

Website Optimization with Web Metrics: A Case Study

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ABSTRACT

Web metrics are the measures that reflect how customers are using a website. Companies use these metrics for further improvement of their website. Although most companies today are engaged in website optimization, the actual use of web metrics is a relatively unexplored area. In this paper we address this topic by first reviewing the strengths and weaknesses of the most important source of web metrics (web logs) and then conducting an extensive case study. The literature review revealed a number of serious limitations to the collection and use of web log data. In the case study we interviewed both marketing and IT managers of a major US networking solutions company to explore how they use web metrics for website optimization projects and try to overcome weaknesses.

We have found that the various data sources fulfil different purposes: clickstream data enable managers to answer 'when' and 'what' questions, customer surveys 'why' and 'how' questions, and external data to make competitor comparisons. Critical issues involve the lack of industry standards, the volume of data, and the need to supplement clickstream data with qualitative information. Managers highly regard web metrics and are eager to learn how to increase the use of this underutilized data source on online customer behaviour.

Category

J.1 Business

General Terms

Management; Measurement; Theory.

Keywords

Website optimization, web metrics, measures, server log, clickstream data, case study.

1. INTRODUCTION

Catalogues can be changed once a year; websites can be updated on a daily basis. Products can be added, text changed, photos included, links and pages inserted or deleted any time. This continuous process of improving websites is called website optimization. It is a process any company should be involved in, to ensure that the site fulfils customers' expectations as well as the purpose intended by the company. The two main reasons for

changing a website are changes in the environment (e.g., a new product introduction, a price change, or a newspaper article featuring the company) and an improved understanding of how customers are using the site. For this latter reason companies are monitoring the use of their site. Which pages are often requested? Which purchases are made and how often? When and where in the site do customers abandon their shopping cart? The answers to these questions are reflected in web metrics.

Web metrics represent a largely unexplored area for most web companies. However, their potential to inform web operations has been recognized, and therefore it is not surprising that *web analytics*, the field that is concerned with collecting, analyzing and interpreting web metrics, is a booming business. To give a few examples: a search on 'web analytics' by the authors in Google led to over 32 million hits. Recently, private-equity firm Francisco Partners purchased WebTrends, a web analytics vendor, for US\$94 million. The widespread need for web analytics is illustrated by the unprecedented success of Google Analytics. Within a few days after launching the free online service in the fall of 2005, Google had to limit new signups due to a lack of capacity.

The goal of web analytics is to assist companies in improving the quality of their website. 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 [e.g. 1, 2, 3, 4, 5, 6]. Other studies considered aspects of website quality as antecedents of performance measures such as the intention to (re)visit and (re)purchase. Most notable in this category are the studies based on TAM (Technology Acceptance Model), originally developed by Davis [e.g. 7, 8, 9], and recently applied and adapted in e-commerce settings in various ways [e.g. 10, 11, 12, 13, 14].

A key characteristic of all studies mentioned is that they consider website quality from the customer's (user or visitor) perspective. In practice, however, managers often prefer web metrics based on clickstream data to study online customer behaviour. An important reason for not conducting customer interviews is that many practitioners already feel overwhelmed by the sheer amount and apparent richness (detail) of the available clickstream data. Hofacker and Murphy [15] refer to these data as "instant, direct and automatic Internet feedback" (p. 227). Day after day, gigabytes of new data become available, which seriously limit the practitioner's appetite for even more data. Still, the available information appears to be underutilized by both practitioners and academics [15, 16, 17].

As a result of these developments, several issues deserve further investigation. Firstly, it is clear that clickstream data can only partially reflect the effectiveness of a site. Clickstream data display the 'when' and 'what' of web visits, but are of limited use to answer 'how' and 'why' questions about customers' site use. Secondly, despite their apparent richness, clickstream data

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have some serious flaws. Often, they do not cover all site traffic in complete detail, and managers need to be aware of the gaps in the available data. Thirdly, since academic researchers tended to focus on customer surveys, our understanding of how managers are actually using web metrics for site improvement is rather limited.

Our objective is to address these gaps. First we review the strengths and weaknesses of using clickstream data for web optimization, based on a review of the relevant literature. In the second part of the paper we will conduct an empirical study. The main goal of that study is to determine how managers are learning to use various web metrics, based on both clickstream data and customer interviews, to improve their website. Since we believe that no company has yet reached the optimal level of the use of web metrics, we are interested in how managers are learning to develop, collect and use these metrics. Therefore we conducted a case study involving various IT and marketing managers of a major US player in the IT industry. This company is well known for its early and advanced use of the Internet (for confidentiality reasons we are unable to disclose the company's name). We used a case study since this is the best approach to generate rich data [18, 19]. The interviews were conducted to gain an understanding of the developments, processes and issues related to the use of web metrics for website optimization.

This paper is structured as followed. Section 2 reviews the literature on the evolving use of clickstream data as web metrics and its limitations. After a brief discussion of the design of the case study in section 3, the main results are presented in section 4. The results section is structured based on a number of relevant themes that emerged from the interviews. The paper concludes in section 5 with an overview of implications, both academic and managerial, and directions for future research.

2. CLICKSTREAM DATA AS WEB METRICS

Since the advent of the Internet, companies have tried to develop web metrics to monitor the use of their site. Consistent with offline performance measures, web metrics have to relate to objectives as established in a web strategy. However, due to the newness of the medium many companies at least initially lacked clear Internet objectives [20, 21]. Compared to offline operations, the availability of data was much less of a problem. Clickstream data are widely available, as it is stored by default in server logs and through page tags.

As concluded in the introduction, many academic studies on website quality are based on customer interviews instead of clickstream data. However, from a practitioner's point of view, such studies have serious limitations. They require a long time interval; it may take days or weeks before data from a sufficiently large sample are collected, analyzed and presented. Designing customer studies is time-consuming because managers need to discuss suitable questions to be asked with the researchers. The collected measurements may be unable to detect the impact of minor site changes, such as the change of a link's text colour from blue into red. Finally, these studies are often too costly and may even lead to negative side effects (how would you feel if your preferred supplier asks you for the third time this week to fill in a survey?). For these reasons, combined with the availability of clickstream data, practitioners tend to prefer web metrics based on clickstream data. The evolving use of this category of web metrics is the topic of the first part of this section; in the second part we focus on the limitations of clickstream data.

2.1 Using server logs for web metrics

Early web performance measurement focused on traffic and exposure. Coffey [22] refers to reach measures that estimated "the number of different people who have viewed at least one page on a particular site over the course of the measured month" (p. 2). Such measures were developed by applying traditional advertising practices and methodologies to the Internet [23]. Other early web metrics include clickthrough rates (percentage of visitors who clicked on a link or banner) and conversion rates (percentage of visitors who completed a desired action). The overall usage of a site is typically determined with traffic measures, such as the number of unique visitors, user sessions, page requests or visits (see Bertot *et al.* [24] and Novak and Hoffman [23] for an overview of traffic measures). For example, Montgomery *et al.* [25] showed how path information assists in predicting online purchasers.

Besides generating metrics through page tags, the majority of web metrics are acquired through server logs. A web server is a computer that delivers pages to the computer that requests information by entering a web address or URL (Uniform Resource Locator). That request and the interaction between server, site and visitor create data that are stored in a log file on the server [26]. Web server logs are not limited to usage data but can also show other information about the website, such as access logs (e.g., IP address, date and time of access), agent logs (e.g., browser, browser version, operating system), error logs (record error events), and referrer logs (list pages that link to documents on the server). Combining these logs creates a picture of users' behaviour on the website, the technology they are using, problems on the website as well as the structure and navigation of the website [27].

Server logs are only the beginning of the analysis, providing the raw data that can be worked with. Reports listing these raw data can be overwhelming. Therefore various software packages such as ClickTracks, WebTrends or Omniture are available to assist in analysing server log data and to provide standardized reports (see Forrester [28] for a recent review of web analytics vendors). They enable a deeper analysis of website actions by monitoring performance patterns and creating data on online searches, the performance of advertising campaigns, and navigation. Web analytics software can evaluate sales and abandonment data as well as track campaigns and analyse different scenarios.

In addition to the server-focused view of server logs, web analytics firms can provide further information based on networks and competitors. For examples, reports created by Hitwise are network-centred, collecting information directly from ISP networks. The reports offer rankings by analysing the traffic for many websites and categorizing them into industries. This information can help web businesses assess their competitive performance and establishing their position within their respective industry.

2.2 Limitations of clickstream data

Despite providing much detailed data, web server logs also have limitations, which may seriously affect the usefulness of clickstream data [15]. These problems made Haigh and Megarity [29] describe log file analysis as "an art disguised as a science". Companies need to be aware of the technical and methodological weaknesses [30] when using server log data to evaluate their web performance. This section investigates the issues that affect the value and quality of server log data.

2.2.1 *Incomplete data*

Server logs report activity on the server and not user activities; therefore they suffer from inaccuracies created through caches, located at various places between the web server and the visitor [31]. Caches are used to reduce response time by storing a web page and providing this page when requested directly from the cache instead of requesting it from the server. Pages shown from cache are not recorded in the server log and the derived measures would underestimate actual traffic [32, 33].

Server logs may also overestimate the actual use of the site, by including requests made by 'spiders' [34]. Spiders are computer robot programs that scan the web to keep search engine databases up to date. Sometimes the automatic traffic identifies itself via a descriptive field in its own coding and can be filtered out [31]. Another reason for overestimates is that page requests are counted even if the user has already left the page before it has loaded [31, 32].

The server log does not include the time spent on the last page, since the page requested after the last page by definition is requested from another server. This can create a serious problem in estimating visit duration if the majority of the time is spent on the exit page [15]. Network-based or browser-based reports such as reports provided by web analytics firms may avoid this issue.

Geographic information may be inaccurate as a computer can be in a different location from where its IP address (the unique identification of a computer) was registered. Another limitation is that unique IP addresses, used to identify unique visitors, can be shared by multiple users. Fixed IP addresses are only provided in TCP/IP networks used in high-speed connections. As the use of broadband connections quickly increase in many countries, this problem may become less significant over time.

2.2.2 *Interpretation of the data*

Especially in the early days of e-commerce, industry-specific benchmarks of web metrics were missing. When yardsticks are missing, interpretation of numbers is problematic, comparisons between companies and departments is difficult, and determining the appropriate metrics to use for a particular website is more challenging [32]. Suppose 2,875 people visited a web page last week, is that good news or bad news? Web analytics firms address these needs by providing comparison statistics. In case external yardsticks are missing, the data may still be useful by concentrating on changes over time instead of absolute numbers. However, the dynamic nature of the Internet, with frequent site design changes, may present a new pitfall.

Server logs show when a visitor requested a page and when the visitor requested the next page. We tend to interpret this time interval as the viewing time of a page. However, the visitor is not directly observed, implying that it is unknown whether the visitor is actually reading the web page or has opened a competitor's web page in another window in the meantime, or is making a phone call, drinking coffee, etc.

2.2.3 *Data not logged*

Although server logs contain an impressive number of data, they also miss important information. They do not include the identities and perceptions of visitors. Some demographics such as country information can be captured but are based on technological details (the server location) rather than personal attributes of the visitor. The server log does not contain data on the next site a user visits after leaving the site. It may also be hard for a researcher to link an initial visit to subsequent visits

by the same visitor. These problems can be (partly) solved by using cookies, linking multiple sessions to the same user, or site registrations. However, the trend towards cookie deletion may hurt the effectiveness of the first solution [35].

In conclusion, the shortcomings of web server logs need to be understood and the available data interpreted correctly. The weaknesses can be partly overcome by technical solutions (e.g., cookies and site registrations), or by triangulating the log analysis with other methods such as customer interviews and reports provided by web analytics firms.

3. RESEARCH DESIGN

From the literature review we can conclude that our understanding of how managers are actually using web metrics for site improvement is rather limited. Therefore we decided to conduct a case study. Exploratory, case-based research assists in answering "how" research questions and explores new and unexplored trends [36]. Since comprehensive data collection is a key characteristic of case study research [19], multiple interviews were used to explore the details of the use of web metrics for website optimization. Also, in our study the observation of processes within a company was critical; it was important to get close to the data [37, 38].

Face-to-face interviews allow a flexible approach (including probes) that generates high quality data. This enables the researchers to analyze and interpret the experiences and beliefs of the respondents in their own terms [39]. The physical experience of the corporate environment was beneficial in enhancing the data. A semi-structured approach was used for the interviews to allow participants to elaborate on particular issues according to interest and experience.

The company chosen for the case study is a provider of products, services and support solutions for building and maintaining network computing environments. The company sells scalable computer and storage systems, and software for operating network computing equipment. The products and services are used for many commercial and technical applications in various industries from telecommunications to financial services, and from manufacturing to retail. The company was chosen for its market leadership, the availability of resources and the significance of the website to the company. An initial review of the business press and available corporate publications confirmed that the firm was dedicated to the use of web metrics and committed extensive resources to generating and utilizing web metrics.

The company's web metrics analyst agreed to enable the researchers access to web metrics information, relevant company documents and key personnel involved with the web operations. To explore the use of web metrics, eight employees were interviewed. The participants were selected based on their work responsibilities and involvement with web metrics in various areas. The sample contained both top and lower level managers, with both IT and marketing backgrounds. For example, interviews were conducted with the VP of Internet Services, the Senior Manager for Online Marketing, a manager for Online Marketing and Web Publishing as well as the Director for the Web Content Strategy. The interviews were all conducted face-to-face and took place in the company's offices in the Western US.

4. CASE STUDY FINDINGS

The most interesting findings of the interviews are grouped into three subsections. At first, we describe how the managers are using web metrics to improve their website. This is followed by a discussion of the limitations the managers encounter in collecting and using web metrics. We conclude by analyzing how the managers try to overcome these limitations.

4.1 Use of web metrics

One of the main areas where web metrics are used within the company is the search function on its website. Since it is expensive to answer phone calls, the company actively promotes the site's search function. Metrics that are used to optimize the search function include the most common queries and the amount of queries originating from a particular site. A large number of queries in a certain area may indicate that this part of the website does not satisfy users with the information they are looking for. The number of queries is also used to determine the areas of the site that justify the commitment of resources for improvement.

"We look a lot at what people search for and then we try to tune our search, for instance, to make sure that the top 100 searches are getting the best possible results."

The marketing managers try to improve customer loyalty by analyzing what customers do online and what they are interested in, and use that information to improve the website. In particular, managers analyze clickthrough rates and referrals from other websites to the company's website. IT managers analyze the most common browsers for site redesign activities.

"If we want to upgrade to our new design that uses a certain CSS [Cascading Style Sheet] feature, some browsers may be left behind, affecting the population."

After changing the design of a page, traffic trends are monitored to observe the resulting changes in user behaviour. Day to day variations such as changing website usage on different days of the week, and periodic changes such as seasonal fluctuations are considered and influence the interpretation of the data (for example, less traffic is expected on weekends). The dynamics and developments during the launch of a website or pages are measured through metrics such as referrals and the costs related to the changes of specific pages.

"I'd like to have data now so that I understand what are we doing successfully, how much is it costing us to do it, and based on that cost, is the return on investment fair?"

Table 1 shows a sample report that lists page views for a specific month, a comparison to the previous month, monthly unique visitors and the relation between those two measures. This is only one example of many thousand possible report variations based on 60 or more variables.

Table 1 – Excerpts from a Page Views Report for a sample page (upper part) and a sample site (lower part)

Summary		May-05	Apr-05
	Total Page Views	53,120	45,479
	Date	Selected Month	4 weeks prior
1	May 1, 2005	1000	665
2	May 2, 2005	1,868	2,151
3	May 3, 2005	2,523	2,373
4	May 4, 2005	1,969	1,807
5	May 5, 2005	1,794	1,972
6	May 6, 2005	1,559	1,363
7	May 7, 2005	528	652
8	May 8, 2005	417	600
9	May 9, 2005	1,768	2,110
10	May 10, 2005	1,289	1,838
11	May 11, 2005	1,804	1,905
12	May 12, 2005	1,767	1,692
13	May 13, 2005	1,963	1,642
14	May 14, 2005	693	567
15	May 15, 2005	630	565
16	May 16, 2005	2,216	2,310
17	May 17, 2005	2,427	2,590
18	May 18, 2005	2,463	2,007
19	May 19, 2005	1,803	1,823
20	May 20, 2005	1,621	1,512
21	May 21, 2005	653	545
22	May 22, 2005	1,382	635
23	May 23, 2005	2,380	1,922
24	May 24, 2005	2,744	2,068
25	May 25, 2005	2,346	1,883
26	May 26, 2005	2,380	2,121
27	May 27, 2005	2,471	1,310
28	May 28, 2005	1,118	524
29	May 29, 2005	756	553
30	May 30, 2005	2,719	1,868
31	May 31, 2005	2,516	2,523
	Total	53,120	45,479
Related Metrics			
		May-05	Apr-05
1	Total Monthly Unique Visitors (MUV)	16,379	15,531
2	Average Page Views per MUV	3.24	2.93
3	Page Views for Top 5 Pages		
	Page a.	11,388	9,980
	Page b.	2,056	2,367
	Page c.	1,270	1,037
	Page d.	1,086	0
	Page e.	914	1,195

Web metrics are also used to determine site optimization priorities. For example, high priorities are assigned to the most common tasks customers perform, the most popular pages or the pages that generate the most sales.

"There are over 40,000 pages and about 2 million [pages] across the [multiple] websites but the top 500 pages account for 90% of our traffic; so we evaluate what are the pages to make the biggest investment in; it's a really important measure."

Metrics derived from server logs or page tags are combined with information from customer surveys. For example, clickstream metrics enable managers to identify areas that receive low traffic; additional survey data are collected to find out why traffic is lower than expected. Notwithstanding the usefulness of survey data, managers highly regard clickstream metrics, as they 'measure what people do, not what they say'. Managers believe that customers tend to act differently compared to what they state, and that the clickstream metrics capture the 'true' behaviour.

Most managers recognize that metrics make the most difference when used for improving online experiences and the interaction processes customers go through. A striking example concerns

the text on a button. Initially, the text next to an expensive product read “buy online”, and the clickthrough rate was very low. Through metrics and surveys the manager found that customers were not comfortable buying an expensive product online but preferred other channels. The customers were online to research the product. So the manager changed the text to “price and buy” which increased clickthroughs ten fold.

The marketing managers are very aware of privacy issues and try to avoid violating the trust that customers have in the company. Thus, they do not link personal and private information gained through sales processes to the clickstream data.

The managers expressed a strong belief in the value of quantitative measures for improving the website. Outcomes and results need to be measured to understand whether objectives have been met. The metrics also indicate where managerial action is needed:

“Without e-metrics you can’t change or drive behaviour.”

In some cases the clickstream metrics make issues measurable that sometimes had not been measured offline. An example is the following statement of a manager of how the availability of web metrics has influenced the way marketing campaigns are evaluated:

“Many marketing programs were never measured, [we] just hoped it worked and was effective.”

Web metrics enable the managers to quantitatively evaluate operations. Managers use these measurements to determine whether certain activities and modifications should be repeated or extended. The managers actively share this information within the company to leverage the exploitation of new insights. In this sense, the availability of web metrics has initiated a change in decision-making style. Decision-making transformed from an intuitive to a more rational and facts-based process. This change was probably not initiated by the metrics; however, the availability of this new, detailed and substantive source made it possible to make the change.

4.2 Limitations of web metrics

The managers admitted that there is a multitude of data that could potentially be used to improve the website. However, overload of information is a concern. For web metrics to be useful the managers try to relate the metrics to the objectives for the website. The objectives are stated as, for example, customer self help, customer service or sales.

Also, the lack of standards in the industry was mentioned as a concern. The topic is so new that standards or benchmarks are not available, and even the nomenclature is not standardized. Details and processes still tend to be confusing. Also, the people involved with website operations need to be trained in the use of web metrics, to ensure that they understand what kind of metrics are needed and what kind of queries managers need to extract meaningful data.

The managers expressed a need for more background information about the users. For example, managers would like to know whether a visitor is an IT professional, a student or a CEO. This information can be collected through surveys, and assists in improving the website.

“We’re also just beginning to gather metrics using our vast audience as a market-testing tool [...], determining whether our messages are getting through.”

One example of the usefulness of survey data concerns the homepage. Clickstream data revealed that of 200,000 homepage visitors, less than 10% actually read the feature story. The managers were trying to figure out whether the visitors believed the story, whether it made an impression, and whether visitors found it insightful. Survey data supplied that type of information, allowing the company to determine what made a compelling story. Web metrics were then used to evaluate the success of the implemented changes. For the future, managers envision a greater use of surveys to investigate the visitors’ thoughts and impressions, e.g., how they rate a story, the quality of the technical information, and the writing itself.

In summary, new problems that arose regarding the use of web metrics included the large amount of available data and metrics, the problem of selecting meaningful measures, understanding of data collection limitations, and the need to understand underlying assumptions. The following section explains how those limitations were addressed.

4.3 Overcoming limitations

There are multiple ways to address the limitations that were discussed in the previous section. They include managerial as well as technological aspects.

4.3.1 Determination of needs

Since standards are not established yet and the application of web metrics is relatively new, it is critical to clearly define information needs before selecting the appropriate web metrics to ensure their usefulness for website optimization. The interviewed managers expressed the lesson learned: that it is critical to set clear objectives before web metrics can be useful for site optimization.

“What do you need, and what do you want to know at the end of it is the question to start with and work back from there.”

For example, one manager mentioned that he analyzed web metrics to create better and more leads for the company. He evaluated the lead generation process from the product site all the way to filling out the contact form to determine where users dropped out and which factors might contribute to this behaviour. His goal was to avoid abandonment of the site, and followed the process by evaluating issues with particular pages and the performance of contact forms used in the lead generation process. This is one example where readily available metrics are used in accordance with objectives to use web metrics for effective website improvements.

“So I think the guidelines should really be about having a measurement strategy and where web metrics fit into that strategy rather than the world begins and ends with web logs because that’s only a very narrow picture.”

Different measures are needed for different site optimization efforts. For example, one of the managers explained that it would be very useful to know the most bookmarked pages to determine redesign efforts or clean out content. Also, it is important to know which pages are never visited, which is hard to derive from clickstream data, as they tend to reflect what people did look at, not what they did not look at.

4.3.2 Multiple sources

Managers consistently mentioned that to really understand online customer behaviour, clickstream data should be complemented with other data such as demographics, internal (sales and customer contact) data, or attitudinal information. For example, usability lab testing is conducted with actual customers, monitoring how they fulfil particular tasks on the website.

This feedback is mostly solicited in the early stages of the web design development when web designers evaluate layouts, terminology or desired features. As opposed to metrics, the lab tests explore the 'why' of user behaviour. Data from lab usability tests and clickstream data complement each other: The metrics might identify a problem but cannot explain the 'why'; lab tests will add valuable information. Likewise, improvements to the site, made based on qualitative feedback, can be tested with analytics.

"So a lot of the in lab usability testing shows you things you couldn't find from metrics, but the metrics show you things over thousands and thousands of users that you wouldn't really see doing a study with eight people."

The company undertakes usability studies in computer labs to provide details about the users' website navigation and to clarify how easy it is to complete specific tasks on the website. These studies also assess the design, information architecture and intuitiveness of the website and show which path the customers' eyes follow on a webpage. The managers use this qualitative information to enhance the value of clickstream data, which can, for example, show a customer's path through a site but not the approach of a single page.

Historic data allow comparisons when site changes are made. In addition, external data such as rankings and reports provided by web analytics firms enable competitive analysis. The managers recognize that in the online marketplace companies influence each other and condition each other's customers; therefore they track carefully whether they are ahead of or behind the competition.

Since the various sources are imperfect (e.g. self-selection problems with surveys and the artificial environment of usability tests) managers consider an integrated approach the most appropriate one. Combining data sources results in a steep learning curve for web managers as the individual applications such as web metrics or usability tests are relatively new topics, and their combination has not been standardized. In addition to using multiple sources of information, aggregation of data across systems and combining transactional and web systems is considered to be really important.

The managers expressed a need for blending in qualitative data, meaning the need for a methodology that can create a picture of a web experience from both a quantitative and qualitative standpoint. Without qualitative measures, managers find it hard to meaningfully interpret the clickstream data, and they feel they are left with a partial picture:

"What does it mean, who are the visitors, what are they doing, what do they care about, how do we leverage visits into real business; [that is] hard to answer with web logs."

"In general, having a holistic view of everything, being able to tie together survey and satisfaction data with traffic data with usability measurements, that's hard to do right now."

5. CONCLUSIONS

Web metrics are the information that companies use to improve their websites. This information can be based on server logs (clickstream data), customer surveys, and external data collected by web analytics firms. These data fulfil different purposes: clickstream data enable managers to answer 'when' and 'what' questions, customer surveys 'why' and 'how' questions, while reports from web analytics firms contain the external yardsticks that enable normative interpretation of the many statistics unavailable until recently. Clickstream data are available in huge amounts, but is less perfect than sometimes suggested. Both the incompleteness of the data and interpretation problems create serious limitations. Careful analysis and selection of measures is necessary to ensure appropriate and meaningful use of this information.

For the future, web managers see the use of web metrics for website optimization growing and the importance changing. Using these data will be critical to determine priorities and needs related to the further development of websites. Processes will be made more efficient and the necessity of changes be made more obvious through the use of web metrics.

Our case study reflects the problems and issues identified in the literature. We also found that managers are eager to learn how to use this source of detailed and concrete data on customer behaviour. However, they have difficulty in selecting the most appropriate metrics, given the enormous amount of available data. Further research could focus on identifying categories of web improvement decisions and the relevant web metrics for making these decisions. The awareness of the potential of clickstream data has led in some instances to a change to a more quantitatively oriented decision-making style. It would be interesting to investigate to what extent the changes in decision-making style, initiated by the data-rich online environment, affect decisions made with regard to offline operations.

We have also found that managers are aware of the value of triangulation. By combining clickstream data with customer surveys and external (comparison) data, managers get a deeper understanding of online customer behaviour. Further research could focus on developing a methodology that leads to a more complete picture of online customer behaviour by integrating data from all available sources. Finally, we have found that managers clearly realize that the insights made available by web metrics are essential in the never-ending process of improving their online offerings but that more knowledge is needed about the use of these metrics.

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