Data Driven Design: Using Web Analytics to Improve Information Architectures

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Abstract — Web analytics, the practice of web traffic analysis, typically provides intelligence for marketers and executives responsible for proving Return On Investment (ROI). While valuable for proving ROI, web analytics' greatest potential lies in improving the online user experience. The use of web analytics to evaluate the online user experience is fueled by an increasing awareness of web analytics in general; however, the sharing of analytics data across units in an organization is not yet the business norm. When analytics data is shared with the design team, a subtler and more sophisticated user experience design can emerge.

1. INTRODUCTION

Web analytic data is mined from site activity logs, and can offer a wealth of information about user behavior. In interviews with information architects about the web analytic measures they felt would be of greatest value to their craft, comments centered on providing context for decisions and heuristic assumptions, singling out user search behaviors as an indicator. Information architects want to understand why visitors come to the site and what they seek, so that the content can be best presented to meet user needs and business goals (Farnum, 2005; Naasko, 2005). To this end, standards in professional practice require conducting an evaluation of the site with respect to established or domain-appropriate information architecture guidelines.

This paper discusses the use of heuristics for site evaluation, focusing on Robert Rubinoff's user experience audit. In the context of informing the information architecture of a web site's redesign, each category of heuristic statements is briefly examined, and appropriate web analytic measures are suggested for selected audit statements.

2. USING HEURISTICS

While Jakob Nielsen's usability heuristics are the most popular and well-known choice of tools for web site evaluation, these design guidelines were created for user interface design in general, and are not web-specific (Nielsen). User experience design for the online medium requires considerations that are not shared with desktop software applications, and information architects must typically make significant adaptations to use this set of heuristics for site evaluation. Robert Rubinoff's user experience audit is another heuristic tool, but takes the medium into better consideration while retaining a necessary level of flexibility; because of its focus on web interface design and repetition of Nielsen's most applicable principles, it may be a superior tool for evaluating web site usability (Rubinoff, 2004).

Providing a context for heuristics is a useful application of web metrics in a site redesign project; creating a framework for measurement is critical to future evaluation of the success and value of strategic but intangible investments like information architecture. Analyzing pre-existing web traffic data can yield insights to user behavior and measure how well a site design meets user needs (Chatham, 2005a; Manning, 2004; Peterson, 2004b; Sterne, 2002). By comparing web analytic data to an information architect's heuristic evaluation, a basic form of validation can emerge for otherwise subjective performance measures. This data is more strategically useful than it might first appear: in addition to heuristic validation, a web analyst will use the information to

engineer effective key performance indicators (KPI) for future evaluation, and the information architect, who will make design decisions based on available user intelligence, can use the additional user data to inform the design (Peterson, 2004a; Sterne, 2002).

2.1. Using Web Analytic Data

Before further exploring the use of web analytics to support information architecture heuristics, a few points of weakness in the source data and current web analytic practices must be acknowledged. Web traffic measurement will never be able to reveal the complete user picture, and this is one reason to use web analytics in combination with other tools used to inform and evaluate the experience design, such as customer databases and user testing (Peterson, 2005b).

Web analytics reveals what users do, but not why they do it, so measures for evaluation must always focus on actions that can be directly mapped to user intent. This is a significant challenge, as many heuristics are subjective and abstract. While there are currently very few standards in measurement and analysis methods and terminology, the web analytics community is actively addressing the problem of standards. This will benefit future research in the area of web analytics, which is currently dominated by practitioners and industry analysts.

Additionally, the available site traffic data to inform a design may be significantly suboptimal for analysis depending upon the volume and nature of the site traffic data available. Particularly influential factors include use of cookie-based measurement techniques, server log fields recorded, and both the temporal span and volume of data available for analysis (Buytendijk & Janowski, 2001; Chatham, 2005c; Gassman, 2003; Peterson, 2005a).

3. VALIDATING RUBINOFF'S USER EXPERIENCE AUDIT

To provide a useful context for design, Rubinoff's user experience audit is one of several tools that information architects can utilize to evaluate a web site (Rubinoff, 2005). Rubinoff presents a format quantifying useful, though subjective measures that information architects can easily assess, and his example uses four broad, equally weighted categories with five evaluative statements in each.

The most functional aspect of this tool is its complete customizability: any heuristics and categories can be selected, categories and audit statements may have varying weights based on their domain relevance, additional categories may be formed, and ten to twenty audit statements can be ascribed to each category. This level of flexibility requires that care be taken that the audit statements reflect the site owners' and users' goals.

Because every domain operates in a different context, information architects and web analysts will achieve greatest success by consulting on the evaluative points that will be most verifiable and valuable for each web site. By cooperatively selecting success measures early in the project's definition or discovery phase, so that the design and evaluation are in alignment from the start, both the information architect and web analyst are better positioned to prove the value of their services and assure that the project's focus remains on business and user goals.

Creating an appropriate set of site traffic analysis reports for supporting the information architect's needs requires the generation of validation measures for the site congruent to the heuristic considerations that the information architect uses. Since the heuristics or user experience audit statements will vary between information architects and projects, this paper will examine a selection of representative evaluative points drawn directly from Rubinoff's user experience audit that can be validated through web analytics:

- Branding
    - The site provides visitors with an engaging and memorable experience.
    - Graphics, collaterals and multimedia add value to the experience.

- Functionality
  - Users receive timely responses to their queries or submissions.
  - The Website and applications adhere to common security and privacy standards.
- Usability
  - The site prevents errors and helps the user recover from them.
  - The site helps its visitors accomplish common goals and tasks.
- Content
  - Link density provides clarity and easy navigation.
  - Content is structured in a way that facilitates the achievement of user goals.
  - Content is appropriate to customer needs and business goals.

Ideally, the most relevant metrics or KPI should be comparable both before and after a site is redesigned, although direct comparisons are often impossible after fundamental changes to site structure are implemented. By nature, a site redesign generates new points of measurement, typically enhanced by improved data collection strategies, and only a handful of the site's previous KPI might still be directly applicable.

3. BRANDING

A popular yet extremely subjective measure of the online brand experience requires judging whether the site provides visitors with an engaging and memorable experience. Because direct measurement of branding is elusive in any medium, web analytics' indirect evidence of brand value becomes far more tangible than brand evaluation in most other channels.

3.1. Returning Visitors Love Your Brand

As a validation metric, the most direct measure of the ephemeral value of brand experience is the ratio of returning visitors. The desirable return visitor ratio for a site will vary: tech support sites typically prefer a low proportion of return visitors, but a continual infusion of new visitors is needed to ensure the viability of an ecommerce site. To effectively measure the online brand experience, the ideal proportion of return visitors must be identified as a KPI specific to the business goals of the site, and this statistic should be tracked over time to evaluate the site's ongoing success in providing a positive brand experience (Inan, 2002; Peterson, 2005d).

Another practical measure of brand experience examines the number of visits referred by search engines with brand terms in the query. Trends in brand query term referrals by new and returning visitors, and the number of direct or unreferred visits by new or returning status of the visitors can be analyzed together for a confirmation of the impact of branding. Better branding should lead to more brand terms in search engine queries for new visitors, and more unreferred return visits.

3.2. Visit Length and Brand Strength

The length of the average site visit, in both time and pages viewed, also provides a level of verification of the information architect's assessment of the brand experience. By using the statistics for the proportions of site visits of each particular visit length, a specific goal for engagement length can be set as a KPI for ongoing analysis of site performance. Similarly, by considering content groups of similar pages, measuring the depth or breadth of visits can assess how engaging the users find the experience.

3.3. Assessing Interactive Media

Unfortunately, the likelihood of being able to validate the assessment of an interactive element's brand value is directly dependent upon whether the interaction was created with measurement in mind. Engaging online experiences like multimedia games, Flash and AJAX are all measurable—as is the ratio of visitors returning to interact with them, and those visitors' behaviors—but only if the design incorporates JavaScript tagging to report key interactions.

KPI for interactive site elements should be considered in the development of the experience design. For example, the length of time users spend with an interactive element, whether averaged or examined by audience segment, provides a concrete idea of how long users are engaged by the application, and the average number of return visits for returning visitors would be a simple statistic to assess how memorable the experience is: just how frequently do visitors return?

3.4. Measuring the Value of Graphics and Multimedia

Another branding element that Rubinoff suggests evaluating is the value that graphics and multimedia bring to the experience. As previously mentioned in section 4.3, KPI for multimedia must be determined in the site planning phase for appropriate implementation, and these same measures can determine whether multimedia applications are providing the value that justifies their expense.

Aside from ensuring that the graphics do not make the pages load too slowly, measuring the experiential value of graphics can be more difficult unless they happen to be clickable graphics leading the user to further content. Tools such as Crazy Egg's heatmap overlay of visitor click patterns immediately reveal whether clickable graphics drive more traffic than text links, and in what positions the graphics generate the greatest activity. The intuitive data visualizations of a heatmap overlay makes it easy for anyone to compare the performance of multiple iterations of a page design.

4. FUNCTIONALITY

Rubinoff's measures of functionality are primarily focused on the technological respects of service integration. Depending upon the production scale for a project, the information architect may be the best person to evangelize privacy and security best practices. The actual service delivery functionality is typically the responsibility of a more technical team member, but the performance of these systems impacts the user experience and therefore deserves attention in a holistic heuristic evaluation.

While the considerations presented here are far from comprehensive, it is safe to advise that all client data transactions should be conducted over a secure server connection, and that access to this data should be restricted with such security measures as are appropriate based upon the site's scale and the information's sensitivity. In terms of privacy practices, sites absolutely must provide an accurate privacy statement, preferably with any appropriate opt-out opportunities highlighted. Privacy statements should be brief and written in layperson's language—and honored.

4.1. Nuts and Bolts Functionality

Analytics can directly measure timeliness of responses, at least in terms of serving site content, as server response time is a standard server log field. These figures should always be examined at peak load to ensure that the site is speedily responding to user interactions under all circumstances, as slow response times are among the most reviled web site usability complaints. When examining server errors, it is worthwhile to check their occurrence against site traffic levels for the same reason: server loads could be unbalanced, leading to avoidable errors that can alienate visitors.

4.2. Privacy and Security

Designing for measurement also impacts the choices that determine privacy and security functionality. Without access to the site's administration and web analytic data, it is difficult to accurately assess whether the site follows appropriate security and privacy practices, and in developing the site's features and functionality, the web analyst has significant value to add to the process with domain-specific knowledge of data collection methods and best practices (Fletcher, Poon, Pearce, & Comber, 2002). As privacy concerns over measurement techniques find voice in the popular press while the demand for web analytic data increases, the importance of considering privacy factors in design will increase (Chatham, 2005b; Safecount.org, 2005; Tedeschi, 2005; WebTrends, 2005a).

5. USABILITY

Rubinoff's usability statements echo several of Jakob Nielsen's usability heuristics. Because web analytic technology is often sold as a usability tool, there is a temptation to believe that it can replace proven usability testing, which simply is not true. In every mention of web analytics as an element in support of usable design, authors are quick to note that traffic analysis, no matter how reliable and sophisticated, is not able to provide the thoroughness or level of insight that lab testing can achieve. However, by combining professional usability testing with web analytics, customer satisfaction information and a/b optimization, usability testing expenses can be cut dramatically, and purportedly without loss in quality (Peterson, 2005b).

5.1. Evaluating Error Prevention and Recovery

Error prevention and recovery is a commonly selected evaluation point for usability that both Rubin and Nielsen recommend. Information architects will find it easy to determine whether a site is offering appropriate error handling, but harder to quantify the value that error handling creates for the site's users.

The most direct measures are simple proportions: the percentage of site visits including a 404 (file not found) error, the percentage encountering a 500 (server) error, and the percentage of visits ending with an error. Combined, 404 and 500 errors should occur for under 0.5% of requests logged to the server, and a quick check can reveal whether errors merit a further investigation. Digging deeper, the analysis becomes more interesting with navigation analysis: by examining the pages most commonly viewed one step before and after an error, user errors can be literally recreated, understood and remedied. An additional value in examining 404 page errors lies in determining pages to redirect in a redesign, ensuring a continuity of service for bookmarked visits to URLs which may no longer exist.

5.2. Helping Visitors Accomplish Their Goals and Tasks

Another favorite heuristic asks whether the web site help its visitors accomplish their goals and common tasks. Analyzing task completion success rates helps to determine whether a site meets this usability goal. Task completion is now a relatively straightforward set of web analytic measures achieved by applying scenario or conversion analysis to specific tasks and examining leakage points and completion rates. Leakage points, the places where users deviate from the designed process, should be of particular interest: when visitors leave a process unexpectedly, where do they go, and do they eventually return?

5.2.1. Conversion and Scenario Completion

The straightforward percentage calculations that comprise conversion analysis are simple to determine once the appropriate page traffic data has been collected. Because it is relatively easy

and often so enlightening, calculating conversion in stepwise (A to B, B to C, C to D), multi-step (A to C, B to D), and overall task completion rates is only a matter of due diligence; determining the significance of conversion rates is another matter entirely.

Conversion rate definitions and goals are often KPI determined by committee, and understanding these measures will facilitate a deeper understanding of the business and user goals that the design is intended to support. A primary difficulty often lies in choosing the tasks to assess; these measures are best defined with the assistance and resultant buy-in of the parties who are ultimately responsible for driving conversion. Shopping cart analysis is the most common application of this type of evaluation, whereas online forms carry just as much weight for a lead generation site as checkout does for an ecommerce site.

5.2.2. Shopping Carts

As the most common type of conversion analysis, shopping cart analysis can be somewhat misrepresentative of what it seeks to measure: a significant proportion of shoppers engage in online research to support offline purchasing, so a high shopping cart abandonment rate may not be as negative as it would first appear (Janowski, 2002). Another notable trend in shopping cart behaviors is that customers often make use of the shopping cart as a calculator for their purchase totals and shipping rates, so frequent shopping cart item deletions can also be misleading: perhaps the customer is simply on a budget. Shopping cart analysis, however dubious in its presentation of the larger customer behavior picture, can be very useful for determining which shopping tools and cross-marketing opportunities may add value by improving conversion rates.

5.3. Pogo-Sticking and Other Cries for Help

Many user navigation behaviors can indicate the site's success in supporting user goals. Just a few of these user cries for help include pages that frequently generate visits to help or error pages, iterative site searching, and multiple views of the site index in a single visit. One common example of this type of navigation phenomenon is known as pogo-sticking, a term often attributed to Jared Spool. Pogo-sticking describes a user bouncing back and forth between two or more pages or levels of a site's architecture, usually indicating that the organization of the content is problematic.

Most frequently seen in product-level pages, pogo-sticking may indicate a need for a product comparison tool. Other interpretations may be that some critical piece of decision-making information is located at the product page level when it is needed at one level higher, or that the product pages are not well enough distinguished from one another and the user is lost among them.

Pogo-sticking is an excellent example of the potential benefits of collaboration: the web analyst identifies the site users' behavioral phenomena and may be able to infer some of the user needs behind them to share with the design team. The information architect armed with the knowledge of specific user behaviors and needs, can design a more successful, usable site (Beyer & Holtzblatt, 1998; Holtzblatt, Wendell, & Wood, 2005; Nielsen, 2000).

6. CONTENT

The final category for user experience analysis that Rubinoff suggests is content, and the evaluative points that he provides include simple queries about the site's navigation, organization and labels. These foundational characteristics of a site's information architecture are simply enormous territories for measurement (Rosenfeld & Morville, 2002). To begin by attempting to decide whether link density affords good navigation, and content is structured in a way that helps users achieve their goals, is to open up a can of analytic worms, as there are many ways to attempt to measure these heuristics and the applicability of any given measure is entirely dependent on

context (Rubinoff, 2004). While sometimes difficult to produce, navigation analysis findings are typically too valuable to disregard, and they have a host of applications from scenario analysis to behavioral modeling. One way to use navigation analysis findings in context is to apply it to augmenting page traffic statistics.

6.1. Content and Navigation Analysis

Performing navigation analysis on the most popular content pages of the site shows the paths users traverse to arrive at and depart from those pages. When pages with similar content are not achieving comparable traffic, web analytics can provide the insight to determine the differences in the ways that visitors navigate to the pages. Looking for trends in visits to content versus navigation pages can also be indicative: if navigation pages are among the site's most popular pages, there is probably good reason to spend some time considering ways the site's navigation might better support user goals.

Examining the proportions of visits using supplemental navigation, such as a site map or index, can also reveal problems with primary navigation elements. In these cases, however, web analytic data is more likely to point out the location of a navigation problem than to identify the problem itself. Taken in context, an analyst can often pinpoint navigation and labelling issues with remarkable accuracy, but this is also a function of the analyst's understanding of the measures and familiarity with the larger picture of the site's business and user goals.

6.2. Appropriate Content for Your Visitors

Determining whether content is appropriate to visitor needs and to business goals is a complex problem. To validate the information architect's analysis of content value for visitors, individual content pages or classes of pages could be examined and compared on such measures as the proportion of returning visitors, average page viewing time length, external referrals to the page and visits with characteristics indicative of bookmarking or word-of-mouth referrals. For some sites, comparing inbound links and the associated tags from social bookmarking sites such as del.icio.us could provide a measure of content value—if the del.icio.us user base is representative of the target audience for the site.

Content group analysis is another common approach to measuring the value of web site content. Site content performance is often measured by dividing the content into logical, mutually exclusive groupings and monitoring traffic statistics and user behaviors within these content groups. The most useful content group analysis will slice and dice the data across several sets of content groupings, which may include audience-specific content tracks; product-related content comparisons by numerous levels of granularity, often presented in a drill-down report that allows a simultaneous view of every sub-level of a content group; and site feature-specific content groupings.

6.3. In Users' Words

To determine how well site content matches user expectations, few tools can outperform search log analysis (Inan, 2002). If analysis of site search query terms reveals a significant disparity between the language that the site visitors use and that which the site employs, the chances are good that the content does not fit user needs.

The terms used to find the site in visits referred by search engines is another source of information for comparing user needs to site content, and these results should be considered in proportion to the amount of traffic that search engines deliver to a site. Monitoring trends in search engine referral terms can provide insight into whether search indexing is matching queries to content well enough to meet user expectations, but the primary reason to track this information is to evaluate and improve upon search engine optimization results (Seda, 2004; WebTrends, 2005b).

The single most valuable heuristic espoused by Jakob Nielsen but missing from Rubinoff's sample analysis is validating the match between the site and the real world. Specifically, Nielsen recommends that the system

> ...should speak the users' language, with words, phrases and concepts familiar to the user… Follow real-word conventions, making information appear in a natural and logical order.

Closely related to the question of whether site content aligns with user needs is the slightly different question of whether the site vocabulary matches that of the site's users. If the content is right but the words are wrong, the site will have difficulty attracting its audience.

6.4. Validating Navigation Labelling

A real-world example shows the results of using a more common word in labelling navigation versus a more site-centric word. In the original design of a regional professional theatre's web site, the site section for content related to actors, playwrights, staff and board was labelled "Artists." In a redesign of the site's information architecture, the original content and structure in the "Artists" site section were unchanged, but the section and its top-level page were relabelled "People." Figure 1 shows the immediate impact of this change to visits to that page.

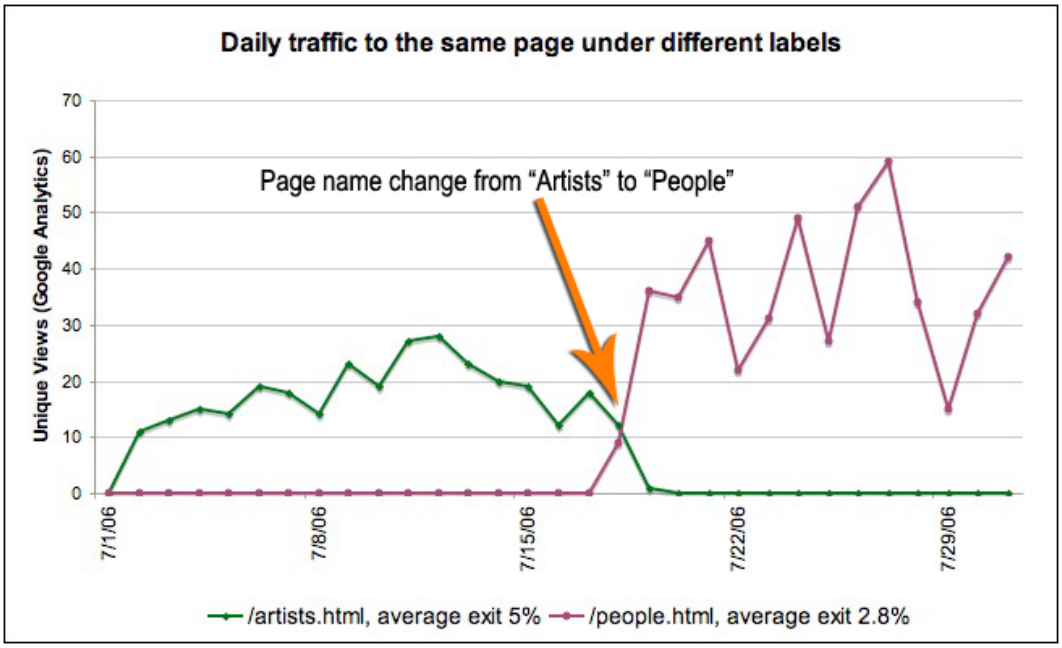

Figure 1: When a page was relabelled from "Artists" to "People" with no other changes, visits to the page immediately increased by nearly 90% on average. A heteroscedastic T-test of visit numbers over two weeks on either side of the name change event gives a p value of 0.0002; the difference in the average number of visits to the page after the change is strongly significant.

By comparing the user's words to the web site's text and mining data from search engine visit referral terms and onsite search queries, web analytics can identify problems with language and terminology. If the site has multiple audiences with significantly different vocabularies, such as investors, doctors and patients, comparing search terms and site text for the pages designed for these specific audience segments offers more targeted evaluation of whether the site's labels and content meet user expectations.

The same search term analysis can also provide insight into what users expected to find on the site but did not, identifying business opportunities or gaps in search indexing (Rosenfeld & Morville, 2002). For this reason, null results deserve a more thorough analysis than is typically afforded, but at minimum, the frequency of null search results should be monitored for anomalies, in keeping with general error handling analysis.

7. CONCLUSION

Web analytic user data can best serve as verification for information architecture heuristics when the analyst and information architect are evaluating the same qualities of a web site, even when the available methods may reflect only a few facets of a complex heuristic concept or user experience audit statement. Web analytic data comes with several disclaimers, primarily that the data is never complete or wholly accurate, and cannot be, due to limitations of technology.

These measurement challenges become increasingly important with the growing need to prove ROI for investments in online presence; in response to demand, improvements in technology, tracking and analysis are regularly introduced to the market (Chatham, 2004; Elliott & Scevak, 2004; Peterson, 2005c). While accuracy improves reliability, accuracy and reliability are significantly different qualities: uniformly inaccurate data often provides reliable intelligence. Despite the challenges to the accuracy of web traffic measurement, reliable metrics can still inform decision-making and provide solid insights to improving the design of the user experience.

An information architect's heuristic evaluation of the user experience is often subjective and gains value with a fact-based understanding of the actual user experience. User testing and web analytic data are currently the only ways to verify the heuristic assumptions upon which a web site is redesigned. Access to web analytic data during the earliest phases of a web site redesign process informs the site's architecture from the very beginning, ideally allowing for a shorter engagement and resulting in a design that significantly improves the site's usability for its primary audiences' needs. In the larger picture, including measurement in site design helps prove the ROI of intangible investments in web presence.

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