a topic. Thus, the system eventually "knows" which topics and web pages are relevant for a community. A user part of a community of archaeologists searching for adobe, for instance, might be confronted with results including historic sites in Peru. By contrast, in a technology centred community documents on the computer software company Adobe might be the result of the query (e.g., [Freyne and Smyth 2004]).

9 Summary and Outlook

During the last few years, new forms of content generation and organisation on the World Wide Web have emerged. Services such as blogs, wikis and podcasting give users the opportunity to become authors and to express themselves. For the first time, even users lacking the knowledge of the underlying technologies can participate in contributing content to the Web. In a way, these new services have finally brought a form of democracy to the Internet, and the traditional distinction between content producers and consumer is blurred (e.g., [Miller 2005]).

With these new technologies, the flow of content is no longer strictly "top-down", from classic producers to readers, but an increasing number of users become writers and contribute new content (e.g., [Lenhart et al. 2004]). Thus, a new "bottom-up" movement can be observed—consumers start producing information that is distributed among other users until it is picked up by mainstream media. The aspect that makes such an approach work is the critical mass of users that allows self-organisation to take place (e.g., [Johnson 2001]). This resembles ant colonies (see section 1.1) when they are, for example, building nests: while single ants can only contribute small pieces, the collective establishes an extremely complex and efficient structure (see [Gordon 2000]). In analogy, new services support individuals in making their knowledge explicit and help collective intelligence unfold.

The novel forms of content development have sparked a "revolution" across all types of media. Classic web-sites are complemented with, or even replaced by, wikis; services such as Wikinews and blogs offer an alternative to conventional news providers and commentary; traditional knowledge repositories are challenged by Wikipedia; and radio broadcasting is supplemented by podcasting. The next logical step seems to be "video-blogging" as an approach to the creation and distribution of television shows.

The community-based types of media introduced in this paper allow for alternative perspectives and views that are not suitable for traditional media. Furthermore, topics that are inappropriate for the mass of users served by broadcast media, as well as news that are possibly not relevant enough for the majority of consumers can be addressed by the new services.

9.1 Major Transformations

The new services that have recently emerged have indeed spawned a series of transformations on the Web. The transformation, however, is not only based on *technological* changes, but more importantly on a fundamental mind shift. The aspects that Web communities (such as blog, wiki, file sharing and social networks, bookmarking services and podcasting groups) have in common are user participation and openness. Basically every user on the Internet can start new blogs, can readily produce podcasts, and can edit the content in wikis. So, the attitude of users has changed insofar as they now enthusiastically make the information they produce available to the public (see [O'Reilly 2005]). In addition to this, even companies make their content repositories publicly accessible and enable new and sometimes unconventional uses of existing data: the content made available by the BBC, for instance, is used in a dictionary of English phrases (e.g., [BBC 2006b]). To put it a different way, the services recently developed on the Web are based on "an attitude not a technology" (from [Davis 2005]).

Apart from making the Web more democratic and enabling user participation, the community-based services have opened up entirely new opportunities. Wikis, for example, have the potential to alter the way collaboration among users and groups happens. It is no longer necessary to send text documents as e-mail attachments or to employ an expensive groupware solution in order to enable collaborative work on a common body of content. In similar ways, blogs make it possible for users to utilise the Web to express their views—without having to purchase web authoring software or to get acquainted with hypertext technologies.

9.2 Opportunities and Future Trends

Wikis including Wikipedia, blogs, podcasting, file sharing and similar techniques can react faster to recent events and new developments than conventional infrastructures. When an event happens, it can be published instantly on a blog or in a wiki. In contrast, a traditional news service article has to undergo fact-checking and an editorial process prior to publication. Articles in Wikipedia are often updated only minutes after new information becomes available. For instance, only shortly after the spacecraft for the Nasa mission to Pluto was launched photos and other details were included in Wikipedia articles. In contrast to this, a classic encyclopaedia requires an editorial cycle (usually at least a year) in order to incorporate such information.

With the tools and services at hand, users become more independent from classic information providers. Therefore in the future, probably a smaller percentage of information will be authored by professional editors, and distributed by (media) companies. Moreover, new structures might become mainstream: wikis, blogs and podcasts are the environments that produce content. When the authors' names are known they can be looked up in social networks in an attempt to verify their expertise. Finally, social bookmarking services and filter-style blogs are utilised as aggregators and filters in order to offer a balanced selection of reliable information. Hence, individuals as well as large organisations have the potential to establish a network of trust, where information can be accountable to users.

Moreover, systems which rely on a large user community can facilitate the "accidental" encountering of new information. Although environments such as learner

support systems or digital libraries explicitly include functionality that enables accidental information encountering (e.g., [Marshall and Bly 2004]), community-based systems provide this feature intrinsically. Examples are Flickr and del.icio.us (see above). Since users in these large communities have varying opinions and interests, they are likely to access diverse resources on the Internet. The information they gather from these contrasting sources can easily be made available within their communities.

9.3 Challenges and Concerns

The changes the Web is undergoing raise a number of concerns. Most can be clearly observed in very large community-based environments such as Wikipedia. One of the most problematic issues is the lack of accuracy and, connected with this, the lack of accountability. Several evolutionary cycles are required to make information accurate and complete, especially in wikis. In addition, both blogs and wikis do not have the means to indicate the completeness and correctness of articles, which makes it difficult for users to judge the content provided.

Moreover, in most community-based systems it is not a requirement to provide a real name when authoring content. Authors can usually hide behind self-assigned synonyms, or only their IP addresses are shown (as for anonymous authors in Wikipedia). Therefore it becomes almost impossible for average readers to find out who the content authors are, and even simple enquiries such as asking for the source of a quotation might be impossible.

Despite the advantages that new technologies have, readers have to learn how to deal with the new media. Users have to get used to the fact that not everything published on the World Wide Web is true and that it is necessary to find at least another, independent source that corroborates the initial document. Visitors have to realise that the same process is even more relevant where content is authored by numerous, potentially anonymous users.

9.4 Technological Aspects

As indicated above, the technologies introduced in combination with community-based services make it clear that the design of the Web does not allow for these types of interaction per se. There are no bidirectional hyperlinks, therefore a technology like trackback has to be used. The URI and URL scheme and the composition of documents on the Web do not permit to identify and locate an exact portion of content. Hence permalinks have to be employed. The implementation of the Web does not consider a notification mechanism for updated or new documents, which makes a method like RSS necessary. Version management is not part of the Web, and so services such as wikis have to implement version tracking systems, which results in incompatible implementations. Furthermore, content is regularly duplicated in order to be able to quote portions of the original document. By duplicating instead of virtually including content from the original resource, both the context and the reference to the source document are lost.

Although the new services seem to require new technologies, it emphasises the shortcomings of the Web. In the 1960s, Ted Nelson presented the concept of a hypertext system that supported multidirectional links, identification and location of

content on the level of single characters, notification techniques, and the virtual inclusion of remote documents. The environment allowed for collaborative authoring, various of levels of access to documents, and had versioning functionality built-in (see [Nelson 1981]). Since then systems offering similar functionality as Xanadu have been implemented (e.g., [Maurer 1996; Andrews et al. 1995]). The technologies were, however, not included into the infrastructure of the Web.

10 Conclusion and Future Research

"From chaos comes order" is an expression accredited to chaos theory. It can also be applied to the services introduced in this paper. Although the concept of wikis, for instance, might seem utterly chaotic, Wikipedia is the principal example that such an anarchic system can yield structure and to a certain extent even high quality content. The new and successful Web services range from free encyclopaedias to free and independent news services, amateur radio shows, free and legal photo sharing tools and social networks. Since the attitude of professionals and non-professionals has changed in that they are willing to make their content available, hence still more collaborative services can be expected in the near future.

The emerging services, however, appear to be evolving into a "patchwork" of various autonomous or loosely connected, community-based systems, where the synergetic effects that could emanate may be neglected and lost. Therefore our future research will focus on integrating the key benefits of existing community-based systems such as weblogs, wikis and file sharing tools in a flexible framework for an open, collaborative environment on the Web. The essential component of such a service will be an all-embracing social network that connects users and allows for communication in the system. Moreover, through the social network the system can be accountable.

We are confident that our approach can lead to more resourceful communities, besides increasing their productivity. Details of the proposed concept will be described in an upcoming publication.

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