Using Web Analytics Data to support Social Software Users

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Abstract: Web analytics tools offer a quantity of features to website operators. While mostly used in the e-commerce sector, recently web analytics has also been discovered by social software users, e.g. blog writers. Because web analytics tools were initially not built for this purpose and the technology used in many social software platforms, e.g. JavaScript and Flash, is challenging, this paper examines their applicability in social software environments. Additionally, this paper searches for potential benefits arising from the interaction of web analytics tools and social software. Therefore, a tool analysis is performed to determine the capabilities of today's web analytics tools. Based on the outcome, scenarios are developed to illustrate potential benefits for social software users. In addition, a prototypic implementation demonstrates their feasibility and shows how the data gathered by web analytics tools can be returned to the user.

1 Introduction

Web analytics tools are now in operation for about 15 years tracking user behavior on a multitude of websites. Their capabilities have reached a mature state over the last few years and their choice ranges from commercial all-in-one solutions through to free-to-use applications, and open source projects. While web analytics tools and methods are well established in the e-commerce sector, their useful features have now been discovered especially in the blogging community. For example, Technorati [Tec10] gathers tracking data for more than 1 million blogs. But, the target audience are still mainly the blog authors and not directly the readers of a specific blog. According to this trend, this paper aims to examine potentials of web analytics tools for social software and resulting user benefits.

Chapter 2 provides an overview about the foundations of web analytics as well as social software, and potential problems arising when both are brought together. Chapter 3 depicts the results of a web analytics tool analysis and describes available data relevant for social software. Derived from this analysis, Chapter 4 introduces four scenarios presenting opportunities how web analytics data can be used to support social software users. Subsequently, Chapter 5 depicts the prototypic implementation of two scenarios. Finally, Chapter 6 summarizes this paper and provides suggestions for further research.

2 Foundations of Web Analytics and Social Software

Given the purpose of this paper, an overview of the distinct knowledge domains of web analytics and social software is required. Furthermore, specific challenges for web analytics tools operating in a social software environment need to be analyzed in order to support the tool selection for a prototype.

2.1 Web Analytics Evolution

According to Avinash Kaushik [Kau07], the birth of web analytics took place in the year 1995 when Dr. Stephen Turner wrote one of the first log file analysis programs named Analog. This script was widely available on the Web and was able to retrieve some basic informations about website usage out of the server's log file. Commercial web analytics started several years later. Around the year 2000 companies such as Accrue, WebTrends, WebSideStory and Coremetrics have all been firmly established as key vendors of increasingly complex solutions that report massive amounts of data and are capable to visualize them in tables, graphs and diagrams.

The goal of web analytics is to assist companies improving the quality of their websites [WH06]. The quality of websites has been the focus of many academic studies and is typically concerned with the performance and usability of a website. A large number of scales have been proposed and validated in empirical studies to measure website quality [Loi00, KS04, AP02]. In order to enhance a website's quality, its operator needs to understand his users or customers and optimize the website accordingly to their needs. Using mature technologies it is possible to track users over time, measure campaign success and figure out the return-on-investment. Web analytics draw attention mainly in the e-commerce field because such firms generate their revenue mainly or exclusively with their website. Amazon, one of the worlds largest e-commerce companies, developed a recommender-system based on web analytics data [Chi10] which generates about 35% of Amazon's revenue. This enhanced web analytics tool tracks all visitors of Amazon and stores data about the products they view or buy. If several visitors have bought the same products, the recommender-system offers other articles bought by one of these customers to the others.

The technical evolution of web analytics tools proceeded in three stages [Has10]. Firstly, data was extracted out of *server log files*. This was an easy way because the log files are produced by the web server anyway. However, this server-based approach, which is still implemented by some tools in operation today, has some limitations. For example, a server is not able to recognize page views served by proxies or caches. Furthermore, user-tracking based on IP (Internet protocol) addresses is highly error-prone. In order to overcome these obstacles, in the second stage client-based approaches were implemented. Therefore, an invisible image is embedded in every page, the so called *page tag*. Every request of this image can then be counted as a page view. It is also possible to store the image at a provider's server, which enables companies to outsource their web analytics

technologies. Furthermore, additional data can be gathered if cookies and JavaScript are used. Such client-side approaches are implemented and used by nearly all web analytics tools today, but one limitation remains: a web page is only counted as a whole. Therefore, the third stage of web analytics' evolution refines the second stage by allowing the site operator to define *events*. This feature enables web site operators to define an event for every user-interaction they want to track. For example, an event can count how many times a file has been downloaded or how often a user stayed more than five minutes on a single web page. However, this approach only works in an appropriate environment. If the client disables JavaScript and uses a text browser, he becomes invisible for client-side tracking approaches.

In summary, web analytics tools provide lots of data for companies. They are able to visualize results in different ways and are easy to configure even for beginners. After the three stages of evolution: log file analysis, page tagging and event tracking, the web analytics technologies got mature over the last 15 years. Nevertheless, the results provided by web analytics tools should always be regarded carefully and questioned because they suggest precision while technical boundaries still limit the ability to track user behavior exactly.

2.2 Social Software

Social software encompasses all web-based applications which support human communication and interrelation [Hip06]. Information provided by single participants of a community is associated to form collective knowledge and generate additional value. Furthermore, Schmidt [Sch06] identified three basic functionalities of social software:

Information management: The ability to find, rate and administrate online information.

Identity management: The ability to depict aspects of oneself in the Internet.

Relationship management: The ability to describe contacts and socialize.

According to Richter and Koch, four categories of social software exist, namely weblogs, wikis, social tagging and social networking [RK07]. Beside social tagging, which is out of the scope of this paper, all of them are described in the following paragraphs.

Weblogs (blogs)

A blog is a regular updated news service whose information is listed in reverse chronological order. Usually, the author writes about specific topics from an individual point of view. The software used to publish blog articles is easy to use and does not require any knowledge in programming languages. Beside the ability to publish articles, blogging-software often adds additional features, for example the ability to let users leave comments or trackback other related articles.

Wikis

The idea of Wiki Wiki Web, or simply wiki for short, comes from Ward Cunningham [LC01] who also presented the first running implementation of a wiki. The main characteristic of a wiki is that users can contribute by adding content on any page or even create new pages. Due to the simple syntax used to add or edit a page no programming knowledge is required. In addition, wiki pages can often be extended by user comments and are mostly linked to each other in order to support user's research. The most popular wiki today is Wikipedia, a free encyclopedia, with nearly 13 million registered users [Wik10].

Social networking

Boyd and Ellison define social network sites as "*web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system*" [BE07]. Prominent representatives of social networks are, for instance, Facebook, MySpace and XING. While social networks are pervasive in the private sector and used mainly by young-twenties, college students and teenagers, they now get attention even in the business sector. Companies expect that professionals use internal social networking to build stronger bonds with their weak ties and to reach out to employees they do not know [DMG+08].

2.3 Challenges for Web Analytics Technologies in a Social Software Context

Taking the last two chapters about web analytics tools and social software into account, some challenges arise if these two domains are brought together.

Social software relies heavily on user generated content and Web 2.0 technologies. AJAX and Flash are common technologies to realize an interactive social software site generated on thy fly. The resulting pages, also known as Rich Internet Applications, cannot be considered as a single page anymore, but form a collection of independent entities like menu bars, media players or image galleries which have to be analyzed separately. Therefore, web analytics tools are required to track user interaction on a very fine granularity. Event-tracking, as mentioned before, is actually the only way to accomplish this, with the drawback of increasing effort for its configuration.

On social software platforms, user can generate content every time. Especially in microblogging applications, as for example Twitter or Facebook's feed, a huge amount of data is generated every minute. Web analytics tools are required to take such content immediately into account if their analyses should support the social software users before the content is out of date. Such an approach, together with the capability to provide immediate feedback to the user, is called real-time analysis and often essential in a social software environment.

3 Web Analytics Tool Analysis

The previous chapter presented an overview about the history of web analytics as well as its general purpose and scope. To provide social software users with web analytics data, the actual capabilities of web analytics tools have to be determined. Based on these insights, the development of scenarios showing interesting use cases for web analytics data in social software will be possible.

3.1 Tool Comparison Overview

Web analytics tools have been evolving for about 15 years. Today many vendors, for example Omniture or Webtrends, compete for a greater market share. They offer mature solutions and support, but can be very expensive for sites with a lot of traffic. Beside such commercial software, free tools are also available and successful. Google offers a free web analytics tool named Google Analytics which is actually the leading product in its market [Bri10, Ham08]. However, the use of free tools has to be paid by sharing data with the vendor. Thereby, offering companies like Google or Yahoo get access to all analytics data they gather, and in case of Google, use it to enhance their other products as for example AdWords. Additionally, a third category of web analytics tools got attention over the last few years: open source software. Prominent representatives are for example Piwik, Webalizer and Open Web Analytics, all of them evolving in an active community. These open source tools all have to be hosted on own servers which causes cost, but the data gathered by the tool needs not to be shared with other companies.

To examine the actual capabilities of web analytics tools, three tools will be analyzed in detail, one of each category introduced before. The tools analyzed are: the open source tool Piwik, the free tool Google Analytics, and the commercial tool SiteCatalyst by Omniture. Google's and Omniture's tools have been chosen because at the beginning of 2010 they had the greatest market share, together 78% [Bri10]. With respect to the protoypic implementation described in Chapter 5, Piwik has been chosen because it promised to be a good prototype candidate. Unfortunately, the analysis of SiteCatalyst had to rely on the descriptions and the feature list of Omniture due to its license costs. Google Analytics has been evaluated by analyzing the data provided in its administration zone. A very detailed analysis of gathered data was possible with Piwik due to the available code.

3.2 Detailed Data Analysis

The following data is provided by all analyzed web analytics tools. Some e-commerce and advertising related data is not shown here because it is not relevant for social software analytics. Table 1 lists key figures about the number and type of visitors and their technical environment.

In this context, *unique visitors* is the number of visiting persons who could be identified by

Visits	Loyalty	Technical
Total visits	Length of Visit	Browser type
Unique Visitors	Depth of visit	Connection speed
Total pageviews	Return rate	Operating system
Average pageviews	Recency of visits	Screen settings
Bounce rate	Time on Site	Flash settings
Location		Java settings

Table 1: User data of web analytics tools

a cookie. If, for example, such a person visits the website in the morning for 10 minutes and in the evening for 15 minutes, for that day one *unique visitor* is counted, but there are two *total visits*. A *pageview*, also sometimes called a hit, is generated when a visitor loads a new page. If a visitor loads only one page this is considered as a *bounce*. In Table 2, gathered data about the context of the website is shown, for example a list of search engines used to find the web page.

Traffic sources	Content	Internal search
Search engines	Top content	Search terms
Referring sites	Top landing pages	Start pages
Direct traffic	Top exit pages	Destination pages

Table 2: Context data of web analytics tools

In addition, all events configured manually are listed with their number of occurrence.

Differences between the analyzed web analytics tools exist, for instance, in their capabilities to integrate them with other applications. Integration becomes relevant, for instance, if online tracking data should be combined with offline data, or if reports should be enhanced in other desktop tools as for example MS Excel. Regarding import options, neither Google Analytics nor Piwik offer any possibilities to import data from other sources. However, SiteCatalyst offers different opportunities to import data, for example, from customer relationship management (CRM) tools. Regarding export options, Google Analytics offers PDF, XML, CSV and TSV. In addition, Piwik offers a JSON and RSS export of reports. A native export to Microsoft Excel or Word is only included in SiteCatalyst. Another advantage of SiteCatalyst is the availability of a SOAP-based Web service API, and the ability to integrate its reports with other reporting tools.

An important means to determine the success of a website is to measure conversions. The term conversion refers to the transformation of a visitor to a customer [Ste02]. Extensively used in e-commerce, conversions can, for example, be defined as the purchase of a product or the registration of a customer. The presented web analytics data analysis excludes all data and respective reports of conversions. The reason is, that conversions are difficult to define for social software and not the focus of this paper.

4 Scenario Development

Based on the features of web analytics tools presented in the previous chapter, scenarios describing how social software users could make use of web analytics data can now be developed. A total of four scenarios describing the user benefits, resulting requirements for both, social software and web analytics tools, and their area of applicability have been generated. They also serve as a basis for the upcoming prototypic implementation.

4.1 Scenario 1: Quantitative feedback

Beside information consuming, usually social software users also want to contribute to a community. When doing so, for example by commenting on a blog post or creating new pages in a wiki, qualitative feedback might be provided by other users commenting or editing the user's generated content. However, the user does not get detailed quantitative feedback about his contributions. Given the ability of web analytics tools to track user behavior, such quantitative feedback might be possible. For example, information about the number of people reading the user's generated content can be interesting as well as motivating to generate more content. Other figures of interest might be the time other users spend for reading the content and their loyalty (return rate). These figures can be presented as numbers or visualized as charts showing the progress for the last days. Another possible feature is the determination of a user's most accessed content.

User benefits: Quantitative feedback on a user's generated content

Requirements: Association of a user with his content, live reporting

Applicable for: Wiki, Blog, Social networks

4.2 Scenario 2: Popularity data for search engines

Search engines are an essential part of social software because they provide easy access to the information contained therein. The ranking of search results can be enhanced if data about the usage of websites is also considered. A new property containing such information can be built by summing up either the number of views over the last X days to determine the content's actuality or the number of views since its generation to determine its overall popularity. Such an indicator can be computed by web analytics tools and then be included in search engine's ranking of search results.

User benefits: Enhancement of search results

Requirements: Configurable search engine

Applicable for: Wiki, Blog, Social networks

4.3 Scenario 3: Recently most viewed content

It is a common means to present the currently most viewed web pages to users in order to attract their attention. Usually, the interests of several social software users overlap and so the most viewed pages are likely to be viewed even more often. Of course, this approach has an reinforcing effect, but users like to see what others are interested in. Such a feature is nothing new, but web analytics tools provide an easy way to implement it.

User benefits: Access to most interesting content

Requirements: -

Applicable for: Wiki, Blog, Social networks

4.4 Scenario 4: Individual navigation

Today's social software platforms offer a multitude of features in parallel, for example messaging, chat, micro blogging, relationship management, or even the opportunity to develop custom add-ons. Usually, a user utilizes some of these features more often than others. A web analytics tool is basically able to identify the features frequently used for each user. The resulting data can then be imported by the social software platform to adapt the website's navigation menu to the respective user. If, for example, the user performs some of his frequent tasks in the same order, including a link to his probably next task can ease his navigation.

User benefits: Easy navigation, suggestions of frequently used features

Requirements: User identification for all of his visits

Applicable for: Wiki, Blog, Social networks

5 Prototypic Implementation

After generating several scenarios describing the benefits of the cooperation of web analytics tools and social software, a prove of their feasibility is required. Therefore, the open source tool *Piwik* is used to track user activities in a testing instance of *Tricia* which is also developed as an open source project [Piw10, Inf10]. *Tricia* provides integrated web collaboration services such as wiki collaboration, personal & team blogging, file & directory sharing and social networking.

5.1 Prototype Description

The objective of this prototypic implementation is to demonstrate the feasibility of the scenarios described before and to lay down the basis for further developments in this area. Therefore, the social software as well as the web analytics tool have to meet a few requirements: (1) the source code of the social software needs to be available and allowed to be extended, (2) the web analytics tool is required to provide easy access to its data, for example via a Web service and (3) both tools need to be available free of charge.

The Java based open source tool *Tricia* is currently developed by the InfoAsset AG and comprises wiki, blog, social network and file sharing features. The open source tool *Piwik* aims to be an alternative to Google Analytics and is based on PHP and MySQL. Both meet the previously listed requirements and therefore have been chosen for this prototypic implementation. The resulting architecture limited to the relevant aspects is presented in Figure 1. The particular elements are described in the following sections. For more information about the internal structure of *Tricia* and *Piwik* please refer to [Inf10, Piw10].

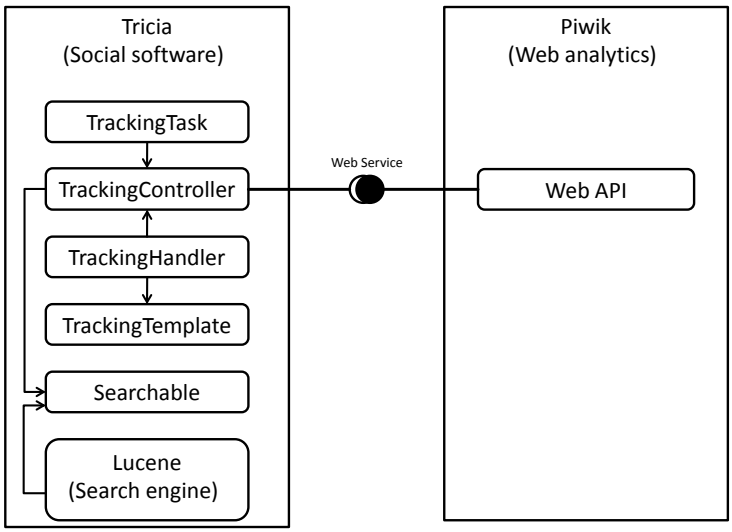

Figure 1: Prototype architecture

5.2 Solution

To show the feasibility of the previously presented scenarios two of them have been implemented prototypically. A prerequisite to all scenarios in this prototype is the interaction of *Tricia* and *Piwik*. Therefore, the first step is to setup *Piwik* and configure it to track *Tricia*.

Due to the "speaking URLs" used in *Tricia*, this task is relatively easy to perform. The JavaScript tracking code has simply to be embedded in all pages to be tracked which was achieved by adding it to the main template which all pages are based on. The second step is to import tracking data from *Piwik* to *Tricia*. Therefore, a new class called *TrackingController* has been implemented in *Tricia's* core, including methods to establish a connection to *Piwik's* RESTful Web service via HTTP and to process the received data. As the connection and import are relatively easy to achieve, the processing of the received data is more challenging. Unfortunately, *Piwik's* API lacks of a detailed documentation so the task of finding the appropriate methods to call can be time consuming. Furthermore, it is not possible to request data directly for a specific page by passing its URL. Consequently, *Piwik's* data has to be loaded as a whole which is done in an overnight process triggered by the *TrackingTask* class shown in Figure 1. *Piwik* offers several formats for data delivery such as XML, HTML and PHP. In this prototype, the JSON format is used because it facilitates the further processing of received data. As a result, the *TrackingController* class stores and provides access to all tracking information gathered by *Piwik*.

5.2.1 Implementation of Scenario 1: Quantitative feedback

The scenario *Quantitative feedback* aims to provide usage data of pages a user has contributed to back to the user. Therefore, a new handler called *TrackingHandler* and a corresponding HTML template called *TrackingTemplate* have been implemented to generate a page with this information. The approach consists of four steps and is relatively straightforward:

1. determine the current user via current session data
2. determine all contents (wiki pages, blog posts) he has contributed to
3. request the corresponding tracking data from the *TrackingController*
4. process data and pass it to *TrackingTemplate* to generate HTML output

The new page can be accessed by all authenticated users of *Tricia*. In this prototype, the information listed below is thereby presented to the user for each page, for example a blog post or a wiki page, he has contributed to.

- Number of hits over the last 30 days
- Number of visits over the last 30 days
- Number of unique visitors over the last 30 days

As result, the social software user gets the tracking data provided by *Piwik* for exactly the pages he has contributed to. Due to the difficult access to *Piwik's* data about specific sites and the necessity in this scenario to provide this data about every site a user has contributed to, live statistics are currently not achievable. As a consequence, *Tricia* is required to update the tracking data about every page in a batch process and store it until the next update, for example the next day.

5.2.2 Implementation of Scenario 2: Popularity data for search engines

The scenario *Popularity data for search engines* aims to enhance search results by adding usage data to prioritization calculations. Therefore, a new attribute called *UsageBoost* has been added to every searchable content in *Tricia* which is represented by the *Searchable* class shown in Figure 1. This attribute can be compared to the PageRank rating used by Google [PBMW98] because it also influences the ranking of search results invisibly for the user. But, instead of the static link structure among websites it is based on dynamic user behavior data. The computation of this new attribute is done by the *TrackingController* class in an overnight batch process. The *TrackingController* class proceeds as follows:

1. request tracking data for all pages via *Piwik's* Web service
2. find the corresponding *Searchable* entity in *Tricia* for each URL received from *Piwik*
3. calculate its new *UsageBoost*
4. update its *UsageBoost* attribute

There are many sensible ways of calculating the *UsageBoost*. Usually, in websites there are some pages visited very often and other pages visited less often. Therefore, a logarithmic function seems to be appropriate. In this prototype, the *UsageBoost* is based on the number of visits over the last 30 days. Due to the ranking formula of *Lucene* and its existing configuration in *Tricia*, the maximum boost value should be 5 to avoid outweighing of other criteria. Formula 1 shows how the *UsageBoost* is calculated. The number of visits is thereby divided (normalized) by the overall number of visits to respect a possible increasing number of website visitors. The multiplication by 100,000 is needed to map the results of the logarithmic function to the mentioned scale from 1 to 5.

$$UsageBoost = \log_7 \left(\frac{number\_of\_visits\_per\_page \times 100000}{total\_number\_of\_visits} \right) \quad (1)$$

As result, every searchable content in *Tricia* holds information about its own usage according to the specified calculation formula. *Lucene* has then been configured to include this information in its search results' ranking.

6 Conclusion

Chapter 2 regarded the fundamentals and challenges of web analytics and social software with the result that live reporting and event tracking are useful capabilities if both are interacting. The web analytics tool analysis performed in Chapter 3 summarizes relevant data for social software users provided by these tools as for example the number of visits and the user's return rate. Subsequently, four scenarios have been developed based on these insights. They illustrate the benefits social software users can achieve by the use of web analytics tools, for example quantitative feedback about their content and enhanced search

results. The prototypic implementation of two scenarios described in Chapter 5 proves their feasibility. In addition, they might be used as a foundation for further developments in *Tricia*. The prototypic implementation also revealed that social software has some additional requirements for a web analytics interface, for example the possibility to request tracking data for a single page, which is at least not implemented in Piwik.

The generated scenarios and their prototypic implementation are only a first step towards the usage of web analytics tools for social software platforms. To loose the coupling between the web analytics tool and the social software, a common interface between them would be necessary. Further research is needed to verify the user benefits introduced in this paper and to evaluate if additional benefits could be achieved. In addition, empiric research should also determine, how users change their behavior when web analytics data is integrated in social software.

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