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Google Analytics for Digital Library Evaluation

Abstract

This master dissertation use the evaluative purposes and e-metrics found in the literature review to examine the appropriateness of applying the web analysis tool, Google Analytics (GA), for the evaluation of digital libraries. The final aim of the study is to provide a useful guideline based on its insightful discussion over the possibilities and limitations of GA for digital libraries.

The dissertation is structured into five chapters. First chapter introduces the research background, research questions, research motivation, possible limitations and methodologies.

Chapter two is the review of the literature as well as the seven case studies. The purposes and metrics found through those reviews are presented as a table in the end of chapter two.

Chapter three presents the introduction of GA. The introduced aspects include the technology of GA, its metrics definitions, its report interface and a discussion over its business-oriented nature.

Chapter four analyzes the possibilities and discusses the limitations of applying Google Analytics to a digital library environment. Such analysis is carried out by using the eleven evaluative purposes grouped in three evaluative themes.

In chapter five, using the comprehensive literature review as well as the analysis on Google Analytics as a digital library evaluative tool, the paper has concluded that the analytics tool has more possibilities than limitations to offer.

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1. Introduction

1.1 Research Background

By the official definition of Web Analytics Association (WAA, 2011), web analytics is the measurement, collection, analysis and reporting of internet data for purposes of understanding and optimizing web usage. Web analytics, or web analysis, may seem far-fetched to digital libraries in terms of terminology, but in truth the industry has been conducting activities with similar, if not exactly the same evaluative purposes under different names with different vocabularies.

Libraries have been gathering offline statistics such as the number of visitors, circulation data, average age of books in the collection, quantity of volumes and the number of reference questions answered long before the creation of computers and internet (White & Kamel, 2006). Since the birth of digital libraries have brought a new need for data, transaction log records and users' online activities information were brought into focus. And ever since then, a mixture of initiatives, projects or even a creation of a specific analyzing method have been developed by the various digital library communities. Efforts have been put into standardizing the library e-metrics measurements and researching the potential use of such data. Besides library science, information scientists, computer scientist, funded research granters, human-computer interaction (HCI) scientists and especially business people are all equally interested in the subject (Franklin, Kryillidou & Plum, 2008).

Among those, the world of e-commerce has pick up its speed for the application of web analysis to generate more revenue and to learn more about its customer needs. More importantly, through years of application and testing, a model of how to apply such technique to create the maximum benefits for the commercial industry has been strongly formed and improved continuously.

With regret, such evolution has not been made for digital libraries. As Khoo, Buchanan & Cunningham (2009) reported, due to issues such as personnel and financial constraints, technical barriers or lack of necessary expertise to develop a robust instruction, web analysis in libraries is often limited with the goals to just 'proof of concept' test instead of prescribing user motivations, or other high-effort evaluation purposes.

1.2 Motivations and Research Problem

The introduction of a free web analysis tool, Google Analytics (GA), has revolutionized the online marketing and assessment industry. Prior to the use of GA, web analysis was the responsibilities for IT departments. At this time, most of the company resources were devoted into making the raw data readable, or paying a high annual fee to the web analysis provider. With the release of GA, marketing and business stakeholders are starting to manipulate the statistics and twist the data to draw insights themselves. In addition, most of the resources have been reallocated to dedicated business intelligence analysts.

Looking from the past, transaction log analysis indeed has its vital importance for digital libraries. The online usage of data has been proven useful to help digital libraries in demonstrating success, justifying expenditures, understanding user behaviors and assisting strategic planning. With the possible usage of a free tool that comes with ready-made tables and charts for the same purpose, many digital libraries were also eager to try GA for their digital library websites.

However, the application of GA in a digital library environment is still in its infancy. Without a robust debate on whether GA is indeed suitable for the industry, digital libraries are lacking an actionable guidelines on utilizing such tool. For this reason, it is the finding of this report that the investigation of possibilities and limitations of GA for digital library evaluation is essential in helping library communities to leverage the value of web analysis and maximize the potential of GA.

1.3 Research Questions and Methodologies

To examine the appropriateness of adapting GA as an evaluative tool for digital libraries evaluations in the real world, the following research questions would need to be answered,

- What is the purpose of conducting web analysis evaluations in digital libraries?
- What are the e-metrics used to conduct such evaluations in digital libraries?
- What are the advantages and disadvantages of using GA for digital library evaluation?

To make the examination realistic and constructive, the research will be first carried out through a comprehensive literature review on past research and cases of web analysis found in digital libraries. Using the most commonly seen evaluative purposes and metrics in the literature review,

the report will present a theoretical discussion on the abilities and restrictions for using GA as an evaluative tool within the digital library context.

1.4 Potential Limitations of the Research

The study on appropriateness of GA in this dissertation is based on the author's understanding of the tool and an internship experience in Poznan Supercomputing and Networking Center (PSNC). Since it is a conceptual discussion and the author's actual experience is also limited to one specific digital library system, there is a high likelihood that the scenario and solution provided is not applicable to all situations. For the purpose of this dissertation, it is also not the intention of the author to be comprehensive on the subject matter.

In addition, the possibilities and limitation mentioned in this paper are based on the current version of GA. With the advance of technology, as well as the possible adjustment of GA functions in the future, one should always reconfirm with current best practice before applying findings.

1.5 Structure of the Dissertation

This dissertation is structured into five chapters.

- Chapter one briefly presents the research background, motivations, statement of research problem, research questions, research methodologies, limitations and structure of the paper.
- Chapter two is a comprehensive review of the available literatures and case studies related to digital library evaluations. The focal point is mostly connected to the evaluation conducted using web analysis.
- For building the necessary background for analysis, chapter three is the introduction of the evaluative tool in discussion – Google Analytics.
- This chapter is devoted to the examination of the abilities and limitations of GA for digital libraries, using eleven evaluative purposes grouped in three evaluative themes.
- Last but not the least, chapter five summaries the research findings and suggests some of the possible direction for the digital libraries in the future.

2. Literature Review

2.1 Digital Library Evaluation

According to Khoo and Giersch (2009), digital libraries are composed of a wide range of social, technological, organizational and other phenomena, embedded in a variety of external social, political, economic and organizational contexts. They can be modeled as sociotechnical systems, comprised of many components linked in complex and mutually constitutive ways (Bishop et al., 2003). For the nature of its complexity, Marchionini (2000) even stated that evaluating digital libraries is a bit like judging how successful is a marriage.

Based on reviews of literature, most researchers interested in the evaluation of digital libraries usually narrow down the scale of studies by focusing on one or two specific themes, as holistic approach is often too difficult and too overwhelming. For example, Marchionini (2000) concentrated on studying the impact of digital libraries, while others studied IR system performance or HCI (Saracevic & Covi, 2000) (Chowdhury & Chowdhury, 2003), outcomes assessment (Tsakonas & Papatheodorou, 2009), quality of services (Kyrillidou et al., 2009) or usability and users' information-seeking behaviors (Xie, 2008) (Nicholas, 2009) (Jeng, 2009), etc.

Generally speaking, aspects of digital libraries evaluations could include the matter of internal processes, levels and quality of service, library impact on institutional goals, quality of collection, organization of resources, metadata, cost-benefit analysis, cost-effectiveness analysis, performance evaluation, interactivity, functionality, accessibility and usability (Wright & White, 2007)(Jeng, 2009).

2.1.1 Purposes of Digital Library Evaluation

Stated by Saracevic (2009), evaluation can be done for the sake of gathering and learning the knowledge, insight, performance or value of digital libraries. But more pragmatically as he pointed out, evaluation could and should also be done to gather a rational and factual base for improving digital libraries, in terms of becoming better, more effective, more efficient, easier to use. Similarly, Garoufallou et al. (2009) also mentioned the necessity of digital library evaluations by stated that the need for evaluation is an inherent characteristics of human beings as they are engaged in a

continuous effort to make things around them better.

Another rationale for conducted evaluation was posted by Reeves et al. (2005). They believe the only defensible rationale for evaluation is to inform decision making as anyone involved with digital libraries must make decisions on a regular basis. And evaluation should be conducted to provide decision makers with the timely, accurate information they need to make the decisions. Though better information does not guarantee the best decisions will be made, they pointed out evaluation is still crucial in providing decision makers with information needed to make the best possible decisions. This importance of supporting decision making was also mentioned by Wright and White (2007) in the ARL Spec Kits. They argued that in order to make decisions and to improve customer service, library staff need to assess operations by collecting, interpreting and using data.

More specific and defined purposes for digital library evaluation were articulated by Covey (2002) in details in an article structured according to different types of assessment techniques (surveys, focus groups, user protocols, and transaction log analysis). Under each technique, Covey discussed the definition, application, strengths, weaknesses, purposes and functions in library evaluation for each method.

Following are the purposes listed in the literature (Covey, 2002),

Assessment Technique	Purposes
Surveys	<ul style="list-style-type: none"> • to assess patterns, frequency, ease, and success of use • to assess user needs, expectations, perspectives, priorities, and preferences for library collections, services, and systems • to assess user satisfaction with vendor products, library collections, services, staff, and Web sites • to assess service quality • to assess shifts in user attitude and opinion • to assess relevance of collections or services to the curriculum
Focus Groups	<ul style="list-style-type: none"> • to clarify or explain factors influencing survey responses, for example, to discover reasons for undergraduate students' declining satisfaction with the library • to determine questions to ask in survey questionnaires, tasks to be performed in protocols, and the vocabulary to use in these instruments • to identify user problems and preferences related to collection format and system design and functionality • to confirm hypotheses that user expectations and perceived needs for a

	<p>library Web site differ across discipline and user status</p> <ul style="list-style-type: none"> • to confirm user needs for more and better library instruction • to confirm that faculty are concerned that students cannot judge the quality of resources available on the Web and do not appreciate the role of librarians in selecting quality materials • to target areas for fundraising • to identify ways to address concerns in grant-funded projects
User Protocols	<ul style="list-style-type: none"> • to identify problems in the design, functionality, navigation, and vocabulary of the library website or user interfaces to different products or digital collections • to assess whether efforts to improve service quality were successful • to determine what information to include in a FAQ database and the design of access points for the database
Transaction Log Analysis (<u>Local Server</u>)	<ul style="list-style-type: none"> • to identify user communities & patterns of use • to project future needs for services and collections • to assess user satisfaction • to inform digital collection development decisions • to inform the redesign and development of the library Web site • to assess whether redesign of the library Web site or digital collection has had any impact on use • to assess whether providing additional content on the library website site or digital collection has any impact on use • to target marketing or instruction efforts • to assess whether marketing or instruction has any impact on use • to drive examinations of Web page maintenance requirements • to inform capacity planning and decisions about platform • to plan system maintenance • to allocate human and financial resources
Transaction Log Analysis (<u>Vendor-Supplied</u>)	<ul style="list-style-type: none"> • to help secure funding for additional e-resources from university administrators • to inform decisions about what subscriptions or licenses to renew or cancel • to inform decisions about which interface(s) to keep • to determine how many ports or simultaneous users to license • to assess whether instruction has any impact on use of an e-resource • to determine cost per-use of licensed e-resources

2.1.2 Methods of Digital Library Evaluation

Reviews from the digital library evaluation literature pointed out various kinds of evaluation methods and instruments for collecting evaluative information. For example the use of surveys, structured interviews, focus groups, questionnaires, experiments, exploratory observations, transaction log analysis, case studies, economic analysis or even HCI studies, and the employment of think-aloud protocol, user diaries and other instruments (Saracevic, 2004).

While conventional classification separates quantitative and qualitative evaluations, worth mentioning is that the distinction between definitions of “quantitative” and “qualitative” lie within the data generated in the evaluation process, rather than judging from the adopted methodologies used. Garbarino and Holland (2009) clarified the terminology by stating that quantitative data often are presented in the form of numbers while qualitative tends to produce data that are presented in prose of textual forms.

By the definition from the same authors, Garbarino and Holland (2009), the former could be aggregated and analyzed to describe and predict relationship whereas the latter could help to probe and explain those relationships and to explain contextual differences in the quality of those relationships.

In practice, triangulation across data sets, which in general involves relating findings from more than one approach, is often used in evaluations for developing a richer and more holistic understanding on not only the phenomena but also the explanations (Mackay and Fayard, 1997) (Blandford & Bainbridge, 2009).

Quantitative and qualitative data are therefore intertwined in a co-dependent sense. A clear cut of quantitative outcome measure is flawed by the failure to establish the importance or relevance of the outcome indicator (Reeves, Apedoe & Woo, 2005). On the other hand, a qualitative analysis sometimes needs quantitative testing with larger sample group later in order to examine the variables it first identified (Monopoli, 2009).

Studies conducted in 2007 by Wright and White surveyed seventy three of the one hundred twenty three ARL member libraries and found out that the top five assessment methodologies in used are: (1) statistics gathering – at least for the purpose of collecting ARL statistics, (2) a suggestion box, (3) web usability testing, (4) user interface usability and (5) surveys.

Among these, user surveys are used by over half of the responding libraries when starting an evaluation (Wright & White, 2007). The phenomenon may possibly be explained by the point made by WITLATCH in 2001. WITLATCH reported surveying as the most frequent way of assessing traditional reference services and as the most efficient method of assessing a large group of representative users. Moreover, he pointed out that surveys appear easy to design, especially for the first-time

inexperienced researcher (Witlatch, 2001).

Despite its popularity, all data collecting methodologies have its strong sides and pitfalls. While surveys and questionnaires enable collection of individuals' thoughts, beliefs, attitudes, and opinions, with some objective data like education, gender, and even income. They may end up obtaining meaningless information due to poorly designed questions or lack of deep information from standardized responses. Other risks include the possible low response rates and the probability of those who do not complete the survey may greatly differ from those who do (Whitlatch, 2001).

Other researchers such as Nicholas (2009) have argued and raised doubts on the validity of self-report data because the participants may not remember or may not want to say what they really do in cyberspace. Similarly, Alexander(2008) pointed out that people have poor recall of what they did even a few days ago and the occurrence is especially high and true of what user did in cyberspace when they seem to leave the memory behind them.

2.2 Digital Library Statistics

Besides user surveys, one of the common methodologies of collecting evaluative data is through statistics gathering (Wright & White, 2007). In regard of the scope of digital library usage data collection, Franklin, Kyrillidou and Plum (2008) categorized the process into (1) census counts and (2) sample counts.

Looking of these two categories together with other dimensions, they believed the approach of how librarians evaluate digital resources can be concluded as below,

- Census counts:
 - External generated, vendor usage data
 - Locally or internally generated usage data
- Sample counts:
 - Externally generated, web survey data
 - Internally generated, web survey, usage data

Traditional library statistics such as number of visitor to the physical library or number of collection being borrowed are used most often as indicators or measurements for library performances. However, statistics derived and collected specifically within the digital framework seems to offer yet more potential for statistical analysis. According to White and Kamal (2006), census count from

online usage log files presents an infinite variety of dimensions that easily surpass the accuracy and value of any prior attempt at quantifying operations.

In the subsequent paragraphs, the author will focus the examination on those under the category of census counts as they provide a more associable and more comparable characteristics with the commonly defined web analysis.

And to provide a comprehensive picture of such methodology, general concepts, brief history and fundamental characteristics of web metrics analytics will be first illustrated within the digital library framework. Afterward, the author will review some of the past works and cases on both vendor-supplied usage data and locally developed usage data by the library communities as well as looking at individual case with specific scenario.

2.2.1 Methods of Collecting Online Usage Data

There are few different ways of capturing usage log metric data to enable further analysis. According to NSDL (2006), web-metrics tools differ widely in cost, functionality, and ease of operation; they can be free or proprietary, implemented on project servers or operated remotely from third party servers, and can require varying levels of expertise and server access for their operation.

As far as methodologies of collecting web metrics data are considered, Kaushik (2007) has pointed out four mechanisms: (1) locally-stored web logs, (2) separately-stored web beacons, (3) externally-stored JavaScript tags and (4) externally-stored packet sniffing. Among them the two most talked about in the reviewed literature are the (1) web logs and the (3) JavaScript tags.

Historically speaking, the analysis of locally-stored web logs or sometimes called the server-side log files are most known to libraries and librarians as the Transaction Log Analysis, also called TLA.

Earlier literature reveal some tedious efforts of extracting robust information from the raw data stored within the library server. But soon libraries started discovering better solutions through the use of free or proprietary software such as Webalizer, AWStats and WebTrends (Mento & Rapple, 2003) (Khoo & Donahue, 2007) (NSDL, 2009). In recent years, as more and more tools and web analytics designs such as Google Analytics and Omniture are using JavaScript tags, many users have started resolving their website evaluative problems by having both web logs and JavaScript tags approaches (Kaushik, 2007).

2.2.2 Web Analysis in Digital Libraries

Defined by (Peters et al., 1993), transaction log analysis is the study of electronically recorded interactions between online information retrieval systems and the persons who search for the information found in those system.

The method was developed and used since 1960 for different purposes but regarding its application in the field of library science, TLA was first introduced for analyzing performance of an online public access catalog (OPAC) (Peters, 1993). But as library shift its attention to digital interface, TLA stated to become increasingly used for understanding usage data not only on online information systems but also for library websites with the intention of improving design and functionality to meet users' needs and expectations (Reeves, Apedoe & Woo, 2005).

TLA works in a way that whenever a user's browser requests a file of element from the web server of the website, the web server accepts the request and creates an entry and record of this request in the web log, which is stored within the internal server of the website or in the external third-party server (White & Kamal, 2006) (Kaushik, 2007) (COI, 2010). This is done usually through transaction monitoring software that is built into a digital library system or based on a web server that automatically tracks specific interactions (Reeves, Apedoe & Woo, 2005). Web logs are normally taken from the server on a set schedule and a standard log-parsing tool can be pointed in their direction to analyze the web logs and produce standard reports (Kaushik, 2007).

Since its invention to date, log files have evolved from its original purpose of capturing errors generated by web servers to include more information about how visiting users interact with the websites and online systems (Kaushik, 2007). Typically, web log files record seven basic elements, including the requesting IP address (unique internet Protocol number attached to each internet computer), authentication information, a time stamp, the transfer success status, and the transfer volume. Using web log analysis software enables libraries to analyze the use of a website in various ways such as a virtual visit (session to the website), page access (web page accessed by the user), and content unit (document, image, or other form of unit) (ISO, 2006).

In addition, the presentation of the basic raw metrics data (Figure 1.1) has also endeavored to become more organized and understandable, such as using automatic log-parsing (Figure 1.2) and adding graphical improvement (Figure 1.3).

```

j-henderso.uncg.edu - - [01/Feb/1997:14:29:13 -05001 "GET
/Local/mazur/burgh/pghRule.gif HTTP/1.0" 200 359

pit-08.ix.netcom.com - - [01/Feb/1997:14:29:16 -05001 "GET
/Local/mazur/burgh/cyber.html HTTP/1.0" 200 6044

```

Figure 1.1 example of basic transaction logs file (Mazur, 1997)

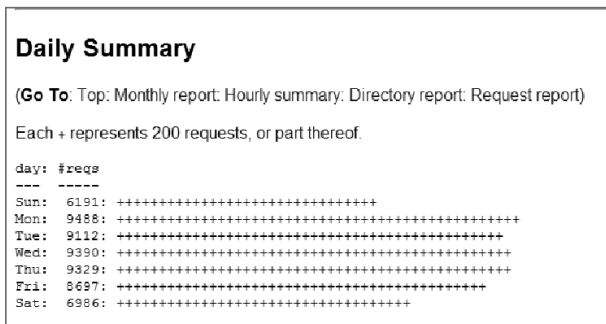


Figure 1.2 Sample Report from Analog, version 0.9 beta (Kaushik, 2007)

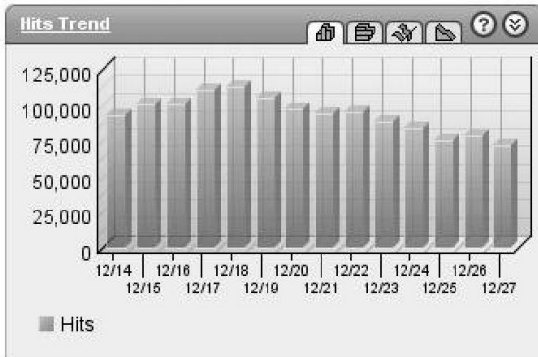


Figure 1.3 Sample Report from WebTrends (Kaushik, 2007)

2.2.3 Characteristics of Transaction Log Analysis

Having several potential advantages and disadvantages, transaction log analysis and particularly the mechanism of locally-stored data collection process has led to researchers adopting contradictory views about the methodology (Jamali, 2005). According to Covey (2002), TLA has the advantage of being an unobtrusive way to study user behavior, to test hypotheses and an efficient

way to detect discrepancies between what users say they do, for example in a focus group study, and what they actually do when they use an online system or website.

In the following section, the author listed seven characteristics of TLA articulated in other literatures with no particular meaning in the ordering,

- Automatically collected with unfiltered census details.

Defined by Trochim (2001), sampling is to determine the actual units you select to participate in the study and in reality, the size of sampling in reality is usually a tradeoff between small cheaper sample and generalizability.

As Log data are unfiltered and automatically collected (Nicholas et al., 2001), there is no need to take a sample, and thus questions concerning the representativeness or validity of the findings never arise as nothing matches logs for the size of the population studied (Nicholas, 2009).

Considered a non-intrusive way to collect direct and immediately available record of what people have done, web logs do not rely on human memory but also rely on the users to provide 'honest' data (Nicholas 2009). As data are collected routinely, automatically and quite anonymously with no problems of low response rates or resource restraints (Nicholas and Huntington, 2003)(Nicholas 2009), web logs have become a suitable tool for longitudinal study and digital library assessment (Marchionini, 2000)(Xie & Wolfram, 2008).

However, it is due to the same nature that extracting data from TLA can be time-consuming as transaction logs can quickly grow to an enormous size (Covey, 2002). For instance, internal traffic sometimes make up large portion of traffic when in fact it is one of the potential unwanted counts. One may need filtering or at least account for such data before using the data (Burby & Sterne, 2007) (COI, 2010).

Kaushik (2007) also talked about 'lots of data and metrics but not the most important one' and suggested applying the right filters to remove image requests, page errors, robot traffic, requests for CCS (Cascading Style Sheets) files to better accurate traffic trends and behaviors.

- Non-user activities inflate the counts of traffic.

Log files contain a great deal of non-human traffic such as search engine spiders, crawlers and robots which frequently crawl sites and leave non-user entries in web logs that would be counted in the metrics reporting (Kaushik, 2007)(COI, 2010). As stated above, if the data is considered as noises then it needs to be filtered and removed before further analyzing.

However, some studies pointed out that it is also because this nature of monitoring on non-human traffic, locally-stored basic web logs is the only data capture mechanism that will record and store the visits and behavior of search engine robots (Kaushik, 2007). In this light, Kaushik also claimed that TLA is somehow an ideal approach to measure the success of website's search engine optimization efforts.

- Caching reduces the counts of traffic.

Caching is the storing of previously viewed pages on the client's computer for speed of retrieval; repeat in-session accesses to these pages are made from the cache and are not requested from the website's server and hence not creating entries in the logs, especially that of tables of contents and other frequently consulted pages (Kaushik, 2007) (Nicholas, 2009). On the other hand, dynamically generated web pages such as page via CGI script are not cached.

There are several levels of caching: browser cache, local cache and large regional caching. Local cache like proxy servers, firewalls with network address translation, VPNs (Virtual Private Network) and large regional caching provided by ISP (Internet Service Providers) or mirror sites are all possible in biasing the logs when multi-user activities are seen from one IP. Therefore, only be counted as one unique user, when in fact there were many (COI, 2010)(Franklin, Kyrillidou & Plum, 2009). Kaushik (2007) reported that 10 percent or more of the usage traffic is actually invisible due to page cached by ISPs and proxy servers.

- Uncertain about user identification.

According to COI (2010), generally user identification are recognized through the use of IP address or cookies. Overall speaking, each unique and valid identifier would be calculate as one unique user or unique visitor. In the case of using cookies for detection, unique visitor should be better framed as the "unique browser" as different browsers or different user log-in within the same computer store cookies separately. Therefore, by the definition of WAA (2008), unique visitors count is the number of inferred individual people (filtered for spiders and robots), within a designated reporting timeframe, with activity consisting of one or more visits to a site and each individual is counted only once in the unique visitor measure for the reporting period.

As cookies set up requires further expertise, most literature reviewed show that digital library web analytics evaluation was mostly just using the IP addresses to identify unique users. However, as users nowadays may be assigned with dynamic IP addresses by ISPs during a session (Sen, Dacin & Pattichis, 2006) or connected to internet via a proxy server(Kaushik, 2007), this would be problematic as the former creates different IP numbers within a session, when actually it was the

same user, and the latter results in a number of computers appearing together under one single IP (Nicholas, 2009).

Alternatively, Kaushik (2007) reported that some vendors are using IP address plus user agent ID (other identification such as the user operating system and browser) to distinguish better. But as the option was yet not quite optimal, cookies should be set up to help identifying visitors with a higher degree of accuracy .

- Lacking exit time stamp.

Defined by WAA (2008), to calculate the time a user spent on the website, typically the timestamp of the last activity in the session is used to minus the timestamp of the first activity of the session.

But the accurate calculation becomes challenging and difficult as in fact users don't log off on the web but rather depart anonymously (Nicholas, 2009). Whether the user exits through closing the browser window, click on an external link or simply type in another URL, no estimate can be generated for the last page viewed in a session as the logoff motion would not leave mark to be track by the server (Kaushik's Blog, 2008) (Nicholas, 2009). In addition, the calculation complicates further when browser tabs become increasingly common and popular. In which case, users are opening several different web pages of one single website simultaneously in the same browser using many browser tabs (Viernitz, Stolz & Skubacz, 2006).

Most studies indicate the suitable inactivity interval of 30 minutes to be the standard for the assumption of user log-off and session ending stamp. This means when the users are no longer interacting with the website for more than 30 minutes, the system would automatically log-off users or started a new session calculation. But some experts argued the possibility of and adjustments of varying the standards for the number of minutes, according to the types of pages and the number of words contains within the page being viewed (Nicholas, 2009) (Khoo et al., 2008).

- Needs of triangulation with other methods.

Log analysis, as it is clear from its name, just records the interaction between an information system and a user whose identify usually is not clear (Jamali et al. 2005). It indeed provides a level of detail not obtainable by other method as it records the users' viewing, searching, browsing and navigating over the period studied (Nicholas, 2009).

However, unlike interviews, observations and focus groups which capture users' perceptions, opinions, attitudes and feelings for experience analysis, log files is meant to only helps in behavior

analysis (Kaushik, 2007) (Monopoli, 2009).

The importance of data interpretation was the ability to consider different aspects holistically because log files can only help as best as it does to infer the intent of the users (Burby & Atchison, 2007) (Kaushik, 2007). For instance, the number of sessions on a website does not necessarily represent number of users, and decrease in number of searches conducted may actually be reflecting increased efficiency and higher user satisfaction rather than less use and lower value of the website (NISO, 2001).

Kurth (1993) reported the inability to find user satisfaction for the interacting systems through looking at log files; Magarity (1998) found logs lack of the explanation for reasons behind requests, motivation of why user use and react the way they are or any other qualitative aspects of use. Projects of Library of Congress (LoC) and National Science Digital Library (NSDL) also show the needs of reading log data with triangulate with other methods (Khoo et al., 2008), and as Reeves, Apedoe and Woo (2005) concluded, transaction log analysis alone usually and simply requires too much inference.

On the other hand, log files evidence indeed provides important information which could be explained with additional data obtained from other methods. (Jamali et al., 2005) reported that when combining with other studies, log analysis is an effective way to raise evidence-led questions to be asked in questionnaire surveys or interview studies. Studies from the previous researches and projects also demonstrate the usage and value of web log data when read in conjunctions with information derived from other methodologies (NSDL, 2010).

In sum, as pointed out by NSDL (2010), though metrics provide useful data, reporting values is not enough for assessing impacts. The evaluation strategies and methods must be employed beyond those that focus on individuals; namely, data from metrics must be triangulated with interviews, focus groups, ethnography and other approaches in order to reach a rich program evaluation.

■ Double counting may cause skewed data

Finally, one of the other concerns were pointed out by Nicholas (2009). When a user wants to see the PDF full-text version from a gateway or third-party site that only indexes the HTML version, the user has to come out of the HTML full-text version and load up the PDF. And this would tend to be counted as two views by most of the proprietary software, which for most librarians would consider as one user request in reality. One of the solutions was to use the mechanism of allowing only one count when such events happen within a few seconds of each other (Nicholas, 2009).

All in all, different mechanisms inherit different traits. Though locally-stored web server logs

analysis comes with concerns, still has its incomparable values. It is a feasible method to study visits of search engine robots and to ensure the original log file data would not be captured, processed and stored unless permitted (Kaushik, 2007).

As mentioned above, there is another widely talked about method to collect usage log metrics data, besides web server logs analysis. It is the method of using embedded JavaScript code in HTML source code. This method would be introduced later in Chapter three with the introduction of Google Analytics.

2.3 Review of Researches and Cases

Reviews on the literature have found several national and local libraries using various way to generate more insights from the enormous usage log data. In addition, some of the major national and international library organizations, standards bodies, and digital publishers have also addressed the recognized needs for new measurement standards by developing and funding a number of e-metrics projects (White & Kamal, 2006).

Out of all the past works and cases, this dissertation will look at some of the representative projects and exemplified cases, including (1) ICOLC Guidelines, (2) ISO Standards and EQUINOX Project, (3) ARL E-Metrics Project, (4) NIZO Z39.7, (5) COUNTER for standards originated from library community, and (6) CIBER Deep Log Analysis as well as (7) NSDL Digital Libraries as individual case reviews.

The intention of these reviews are aiming to result in a sets of (1) web related evaluative metrics and (2) evaluative purposes for analytics practices from the digital library perspective. And as the main function of the following cases is to exhibit the past efforts endeavored by the digital library community, the author will not separate the discussion by its data collection method of whether it is collected using the locally-stored web server logs or third-party server stored JavaScript tags.

so to apply the same metrics and purposes on the later examination of Google Analytics in the chapter three.

And as the main function of the following 7 cases is to exhibit past efforts endeavored by the library community bodies and individual library, methodologies of how each case collect its web metrics are not in particular concerns and hence would be seen and discuss under the general definition of web analytics, regardless the data collecting process being using the locally-stored web server logs or third-party server stored JavaScript tags.

2.3.1 ICOLC Guidelines

In the mid- and late 1990s, libraries and online content publishing industry attempted to measure the use of periodical indexing, abstracting and full content utilities and this had resulted in a series of initiatives emerged in parallel in 1998 (Davis, 2004).

White and Kamal (2006) claimed that perhaps most influential set of results from those earliest e-metrics projects was the document of ‘*Guidelines for Statistical Measures of Usage of Web-Based Indexed, Abstracted, and Full Text Resources*’ generated from the ICOLC (International Coalition of Library Consortia) representatives. At the time of its reporting (1998), the coalition comprised over 90 library consortia in North America, Europe, Australia, Israel, China, and South Africa.

Based on the *JSTOR Web Statistics Task Force*, the Guidelines had expanded to reflect the diversity of resources licensed by its members. First version of the document in 1998 was designed to achieve several goals listed as below (ICOLC Press Release, 1998),

- to provide an international perspective on preferred practices in the licensing and purchasing of electronic information
- to describe the types of use data and measurement that the ICOLC members expect from vendors of web-based indexed, abstracted and full-text resources
- to ensure the value of licensed electronic resources is fully understood in the consortium setting
- to enable consortia and vendors to analyze use and frequency of use without violating the individual’s privacy

In the ICOLC Guidelines, the following online usage metrics were documented as use element that must be provided to measure a digital library (ICOLC, 1998)(White & Kamal, 2006),

ICOIC Guidelines Metrics	Explanations
■ Number of Queries /Searches	Categorized as appropriate for the vendor’s information. A search is intended to represent a unique intellectual inquiry. Typically a search is recorded each time a search form is sent/submitted to the server.
■ Number of Menu Selections	Categorized as appropriate to the vendor’s system. If display of data is accomplished by browsing (use of menus), this measure must be provided (e.g. an electronic journal site provides alphabetic and subject-based menu options in

	addition to a search form. The number of searches and the number of alphabetic and subject menu selections should be tracked.)
■ Number of Sessions (Logins)	If relevant, must be provided as a measure of simultaneous use. It is not a substitute for either query or menu selection counts.
■ Number of Turnaways	If relevant, as a contract limit (e.g. requests exceed simultaneous user limit).
■ Number of Items Examined	Viewed, marked or selected, downloaded, emailed, printed to the extent these can be recorded and controlled by the server rather than the browser. Items include, <ol style="list-style-type: none"> 1. Citations displayed (for A&I databases) 2. Full text displayed broken down by (a) table of contents displayed, (b) abstracts displayed, (c) articles or essays, poems, chapters, etc. viewed (ASCII/HTML) or downloaded (PDF/Email)

Later in 2001, ICOIC revised the original version of the Guidelines with improvements of simplifying the data elements to be reported, strengthening administrative aspects of confidentiality, access, delivery, and report format (Shearer, 2002).

2.3.2 ISO Standards and EQUIONOX Project

In a 2002 report of *Background Series #3*, the Canadian Association of Research Libraries (CARL/ABRC) documented that the standards at the time around 2002 for the collection of aggregate statistics in academic libraries are outlined by the International Standards Organization (ISO 11620 and ISO 2789) in Europe and the National Information Standards Organization (ANSI/NISO Z39.7) in the United States (Shearer, 2002).

Among these standards, ISO 2789 – International Standard on Library Statistics, having its first released version dated back in 1974, has gone through 4 revisions and is currently most updated by its 2006 edition. The original work started from 1960s’ under the request of UNESCO. Experts from IFLA and ISO had come together for UNESCO to create a set of general guidelines for library statistics aggregation at an international level (Rnard, 2007).

For the purpose of keeping the standards valid at different levels through time, the 2006 revision categorized more than 100 definitions of data into 6 groups: libraries, collections, use and users,

access and facilities, expenditure, and library staff (Renard, 2007). In addition, there was an annex of “Measuring the use of electronic library services” besides the report (ISO, 2006). Apart from its clear classification of various forms of electronic library services and resources, the following measurement were identified and defined clearly to be relevant and should be collected when possible and appropriate (ISO, 2006) (White & Kamal, 2006),

ISO 2789 Metrics	Explanation
<p>■ Number of Sessions</p>	<p>A session is defined as a successful request of a database or the online catalogue. It is one cycle of user activities that typically starts when a user connects to a database or the online catalogue and ends by terminating activity that is either explicit (by leaving the database through log-out or exit) or implicit (timeout due to user inactivity).</p> <p>For services which are the aggregation of a number of individual databases, further information should be provided as to the separate databases hosted. For example,</p> <ol style="list-style-type: none"> 1. Online catalogue: Data are usually available from the library's system. Many online catalogues offer immediate order and/or availability check functions for chosen titles. The number of searches and records downloaded should be counted in addition to the number of sessions. 2. Electronic collection: Data are available either from the library's own servers or from vendors/suppliers. The delivery of statistical data should be included in license agreements. Use of free internet resources which have been catalogued by the library in its online catalogue or a database should be counted separately, if data are available. <p>In some cases, e.g. online catalogue use inside the library, several users might make use of the same workstation one after the other, and sessions could not be separated. In most systems, a session is cut off after a specified time of non-use, thus avoiding part of the problem. The average timeout setting would be 30 min. If another timeout period is used, this needs to be reported.</p>
<p>■ Number of Content Downloaded</p>	<p>A content downloaded is defined as a content unit being successfully requested from a database, electronic serial or digital document. Downloading content units from the library collection indicates that the users have found items that they consider relevant.</p>
<p>■ Number of Record Downloaded</p>	<p>A record downloaded is defined as a descriptive record being successfully requested from a database or the online catalogue.</p>

	<p>Downloading records from a database or the online catalogue indicates that the users have found bibliographical or other information that they consider relevant.</p>
<p>■ Number of Virtual Visits</p>	<p>A virtual visit is defined as a user's request on the website from outside the library premises, regardless of the number of pages or elements viewed.</p>
	<p>Virtual visits can be compared to traditional library visits.</p>
<p>■ Session Time</p>	<p>Session time is defined as the period of time between a log-in to and an implicit or explicit log-off from a databases or the online catalogue.</p>
	<p>The search time depends on many variables. E.g. ease of handling, users' experience and automatic lo-off settings. A long connect time, therefore, does not always reflect the users' interest in the service.</p>
	<p>This count gives additional information on the intensity of use of a certain service.</p>
<p>■ Number of Rejected Sessions (Turnaways)</p>	<p>A rejected session (turnaway) is defined as an unsuccessful request of a database or the online catalogue by exceeding the simultaneous user limit. Request failure because of wrong passwords is excluded, though it can't always be differentiated. This dataset shows how far the simultaneous user limit is sufficient for users' demand.</p>
<p>■ Number of Searches</p>	<p>A search is defined as a specific intellectual query. Typically, a search is recorded each time a search request is submitted to the server.</p>
	<p>Immediately repeated duplicated searches, double clicks, or other evidence indicating unintended user behavior needs to be excluded.</p>
	<p>Mistyped search strings do not represent unique intellectual inquiries. In practices, however, libraries will have difficulties to differentiate these unintended searches from intended, but unsuccessful searches.</p>
<p>■ Number of Internet Sessions</p>	<p>An internet session is defined as internet access by a user from a workstation owned by the library or from a user's private computer inside the library via the library's network.</p>
	<p>This dataset shows to what extent the library provides access to the internet for its users via its workstations or a network connection.</p>
	<p>The number of internet sessions can only be counted if users have registered or authenticated themselves when accessing the internet. If these data are not available, the number might be estimated by surveying users.</p>

The other ISO standard, ISO 11620 – Library Performance Indicator was released at 1998 and focuses its initial dimensions on (a) user satisfaction (b) public services and (c) technical services (Shearer, 2002). Some researcher argue that ISO 11620 is merely an extension of ISO 2789 (Renard, 2007), but both standards in evidently contributed greatly to the later relative projects which would try to integrate and expand the already existing standards.

For example, the two-year EQUINOX Project (1998-2000) had benefited from the ISO Standards. Supported by European Commission, the project aimed to further develop aforementioned international agreement on performance measures of ISO by including performance measures for the electronic library environment (Shearer, 2002).

In its 14 performance indicators, EQUINOX covered many aspects. Besides the part on library staffing and expenditures, there are four measuring metrics specifically extractable from the raw data of a log file (EQUINOX, 2000),

EQUINOX Project Metrics	Explanations
■ Number of sessions	on each electronic library service per member of the targeted population
■ Number of remote sessions	on electronic library services per member of the population to be served
■ Number of documents and entries (records) viewed	per session for each electronic library service
■ Rejected sessions	as a percentage of total attempted sessions

2.3.3 ARL E-Metrics Project

On the other hand in the United States, Martha pointed out in 2000 that the ARL (Association of Research Libraries) libraries had been collecting statistics related to budgets, collections, services, and personnel (Martha, 2000) but statistics regarding the use of electronic resources had been underdeveloped and underused.

Though this type of information is essential to libraries in financial support, infrastructure, comparisons and during vendor negotiation (Blixrud, 2010), lack of clear and consistent definition of data elements still resulted in vendors counting things in different manners. Moreover, the fact that libraries do not control access to and use of important data about vendor-supplied resources made it even more complicated to justify or evaluate the increasing total expenditures on electronic resources and services (Miller & Schmidt, 2001).

Realizing its importance, the Statistics and Measurement Committee of ARL created the ‘*E-Metrics Project: Developing Statistics and Performance Measures to Describe Electronic Information Service and Resources for ARL Libraries*’ in 2000 May as part of the ‘*New Measure Initiative*’ developed since the January of 1999. Contracted with the Information Use Management and Policy Institute in Florida State University (FSU), the E-Metrics Project lasted 18 months till December, 2001 (Shim et al., 2000).

Under its main goal of acting upon users’ opinions for service quality, the project was motivated to develop standard definitions for digital library measurements as such information could help libraries or digital libraries in describing the following (Blixrud & Kyrillidou, 2003) (Heath, 2010),

- the e-resources they make accessible
- the use made of the resources
- the level of library expenditures

The ARL E-metric Project eventually resulted in recommending five aspects of statistics and measures for libraries (Blixrud, 2010),

- Patron Accessible Electronic Resources
- Use of Networked Resources & Services
- Expenditures for Networked Resources & Related Infrastructure
- Library Digitization Activities
- Performance Measures

Under the second aspect of “Use of Networked Resources & Services”, the project advised libraries to collect the following online usage metrics for evaluation purposes,

ARL E-Metric Project’s Metrics	Explanations
<ul style="list-style-type: none"> ■ Number of electronic reference transactions 	An electronic reference transaction must include a question either received or responded to electronically (e.g. email, website or other network communications mechanisms designed to support electronic reference), such as Ask-A-Librarian, RefeXpress, DigiRef, QuestionPoint. Count the number of requests, not the number of questions.
<ul style="list-style-type: none"> ■ Number of logins (sessions) to electronic databases 	Number of user initiated sessions in licensed electronic resources.
<ul style="list-style-type: none"> ■ Number of queries (searches) in 	Number of user initiated queries/searches in licensed

electronic databases	electronic resources.
■ Items requested in electronic databases	Number of items requested in all of the library's licensed electronic resources, including viewing, downloading, emailing and printing to the extent the activity can be recorded and controlled by the server rather than browser.
■ Virtual visits to library's website and catalog	User visits to the library's website or catalog from outside the physical library premises regardless of the number of pages or elements viewed. All visits to the website should be counted regardless of repetition by one user. (determined by a user's IP address, which can be misleading due to ISPs and Firewalls or Proxy Servers; thus, this measure is actually an estimate of the visits).
	Procedures include, (a) identify all sources of virtual visits that take place on more than one web server which may be owned by the library or maintained by another department in the university, ISP or vendors. (b) exclude internal use within the premises of the library from the counts for this measure when possible. (c) develop strategies for collecting data from each of these sources using one or more log analysis software packages. (d) determine log analysis software definition that corresponds to the virtual visit definition. (e) where virtual visit counts include the aggregate of internal and external visits, indicate this in your report.

In sum, the new measuring metrics developed in the ARL E-metric Project are more extensive than those put forward by ICOLC, as it accompanied with collection methodologies and precise definitions for each dataset (Shearer, 2002). And after its three-phase work and the approval of its investigators' final reports in October 2001, the contributions of the ARL E-metrics project has been continually reviewed and revised based on further testing and suggestions.

Most importantly, the project's investigation on vendor statistics was continuously made into an effort and support to other initiatives. And in accordance to its documented objectives, multi-agency organizations aimed to develop an achievable and widely supported common code of practice for vendor-based online usage statistics such as COUNTER did gain the benefit from the ARL Project (ARL, 2002) (COUNTER, 2011).

2.3.4 NISO Z 39.7

Founded in 1939, NISO (National Information Standards Organization) is a nonprofit association accredited by the American National Standards Institute (ANSI). NISO seeks to continuously establish and maintain information industry standards that allow content publishers, libraries, and software developers to work together. The ANSI/NISO standards are being revised every 5 years (Shearer, 2002) (NISO, 2011).

One of its standards, '*ANSI/NISO Z39.7 – Information Services and Use: Metrics & Statistics for Libraries and Information Providers Data Dictionary*' started as early as 1968. The first edition of Z39.7 was created on the base of '*Library Statistics: A Handbook of Concepts, Definitions, and Terminology*' by American Library Association (ALA). The handbook was an attempt to clarify definitions, reduce duplication, and close gaps in library data collection (Devis, 2004).

In its 1995 revision, the committee acknowledged that "new data elements need to be created for measuring the new services now available in and through libraries because of developments in computer and telecommunications technology. For example, the gate count measure needs to be expanded to include offsite access to electronic resources. Measurement of interlibrary loan activity needs to be reviewed in light of developments in the area of electronic access and delivery information. But these new data elements must be developed based on experience over the next several years. That experience will result in a very different statistics standard in the next revision." (NISO, 1995).

Efforts for such activities were eventually established in 2001, when an invitational *NISO Forum on Performance Measures and Statistics for Libraries* took place in Washington, DC. Sixty-five participants from various library communities and key vendors were gathered together to discuss the best approach to evaluate the NISO standard on library statistics. The recommendations were taken into close account for the later 2002 and 2004 revisions (Devis, 2004).

The latest 2004 version inherits some of the characteristics of version 2002 such as the assimilation of ISO 2789, using the data dictionary format, and the attribution to its originating documents under each element (Welch, 2007). And it also shares the same aim that was first used in the 1983 revision:

- to assist librarians and researchers [now defined as the information community] by indicating and defining useful quantifiable information to measure the resources and performance of libraries and to provide a body of valid and comparable data on American libraries (NISO,

2004).

Four essential and core e-metrics datasets were identified, if possible, should be collected for all services. Figures can be reported under separation or summed up as a total (NISO, 2004),

NISO Z39.7 Metrics (a)	Explanations
■ Number of sessions	Definition borrowed from ISO 2789
■ Number of searches (queries)	Definition borrowed from ISO 2789
■ Number of units or descriptive records examined (including downloads)	Definition borrowed from ISO 2789
■ Total annual virtual visits to networked library resources	A visit occurs when an external user connects to a networked library resource from any length of time or purpose (regardless of the number of pages or elements viewed).

In addition, with its comprehensive approach on defining elements of libraries' Human Resources, Collections, Infrastructure, Finances and Services, the data dictionary also offers detailed definition and calculation methods on the following elements analogous to web analytics metrics,

NISO Z39.7 Metrics (b)	Explanations
■ Number of rejected sessions (turnaways)	Definition borrowed from ISO 2789
■ Number of menu selections	Definition borrowed from ICOLC Guidelines
■ Number of virtual reference transactions	Definition borrowed from ARL E-Metrics Project

One thing worth mentioning is that the scope of each dataset element should be considered flexibly according to the need of each individual library. To give one example, the metric of examining units or records could be broken down into details as shown below,

- **Units/Records Examined**
 - Commercial services descriptive records examined
 - Commercial services full-content units examined
 - Library collection descriptive records examined
 - Library collection full-content units examined
 - OPAC descriptive records examined

In general, there are already many discussions on digital statistics focusing on the vendor-supplied data report standards by the time around 2002. However, it was not until the formation of COUNTER, that a set of outcomes from a discussion was finally resulted in a wider extent of

acceptance and application within the library community.

2.3.5 COUNTER

Began in 2002, COUNTER(Counting Online Usage of Networked Electronic Resources) provides a set of international, extendible Codes of Practice that allow the usage of online information products and services to be measured in a credible, consistent and compatible way using vendor-generated data (COUNTER, 2008).

White and Kamal (2006) pointed out many of the recommendations and findings from the ARL e-metrics project have since become incorporated into Project COUNTER. The work of NISO Z39.7 has also been incorporated in many ways, such as providing many of the terms' definitions.

COUNTER is now endorsed by a number of significant publisher and information sciences organizations, including the JISC (Joint Information Systems Committee , UK), NCLIS (National Commission on Libraries and Information Science, USA), NISO and ARL. After its first release, the latest Release 3 of the COUNTER Code of Practice Journals and Databases was made obligatory to all COUNTER-compliant vendor since the end of August, 2009 (COUNTER, 2008). Starting from 2011, the COUNTER-compliant report has stretched from Journals and Databases to include also Books and Reference Works (COUNTER, 2010), and the Code of Practice for Books and Reference has its latest release in 2006 (COUNTER, 2006).

The Code of Practice emphasized flexible levels of reporting as the information is important to both the consortium as well as the individual library. Better reporting system has also been considered. For example, when a consortia has more than one member institute sharing an IP address or range of IP addresses, the total usage statistics reported in the consolidated Consortium Reports must be de-duplicated (COUNTER, 2008).

Mentioned by White and Kamal (2006), both COUNTER-compliant and other vendor-supplied e-metrics offer libraries a baseline measurement of subscription journal and article access; therefore, providing libraries with such data would give a broad comparison of title and database usage patterns such as what the most and least popular journal titles from a single service. Besides libraries, librarians and users, vendors are also in essential need of reliable, consistent, and compatible online usage statistics (Shearer, 2002). Publishers and distributors of online information resources could utilize e-metrics to determine user volume and title interest in order to better plan for marketing and production of new titles, subjects, and services (White & Kamal, 2006). For reliability purposes, an independent annual audit is required of each vendor's reports and

processes to certify the they are COUNTER compliant (COUNTER, 2008).

The Release 3 COUNTER endeavors to mitigate the potentially inflationary effects on usage statistics of federated and automatic search engines, internet robots, crawlers, etc. and its incorporation with the XML-based SUSHI (Standardized Usage Statistics Harvesting Initiative) protocol developed by NISO better the automated retrieval for various systems. furthermore, some of the optional additional usage report in Release 2 has become required to better report journal archives usage (COUNTER, 2008).

All terms referred and mentioned in the COUNTER reports were clearly defined. The following list demonstrates some of the most relevant and needed terms when conducting analysis over raw data from log files (COUNTER, 2008),

Terminology	Definition
ITEM	can be a full text article, abstract, chapter, image or video.
REQUEST	happens when user is viewing, downloading, emailing and printing.
SERVICE	is defined as a branded group of online information products from one or more vendors that can be subscribed to/licensed and searches as a complete collection or at a lower level such as ScienceDirect.
SESSION	was defined as a successful request of an online service and ends when the user terminate activity implicitly by time out due to inactivity or explicitly by leaving the service through exit or logout.
TURNAWAY	is the same as a rejected session as an unsuccessful log-in to an electronic service by exceeding the simultaneous user limit allowed by the license.
USER	is an individual with the right to access a platform and interact with items.
YEAR	is indicate by which an article, item, issue or volume is first published in any medium.

The COUNTER-compliant vendors look at the following aspects for generating various reports, such as Journal Reports, Database Reports, Consortium Reports, Book Reports and some other optional reports.

Type of Report	Reporting Metrics
■ Journal Reports	Number of successful full-text article requests by month and journal
	Number of successful full-text article requests from an archive

	by month and journal
	Turnaways by month and journal
	Number of successful full-text article requests by year and journal
■ Database Reports	Total searches and sessions by month and database
	Turnaways by month and database
	Total searches and sessions by month and service
■ Consortium Reports	Number of successful full-text journal article or book chapter requests by month
	Total searches by month and database
■ Book Reports	Number of successful title requests by month and title
	Number of successful section requests by month and title
	Turnaways by month and title
	Turnaways by month and service
	Total searches and sessions by month and title
	Total searches and sessions by month and service
■ Optional Reports	Number of successful full-text item (journal/book) requests by month and title
	Number of full-text article requests by month and journal; usage broken down by html, PDF and other formats
	Number of successful item requests and turnaways by month, journal and page-type
	Total searches run by month and service

2.3.6 National Science Digital Library

The complexity of digital library evaluation work is illustrated by an example from the National Science Digital Library (NSDL). Funded by National Science Foundation's (NSF's) Division of Undergraduate Education, NSDL is a national network of digital environments for the National STEM Distributed Learning Program that dedicated to advancing science, technology, engineering, and mathematics (STEM) teaching and learning for all learners, in both formal and informal settings (NSDL, 2011). According to the website of NSF, NSDL follows four tracks: (1) pathways projects, (2) pathways II projects, (3) services projects and (4) targeted research.

Among them, the NSDL Pathways Projects are the result of the integration of specific individual digital library components (tools, services, collections, etc.) grouped by grade level, discipline,

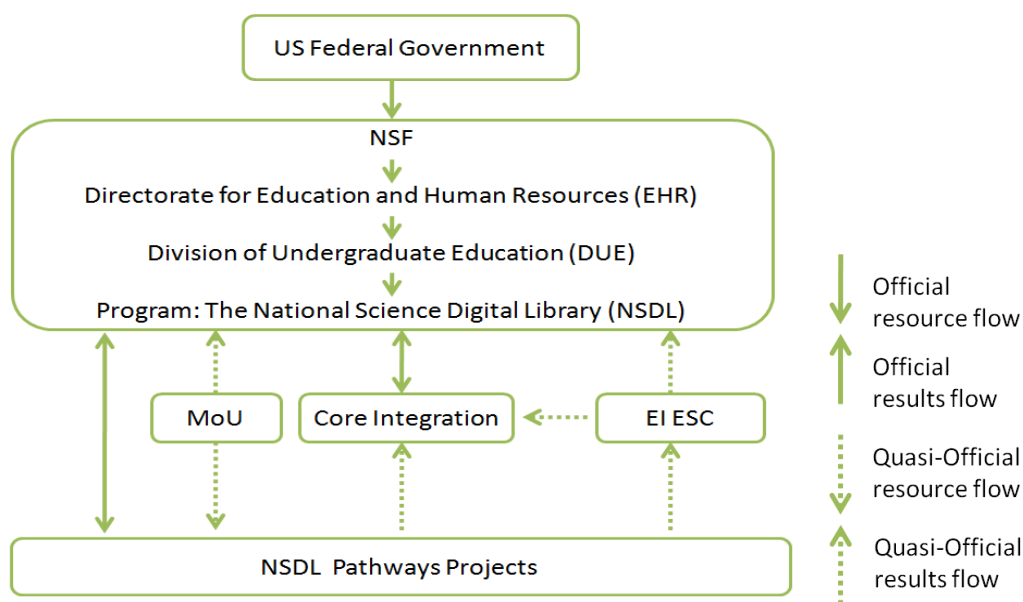
resources or data type into different portals (Khoo, McArthur & Zia, 2008). For example, discipline-focused such as ChemEd DL, audience-focused e.g. Middle School Portal Math and Science Pathways (MSP2), or specialize in the delivery of particular resource types like WGBH’s Teachers’ Domain, providing multimedia resources for STEM education.

Portals are developed and managed in partnership with organizations and institutions that have a history and expertise in serving their portal’s target audiences – in effect, they act as reference librarians for their communities (NSDL, year unknown). The project develop its own websites and catalogues, but are also federated at the main NSDL nsdl.org website.

Judging by its makeup and composition, NSDL is considered as a large-scale virtual organization, which defined by NSDL (2007) consists of geographically distributed teams whose members share a common interest or goal, and work primarily or exclusively at a distance using cyber-infrastructure technologies.

2.3.6.1 NSDL Evaluation Model

Virtual organizations like NSDL naturally result in dynamic new relationship among teams and projects and these connections are often less official and more informal than typical project-program relationships (Khoo, McArthur & Zia, 2008). The author combines two graphs from (Khoo, McArthur & Zia, 2008) to show the following graph which illustrates in detailed the relationships in the NSDL evaluation model, combined,



Looking at its details between NSDL and its Pathways Projects, there are many ‘middle layers’ which consisted of multiple evaluation channels with varying degrees of formality.

Among those, the Core Integration (CI), which was funded by NSF to develop NSDL program-wide technical, logistical and managerial infrastructure, was the most official channel. This former management entity for NSDL (2001—2008) was responsible for maintaining nsdl.org as well as establish recommendation and guidelines for web metrics to pathways projects (NSDL, 2011).

Besides the official CI, there was also a network of informal evaluation channels carried out by EIESC. It included the coordination and collection of cross-project data of interest to NSD like organizational structure, site usage, collection development policies, etc (Giersch, 2005). EUESC presented the results to CI as well as NSF through workshops and reports such as the NSDL annual meeting (Khoo, McArthur & Zia,2008).

2.3.6.2 Metrics of NSDL Web Analysis

As far as web metrics evaluation is concerned, NSDL program operated without any central guidelines for web metrics tools and analysis at the earliest years. CI only used AWStats to measure the traffic of its main site nsdl.org and CI was also unknown what forms of web metrics existed among the NSDL Pathways Projects (NSDL, 2006).

However, as CI started to emphasize the importance of consistent program-wide web metrics, the NSDL's earliest guidelines for cross-projects web metrics was developed under the Memorandum of Understanding (MoU), along with many other. This formal and informal agreements used to describe the relationship between CI and the Projects (Khoo, McArthur & Zia, 2008). The MoU encouraged projects to utilize Omniture while CI would budget for the implementation in order to incurs no financial burden for the pathways projects (NSDL, 2006).

In addition, NSDL also continuously deployed its earlier tool AWStats, which is a free and open source web analytics utility, in parallel to Omniture on nsdl.org. And pathways projects which took on Omniture was also free to run their own web metrics tools in parallel to Omniture(NSDL, 2006) (NSDL, 2010).

According to the report of NSDL (2006), Omniture processed the following traits,

- Is a third-party webmetrics service, meaning the data collected would be stored, analyzed and accessed remotely through Omniture's website. And it is working through a combination of JavaScript and non-persistent cookies.
- reporting data such as number of visits, number of page viewed, browser type, previous page

and next page visited, etc.

- ignoring the metric “unique visitors” to protect user privacy. The non-persistent cookies means that it expires after the user session (determined by a visit going for 30 minutes without initiating any further action) so the IP address information, which Omniture used to identify users, would be deleted and only the anonymous record of the visitors’ path would remain.
- allowing CI to own centralized access to web-metrics for each of the instrumented projects, and to a high-level, coarse-grained ‘roll-up suite’ that aggregates basic metrics across all of instrumented projects while letting individual projects accessing the metrics for its own site, and also to the roll-up suite, but individual projects are unable to view the metrics for any other project.
- permitting CI to lead a consistency in cross-project analyses without having to rely too much on the pathways projects except the implementation and maintenance of the Omniture code on each of the project website.

As mentioned, the tool Omniture has its advantages and disadvantages. CI therefore learned several lessons when trying to utilize Omniture’s strong points and overcome its weak spots (NSDL, 2006) (Khoo, McArthur & Zia, 2008),

- There are certain important pre-work and configurations to be done in advance to the beginning of a real web metrics evaluation.

One difficulty faced by CI is the number and statistics shown by Omniture is not in line with those from AWStats. In May 2006, Omniture reported 13,743 user visits to the website while AWStats reported 25,773 times of visit. In addition, the differences were shown in other most common metrics such as Page Views, Hits, etc. as well. Other technical issues are related to the fact that contribution of non-users such as website developers may inflate the traffic number which brought invalid or corrupted data into the evaluation.

Another problem was the lack of formal organizational channel that encouraged the consistent reporting of program-wide web metrics data to NSF. As mentioned previously, program-level evaluation goals are not all the time in line with projects. The scale of organization as well as the variety of project purposes increased the impracticalness when establishing common or best practices for all NSDL projects.

To solve the complexity, CI first tried at best to exclude visits and statistics from CI through the use of IP filters and cookies. And establish the principle of being cautious in figuring out exactly what figure is being reported and how it is being calculated.

Specifically, CI implemented the selection of an appropriate and useful metric, configured report using appropriate timeframe (e.g. averaging data out over specified time frames), identified and excluded particular ranges of IP addresses, addressed privacy concerns of various projects, supported projects correctly to implement Omniture, and so on.

And while evaluation carried out by the official or quasi-official middle layers do not have the authority of the traditional NSF-project relationship, they do demand attention from project. Therefore, individual projects must identify, translate and adapt these complex NSDL evaluation channels objectives into their own strategic objectives.

In turn, NSDL program needed not only to communicate overall evaluation goals to projects but should also translate goals into different requirements for distinct types of projects. And more importantly, decision-makers will have to establish appropriate levels of compliance for evaluation mandates and to also make sure there are adequate resources within projects to comply the regulations.

- There are differences between ready-to-use metrics and metrics needed triangulation to interpret or infer use behaviors.

Coherent to many experts' opinions, CI also concluded that webmetrics can only report on the traffic of the website. When it comes to inferring user's behaviors, one would need extra information through triangulation with other evaluation methodologies.

For example, CI used web-metrics to track trends in traffic, such as upwards, downwards, daily peaks, monthly peaks, annual rhythm, etc. to acquire some idea of which time zone most users' are from, whether the usage of website was influence by school schedule or not; monitor resolution and clickstream of the users gave CI the idea of how pages layout should be like as well as which section of the content was underused and should be replaced.

However, it was not after triangulation with interviews and user testing that NSDL could explained why the metric "time on site" was short for the majority of visitors. Users in interviewed testified that they wish to search for resources, elect search results and then leave, not spending time exploring the site. This findings runs counter to webmetrics notions of site "stickiness" which prefers users spend more rather than less time on a website.

- Data provided through web metrics can identify research questions for future.

For example, referrals to nsdl.org from search engine, link from other webpages, and typed and/or bookmarked URLs, had the proportions of 20:40:40, which differ from those in other

NSDL projects. As web-metrics do not tell how and why the phenomenon was formed, to understand better and further, additional non-webmetrics research is needed.

These valuable lessons were learned and incorporated later when NSDL Metrics Working Group tried collecting and putting together some best practices from the pathways projects (NSDL. 2010). This report of best practices was intended to offer recommendations that were of use to the full range of digital library projects and services. In the report, NSDL presented the following metrics which might be helpful in identifying trends of usage for web sites,

NSDL Best Practices Metrics (a)	Explanations
■ New visitors	Percentage in total visitors
■ Time on site	Average time on site
■ Visitor locations	geographic: country, state, zip code
■ Traffic sources	direct, referring, search engines. Analysis of types of domains: K12 schools; colleges/universities; museum/science centers, etc.
■ Search engine terms	Keywords users enter in search engine to enter the website
■ Non-library downloads	i.e. downloads exclusive from collection search functions, e.g. for outreach materials

Besides the above, another information regarding the recommendations of web metrics for digital libraries was presented under the Activities Metrics for Web Portal or Web Site,

NSDL Best Practices Metrics (b)
■ Number of registered users
■ Number of visits
■ Pages per visit
■ Unique visitors
■ Bounce rate
■ Most popular pages

2.3.6.3 Purposes of NSDL Web Analysis

According to NSDL (2010), web metrics evaluation are useful to the organization in a way that such data may be used to determine how a site is being used and the audience a site is reading, hence

the information may then be used to help improve digital library functions, tools, and services.

Khoo, McArthur and Zia (2008) also argued that NSF does not think of projects as success or failing, but rather using them to provide a description of what happened in this highly-experimental conditions. All data were potentially useful and may offer the possibility to be repurposed and used to answer different questions at program level than at the project level.

Precisely speaking, the metrics collection plan, being a cyclical process, contributes to both short-term decision making as well as long-term strategic planning internally. For NSDL, it is not only important to define performance metrics that can verify that overall goals are being achieved and that a product or service is effective and useful, but also externally the information is useful as a component of proposals for the government, foundation and business sectors (NSDL, 2010).

As Khoo, McArthur and Zia (2008) pointed out, funding agencies play key roles in digital library projects as they provide financial support, guidelines for research and development and requirements for reporting project outcomes. Therefore measuring impacts and successes of digital libraries are complex but rather important for examining the effectiveness of government investment.

In the case of NSDL, one of the most straightforward methods of measuring impact of projects is through comparing test results of the students. However, the ongoing debate on the effectiveness of such investment of billions of dollars in educational technologies had also pointed out there were a range of other educational outcomes such as promoting critical thinking, increasing student engagement and retention, etc (Honey, 2001) (Viadero, 2007), and hence increase the complexity of NSDL Evaluation purposes and methods in nature.

As Khoo, Buchanan and Cunningham (2009) reported, impact studies take time as it is very complex. The agreement, even among evaluation experts, is often elusive. NSDL therefore proposed the use of web metrics so to reflect the “dailyness” of usage, patterns and trends which can help to uncover impact in an incremental fashion as well as confirming the value of the effort or activity, and the strategic choices or decisions made (NSDL, 2010).

As far as program-level evaluation is considered, NSDL needed an approach which is a holistic and integrative process that focuses on understanding the collective utility of the program as a whole (Khoo, McArthur & Zia, 2008). But worth noticing is these program-level evaluation requirements may not necessarily be clear or useful to all the pathways projects as project-level evaluation were mostly used to determine whether or not they are proceeding according to the schedules provided in original proposals and whether they are meeting the stated goals (Frechtling, 2002).

Standard web metrics are difficult to define for digital libraries due to the variety of project audiences and goals (Manduca, Iverson, Fox, & McMartin, 2005). But in the documents, NSDL at least recommend an short list of metrics that should be include for an overall well-designed and systematic evaluation (NSDL, 2010),

- Help to determine and refine products and services
- Track number of users by demographics
- Provide evidence that users are satisfied with the quality of a product or service
- Provide evidence of impact on user knowledge, attitudes, or behavior
- Compare products and services to others (benchmarking)

Within the same document (NSDL, 2010), the program also provided another non-exhaustive but rather a suggested list after the brainstorming of NSDL Metrics Working Group on what aspects of impact the Metrics could be possibly used to measure,

- Usage
- Audience reach
- Information seeking trends
- Geographic impact indicators
- Awareness/interest building
- Engagement
- Capacity building among users via integration of practices into user workflow
- Attitude alteration; knowledge building
- User satisfaction; customer service
- Reputation; brand monitoring
- Contribution to marketing plan
- Partnership or relationship building
- Project decision-making
- Service provision
- Sustainability

Because NSDL partnerships and projects are diverse in nature, scope and target audience, the above metrics were not intended to be comprehensive or exhaustive (NSDL, 2010). Specifically speaking, each individual digital library portal of NSDL has different goals and asks its own questions related to the above aspects when conducting a web metrics evaluation. Below are two examples of specific projects within the NSDL program (NSDL, 2010).

2.3.6.4 NSDL Case # 1

Funded jointly by the Discovery Research K12 and the International Polar Year Programs, the Beyond Penguins and Polar Bears the product of a project collaborated with the NSDL (NSDL, 2010). Following are the summary of the case, including web metrics used, analytics methods used, and the purposes of using those metrics in an evaluation for the project (NSDL, 2010)(Fries-Gaither, 2009).

According to the project’s monthly web metrics report, the web analytics configuration did not block the internal IP addresses so internal visits are recorded in the statistics; and some of the file downloads were not calculated monthly, but rather collectively (Fries-Gaither, 2009).

Case Name : Beyond Penguins and Polar Bears		
<ul style="list-style-type: none"> ■ <i>The case is an online magazine (cyberzine) designed to help K-5 teachers learn science content and integrate science and literacy instruction.</i> ■ <i>The cyberzine had been using Google Analytics since project launch in Oct 2007.</i> ■ <i>Data collected over a year before making inferences about information seeking trends and help projects decision-making.</i> 		
Evaluative Questions Asked		
<ul style="list-style-type: none"> ■ What kinds of science and literacy content are elementary teachers most interested in? ■ What kinds of resources are teachers searching for on the web? ■ Does the desired content change over the course of the school year? ■ What kinds of content should be provided to best support target audience and project goal? 		
Web Metrics	Analysis	Purposes
Keyword Searches (from Traffic Sources)	Looked at the list of top keyword users’ used in searches on Search Engines and make inferences of explanations.	To identify whether top keywords were part or all of the project name within the cyberzine. This may indicate as “branded keywords”.
Duration of time on page (individual)	Take the Top 15 keywords from Keyword Searches. Compare its time on page metric to the overall average of time on site metrics.	To infer user engagement and whether or not the page met users' expectations or provided enough engaging content to compel users to stay.
Duration of time on site (average)		

Top content	See which articles and resource type (lesson plans, teacher content knowledge, notification reference article, etc) are most viewed.	To infer which content were most compelling to users and reported Top 30 Content. To infer explanation for the phenomenon (inferences need verification later with other methodologies).
Number of page views	Used as general metrics and compared with last month's numbers and figures from the same metrics.	To identify trends and changes in usage such as upwards, downwards in numbers. To infer whether the changes related to significant events such as whether 'the start of the school year' is the cause of increasing the traffic or not.
Number of visits		
Absolute unique visitors		
Average pages per visits		
Bounce rate (single-page viewed session)		
New visitors		
Time of visits	Divided data by day of the week.	To identify differences between weekday and weekend traffic.
Traffic sources	Divided into visits from direct traffic, referring sites and search engines.	To see whether the goal of project was reached: the hope of increasing number of direct traffic would indicate repeated visits from previous visitors. To identify differences in whether which sources attract visitors with higher site penetration or engagement.
	Take top 15 referring sites and top search engines and their search terms.	
	Viewed traffic sources with time spent on site, and pages viewed per session.	
Web 2.0 Metrics	(a) followers on Twitter (b) time saved by users on Delicious (c) number of films viewed on YouTube (d) number of subscribers on Feedburner	To track usage of multimedia content on multi-channels.

2.3.6.5 NSDL Case # 2

The evaluative or exploratory project was conducted by Utah State University and University of California, Berkeley under the funding of NSDL. The two test-bed websites are Instructional Architect (IA) and Exploratorium Learning Resources Collection (ELRC). The evaluation used tool of web analytics, algorithms for data mining, online surveys, user interviews and information from various databases (Recker, His, Xu & Rothfarb, 2009) (NSDL, 2010).

The general research goals for EDM is to (1) collect web usage data in the IA and ELRC and apply web metrics and data mining techniques to infer teacher behaviors and learning online, and (2) contribute new knowledge regarding Knowledge Discovery from Data (KDD) and the application of Educational Data Mining (EDM) to digital libraries (Recker, His, Xu & Rothfarb, 2009).

However, under the specific methods of collecting web metrics data, the project is more in focus about the demographic patterns in access data and the usage of IA web sites. Following are the metrics collected for EDM project as well as for IA's individual website evaluation (Recker, Xu, Garrard & Hsi, 2010)(NSDL, 2010),

Case Name : Instructional Architect (IA) Website

- *Instructional Architect (IA) is an educational digital library service tool aiming to help K12 teachers who are not sophisticated online users to post lessons and internet links on a password-protected web page using search, select, sequence, annotate, and reuse online learning resources.*
- *Teachers can create IA project for "public view" or "student view" only. Project content can be NSDL resources or non-NSDL resources.*
- *Basing in Utah, IA also outreached its program to New York and Michigan. One of IA's main activities is holding workshops where teachers are shown how to use IA and one of the evaluative goals was to see whether the teachers had started using IA or not 6 months after the workshops.*
- *IA had been using Google Analytics since early 2006. Inferences for the evaluation were made in combination with extra information from pre/post workshop surveys to teachers as well as data from IA relational database.*

Case Name : Exploratorium Learning Resources Collection (ELRC) Website

- *Exploratorium Learning Resources Collection (ELRC) is a digital library of over 700 science activities and instructional resources, based on a hands-on museum in San Francisco, California.*
- *ELRC uses "quiet capture" tools such as Google Analytics to understand the geographic*

area their visitors come from and the total number of visitors; and “active elicitation” tools such as online questionnaires to ask users’ demographic/occupational information voluntarily.

- Exploratorium LRC collects web usage through Google Analytics and web server log. Together with other information from online survey, search term capture and interviews. US Census Data and NCES Demographic Data.

Evaluative Questions Asked

- Where in the world are the visitors of the site from?
- What are the demographic patterns in access data?
- Is IA being used by the audiences the website designed it to have?
- How many teachers compared to students are using IA?
- Are more teachers using IA in regions where professional development workshops were conducted?
- Did the outreach and workshops work towards increasing users of IA?

Web Metrics	Analysis	Purposes/Results
Users	Analyzed number of users against the number of IA projects created to find patterns in distribution.	Infer that approximately 10 % of the users account for 90% of the created projects.
Usage	Look at usage over 12-month period to see trends.	Found a dramatic drop-off during summer which reflect school-based usage
Traffic source	Found high percentage of Direct Traffic (e.g. users entry website by typing URL or clicking bookmarked URL)	Infer that IA has more repeated users and purposeful usage. The majority of that traffic came directly to the site. This shows that the major way people find IA through word of mouth.
Bounce rate	Bounce Rate is the proportion of visitors who leave a site after viewing just one page. Found high percentage in bounce rate.	To infer that high bounce rate may indicate that students are logging on and going to their assigned page, then clicking on the link to go to the assigned resource, which matches with the desired website usage.
Location	An analysis of the geographic location of online visitors.	Infer the success of local dissemination as the site attract visits from mostly places where outreach activities had been conducted.
	Join map geo-referenced data with public demographic	To analyze statistically the association between the “geo-referenced data” from

	datasets (per capita income, median family income, number of schools, number of school district, population).	web metrics collection and the “demographic data” from the public databases , and highlight significance predictor variables. E.g. population density as well as per capita income significantly predicted number of online visitors → further infer to the amount of resources such as computers available in the local schools and communities.
Content	Compare number of student login and teacher login. Found a constant ratio of 4 to 1.	Infer the site is used as intended, which teachers created projects for students to use.

2.3.7 CIBER Deep Log Analysis

The Centre for Information Behaviour and the Evaluation of Research (CIBER) is one of the three centers under the University College London (UCL) Department of Information Studies. Stated on its own webpage, CIBER owns its expertise in making sense of how very large numbers of people behave and consume in the digital environment (CIBER, 2011).

To this end CIBER has mapped, monitored and evaluated digital information systems, platforms, services and roll-outs in the field of media (Nicholas et al., 2000), health (Nicholas, Huntington, Jamali and Williams, 2007), publishing, education, science, government and charities. For example, BBC, the British Library, the British Department of Health, Elsevier, JISC, Nokia, Oxford University Press, Research Information Network (RIN), Institute of Museum and Library Services, etc (Nicholas, Williams and Dennis, 2004) (BBC, 2009) (CIBER, 2011).

In simple words, the research team uses robust, big picture, advanced and innovative research methods, particularly deep log analysis, bibliometrics and digital surveying to collect research data (Franklin, Kyrilliou & Plum, 2009).

2.3.7.1 Characteristics of Deep Log Analysis

The web analytics techniques applied by CIBER, the deep log analysis (DLA), was developed by its

own research team and was defined as a methodology for evaluating the digital footprints which consumers leave behind them when they move around the virtual space (CIBER, 2011).

CIBER's important key members, Nicholas (2009), stated that the method DLA is a form of transactional log analysis. But the method enriches the usage and search data of raw transactional log files with user demographic information drawn from a user databases or online questionnaires to provide a whole range of evidence-based user portraits (Nicholas, 2009) (Franklin, Kyrillidou & Plum, 2009) (JISC, 2009).

In addition, the empirical data collected through DLA provides the foundation for follow-up user surveys and interviews, pointing out questions needed to be answered with self-report and qualitative data (JISC, 2007).

According to Nicholas (2003), there are four steps of DLA,

1. Firstly, the assumptions on how the data are defined and recorded (for instance, who is a user, what is a hit, what represents online success etc.) are questioned and realigned as necessary and their statistical significance assessed.
2. Second, the mechanisms to collect the data is put in place if necessary.
3. Thirdly, usage logs are enriched by attaching user demographic data such as age, gender, ethnicity, occupation, subject specialism, organizational affiliation, postcode.
4. And finally the data will be equipped with a detailed picture of the digital environment understood through a whole range of questions asked through survey and qualitative work to study aspects such as personal experiences, satisfaction, outcomes and impacts.

Since DLA is a type of TLA, Nicholas, Huntington, Jamali and Dobrowolski (2008) wrote in the book *Digital Consumers* that DLA data are not completely accurate due to technical difficulties such as caching, proxy connections, unclear session definition, hen inaccurate estimating time spent online and finally the problem of double counting. Other similar drawbacks to TLA are pointed out by Roulands (2010),

- Little or no contextual information about task or motivation
- Unit of analysis is usually the session, not the individual
- What does it mean? (Value judgments inappropriate)

All in all, these are the same issues faced by TLA when it comes to (a) the uncertainty of identifying user units and (b) the need of triangulation with other contextual information in order to gain better insights. And for this reason, CIBER strived to refine the shortcoming of the methodology. For instance, DLA applies another type of study called Micro-Analysis under DLA. The analysis looked at particular user's log file and it encompasses three techniques listed below (Nicolas & Huntington, 2003),

- the construction of a subgroup of users for which researchers can feel confident in regard to their geographical origin
- the analysis of a subgroup of users whose IP addresses were more likely to reflect the use of the same individuals
- the tracking and reporting of the use made by individuals rather than groups

In addition to micro-analysis, the following measurements were applied by DLA, making it possible to provide some powerful analysis not obtainable from the typical TLA standard log analyzing software (Nicholas, Huttington, Watkinson & Jamali, 2005) (Nicholas, Dobrowolski & Huttington, 2005) (Nicholas, 2007) (Guruprasad, Nikam, Rao & Mudkavi, 2009) (Nicholas, 2009),

- Using SPSS (Statistical analysis package) to analyze raw logs instead of proprietary log analysis software. It is more flexible and researchers can define their own variables and breakdowns.
- Classifying users based through a combination of their demographic attributes and their usage.
- Paying more attention to users in analysis and highlight the importance of the metrics returnees and bouncers for possible indicator of measuring user satisfaction.
- Going beyond standard analyses of hit, page views, full-text downloads or number of session to provide information such as number of views in a session (site penetration) or number or return visit.
- Overcoming problems regard to double counting, dealing with proxy servers and estimating time online more effectively.
- Enabling cross-reference data. For instance, to look at how the method of navigating influence the types of pages viewed.
- Raising questions that need to be asked by questionnaires, focus groups and interviews.

In the following section, two cases of CIBER are introduced to demonstrate the web metrics, analytics approach as well as the evaluative purposes used in deep log analysis (Nicholas, Rowlands, Huttington, Jamali & Salazar, 2009).

2.3.7.2 DLA Case # 1

The Virtual Scholar Research Program was an ongoing project conducted by CIBER since 2001, aiming to provide objective evidence from both user and supply perspectives, and thus support a balanced discussion of some strategic issues facing the academic community (CIBER, 2004). The program evaluate and look extensively at the information seeking behaviors of hundreds of virtual

scholars in the virtual scholarly space using DLA techniques to analyze virtual footprints users left behind in the web logs (Nicholas & Rowlands, 2008).

Over the years, the program has conducted various sub-projects with and for different organizations with areas such as the digital transition, new business models, social and policy angles (e.g. academic freedom), open access, repositories, the development of robust methodologies and metrics, creative writing, book history, impact of literary prizes, and changes in book retailing, etc (CIBER, 2004).

One specific project funded by Research Information Network (RIN) called “Evaluating the usage and impact of e-journals in the UK” aimed to evaluate the use of ScienceDirect journals database with regard to Life Sciences, Economics, Chemistry, Earth & Environmental Sciences and Physics by ten major UK research institutions. The project first looked at quantitative log data collected from January to April 2007, and then the qualitative data which seeks to obtain explanations for the usage and behavioral pattern identified by the logs was completed in 2010 (Nicholas, Rowlands, Huntington, Jamali & Salazar, 2009).

Besides the aforementioned project, another one conducted under ScienceDirect was with JISC for the *JISC User Behaviour Observational Study – Scholarly digital use and information seeking behavior in business and economics*. As Virtual Scholar Research Program is an ongoing project, its collected data as well as findings and results from previous works were therefore reused in various other projects later.

CIBER’s role in the study with JISC was to compose a report which informs and provides a evidenced-based context for the small-scale but detailed observational and interview studies undertaken by Middlesex University researchers (Nicholas, Rowlands, Clark, Nicholas & Jamali, 2009). And because it is a study focus on the subject of business and economics, the comparison was mostly down between discipline of economics and others.

Following is the summery of the web metrics evaluation on Elsevier ScienceDirect Databases which CIBER had documented in the report for Middlesex University (Nicholas, Rowlands, Clark, Nicholas & Jamali, 2009),

Case Name : Elsevier ScienceDirect

- *The evaluation was based on raw logs of Elsevier’s ScienceDirect Databases. The sample was for 18 months (2003-2005) with 16,865 sessions and 110,029 pages viewed.*
- *More than 750 authors (users) divided into 12 subjects and scholar disciplines (economics, physics, chemistry, computer science, earth science, engineering, environmental, life sciences, materials science, medicine, mathematics and social sciences) were involved in*

the evaluation project.

Evaluative Goals and Aims

- To investigate UK researchers' behavior, in terms of levels and patterns of usage, content viewed, navigational preferences, routes used to access e-journal content and titles used
- To ascertain whether UK researchers' use and behaviors vary by subjects and disciplines, or in relation to the institutions in which they work

Web Metrics	Analysis & Individual Purposes	Overall Purposes
Type of journal item viewed	Looked at number of views by types (article, journal homepage, search menu, article list, journal list, main homepage, journal issue).	Compare differences of usage between subjects (author users), especially economics and others.
Type of journal content viewed	Looked at number of views by content (abstract, full-text, PDF, full-text & PDF, abstract & full-text & PDF).	Compare differences of usage between three institutions (LSE, Cranfield and Middlesex).
Type of article viewed	Divided data into two types by article in press(AIP/pre-print) and regular (published).	An possible currency indicator (the need for currency on the part of the user).
Age of article viewed	Divided data into three types, by age of article viewed: current (2004-5), declining (1999-2003) and old (1993-2002). Looked at the data by different journal subjects.	Compare the differences of usage behaviors between subjects (author users), especially economics and others.
Number of page views (requests) in a session	Data grouped into five groups by page views of 1, 2-3, 4-10, 11-20 and over 20.	A possible indicator metrics to user busyness and to the degree of user interest and satisfaction.
Number of unique journals viewed in a session	Divided data by number of journals viewed into none, 1, 2-4, 5-10 and over 10. Looked together with "number of searches in a session".	Compared with other subject users. To infer that economists owned the highest proportion of searches with 0 hits returned → possible a problem with search terms or finding what they want
Number of searches in a session	Divided data by number of searches made into 1, 2-4, 5-10 and over 10. Looked together with metrics "number of journal viewed per session".	

Search method	Divided data by search method used by the users. Search within journal, all products, all journals, and other. Then compare with statistics of other subjects.	Compared with other subject users, the “all product search” (everything available on ScienceDirect) was particularly popular with economists.
Number of articles viewed in a session	Averaging number of articles viewed for economists and comparing with other subjects.	Found the lowest average number of articles viewed in a session by economists.

2.3.7.3 DLA Case # 2

Another case conducted by CIBER is the Google Generation Project (CIBER, 2008) which looked at age-related differences in information seeking from April to October, 2007. Commissioned by British Library and JISC, the project particularly looked at scholarly databases evaluation on (1) British Library’s Learning Website and (2) gateway website Intute (Nicholas & Rowlands, 2008).

The Google generation is a popular phrase that refers to a generation of young people, born after 1993, that is growing up in a world dominated by the internet. The two website BL Learning and Intute were chosen because CIBER believed the websites can appeal to a wide variety of users in all ages (CIBER, 2008).

The following illustrated the case with BL Learning website. What CIBER used as web metrics in the evaluation, what was the analytics approach as well as the purposes of the metric evaluation (Nicholas, 2008)(Nicholas, Rowlands, Clark, Nicholas & Jamali, 2009),

Case Name : British Library’s Learning Website (BL Learning)

- *BL Learning is part of the main British Library website which offers a program of workshops, activities and resources for teacher and learner of all ages under several “topics” such as (a)learning, (b)language and literature, (c)history and citizenship, (d) art and images, (e)culture and knowledge, (f)teachers’ area and (g)learning news.*
- *The project aimed to identify how the specialize researchers of the future, currently in school or pre-school years, are likely to access and interact with digital recourse in five to ten years’ time.*
- *And to closely and robustly profile users and evaluate activity records left from users by ages in a virtual space like BL digital library. CIBER used evidence found on log files for a month of April 2007 using DLA technique.*

Evaluative Questions Asked

- Whether or not, schoolchildren (Google Generation) and adults approach the same search platform – BL Learning website, in essentially the same way, or are there clear age-related preferences?
- Whether or not new ways of researching content will prove to be any different from the ways that existing researchers and scholars carry out their work?
- To test the assumption that Google generation is somehow qualitatively different from what went before: that they have different aptitudes, attitudes, expectations and even different communication and information “literacies” and that these will somehow transfer to their use of libraries and information services as they enter higher education and research careers.
- To inform and stimulate discussion about the future of libraries in the internet era.

Web Metrics	Analysis	Purposes
Topics of pages viewed	Look and number of pages viewed by topics.	Indicate topics of most popular pages (top content).
	It's also an aggregated metrics which should be read with other metrics such as 'IP addresses'.	To find out subject preferences (by different types of users).
Types of content viewed	Look at number of viewed by types, including PDF, Flash, audio file, text, images, etc. And examine together by user groups.	To infer whether there's an age-related preferences to the degree of 'visual use'.
	It can also be aggregated with metrics such as 'referral link'.	To see patterns such as users entered BL Learning through images searching on Yahoo or Google are more likely to “bounce”.
IP addresses	Look for .au.uk from DNS to recognize users from UK universities.	To determine users from the listed particular user communities. To identify whether services provided was hitting its target audience. To use later in looking together with other metrics for inferences.
	Use a list of IP addresses from JANET (the UK's education and research network) to identify school users.	
	Look for .edu from DNS to recognize users from US universities.	
	Use a database of IP of top 500 EU universities to identify EU	

	universities.	
	Identify other IP addresses such as commercial users, IP from internet providers, from governments, etc.	
	Three UK schools were picked for Micro-Analysis. Anonymous log files of one unique visitor from each school were used to restore all activities interactions.	To provide a more qualitative and personal data for analyzing log files, e.g. pointed out the particular user was a teacher or a student.
Time of visit	Data should be first cleaned through matching with “location of use” to tackle time zone differences.	Compare users from US and UK to see differences in patterns of use such as US users’ peak time is in the evening whereas UK is in the morning.
	Look at the highest and lowest usage by day of the week, hour of the day.	To see for instance weekend is the lowest usage time for UK users.
Length of viewing a page	Looking at the time spent viewing a page by different academic organization (IP addresses).	To see differences in view times which may be the indicator of level of interest or satisfaction to the content.
Length of session duration	Look at the time duration of time spent in a session by different organization.	A possible indicator for the level of user satisfaction and engagement.
Site penetration	Look at site penetration (number of pages viewed in a session) with other metrics.	To identify trends and patterns such as academic visitors have highest site penetration while ISP users has the lowest.
	e.g. different organizations (IP addresses), different geographical locations (US/UK) and different time of visit.	To provide inferences for future research, e.g. nearly 1/2 of UK school users at 6-8am viewed only two or three pages → perhaps academics were checking for updates before the start of the day
Navigation methods	Percentage and proportion of users using BL internal search facility by organizations (IP addresses) as well as “types of content viewed”.	To see if there is any variation between different user groups, or by the content they are interested in.

Referrer link	Identify users arrived from Search Engine such as Yahoo, Google. Look together with “site penetration”.	To infer that that people using search engine are more likely to be bouncers.
	Identify users coming from blog-type link such as Wikipedia, Facebook or blogs. Look together with “site penetration”.	To infer that users coming from a blog-type link or a school link were relatively sticky and went on to explore additional pages(high site penetration).
	Identify users coming from links on other academic websites. Look together with “site penetration”.	
	Look together with other metrics.	To help portrait heavy and light users’ profile.
Search Terms	Look at users’ search terms from external search engine (referrer links) and internal search facility on BL. Look together with metrics of IP addresses to identify different user communities.	To identify user needs (most popular terms) by different users.
		To infer the nature of users’ search terms such as long/short search strings (number of words in search term) by different users.
		Which are the unique/repeated terms by different users.
		To see differences between internal/external search terms by different users.
	Found high percentage of “British Library” appear in the external search terms.	To infer BL’s low visibility in Search Engines.
		To infer high degree of brand awareness for BL.

2.4 Summary of Researches and Cases Studies

The following is a collective list of purposes and metrics from the above reviews when the digital libraries conduct evaluations under similar endeavors with web analytics. In this form, the metrics recommended or used by the library community and the individual cases were further categorized into (a) vendor report, (b) web analytics or (c) system report by its available sources.

Evaluative Purposes

- to identify user communities and patterns of use
- to project future needs for services and collections
- to assess user satisfaction
- to inform digital collection development decisions and assess the impact of use from changes
- to inform the redesign and development of the library Website and to assess its impact
- to target marketing or instruction efforts and to assess the impact
- to drive examinations of Web page maintenance requirements
- to inform capacity planning and decisions about platform
- to plan system maintenance
- to allocate human and financial resources
- to verify whether the overall goals are being achieved
- to verify whether a product or service is effective and useful
- to use as a component of proposals for the government, foundation and business sectors
- to examine the effectiveness of government investment
- to understand the collective utility of the website from a parent institutional level
- to help in determining and refining products and services
- to track number of users by demographics
- to provide evidence that users are satisfied with the quality of a product or service
- to provide evidence of impact on user knowledge, attitudes, or behavior
- to compare products and services to others (benchmarking)
- to measure usage, audience reach, information seeking trends, geographic impact indicators, awareness or interest building, user engagement, attitude alteration, user satisfaction, brand monitoring, contribution to marketing plan, partnership or relationship building, effectiveness of decisions made and service provision.
- to track usage in other channels such as web 2.0 platform

Metrics from ICOIC guidelines	Data Source
number of queries/searches	vendor report
number of menu selection	vendor report
number of sessions/logins	vendor report
number of turnaways	vendor report
number of items examined	vendor report
Metrics from ISO 2789	Data Source
number of sessions	web analytics
number of content downloaded	web analytics
number of virtual visits	web analytics

session time	web analytics
number of rejected sessions	vendor report
number of searches	web analytics
number of internet sessions	web analytics
Metrics from EQUINOX Project	Data Source
number of sessions	vendor report
number of remote sessions	vendor report
number of documents/entries viewed	vendor report
rejected sessions	vendor report
Metrics from ARL E-Metrics	Data Source
number of electronic reference transactions	system report
number of logins/sessions to electronic databases	vendor report
number of queries/searches in electronic databases	vendor report
items requested in electronic databases	vendor report
virtual visit to library's website and catalog	web analytics
Metrics from NISO Z39.7	Data Source
number of sessions	web analytics
number of searches	web analytics
number of units or descriptive records viewed	web analytics
total annual virtual visits to networked library resources	web analytics
number of rejected sessions	vendor report
number of menu selections	vendor report
number of virtual reference transactions	system report
Metrics from COUNTER	Data Source
COUNTER Metrics	vendor report
Metrics from NSDL Best Practices	Data Source
new visitor	web analytics
time on site	web analytics
visitor locations	web analytics
traffic sources	web analytics
search engine terms	web analytics
non-library downloads	web analytics
number of registered users	system report
number of visits	web analytics
pages per visit	web analytics
unique visitors	web analytics
bounce rate	web analytics

most popular pages	web analytics
Metrics from NSDL case 1	Data Source
keyword searches	web analytics
time on page	web analytics
time on site	web analytics
top content	web analytics
number of page views	web analytics
number of visits	web analytics
absolute unique visitors	web analytics
average pages per visits	web analytics
bounce rate	web analytics
new visitor	web analytics
time of visits	web analytics
traffic sources	web analytics
web 2.0 metrics	web analytics
Metrics from NSDL Case 2	Data Source
Users	system report
Usage	web analytics
traffic sources	web analytics
bounce rate	web analytics
Location	web analytics
Content	system report
Metrics from DLA Case 1	Data Source
type of journal item viewed	web analytics
type of journal content viewed	web analytics
type of article viewed	web analytics
age of article viewed	web analytics
number of page views	web analytics
number of unique journal viewed in a session	vendor report
number of searches in a session	web analytics
search method	web analytics
number of articles viewed in a session	web analytics
Metrics from DLA Case 2	Data Source
topics of pages viewed	web analytics
types of content viewed	web analytics
IP addresses	web analytics
time of visits	web analytics

length of viewing a page	web analytics
length of session duration	web analytics
site penetration	web analytics
navigation methods	web analytics
referrer link	web analytics
search term	web analytics

To summarize the findings, library communities regularly emphasize the importance of examining databases providers and subscribed journal vendors. Apart from that, without a clear evaluative goals, questions to answered, or intentions to fulfill, library communities could only propose general evaluative purposes which need to be adjusted later by the applied digital library. On the other hand, the four individual cases reviewed here were framed under specific intentions and therefore able to provide some less ambiguous evaluative purposes.

As for data sources, though possible for integration, Google Analytics is still mainly used to gather data from websites. The ability of GA sharing and using data with another system varies greatly, apart from other Google-brand services which is clearly encouraged to be used together with Google Analytics. As far as digital libraries are concerned, to achieve collecting metrics data freely from vendors or systems involved the issue of data ownership, accessibility and level of authorization.

For the discussion of this dissertation, those metrics labeled web analytics would be used in the later analysis as they are the closest in nature on its collectability with Google Analytics. And for the evaluative purposes, the author would take the bigger picture from those proposed by digital library communities and add it with the support of questions based on the experiences drawn from the specific detailed cases.

3. Introduction of Google Analytics

Google acquired Urchin Software Corp. in the April of 2005. After 6 months of the acquisition, Urchin's web analysis tool product Urchin On Demand was rebranded as Google Analytics (GA) and offered freely to the public in the mid of August 2006. As a web analysis tool, GA provides users with the information related to their websites such as the number of visits, the source of visiting traffic, the most viewed content of the websites, the percentage of new visitors, etc. (Google Analytics, 2011) (Urchin, 2011) (Wikipedia, 2011).

The fully available free version has gone through continuous changes such as new user interface (latest version since May, 2007) and GA's JavaScript Tags (from `urchin.js` to `ga.js` since December, 2007). Google also sells a standalone installable software product called Urchin (with latest version Urchin 7 in 2011) under a retail price of USD\$ 9995, which gives clients more control into the log file details compared to the free Google Analytics. (Google Analytics, 2011) (Urchin, 2011) (Wikipedia, 2011).

In the following, the author will introduce some necessary concepts of GA. These are important elements that should be understood about GA, including its technology, implementation, common functionalities, metrics and characteristic.

3.1 Characteristics of JavaScript Tagging

Traditional log files analysis use the transaction records on the server as the data to be analyzed. Compared to TLA, JavaScript tracking technology provides web analysis with another alternative. Using this method, the web administrator would first need to insert a JavaScript tag, which is a few lines of JavaScript code, to the webpage they want to track. And as part of the source code, a browser would run this JavaScript code whenever the pages is being loaded. When the JavaScript is fired off, it would execute the required actions such as sending data to the data collection server, which is often a third-party server, or placing additional cookies to user's browser. The standard report or customized report would then be produced at a set time, using the web logs in the data collection server.

Kaushik (2006) pointed out that JavaScript log files were easier to maintain than web server log files. In addition, they shifted the responsibility of collecting and processing data from internal company IT departments to web analytics vendors in most cases. This made implementing web

analytics easier. Now the vendor could do the storage, analyzing and reporting rather than having librarians to go through the company IT department.

Web logs and JavaScript tags are very different in data processing, storage and impacts, hence having different sets of advantages and challenges. Challenges in traditional web logs data collecting methods are primary (a) robot data filtering, (b) better unique visitor defining and (c) overcoming data caching. In the JavaScript solutions, robots traffic doesn't exist as robots don't execute JavaScript; unique visitors are defined with cookies instead of user IPs and page caching is not a problem for JavaScript tagging as regardless of where the page is being served from, the code will still be execute (Kaushik, 2010).

Nonetheless, though solutions with embedding JavaScript works in a different way compared with raw data log files analysis, it still shares some of web logs' fundamental concerns when it comes to defining metric formulas and calculating the accurate user session length (Clifton, 2010). Moreover, with its use of JavaScript tracking code and browser cookies identifier, there are new limitations which were not identified in server logs analysis merging to be the new challenge. Visitors who block first-party cookies or disable JavaScript on their browsers would not be tracked. This often depends on users' anti-spyware programs or firewalls settings. Kaushik (2010) documented that the primary obstacles for JavaScript tags are browsers that have JavaScript turned off (typically accounts for 2-3 percent of browsers).

3.2 Implementation of GA

In order to use GA, one would first need to have a valid Google account. This account is composed by an email as well as password. The email can be Gmail or from any other email services. Once the Google account is created, one would also gain the access to the service of Gmail, and Google would automatically link the registered email together with the newly created Gmail address. But having a Google account does not mean one is granted the access of GA. It is only by further activation that one can truly start reading and creating GA profile under the activated GA account.

With each GA account, one can create up to 50 GA profiles. And with each Google account, it is possible that the user has multiple access to more than one GA account, such as to the profile created under the personal account as well as to another profile created by someone else's account. The original account owner can grant access of one or more of the account profile to any other Google account user. An each user within one GA profile can either be an administrator which has the whole access ability, or a report viewer who only can read data but not able to alter the fundamental settings.

Each GA Account can use its 50 profiles to track one or more web property, such as one profile for “www.dl.com” and another profile for “www.dl2.com”. Moreover, any web property such as “www.dl.com” can also be tracked by another profile if required. One can do so by either create a duplicate profile under the same GA account or use another GA profile in another GA account.

For each GA Profile that has been created, Google Analytics would automatically generate the JavaScript tag, which common called the Google Analytics Tracking Code (GATC) via the Profile Settings page. The GATC contains a profile-specific identifier which starts with UA and followed by a series of number (e.g. UA-12345-1). This identifier makes each GATC unique and personalized to the specific profile user created.

```
<script type="text/javascript">
var gaJsHost = (("https:" == document.location.protocol) ? "https://ssl." : "http://www.");
document.write(unescape("%3Cscript src=" + gaJsHost + "google-analytics.com/ga.js'
type='text/javascript'%3E%3C/script%3E"));
</script>
<script type="text/javascript">
try{
var pageTracker = _gat._getTracker("UA-xxxxxx-x");
pageTracker._trackPageview();
} catch(err) {}
</script>
```

Figure 3-1 Example of a Google Analytics Tracking Code

According to Google Analytics (2011), The users shall copy and paste the GATC immediately before the </body> tag of each page that the they wish to track. The tracking works in a way that whenever the page with the embedded GATC is being requested or loaded by a browser, the GATC snippet would fire off and send related visiting data to the data collection server of GA.

One thing to be aware of is the positioning of GATC. It is important due to the order of source codes being run when pages loaded. It is suggested by GA to paste GATC after the ending of </body> to ensure that the browser runs the content first before executing GATC, which can avoid any trouble when running the GATC effecting the loading of the real content. Nonetheless, in cases such as tracking Outbound Links where loading or processing could be completed too quickly before GATC even fire off, one should put GATC on top to ensure data is always passed on to GA.

In many cases, one could simply apply such tag to the common template for the whole website.

However, depending on the Information Architecture (IA) of the site, some web administrator would actually need to copy and paste GATC manually on each and every single webpage intended to be tracked. Overall, the ease of implementing a GATC on the website could really differ largely from website to website, based not just on the website structure but also the type of pages. For example, data-driven pages, pages with frames and secure pages (https) may require extra attentions and efforts.

Finally, compared with transaction logs files which collect and store all raw in an accessible location, GA doesn't provide raw data. The raw data in the JavaScript log files is only used in producing GA reports. Under this mechanism, some configurations such as profile filter to exclude company traffic would result to a permanent and irreversible change.

According to Cutroni (2010), not only mistakes made during setup or configuration can permanently affect the quality of the data, but this also means that configurations can only change future data and not the past. Extra cautious should be taken when making sure for example all pages' source code are tagged (Google Analytics, 2011) and the best practice (Clifton, 2010) (Cutroni, 2010) (Kaushik, 2010) ultimately is to create extra profiles under the same account for any major configurations and most importantly, always keep an untouched default profile as a backup in case of something goes wrong with the configured profiles.

However, there are also some functions which has been referred to by some literature as ex post factor analysis (Kaushik, 2006), which allow segmentation after the data has been collected, without users necessarily defined and passed all the segmentation variables up front. In the following the author will introduce the report interface as well as some important on the fly ex post factor analysis which would be useful and needed by digital libraries during evaluations.

3.3 Reporting Interface of GA

After the correct implementation, first GA report should be ready and available in the upcoming 24 hours. GA has over 80 reports but a Dashboard, as shown below, is the first section one will see when viewing the reports. Dashboard is mainly designed for displaying the most important and relevant data which users wish to see at a glance right after entering GA. Users are able to change and determine which metrics should be deleted or added to the Dashboard. According to Clifton (2010), up to 12 reports can be changed within Dashboard and since it is on the per-user basis, different user logins may see different metrics on their dashboards.

By default, the standard report gives one a quick look at the visiting trends by graph and direct

access to basic metrics such as Site Usage, Traffic Sources Overview, Map Overlay, Visitor Overview and Content Overview (D – H in Figure 3-2). For in-depth drilldown on each metrics, user can simply click into the report set. A more comprehensive view though is by looking at the top left column where all reports and metrics are categorized into different topics such as Visitors, Traffic Sources, Content, etc (I in Figure 3-2).

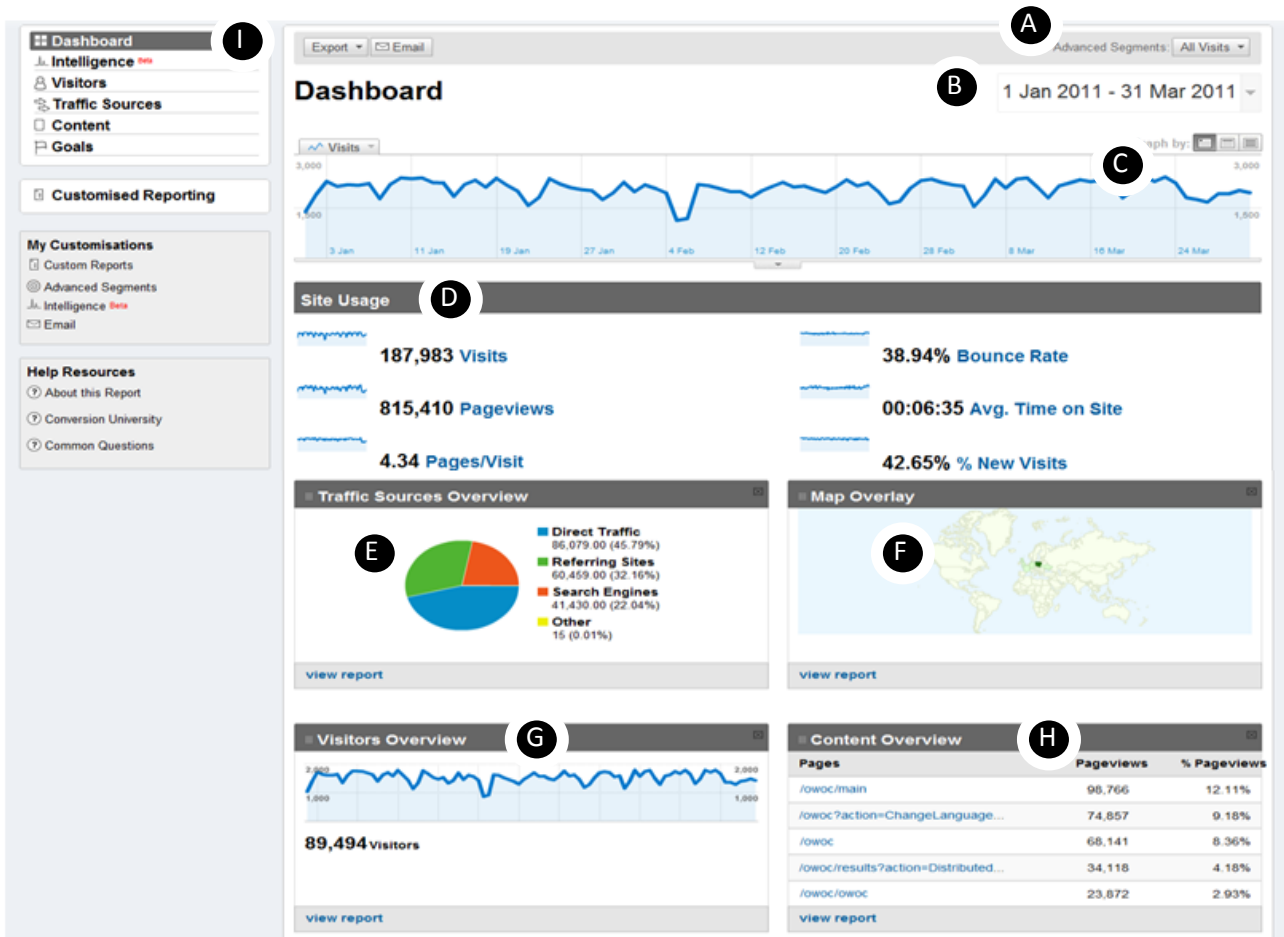


Figure 3-2 Google Analytics Dashboard Report

One of the function in GA is for users to create his or her own customized Dashboard. This means that one can decide to delete any of the Site Usage, Traffic Sources Overview or Map Overlay sections and replaced them with any other metric reports. To add any new section to the Dashboard, use the “Add to Dashboard” button in almost all the GA reports to create a section that displays the summary statistics of the particular report.

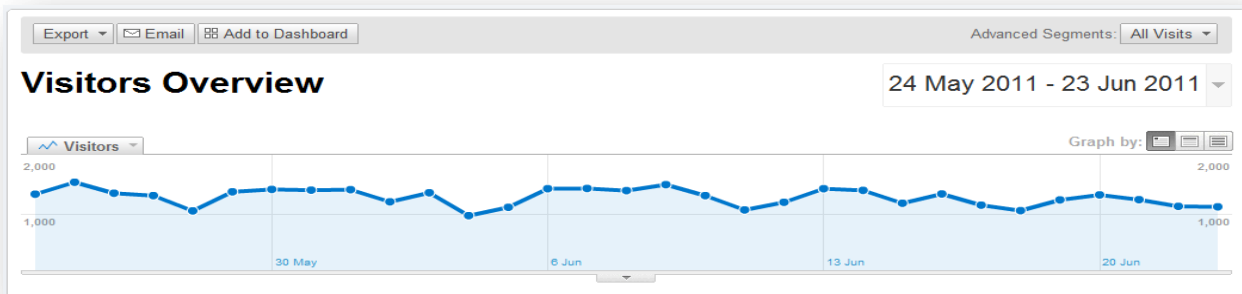


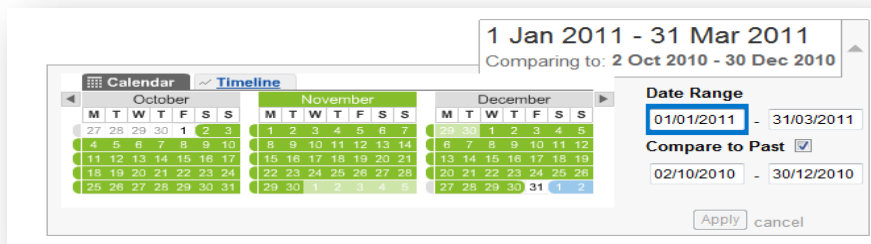
Figure 3-3 Visitors Overview Timeline Graph

As mentioned above, configurations and customized setting may change the data in GA report for good. While filtering are used a lot more than just excluding internal traffic, there are many options in ex post factor analysis which help users flexibly segment specific data during report viewing. This is different to the configurations as it doesn't change the way how GA collect the data at the first place,

- **Advanced Segments:** here (A in Figure 3-2) the user can apply data segmentation and data comparison on the fly by checking on or off different dimensions. For example, by default the data is shown by All Visitors, but the graph below asks GA to show the comparisons between All, New and Returning Visitors instead. This setting will be automatically applied to all report pages viewed later, but it can also be changed or cancelled immediately at anytime.



- **Date Range:** (B in Figure 3-2) here the user can select a date range through a calendar or timeline slider to graph the report data by clicking on the arrow (Google Analytics, 2011). Users can also compare data under data under two periods of time by clicking the Compare to Past checkbox. To conduct a more precise data comparison, Clifton (2010) advised to identify, consider and eliminate time variations applying considerations such as aligning days of the week (compare Monday with Monday) or to pointed out seasonal variables when reporting differences between the two time periods.



- **Graph By:** (C in Figure 3-2) here the user can view data and statistics flexibly by hours, days, weeks or months. And when seeing more than one data set, the user can move the cursor over the Summary Graph to see not only the exact number of visit but also the differences in comparison in plus or minus percentage.



3.4 Metrics Definitions of GA

Knowing how to segment and locate data is important, but more crucial is to understand exactly what each metrics means and how it was calculated before interpreting them. Following is a list of the GA metrics and their definitions put together by the author using the available references (Cutroni, 2010)(Google Analytics, 2011),

Metrics	Definition
Page	a page is an analyst-definable unit of content.
Page view	The number of times a page (an analyst-definable unit of content) was viewed. GA refers to this metric as the pageview. A pageview is created each time the <code>_track Pageview()</code> method is executed. Any value passed to the <code>_trackPageview()</code> method will appear in the Content reports, thus making a page analyst-definable.

	The number of times a page (an analyst-definable unit of content) was viewed.
Visits/sessions	A visit is an interaction an individual carries out on a website consisting of one or more requests for an analyst definable unit of content (for example, “page view”). If an individual has not taken another action (typically additional page views) on the site within a specified time period, the visit session will terminate.
	By default, a visit will terminate after 30 minutes of inactivity by the visitor. You can configure the inactivity timeout by altering the Google Analytics tracking code.
Unique visitors	The number of inferred individual people (filtered for spiders and robots) within a designated reporting timeframe, with activity consisting of one or more visits to a site. Each individual is counted only once in the unique visitor measure for the reporting period.
	In Google Analytics, a visitor is defined using a unique numeric identifier stored in the Google Analytics tracking cookies. This value is set at the time of the visitor’s first visit.
	Each visitor is counted only once in the unique visitor metric, regardless of how many times he returns to the site during the reporting period.
New visitor	the number of unique visitors with activity, including a first-ever visit to a site during a reporting period.
	While Google Analytics shares the same definition for a new visitor, it does not count the number of new, unique people (visitors) who visited the site during the reporting period. Google Analytics counts the number of visits generated by new people.
	Google Analytics calculates the number of New visitors by identifying the number of new unique visitor IDs created during the reporting period. It is possible to measure the number of new visitors using a profile and include filter.
Repeat visitor	By default, this metric does not exist in GA. You can create this metric with an elaborate mix of filters and custom reports.
Return visitor	The number of unique visitors with activity consisting of a visit to a site during a reporting period and where the unique visitor also visited the site prior to the reporting period.
	While Google Analytics shares the same definition for a return visitor, it does not count the number of returning unique people (visitors) who have visited the site during the reporting period. Google Analytics counts the number of visits generated.

	Google Analytics defines a return visitor as any visitor whose unique identifier cookie was set prior to the reporting period.
Entry page	the first page of a visit
Landing page	a page intended to identify the beginning of the user experience resulting from a defined marketing effort.
Exit page	The last page on a site accessed during a visit, signifying the end of a visit/session.
Visit duration	The length of time in a session. Calculation is typically the timestamp of the last activity in the session minus the timestamp of the first activity of the session.
	Google Analytics calls this metric “average time on site.” It is calculated by dividing the total time spent on the site by the total number of visits.
Referrer	<p>The referrer in Google Analytics is the page URL that originally generated the request for the current visit. This value is then added to all pageviews in that visit.</p> <p>The referrer is identified in Google Analytics as any source whose medium is “referral.” Google Analytics also has a field called “referral” which conforms to the WAA’s definition of “referrer.” However, this field is not displayed in any report — it is available only as a filter field.</p>
Internal referrer	The internal referrer is a page URL that is internal to the website or a web property within the website as defined by the user.
	This metric is not available in Google Analytics.
External referrer	The external referrer is a page URL for which the traffic is external or outside the website or a web property defined by the user. Not available in GA.
Search referrer	The search referrer is an internal or external referrer for which the URL has been generated by a search function.
	This metric is not available in Google Analytics. While Google Analytics tracks both external search phrases and internal search phrases, the term “search referrer” is not used in reporting.
Visit referrer	the visit referrer is the first referrer in a session, whether internal, external, or null. This data is called a "referral" in GA and can only be the external referrer.
Original referrer	the original referrer is the first referrer in a visitor's first session, whether internal, external, or null. This metrics is not available in GA.
Click-through	the number of times a visit clicked a particular link.
	GA refers to click-through as "clicks". This metrics is available only in the AdWords reports.

Click-through rate/ratio	the number of click-through for a specific link divided by the number of times that link was viewed.
	Click-through and click-through rate are the percentage of impressions that resulted in a click. It is calculated by dividing the number of clicks on an ad by the number of impressions for the ad. This metric is available only in the AdWords reports.
Page viewed per visit	The number of page views in a reporting period divided by the number of visits in the same reporting period.
Page exit ratio	the number of exits from a page divided by total number of page views of the page.
	In GA, this metric is called exit rate and is shown in content report as "exit %".
Single-page visits	visits that consist of one page regardless of the number of times the page was viewed.
	this metric is not available in GA.
Single page view Visits (bounces)	visits that consist of one page view.
	Bounces can be modified by other Google Analytics features, specifically event tracking. When event tracking is used, the Google Analytics tracking code will request the invisible.gif from the Google Analytics server. Google Analytics will interpret this .gif request as a visitor action and will conclude the visitor is engaged with the web page and will not count it as a bounce.
	For example, if a visitor lands on a page, views a video that is tracked using event tracking, and then leaves the site from the original landing page, it will not be counted as a bounce.
	The same is true for custom segmentation. If a visitor is placed in a custom segment on a landing page and does not view any other pages, it will not be counted as a bounce.
Bounce rate	single page view visits divided by entry pages.
Event	any logged or recorded action that has a specific date and time assigned to it by either the browser or server.
	there are multiple attributes to an event in GA. These are objects, actions, and labels.
	Event tracking is a Google Analytics beta feature and may not be enabled for your account.
Conversion	A visitor completing a target action.

In addition to conversions, Google Analytics will also calculate the conversion rate. The conversion rate is the total number of visits resulting in a desired action divided by the total number of visits. A conversion will only be recorded once per visit. Visitors cannot convert more than one time per visit.
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3.5 Marketing and Business Oriented

According to Metric Mail (2010), Google Analytics was reported to own 49.95% of the market share among other web analysis tools by a list of the top 1 million website domains, ranked by Alexa. In Web Technology Surveys (W3Techs, 2011), GA reported to be used by 50.4% of all the websites, owning a high market share of 81.1% within the websites monitored by W3Tech. BuiltWith Trends (2011) also reported the percentage of market share of Google Analytics being 57% when they looked at the use of Google Analytics within the top 10,000 most viewed websites (ranked by Quantcast).

Clearly, Google Analytics is in favor of many websites and is constantly claimed to be the most popular web analytics tool. Nevertheless, one should also study the nature of those websites being sampled. And perhaps most importantly, looking at how Google describe its own tool and what the aims and goals of it in its own definitions.

As an industry of dominated by technologists before, Google Analytics differentiate itself by aiming to help marketers utilizing the data directly. Stated in its official website, GA was designed to be the enterprise-class web analytics solution which gives user rich insights into website traffic and marketing effectiveness so one can be more prepared to write better-targeted ads, strengthen its marketing initiatives and create higher converting websites. Google encourages the user to use GA to improve site and increase marketing ROI (Return of Investment), turn visitors into customers, learn which marketing initiatives are cost effective and how see visitors actually interact with the site to make informed site design improvement, drive targeted traffic and ultimately increase conversions and profits (Google Analytics, 2011).

Judging from the digital library's point of view, the community could possible share some of the goals listed above by GA, such as getting insights into website traffic, finding out user interactions with the site, making site design improvement, driving targeted traffic or even turning visitors into customers or increasing conversions with the definition under the digital library context. Nonetheless, there are also some controversies and issues worth looking upon related to the usage of Google Analytics due to the differences between business environment and a digital library

framework,

■ Monetary measurement of success

Google Analytics are highly optimal when connected to ROI (Return of Investment), PPC (pay-per-click), CPC (cost-per-click) or SEO (search-engine-optimization). And to match its goal, GA's main features are inevitably created to perform its maximum when integrated with the other Google ecosystem, especially those for business or e-commerce to see insights across marketing activities such as AdWords, AdSense, Website Optimizer, Webmaster Tools, etc.

Business websites and digital libraries by their general definitions both exist in various forms for widely diverse purposes. For example, business often related to several web properties such as a company website, an online shop, a blog, and its help center website. While it is fair to say each separately has its independent purposes, many e-commerce and marketing activities at the end of the day are still highly tied to transactions and purchases, making the outcome direct and visible.

One may argue that a high usage of services and collections could also ultimately be the primary goals for many digital libraries. Nonetheless, while the success and achievements of businesses can often be measured and presented in monetary value, many digital libraries are non-profit with entirely no or minimum cost to the users, which means the accomplishments and triumph could be much more intangible and harder to evaluate by some of Google Analytics metrics such as cost, revenue, profit, etc.

■ Different navigation structures

One of the popular and highly recommended features in Google Analytics is Goals and Funnels. Users can define different goals (e.g. when visitors register as members, complete a purchase, make a donation, reserve a book, download a PDF, etc.) and their funnels, which represents the expected path that the visitors would take in order to reach the goal. The report aims to track the actual percentage of users who reach the goal and if not, in which step they give up to exit the process. The value of goals and funnels being one can easily see where in the structured experiences is under-performed; hence, pointing to possible areas needed to be improved.

Nonetheless, upon setting the goals and funnels, only the first step in the funnel can be checked as "required", meaning if a user set up two goals which is the same with the same first step, and only differ in the middle steps of the funnels, the final number of goal conversion would be reported as the same number. If the digital library would like to see whether browsing or searching from the homepage resulted in more PDF downloads, the number would be very confusing. This design is obviously more useful to e-commerce websites, since they calculate results and achievements from

a more structured website experience such as the shopping cart checkout process.

While this issue can be solved by other means such as Navigation Paths Analysis, Event Tracking or Funnel Visualization report where the actual number of each step is displayed, and one can always argue that there could be some structured experiences in digital libraries, it is reasonable to point out that the design is not user-friendly for many digital libraries that have multiple paths for its primary goal.

■ Help and development

As Google Analytics are designed to perform its maximum when tracking a marketing or commercial activities, not only the majority of its clients are e-commerce websites but inevitably most of the new features developed, extended applications created or discussions made are also more related to helping the business environment.

As far as digital libraries are concerned, similar to ecommerce website where some information are stored in Customer Relationship Management (CRM), data in OPCA, vendor databases or Content Management System (CMS) can also help digital libraries in getting more from the basic web analysis. To some level, it is fair to say that actually some progress has already been made in the digital libraries field as there are quite some discussions on how to use GA with proprietary OPAC or DSpace, or other systems that some libraries are using like Drupal and Joomla.

Nonetheless, a look at the GA Application Gallery, one can see the tools and plug-ins designed to extend the functionality of GA are mostly to for Business Intelligence, Mobile Solutions, Phone Call Tracking, etc. Comparatively speaking, Google Analytics is more agile and active in providing insights in the business community and there are still more efforts in developing tools such as GA plug-in for CRM platform. While faster advance is being made in ways how ecommerce apply GA to its maximum benefits, it is also to ecommerce's advantage that being the profit-oriented industry, many can and are willing to hire a certified web analyst, whereas digital libraries often needed to resolved problems using online help or through trials and errors.

The differences between a commercial website, which the Google Analytics primary aims to help, and an information services provider websites make the use of GA in the digital libraries interesting but tricky. Therefore, in the following section, the author would like to explore, discuss and analysis the appropriateness of GA for digital library evaluation through three main themes of digital library evaluative purposes.

4. Exemplified Evaluation Themes

In chapter four, the appropriateness of GA as an evaluative tool for the digital library environments will be discussed under eleven different evaluative purposes. These evaluative purposes are picked out by the author as they are the most commonly seen as well as the most defined scenarios in the literature review of chapter two. Due to the same reason, the author also believes that the purposes would be the most capable in providing a critical analysis of GA for the examination of this dissertation.

In the following section, the eleven evaluative purposes that share the same topic in nature are further grouped into three themes. Specifically, the three themes demonstrate the possibilities and difficulties of using GA to infer user satisfaction, to assess impacts, and to assist decision makings within the digital library context.

And for the clearness of format, a vocabulary from the Google Analytics will be shown as underlined text, where JavaScript listings will be marked with grey background.

4.1 Theme # 1 – Inferring User Satisfaction

User satisfaction is in core a qualitative attribute, but found in the literature review, digital libraries could still use data found in web analysis as an evidence-based support when making the user satisfaction inferences. To most of the e-commerce website, conversions and transactions are the ultimate goals. Digital libraries, however, exist in wider variety of forms for a greater mixture of purposes.

Depending on the definition of a satisfying user experience, each digital library may have different success formulas to indicate user satisfaction using the web metrics data. This formula of “satisfactory” is often in accordance to each digital library’s aims, functions and serving principles, or based on results found from its previous user studies. It is therefore important to define (1) what would be a satisfactory experience for the user and (2) how would those experience be shown by web analytics, before starting measuring user satisfaction.

In the following section, four evaluative purposes would be presented, each aiming to the bigger picture of measuring user satisfaction. Under each purpose, the author will discuss the possibilities and potential pitfalls of GA for the digital library use.

4.1.1 Purpose #1 - Using Basic Metrics to Infer User Satisfaction

Basic Metrics are the most easily found in any web analytic tool. For example, the number of visits to the site, the number of pages visitor viewed in a session, or the time visitors spent on the site. Though basic to understand and simple to obtain, these metrics may often be calculated differently by different technologies between tools. For example, the number of pageviews in GA will never be the same as those found in Yahoo Web Analytics. One should realize that the trends of traffic could be similar between tools, but the number would always be different. It is essential for administrators to dig in and learn how each metrics of the chosen analytics tool is computed.

Moreover, the interpretation of these basic metrics could be very tricky. As they were the most commonly used from the past, administrators could have preconceptions of how the data should be read already. However, it is also common that the pre-fixed idea was suboptimal or even misleading in other particular situations. As a result, further look-ups are always needed as basic metrics may be easy to get, but most likely complicated to interpret and use. For digital libraries, which is a novice in the field, it is especially important to exam the usage of these basic metrics with critical viewpoints instead of taking them for granted.

4.1.1.1 Metrics for Purpose #1

■ Site Usage Metrics

Shown as Figure 3-2, without any user configuration, the default GA Dashboard has a section called Site Usage which displays 6 metrics in total (Figure 4-1). Among them, the Avg. Time on Site indicates the average time spent per visit on the website, such as zero hour, five minutes, thirty seconds.

Bounce Rate is the percentage of visits which only has one page view during the visiting session.

Pageviews and Pages/Visit, which are both related to the number of webpage being loaded, respectively represents the number of total pageviews by all visits and the average pageviews number per visit. These statistics can all be viewed per hour, per day, per week and per month through graphs and bars, using the function shown as C in Figure 3-2.

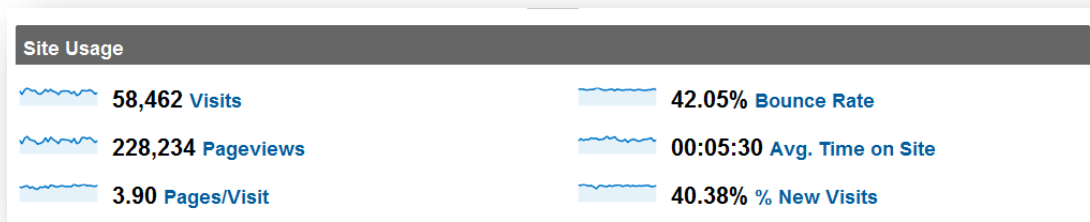


Figure 4-1 Site Usage section in the GA Dashboard report

■ Length/ Depth of Visit

Another related reports are Length of Visit and Depth of Visit reports. Using the same data as basic metric Time on Site and Pageviews/Visit, these two graphs visualize the distribution of duration of visit session and pageviews instead of a conclusive average number. As shown in the left column of Figure 4-2, these reports can be found under the Visitor Loyalty within the Visitors report section.

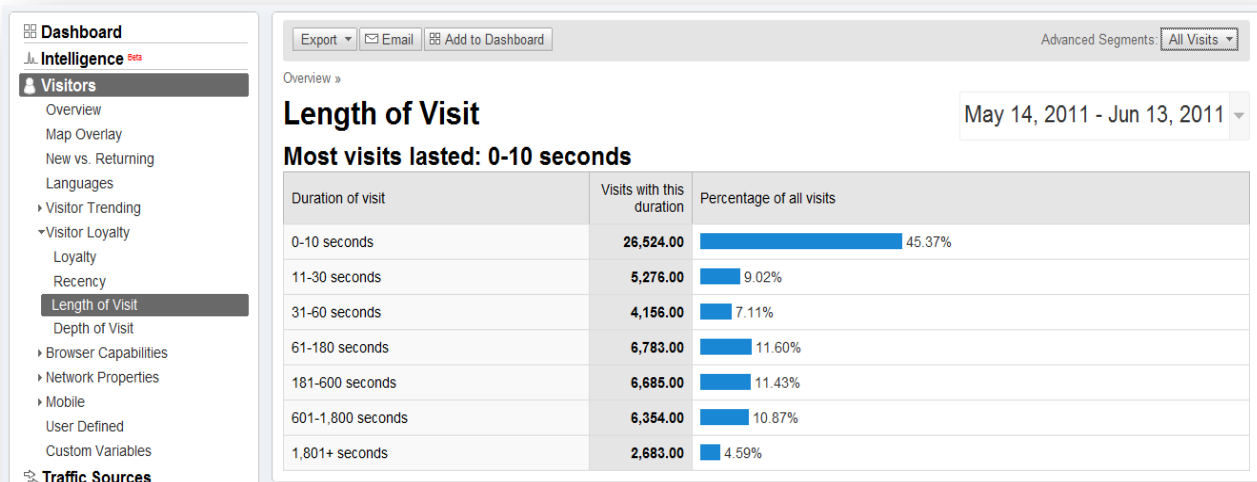


Figure 4-2 Sample page of Length of Visit report

4.1.1.2 Considerations for Purpose #1

■ Applying Time on Site

A general belief is that the longer a user stays within the website, the more appealing, addictive and “stickier” the website must be to the user. Namely, the website must bring more satisfaction to the users. This behavioral indicator is especially desirable for websites which generates income

from its on-site advertisements, since the longer a visitor stays, the more advertisement impressions the website can make.

For digital libraries which provides textual, images or interactive content on its website, it is also ideal to have a longer visiting session since a long stay, especially on a content webpage. This could be used to for showing a high user engagement level and a successful provision of interesting or relevant information from the webpage.

Nonetheless, there are also many digital libraries which aim to provide quick relevant results with an effective and easy to use interface. For those, a longer time on site could actually be translated into user satisfaction deterioration, as a possible explanation would be the confusing navigating designs or the failing to provide useful results immediately.

■ Applying Pageviews and Pages/Visit

Similar to the situation of time on site, a high number of pageviews is often interpreted as a positive indicator, especially for those websites which are content-oriented such as news or blogs. For digital libraries, this could also be an indicator of user satisfaction. But whether the satisfaction level is high or low would be depending largely on the presentation of the services and the content of the digital libraries. For example, if users are supposedly to come to the website, search, look through the result, find and download, a overly-high webpage viewed before even a single-download would be worrying.

Another precaution to ensure the correctness of the assumption is to drilldown the type of pages being viewed before making the conclusions. For instance, it is acceptable when the single-pageview occurred to the contact us page, whereas it is not desirable if many pageviews are generated by the 0 search result page.

■ Applying Length of Visit and Depth of Visit

As demonstrated above, though easy to obtain, basic metrics are hard to interpret as there are too many variables behind them. Especially when they are presented with the conclusive average. An average number can be deceiving since an average of 50 could be derived from 50 plus 50, or 99 and 1. In that case, a low time on site average could be actually skewed by user leaving the webpage open without reading, not because they examining the content then decided it is invalid.

To look for more actionable insights, librarians should look at Length of Visit as well as Depth of Visit, which displays the distribution of the time spent and pages viewed. However, when applying metric data related to session time calculation, librarians should always remember that due to the

inability to capture exit time stamp when visitors leave the website, the last page of any visit will be recorded as 0 second in GA.

Therefore, in the Length of Visit report, a bounce visit would always be assigned to the 0-10 second category, though not all traffic under 0-10 second category are bounce visit. For the Depth of Visit report, on the other hand, traffic within the 1-pageviews category are in fact all resulted from the bouncing visits.

■ Applying Bounce Rate

A bounce which conventionally being interpreted as the “unsuccessful landing page indicator” could actually happen in many other scenarios in a digital libraries context. For example, it is common to have users who found one of the collection content pages through search engine, and after consuming the content by reading or downloading, he or she then left the site or close the browser.

Since reading the webpage or downloading a file normally does not required another GATC-tagged page being loaded, and if no further efforts are made into tracking those clicks, this visit would be recorded as a bounce. But in fact, the visitor actually obtain some valid information and perhaps felt satisfied throughout the whole experience.

Therefore, besides setting up to track user download, which would be discussed later in Purpose #2, librarians could also segment traffic in the 0-10 second category to see whether the visitors are actually coming from. A look into the Bounce Rate report to identify the potentially “good” traffic could also perform the same effect.

■ Finding Explanations and Variables

As the overall traffic is actually composed by different visitor groups with various visiting purposes, another important technique to draw further insights from these basic metrics is by segmentations, comparisons and drilldown.

Libraries could use Advance Segments drop-down menu on the top right of most reports to segment traffic for comparisons and benchmarking. For example, one can see if visitors coming through from Facebook campaign are demonstrating a longer time on site than the overall visits, or whether a new visitor has a shorter time on site compared to the returning visitors.

In some cases, Advance Segments can also be helpful to make pageview statistics more meaningful and obvious, such as selecting the Non-bounce Visits checkbox to exclude the bouncing traffic

when calculating usage percentages in Pages/Visits or Depth of Visit report, as shown below.

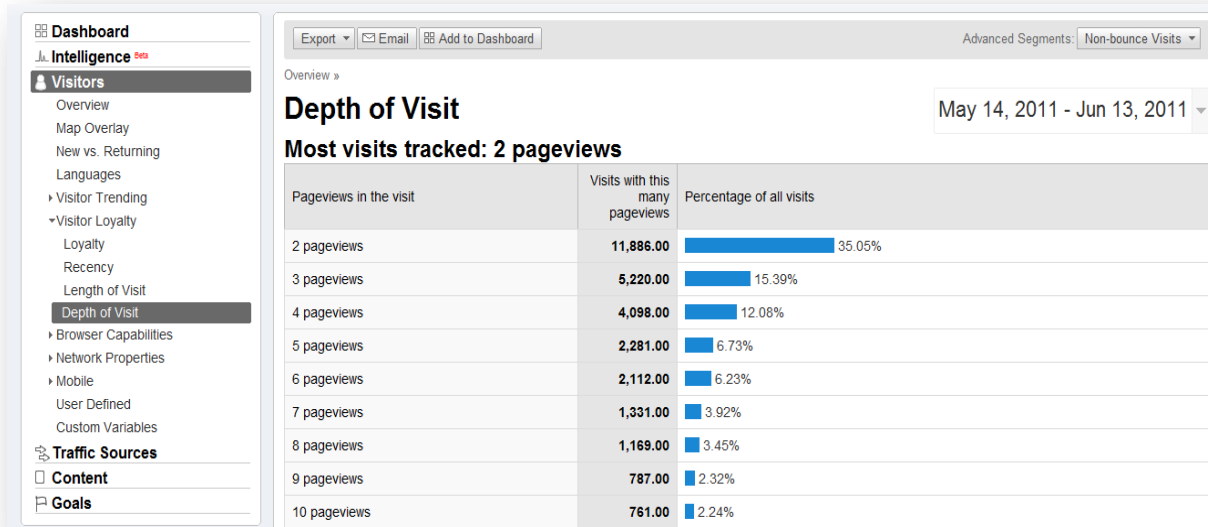


Figure 4-3 Depth of Visit report

4.1.2 Purpose #2 – Tracking Actions to Infer User Satisfaction

Besides using basic metrics to infer user satisfaction, found in the literature review another common attempt is to use task completion rate for inferring user satisfaction. The definition of a user task is often set through the objectives of the business. For example, compared to e-commerce website, where customers transactions are the most commonly seen goal, digital libraries usually aim to provide services and content to the users. And from this point of view, digital libraries are often assuming users coming to its website have tasks related to using the materials.

These tasks in web analysis could be translated into meaningful actions such as downloading a PDF files, requesting an image, playing an embedded YouTube video or interacting with digital library's online content reader. And whether this action was performed or not, would be the potential indicator for user satisfaction.

However, as introduced in chapter three, GA uses embedded JavaScript tags in HTML source code to track usage data on the basis of pageview. And those in-page actions such as clicking the "download this file" link, pressing the "play" button of the videos, or interacting with elements of Ajax and Flash, will not be traceable as they do not trigger any GATC to fire off and therefore will not generate pageview record. Though many of the digital library OPAC systems may already have an in-built function of showing the number of downloads, libraries wish to integrate all data into GA could still make the extra efforts into creating Virtual Pageview or setting up the function of Event Tracking for tracking such actions.

4.1.2.1 Metrics for Purpose #2

■ Virtual Pageviews

The concept of creating virtual pageviews is simple. Since non-HTML files could not cause a pageview record, this approach simply create a fake pageview which then be traceable by GA. Technically speaking, for each of the in-page object wish to be tracked, librarians can add a `_trackPageview()` to the onclick event of this particular element.

For example, a click for downloading the PDF file of a book called book.pdf which originally looks like : `the pdf file of a book` could be made traceable by GA, when modifying the code into `<a href= "book.pdf" onclick= "_gaq.push(['_trackPageview', '/book.pdf']);"`

>the pdf file of a book.

In addition, as materials in digital libraries are often organized structurally. To have the same categories shown in the GA report for the virtual pageview records, librarians can create a virtual directory structure when naming the value by including more information such as showing that book.pdf is under the classification of fiction which belongs to the section of e-book: the pdf file of a book.

The result of the all the tagged-virtual pageview would be presented at the Content report such as Top Content, which would be introduced later in purpose #9, of GA just like all the other pageviews.

■ Event Tracking

Besides creating fake pageview records, GA Event tracking can also track user interactions with rich media elements on the website. Different from Virtual Pageview, the result of Event Tracking By default, the Event Tracking reports can be found in the Content section of GA Dashboard, and similar to Virtual Pageviews, it requires extra work of the librarians. Specifically, with Event Tracking, there must be a _trackEvent() function in the source code of each webpage element or application wish to be tracked.

The GA method of _trackEvent () has a hierarchy data model which consist of four components for mapping up the Event when this particular Event record is being shown in the report: _trackEvent (category, action, opt_label, opt_value). Looking at each component in standard, Category is designed to group multiple elements such as videos, submissions or ebooks. Action is used to describe the actual interaction such as download, submit, play or stop. Label is useful in providing the extra information for the elements such as naming the file or video, and the final string parameter Value, is intended to offer something different than the other three text strings. Value being a numerical value must be integer such as a dollar value. The opt_ indicates that some of the components are optional.

To give specific example, for tracking a play button being clicked on a commercial video, the _trackEvent() method would look like: Play. This indicate that when a user hit the play button on the commercial video, an event for the videos/play combination is triggered and would be later shown in the Event Tracking report in GA. And if one determine that each click has the potential value of \$1, the value could be added to the numerical value parameter and change the _trackEvent() into: <a href= "#" on Click= "_gaq.push(['_trackEvent', 'videos', 'play', 'commercial video',

'1']];">Play.

4.1.2.2 Considerations for Purpose #2

■ Applying Virtual Pageview

Virtual pageview is the technique to track in-page action and displaying each action as a pageview in GA. As a result, this would inevitably raise the number of pageviews and influence any metric that use the calculation of pageviews. For example the drop of bounce rate. While decrease of number in bounce rate is welcoming, many e-commerce websites are troubled by the change of pagview number.

However, for digital libraries, this could actually be useful as a visit which lands at the content page from a search engine and did click on the download link before leaving the site, would be no longer calculated as a bounce, but rather as a 2-pageviews visit. This enablement in tracking links would also change the bounce rate as well as the time on site, but only making the number closer to reality.

However, for digital libraries using virtual pageviews to track outbound links such as a link on its homepage to another library, such action of the users may not really be considered as another pageview to the original library. In this case, libraries would have to remember to apply the Exclude Filter for taking the outbound link pageview records off from the report.

■ Applying Event Tracking

Compared to Virtual Pageview, many e-commerce websites believe Event Tracking offers a more sophisticated way to present statistics as the number of Event is counted and reported separately from the pageview counts. In addition to that, one can use the four parameters to assign attribute, giving more dimension to the analysis in reporting.

However, with Event Tracking, the administrator need to define the exact data that one would like to captured in advance, whereas Virtual Pageview data is collected in all aspect, allowing later segmentation and application just like any other pageview record. For a website which aiming to track only one or two promotion video and three PDF files, it is resolvable even when there is no clear naming convention. But for most of the digital library, the number of links and elements that needed to be tagged, no matter for Virtual Pageview or Event Tracking, could be much larger.

It is therefore important for libraries which use Event Tracking to agree on a clear plan in advance of how the links should be structured and assign according. For example, should the parameter of category be the type of material of the collection, such as e-book, video, audio clip, map, or whether it should be the subjects of content such as using the classification category of fiction and non-fiction. For best practice, it is always better to communicate with the report users and related stakeholder to find out the optimal solution for structuring the links and elements.

And as it will be introduced later for purpose #5, though Event Tracking is preferred in many websites but Event in GA so far can not be assigned as Goals. Therefore, when using non-URL destination for Goal and Funnel in GA, one would need to use Virtual Pageview tracking.

■ Achieving flexibility in reporting structure

Besides needed to be well-planned, consistent, logical and structured during naming, compared to traditional libraries, digital libraries have also broken down the barrier of having limited attribute assigning to a single material during classification. Now with every rearrangement just a click away, the categorization of collection could be extremely diverse and flexible.

As a result, many digital libraries may also like to reflect the structural design and organization of the materials such as arrange the whole collection according to a specific metadata in its reporting. For example, a digital library may like to view its top 10 most downloaded-items between authors, between different published years or between different content categories in its GA report for Event Tracking or Virtual Pageview. However, as both methods have limited attributes, to mirror the dynamic organization of materials for digital library in GA report would be challenging.

In it true that there are already some ready-made third-party software that can found on the GA Application Gallery, such as Analytics Canvas, which allows administrator to join and analyze several huge dataset from various sources. But since those solutions does not come cheap, one of the simplest way for digital libraries to integrate GA data with its already exist collection database is by extracting data from both side into EXCEL and use a common attribute as the primary key to merge the datasets. For example, putting ISBN number in the fourth parameter of Event Tracking and use it as the primary key to match with items within the collection databases. Afterward, libraries could use the original database attribute to display the results in all possibilities with all items in the collection.

■ Practical Concerns

As mentioned above, the scale of naming elements and links for both functions in digital library can often be big. In theory, setting up such tracking code is fairly simple. But in practice, it could

actually be a tedious job which may be especially time and labor consuming.

In addition, one can never be sure if the visitor is really watching when the video being play or using the material that has been downloaded. This situation could be even more common compared to an online purchase website which requires actual monetary cost from a visitor. Since to download PDFs, images or podcasts from digital libraries are mostly free, users can have a much easier choices to just download and delete the item afterward.

Digital libraries should therefore pay extra attentions into further investigations on other characteristics or the use of materials afterward. For example, segment and compare the heavy and light users to see together with their other metrics performances such as Loyalty, Recency, or which item they downloaded to seek explanations and possible insights. Or for digital libraries providing educational materials, interviews or questionnaires to key users such as school teacher should also be used to confirm the actual use of the resources in the classroom.

It is also important to measure the long-term success, namely whether the user really make use and fell satisfied about the material, instead of just focusing on the immediately available victory of user download.

4.1.3 Purpose #3 – Using Retention to Infer User Satisfaction

As mentioned above, an apparent measurement of user satisfaction in the e-commerce website could be the number of customer transactions. This for digital libraries may most likely be projected as the number of download being made to its collection items by the user as presented in purpose #2.

However, while it is important to measure the immediately available victory of user download, it is also crucial to measure a long-term relationship with the users for the more sustainable success. Namely, digital libraries should go beyond using tracking PDF downloads to demonstrate user satisfaction. Found in the literature review in chapter two, some digital libraries indeed go beyond using tracking PDF downloads for demonstrating user satisfaction and instead having user retention also as the attribute to infer user satisfaction.

The proxy of user retention could be associated with the feature of personalization, social networking function, navigation and searching ability, incentive for revisit, etc. But in terms of utilizing web analysis, there are some metrics data which one can first use to infer the level of user retention before moving to find explanations for the phenomenon. Following the author propose looking at metrics of returning visitor, direct traffic, visitor loyalty and visitor recency for such purpose.

4.1.3.1 Metrics for Purpose #3

■ Unique Visitors Count

Before introducing metrics for inferring user retention in GA, it is important to understand how GA calculate and identify user identity.

Compared with TLA which uses IP address in distinguishing users, GA installs a cookie named _utma to the visiting browser on its first visit to start tracking this particular Unique Visitor. This persistent cookie updates itself with each returning visit and each page view until its two years from set or update expiration date. However, as cookies can easily be deleted by the user, he or she would then be counted incorrectly as another unique visitor, with a different _utma unique ID in his or her next time visit. Other scenarios results in miscalculation are when users use multi-device or multi-browsers such as one computer for work another for home, or multi-users access on the same computer in schools or libraries. So instead of unique visitor, it is more the

calculation of unique browser.

■ Returning Visitor

As introduced in chapter three, GA uses cookies for identifying each unique visitor. And a returning visitor by definition is a visitor with existing GA cookies, as opposed to New Visitors which are browsers without the utma cookie. These metrics should be better describe as dimensions which one can also use for segmenting other GA report, such as looking at Bounce Rate of New Visitor and Returning Visitor separately.

■ Direct Traffic

In GA, this statistics could be found in Traffic Sources report in the default GA Dashboard as shown below. And based on the way user enter the website, GA puts all the visiting traffic into four categories, the Direct Traffic, the traffic from other Referring Sites, traffic resulted from Search Engines and Other such as a user-customized marketing campaign.

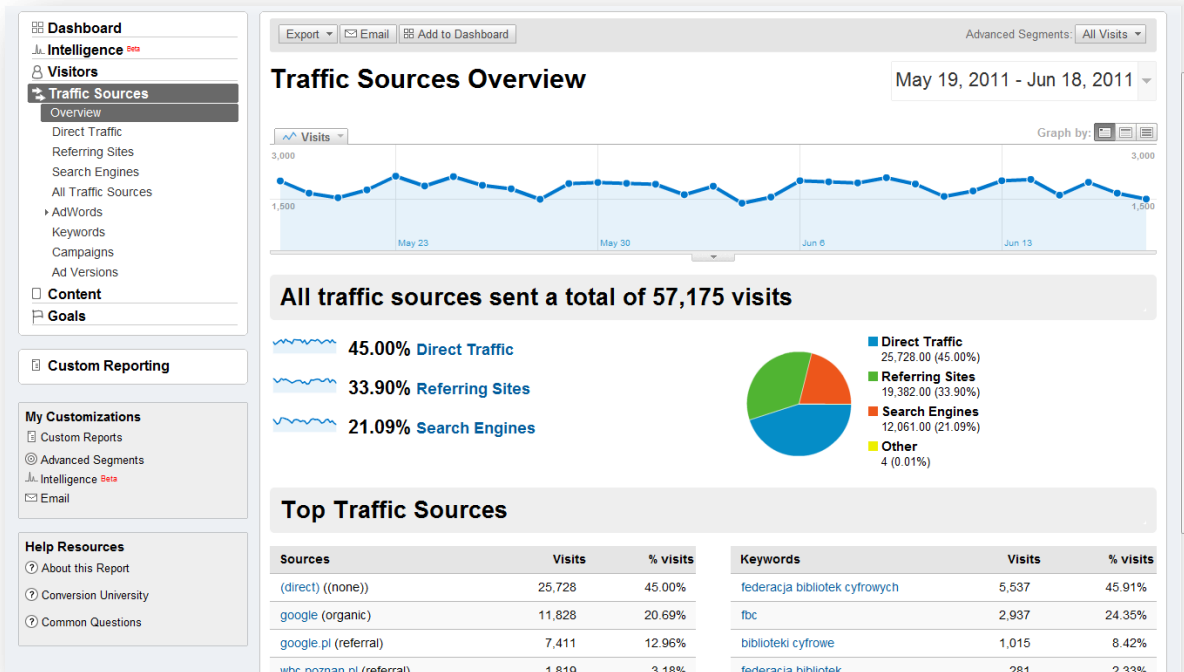


Figure 4-4 Traffic Sources Overview report

■ Visitor Loyalty

As shown below, Loyalty metric is a report which puts each visit into different groupings under the visits that were the visitor's Nth visit categories, such as 10 out of the 100 visits (10%) were the users' 2nd visit to the website. This calculation is based on the record in the persistent unique

visitor cookie of the browser, so it stays the same regardless of the reporting Date Range setting. For example, user A visited the website first time in January, and without deleting the cookie or change its browser, he made a second and third visits in April. If the Date Range of reporting is fixed to April, Loyalty metric would report one record each of the visits that were the visitor's 2nd visit and visits that were the visitor's 3rd visit category.

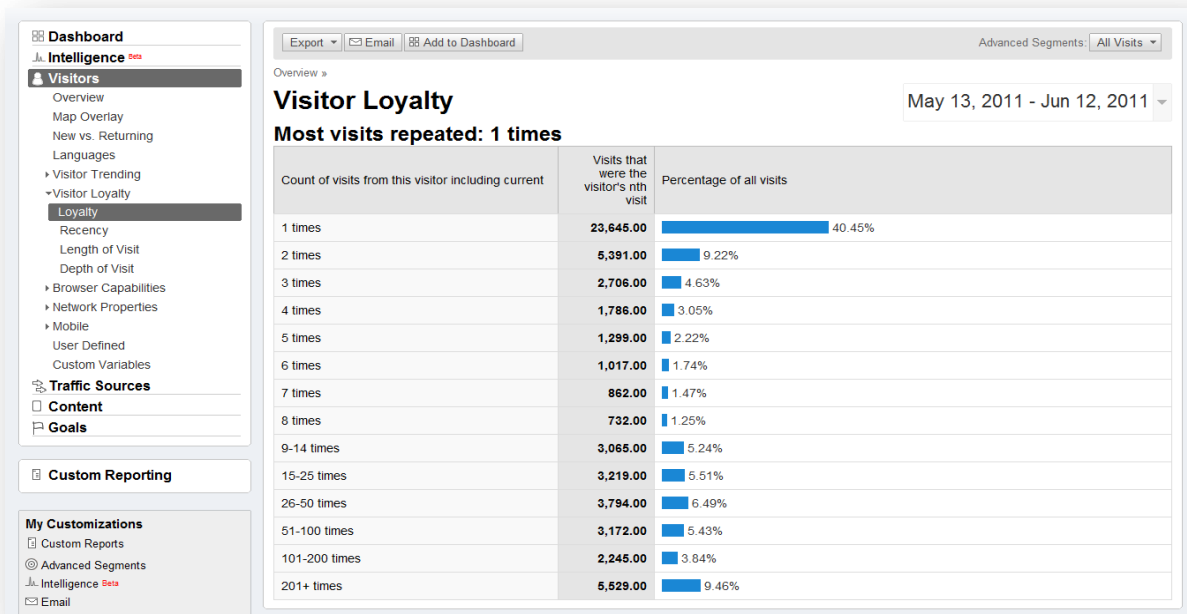


Figure 4-5 Visitor Loyalty Report under Visitors section

■ Recency

Similar to the presentation of Visitor Loyalty, Visitor Recency shows the gap of time between two visits from the same visitor. The visiting records are sliced into categories of First visit, Same day, <0 days ago, 0 days ago, 1 days ago, 2 days ago, and so on. And as a visitor's uniqueness are identified by the cookie, Date Range will not make a difference. GA computes the time delta in seconds and if it is less than 24 hours, it will be categorized into the 0 days ago section, while if the number is greater than 24 hours, it will be put into the 1, 2, 3 days ago categories. For first time visitor since there is no second time stamp, GA would put such visit under both of the First visit and 0 days ago categories.

4.1.3.2 Considerations for Purpose #3

■ Estimated Inaccuracy in Unique Visitor

Besides the Direct Traffic metric, all the other metrics above has its relation with the count of Unique Visitor. And as introduced in chapter three, the use of cookie in GA has many possible downfalls such as the deletion of cookies from the users and the inaccurate count of the actual visitor as it is the browser which is being identified.

For many e-commerce websites, online visitors access and conduct transactions through the use of their personal computers. However, for digital libraries, especially those for educational purposes, it is common to find user accessing the website from a public environment such as through the common computers in schools or libraries. And as a result, this possible incorrectness in recognizing an Unique Visitor could be more harmful to digital libraries. Investigating on how the majority of users are typically accessing the digital library site is important as it could possibly help to library to better understand and estimate the scale and percentage of this inaccuracy.

■ Applying the metrics of Traffic Sources

By definition, Direct Traffic means there is no prior record of other webpage before user entering the site. And since such situation could occur when user type in the URL directly into the browser, click on an un-tagged link within a promotion email, or using a browser bookmark, direct visits are often read as visits done by visitors who already knows or needs something from the website. Hence, giving a hint of possible indication for user retention and user satisfaction toward the site.

However, direct traffic can also happen when the page is the default homepage of the browser, which for digital libraries is often quite common, and for those visitors who are library staff or students using school computers for other purposes, visits are not only low in quality, as far as web analysis is concerned, but may also resulted in bounce visits where visitors immediately exit or close the website for other tasks. Another possible data contamination is during testing of the web developers.

Therefore, to ensure traffic is indeed done by non-employee, one solution among e-commerce is to exclude internal visitors by blocking traffic coming from the company network. In GA this is often carried out using the Predefined Profile Filter which administrator can include/exclude traffic from a specific domain, subdirectory or sources. For digital libraries, however, such solution may have flaws as it is also possible that a user also access the website through the library wireless network or public computers. For that reason, It is maybe more suitable to label staff computers with persistent cookies which GA can recognize and exclude.

■ Applying Returning Visitors

After cleaning the data to exclude internal traffic, some e-commerce also use Advance Segments to

include only traffic from the Returning Visitors for a clearer customer retention rate. However, as unique visitor actually means unique browser, and to take the high possibility that a digital library user is using a public computer into account, this practice may not be optimal for digital library as unique visitor data is more skew. Therefore, perhaps the most robust solution is a further drilldown in the report to truly see the quality of Direct Traffic. For example, are they having a higher degree of loyalty, recency or goal completion rate? Do they tend to have the preferred longer or in some cases shorter time on site? Do they make more comments on the materials or are they mostly registered member of the digital library already?

Besides looking at revisit for see whether users are satisfying or not, the number of times and how often they visit could further indicate the level of their satisfaction. For many websites, especially loyalty driven website such as news, blogs or social networking websites, constant visits are used as critical measurement since it helps to infer a high user engagement or even addiction to the site.

■ Applying Loyalty and Recency

As both metrics involved the count of unique visitor, librarians should always remember there is an inaccuracy related to cookie deletions and multi-users access. In addition, in the Loyalty report, first time visitor who has not even get the chance to demonstrate any loyalty would be put under the “1 times” category in the report. From the first glance, it could appear to be that the most visits are done by single-visit visitor. To avoid such confusion, librarians could use Advanced Segments to only include the traffic of Returning Visitors.

Further insights could also possibly be drawn if librarians compare Loyalty or Recency performance between traffic from different sources. Both Loyalty and Recency can be used as a visitor threshold in Goals such as to “include only traffic that has the loyalty greater than 10th times” or to “exclude traffic that has the recency lesser than 3 days”.

All in all, due to common practices for digital libraries such as sharing computer, many of the unanswered concerns are to some level more serious for digital libraries. And as it is impossible to identify Unique Visitor with a complete accuracy, librarians should try to focus on the trends instead of the numbers when reading GA report. Though the number is incorrect, but the percentage of incorrectness could at least be more or less consistent throughout the time.

4.1.4 Purpose #4 – Using Triangulation to Further Investigate

Despite numerous metrics and statistics are available in support of making inferences on user satisfaction, a satisfying feeling in core is still a qualitative substance and it is highly subjective based on each individual's experiences, expectations, needs, standards and judgments. As mentioned several times already in the previous second, goals of visiting a digital library various and sometimes even unexpected or unaware to the digital libraries. It is not possible to define and track all the possible purposes which differ so widely. Therefore, for many digital library metrics data alone would not be enough to measure success in the holistic picture. User satisfaction inferences inevitably still needs qualitative studies such as online survey or focus group to clarify or confirm.

4.1.4.1 Metrics for Purpose #4

- Google Analytics Extended Application – 4Q

In terms of using GA, there are some third-party on-site survey software which designed specifically to integrate later with the web metrics from GA. These tools are listed under the GA application Gallery, which GA uses to display all application designed to extend GA's original functionalities. For on-site questionnaires, 4Q could be one of the most useful for digital libraries. Once implemented to a digital library, it asks users 4 questions related to overall satisfaction, primary purpose of visit and task completion rate.

4.1.4.2 Considerations for Purpose #4

- Applying 4Q with Google Analytics

The data of 4Q can be analyzed together with other GA statistics such as showing satisfaction rates (collected by 4Q) by specific visitor groups (segmented by GA), examining time on site (shown by GA) by task completion rate (collected through 4Q), or comparing satisfaction rates (gathered from 4Q) by time on site and geographic locations (segmented by GA). However, one of the issues worth noticing is that most of the tools listed under the application gallery are highly business oriented. And for some digital libraries, a possible challenges would be then how to flexibly aggregate data from the GA reports with its other tools, such as an online survey system that has already been used by the digital library.

4.2 Theme # 2 – Assessing Impact and Performance

Besides putting GA into the examination on its ability to indicate user satisfaction, another commonly found evaluative theme in the literature is impact assessment and performance evaluation. Looking at e-commerce websites which create online marketing strategies and run advertising campaigns, digital libraries also perform a diversity of activities online and offline for different purposes. Whether the goal is to raise publicity, improve user engagement, increase usage of a certain collection or simply promote the digital library, a periodical or final assessment on the impacts of the activity is essential.

In a sense, these activities in web analysis are inevitably connected with segmentations and comparisons. And through looking at a specific data set or comparing two, one can not only assess the impact of certain effort or event, provide the necessary content for making judgments, in some cases, the investigation may even resulted in discovering unexpected variables to the phenomenon.

Similar to inferring user satisfaction, this evaluative theme is composed of 4 different evaluative purposes, including how to assess impact on site usage, on targeted user groups, on the goal of raising publicity and of different channels. And instead of being comprehensive, the purposes being addressed below are the most commonly found in the literature review on the discussion of digital library impact assessment.

4.2.1 Purpose #5 – Assessing Impact on Usage Behaviors

As demonstrated in the first evaluative theme, there are many possibilities for digital libraries to use web analysis for understanding the status quo of the website usage. However, if the current performance is not satisfying to the administrator, the digital library may endeavor through various activities for improvement. For example, other goals besides increasing the download of the materials, as shown in purpose #2, could be to extend the engagement level of users, increase visiting frequency of its users, raise the amount of users subscribing to the RSS feed, etc.

Looking at the literature review in chapter two, many digital libraries have utilized web analysis to demonstrate the final result of a certain effort as well as monitoring the trends of improvement over the period. And as mentioned earlier, regardless of its nature though, most of the impact assessments in evidently have to use the technique of comparisons and segmentations for the data set.

Depending on the goals that the digital library would like to achieve, some goals could be very specific while some may be more intangible for measurement. For example, to increase user retention by 10% is a clear-defined objective, whereas to increase the use of a certain service would require more context for placing judgments. And many users would actually perform micro-goals before conducting the ultimate macro-goal such as register as member of the library before log in to download the material.

In addition, from the literature review, it shows a possibility that the library-defined objectives and its preferred user behaviors are not in line with the actual purposes of the users. And while performing impact assessment and applying web analysis, digital libraries may even discover purposes and usage patterns which was unforeseen by digital libraries' original existing purposes.

4.2.1.1 Metrics for Purpose #5

■ Defining Goals

Looking at Figure 3-2, on the left column of GA Dashboard report, there is a section dedicated to Goals. And to enable function of Goals and Funnel, one must first edit and define one or more goals. For GA setting, there is a limitation of 20 goals in total for one profile, and it is possible to group different goals together into a bigger goal sets, but each group sets can only have 5 goals.

In GA, there are three types of goal, including the URL Destination, Time on Site and Pages/Visit. For the first type of goal, the completion record would be triggered when the destination URL has reached by the user, such as typically seen in e-commerce websites when the window of “order confirmation” or “thank you for ordering page” has shown up. The latter two types of goal act more like thresholds to track visits which has either more or less than a specified amount of time on site or pageview. For example, a goal to track sessions that have the “time on site greater than 10 minutes” or “pageview per visit less than 3 pages”.

■ Funnel Visualization

For every type of goal, there is also an option of assigning a monetary value such as \$10 for the completion of goal. However, only an URL Destination goal can have a Funnel set up with it. The Funnel allows administrator to specified and follow through the path that a user takes before reaching the URL goal. The most common practice of this function is the checkout process of an e-commerce transaction. For example, if there are three pages in the paying process, including shopping cart page (Step 1), shipping detail page (Step 2) and payment information page (Step 3), before the order confirmation page (URL Destination), one can define each step to be tracked.

Below is an example of a two-step Funnel Visualization report. Here administrator can see how many visitor has completed each step by number as well as percentage. The report also shows a simple path of which webpage visitor has entered from and exited to each specified funnel step. For example, in a four-step funnel goal, maybe out of the 100 initial visits in step 1, 40 (40%) enter the next step while 60 (60%) exit to other webpage or even exit the website. And in the end, perhaps there are 20 visits left, resulting in a 20% goal conversion rate.

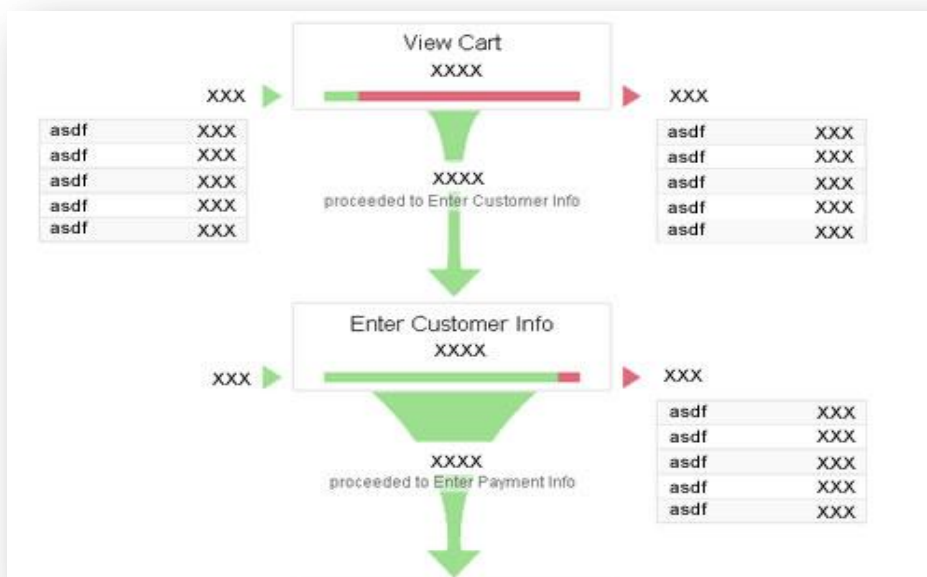


Figure 4-6 Funnel Visualization report

■ Annotation

Annotation is a function which allows administrator to add text to any of the overtime graph (C in Figure 3-2) about a specific activity with its time and person who made the annotation. For instance, one Annotation could be “new website redesign launch on January 1st of 2011 by IT department” or “new Facebook profile created on January 1st of 2010 by PR department”. Such notes can be read together with the timeline graph as shown below.

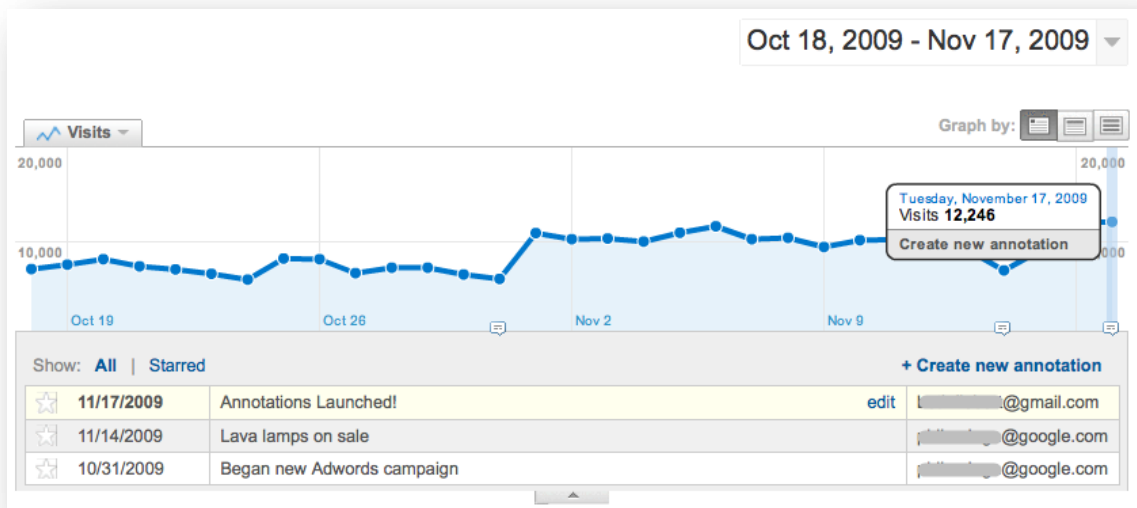


Figure 4-7 Timeline Graph with Annotations

4.2.1.2 Considerations for Purpose #5

■ Implementing and applying metric Goals

For most of the e-commerce websites, the most commonly used goal type is the URL Destination. Such application is used in the last page which often pops out in the final stage of a customer transaction. In terms of digital libraries, many of the desired goal set up by the digital libraries may be those mentioned in purpose #2 such as download a material. Libraries wish for such implementation would also use URL Destination for goal set up. But first one must use Virtual Pageview, and not Event Tracking, to first enable GA to track those in-page action which does not generate any pageview records at the first place.

And compared to most of the e-commerce websites which exist to increase user transactions, digital libraries often exist in a various forms for a wide mixture of purposes, making defining goals for web analysis a potentially challenging work. Moreover, not all digital libraries have a specified

goal ready to be evaluated when starting the assessment of impact on usage statistics.

In this case, it is important for the digital library to at least have a list of defined purposes of its activities. This objective can be as general as “to create engaging content for the users”, which can later be translated into web analysis as to look at the engagement level of its visitors. Specifically in this case, the digital library may defined a more directional goals such as to increase the number of active users, to increase the time user spent on site and the pageview number per session. Those goals which is specified and quantifiable can be use as illustration in the second and third type of goals.

Similarly, another technique mentioned by Avinash (2010) is for organization to set up a list of macro and micro goals for the website. Macro goals could be referred to as those which are obvious, closed to the original library objectives, required many steps before user finally make it, etc. And micro goals would refer to those which is not the most obvious, or as those steps before the macro goals. As GA offers many possibilities on statistics reporting, these data can be overwhelming without a specific evaluative purposes. These macro and micro goals could serve as the guideline of what to look for during assessment and help keeping the librarians on track to focus on the most related data to its library while reading the GA reports.

■ Technical understanding

In addition to understand the needs and goals for the usage data evaluation, digital library may also need the knowledge of Regular Expressions (RegEx) in some of the scenario setting of GA. Though fairly user-friendly, to give more powerful, flexibility and user-defined variables, GA relies on the use of Regular Expressions, which are a set of characters one can use to match one or more strings of text, to help match the data and perform an action when a match is achieved. For example, if the library wish to set up a goal which has a dynamic webpage URLs, one inevitably needs to use Regular Expressions since there is no way one could define all the possibility for GA at the first place.

As mentioned in the literature review, many digital libraries may have restricted personnel as well as financial resources, it is therefore possible that the staff which is responsible for implementing and reporting web analysis has limited knowledge on computer science. Regular Expressions may not be the most difficult, but it requires logical understanding and real hands-on practice before one can truly master with confidence. Digital libraries should seek help through online resources not only to learn RegEx but also using tool which helps troubleshooting to double-check before setting up a goal with RegEx.

■ Providing context for comparison judgments

There are many different ways for one to conduct an assessment through comparisons. But without a specific goal to measure upon or a apparent counterpart like New Visitor versus Returning Visitor to benchmark on, libraries should try to apply their ingenuity and common sense for the industry to set up an extra context for the assessment to take place. One of the easiest way for comparison is by looking at the specific usage performance to the overall site average. For example, is the bounce rate of this webpage relatively low or high compared to the overall bounce rate of the site?

Other contexts one could provide for assessment are often involved with segmentation. For example to look at the performance of a specific Goal by segmenting the traffic by its traffic source, to see whether there is a distinct differences between performance of Direct Traffic, Referral Sites or Search Engines. And supposing the referral sites traffic is giving a large quantity of high quality visits, which of the referral sites is the largest contributor? And if Search Engines are performing less than optimal, which is the keywords that generate the less valuable visits?

Another high-level context would be the benchmarking against another similar digital library. Such information in the commercial industry would be referred to as “Business Intelligence”. In the online e-commerce industry nowadays, it is most likely possible to find another comparative competitor for benchmarking. The problem lies largely on the difficulty of obtaining such information.

For digital libraries, information may be easier to obtain as library statistics especially though of the public section seems rather open, available and less sensitive. However, not only for some niche market digital library it could be hard to identify another digital library with the similar purposes, collection content or size for comparison, also one should consider the value of such competitive information to a digital library. Since many digital libraries are more inclined to search for cooperation rather than competition, whether this practice is really practical and useful to the context would really in the end opt to the purposes and choices of each individual digital library.

■ Observing and comparing trends overtime

In addition to the above mentioned context, another commonly seen comparisons is by utilizing the variable of time. This can be done either by comparing two periods of time or by looking at the trends over timeline. In GA, most of the reports are equipped with the overtime graph (C in Figure 3-2), and through visual comparison in the Total Conversions report, one can see the trend of conversion overtime to find irregularities or particular peak or dip in the graph. In addition, it will be most optimal if one is combining the trend observation with the function of Annotation to explain the spikes and dips in the trends such as understanding the dig happens around the time with the Annotation of “school vacation starts”.

As for comparison data between two different periods, one can use the Date Range function (B in Figure 3-2) to compare the differences. For example, a digital library designed for students in high school may want to track how the goal conversions differ and how much it varies between months of school time and summer or winter vacations. Or to see whether there is a noticeable difference between usage on weekends and weekdays.

However, some of the comparisons may not be so easy to operate as GA allows administrator in comparing two time period but not so flexible as to compare weekends versus weekdays traffic. And it is also advised to eliminate as much variable as possible during comparison, for example to line up the days of the week such as compare a Monday to another Monday, or months of the year as looking at January 2011 with January 2010.

■ Applying Funnel Visualization report

Most of the e-commerce websites have a structured experience before the ultimate tracking goal. For example, the checkout process (Funnel) to its purchasing transaction (Goal) are often time a one way channel which customers either get out the process or keep going. Even in many which allows user to go to the previous step, the user experiences before the final checkout is restricted in a defined path. For GA, the Funnel visualization report is designed for such environments to see which step of the checkout process is the least appealing to its users, namely the page with the highest drop-off rate. This could help to see possible improvement in its webpage design and increase the completion rate for those who started the process of goal conversion.

However, on reflect to its designing purposes for ecommerce, only Step 1 of the Funnel can be checked as the “Required Step”, and the count of goal in the final goal conversion report is never effected by the funnel setup. In other words, if two goals are exactly the same, no matter how different their funnels set up are, the final number for their Goal Conversion would always be the same.

Moreover, for websites such as digital libraries which uses little or no clear linear path to its goal, the report could be confusing. For example, to see whether a search or browse function (two funnels) of the digital libraries lead to more downloads (goal conversion), one would first see the same number of conversion for both goals since they share the same URL Destination. In addition, the data in Funnel Visualization could be chaotic as in a non-regulated checkout channel like digital libraries, visitors are allow to enter, exit or start from any step of the funnel toward the URL Destination goal. And even with a required Step 1, as long as users hit the Step 1 page and the final URL Destination page, visitors would always be counted in the funnel even when they actually omit the middle steps set up in the funnel. In other words, GA will automatically backfill the missing steps for consisting a goal completion.

4.2.2 Purpose #6 – Assessing Impact on User Groups

Before starting a company or launch a product, one must first understand the market and decide on its potential customers. Similarly, each digital library exist for a purpose and most of the collection has its targeted user groups. To see whether the reality is in line with the original objective and to see how accurately the marketing strategy is hitting its target, digital librarians need to investigate on visitors who are making the visits to its website.

For example, the British Library (BL) Learning Site has set its targeted user to teachers and learners of all ages, and to evaluate the accomplishment of such goal, BL may conduct an analysis on the relationship between the user groups and its collection materials to see whether the right collection is used by the designed visitor groups.

Compared to the traditional libraries where users can actually be seen, digital libraries have its visitors displaying through IP addresses in bits and bytes. Besides trying to relate the offline users profile to its online visitors, using a log-in system to match behaviors with the user-provided demographic information, or simply asking the users with qualitative approach such as interviews or questionnaires, some digital libraries in the literature review also attempted to use web analysis to identify user groups in order to help such impact assessment.

In purpose #5, the author has covered the possibilities and concerns of using GA to identify impact by tracking usage data. For this evaluative purpose, the identification of impact would be more focus on the visitor aspect, but some of the aforementioned aspects would also be combined together for the impact assessment on user groups.

4.2.2.1 Metrics for Purpose #6

■ New Visitors

As introduced already in purpose #3 for user retention, New Visitors are those browsers without GA cookie. And cookie deletion would make the user appear to be someone new, while multi-user on single device would make users appear to be the same person in web analysis.

■ Map Overlay

Being one of the most commonly seen metrics, Map Overlay in GA is a report showing the

geographical location of the browser which made the visit. In GA, Map Overlay report is located at the bottom right of the default Dashboard. And seen as below, at the first glance it is a world map using different color in spectrum to indicate the density of visits coming from different part of the world. Going further by clicking in the report, it could provide information in different detail levels including continent, sub continent region, country/territory and city.



Figure 4-8 Map Overlay report

■ Service Providers

Under the report section of Visitor within the left column of GA Dashboard, one can see Service Providers in the sub-section of Network Properties. And according to GA, this is the report that allows administrator to track the internet service provider (ISP) domains to which the user resolves. This information is gather by looking at the ISP which owns the user's internet protocol (IP) identifier.

■ Advanced (Table) filter

There are several methods one can use in GA to segment or filter data. An Advanced Filter beneath any report table is a function which provides user with an on the fly filtering function to a specific data table. Instead of having custom report or profile filter, and similar to Advance Segments, this table filter allows administrator to perform ad hoc missions with the already processed GA report.

Shown below is the Advanced Filter for the report table of Service Providers. Administrator can apply different metrics or dimensions with attributes to the data result shown in the original dataset in the table. For example, to see all the Service Providers which produce a Bounce Rate

lower than 30%, one can use the filter of “Bounce Rate less than 0.3”. Or to see only the Service Providers which generate a percentage of new visits more than 10%, the filter can be “% New Visits greater than (or equal to) 0.1”.

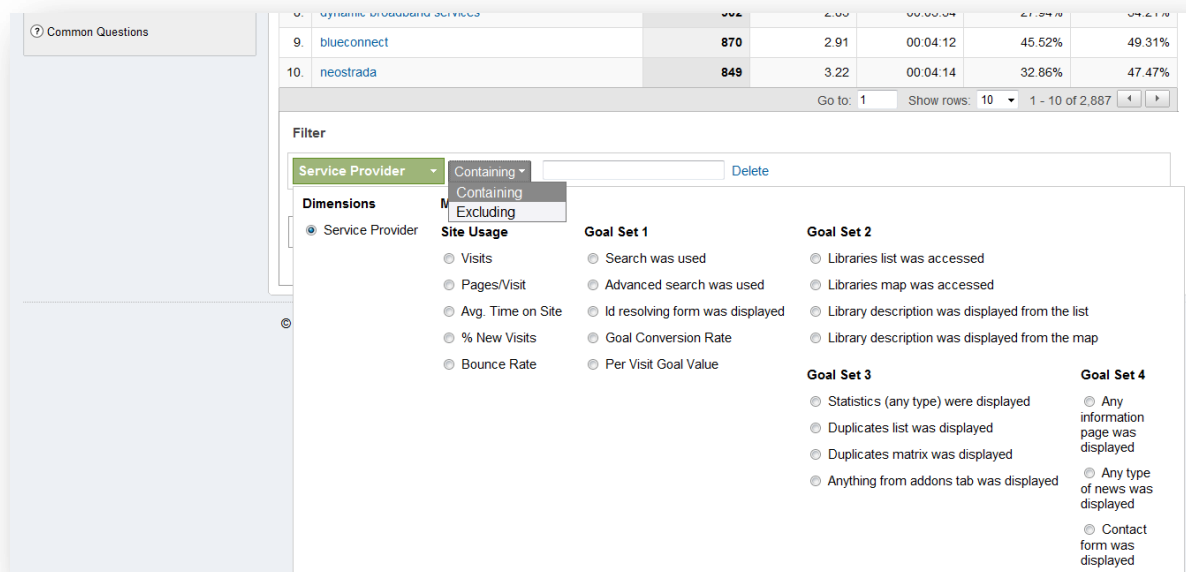


Figure 4-9 Advanced Filter for report tables

4.2.2.2 Considerations for Purpose #6

■ Applying the metric of New Visitor

When speaking of marketing strategy targeting specific user groups, one should also define whether the strategy and goal is more for the focus of visitor acquisition or user retention. In the optimal situation, one would most likely wish to achieve both by retaining the old visitors yet attracting more new comers. But in reality, it is almost always better and more effective to have a focus target for the effort. This would also enable a more straightforward assessment as there are less variables and the data comparison would be more accurate and easy to perform.

Many of the GA functions support to disambiguate newly acquired users from the retained returning, and in most cases one can view a specific report with traffic of all visits, traffic of New Visitors and traffic of Returning Visitors together in the timeline graph (C in Figure 3-2) for comparison. Such function are for example the Advance Segments discussed in purpose #3 for user retention, or the Advanced Table Filter which would be introduced in the next section. However, one should yet again be reminded of the restrains in digital libraries environments. The flaws of inaccuracy for unique visitor counts could be more skewed for the public computer users.

In addition, through looking at the trends and statistics related to New and Returning Visitors, digital libraries may gain some unexpected insights which help to better its marketing strategy or other aspect. For example, a digital library with a large quantity of collection materials and many complex interface features such as PubMed may realize most of its conversions were made by the returning visitors through looking at its historical statistics in web analysis.

With this in mind, the digital library could go further to investigate the reasons of the phenomenon and may find out that the interface is too sophisticated for first-time visitor and would actually need some education before users get acquaintance to utilize the whole features. This findings may lead to experiments and interface redesign, or the digital library may decide to enclose help guilds or on-site tutorials about specific features in certain webpage.

In another exemplified scenario, a digital library may realizes that its new visitors are also making the conversions, but the number of the new visitors are not yet optimal. In this case, to promote the site to as many new visitor as possible through various channel could be the marketing strategy for getting a better goal accomplishment.

■ Applying Map Overlay

The most common approach is to use the accessing IP addresses for user information. For example, geographic locations of where the visits are being made. In GA, Map Overlay report in the default Dashboard provides location information in different detail levels including continent, sub continent region, country/territory and city. This single metric may not seem particularly interesting, but it may be potentially helpful when seeing together with other metrics. By default, GA puts five most commonly seen metrics such as Time on Site, Bounce Rate or Pages/Visits, etc. alone with the map overlay report. Administrators could also use the drop-down menu of the table to choose other metrics such as the library-defined goals mentioned in purpose #5.

In the case review in chapter two, one of the NSDL digital libraries was keen to find out the impact of the workshops it hold in some specific regions. They compare the usage data of different cities using web analysis and was glad to see on the record that more visits are indeed coming from those areas which they had been working on. This can indicate the success of those workshops as they effectively reach its targeted audiences.

Another functions provided by GA is to look at the data in different formats. Among them, Comparison looks at the five basic metrics against its site average counterpart using a green or red bar to indicate plus or minus differences. Shown as below, this visualization helps library administrator to identify locations which the website is popular and areas that still have room for

improvements with a glance. For example, a digital library aiming to promote European culture to the world can compare information at a continent level to see its main users are in fact largely coming from Northern Europe and North America.

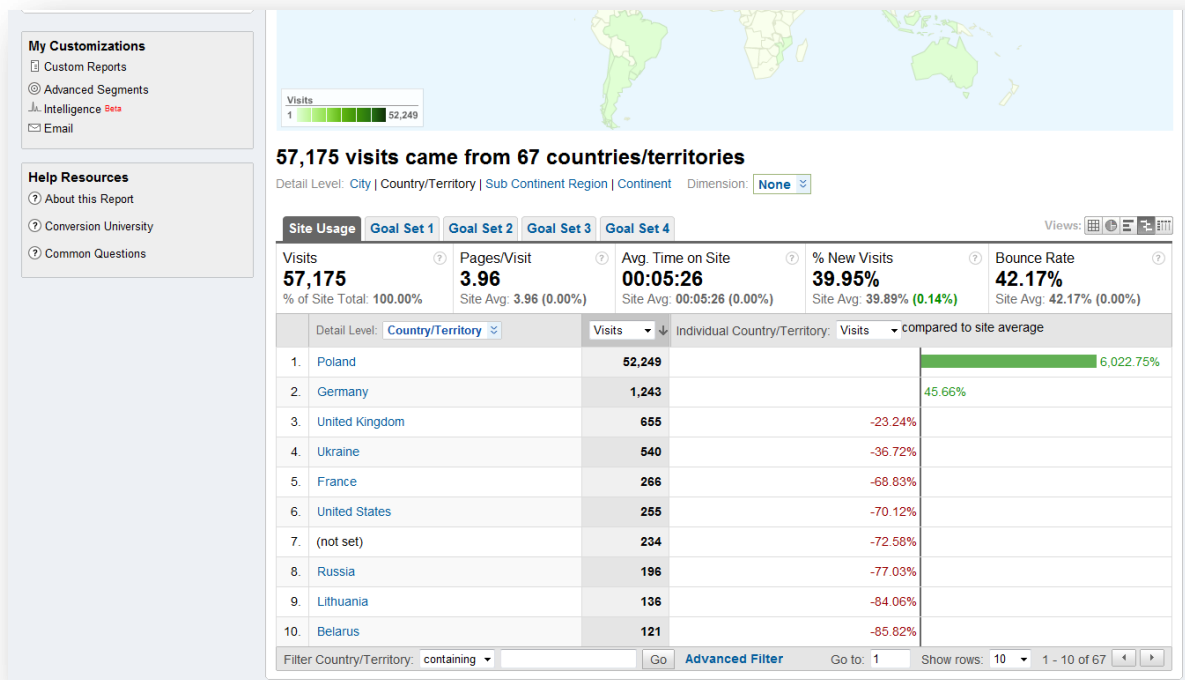


Figure 4-10 Comparison format presentation

■ Applying Service Providers report

Besides assessing impacts by geographical locations, many digital libraries are designed for scholarly used and educational purposes. For those websites, it is reasonable to expect users to access the digital libraries through an academic network infrastructure.

In GA, such information is provided under the Service Providers report. First look at the data, one will most likely see a lot of different ISP being displayed. But using the Advanced (Table) Filter, one can set to Filter Service Provider with any ISP that has the word of university or college inside. The value of the filter would be “universit | college” in this particular instance, with the sign | used to represent OR in the filter function. Similar to the table of data in the Map Overlay report, next to the displayed list of service providers, one can also compare the five basic metrics between different service providers for traffic quality of each. In addition, one can also use such data to compare with the site average for benchmarking.

Last but definitely not the least, libraries should be reminded yet again about the multi-user single device inaccuracy. Especially if the administrator specifically isolate the traffic coming from university or college service provider just as in the example. For privacy security reasons, most of

the public computers in the campus and library has set its browser to disable its cookies. Therefore, any visit would be seen as a new visitor to GA from such system. In this case, libraries should avoid reading statistics related to the count of visitors since the number will be most likely inflate in correctly.

■ Data Drilldown

Some web analyst are arguing that the geographical locations as well as the network providers of the visitors are information that is nice but not necessary to know as the data seldom provide the actionable insights for many businesses. Indeed, compared to ROI or revenue index, such reports may seem to have less value or lack of the urgent push for the company executives.

Nonetheless, depending on the nature of the websites and business, further drilldown can almost always provide some useful information for the company. For example, after knowing that Europe is its biggest visits provider, one can go down further to see which part of Europe and which country that is. And putting many different metrics together with geographical, one could understand better when illustrating heavy or light user profiles. Or in some cases, using the ISP list, one can also see whether the competitors are visiting the company's website or not.

In examples of digital library evaluation, using GA report to judge the impact on geographical or institutional-level are doable. But to be able to assume which visits were made by students and which by teachers would be quite challenging and less obvious. In addition, this information could be inaccurate since the possibility of many academic users are connected to the proxy server remotely. And as one should never just use web analysis information for making the absolute inference, digital libraries should always use other qualitative methods to cross-reference the metrics findings and results if possible and achievable.

4.2.3 Purpose #7– Assessing Impact of “Brand Awareness”

In the marketing world, there are many different types of branding such as concept branding, commodity branding or in the most straight forward and obvious form, branding using the name of the company. But according to Aaker (1991), a brand is also the identify of a specific product, service, or business, meaning a key product or services which made an impression as a trademark can also be valuable in terms of increasing awareness on brands.

For instance, to the company SONY, another branding keyword can be the name of its latest camera. And for digital libraries or any other institutions, such concept could also be translated into a set of keywords that one wish users to remember and connected to, such as British Library and a project it is running, BBC and one of the program it is broadcasting or Oslo University College and an annual international conference it is holding.

Found in the literature review, many new or old digital libraries were found to aim for the goal of “increasing publicity” to the market, or promote one of its new service or collection to the user. This is a similar practice to the brand awareness building in the business industry. Therefore, in the following section, the author will present some of the possibilities and downfalls of using GA to provide insights for assessing the impact of branding effectiveness.

4.2.3.1 Metrics for Purpose #7

■ Search Engine Keywords report

Already mentioned in purpose #3, Traffic Source Overview report gives one the idea of how visitors find and enter this specific website. Whether they come from another website (Referring Sites), through a search engine result page (Search Engines), by an online marketing campaign banner (Other) or by typing the URL directly to the browser (Direct Traffic), GA would always assign any traffic to one of its traffic source categories. And as seen in the Figure 4-4, the statistics of each traffic source can be viewed in number of visits as well as the percentage of each source’s contribution to the total traffic.

Within the overview report for traffic source, one can click further to segment traffic only from Search Engines. And by default, administrator would first see the list of Search Engines ranked by its contribution to the number of total traffic. But choosing from the top drop-down menu, one can also view traffic under Search Engines ranked by the Keywords user used to search and

entered the website.

The Keywords report, shown as below, allows site owner to look at the keyword that visitors search for to enter the website. The list of keywords would first come with other metrics related to traffic quality such the number of pageviews per session, its time on site, the proportion of new and returning visitor it consist of and the bounce rate of the traffic. And just as any other table report in GA, keyword report can be sliced and diced with Advanced Segments as well as Advanced (Table) Filter.

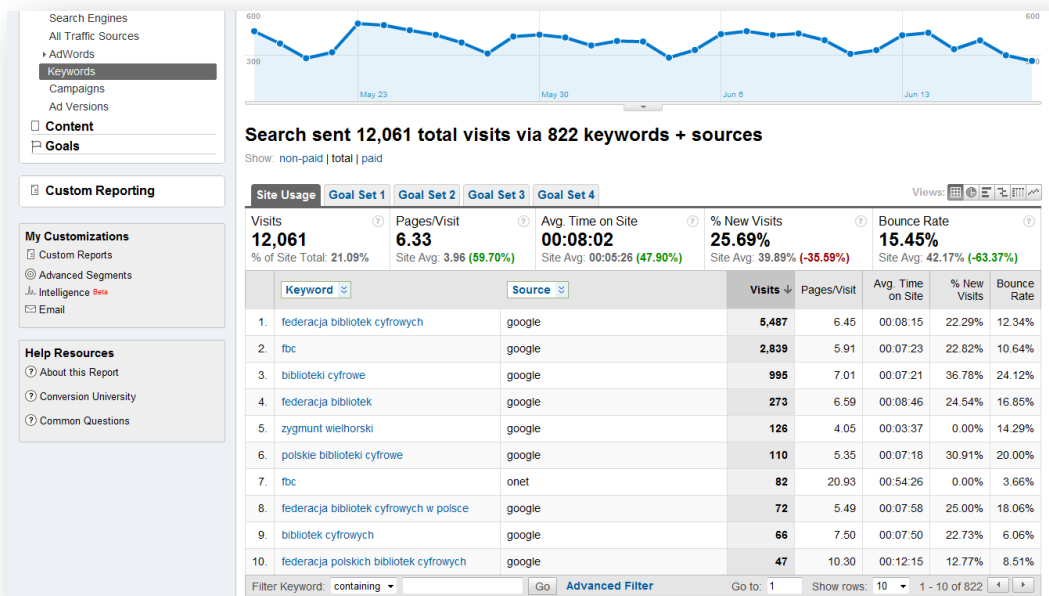


Figure 4-11 Keywords/Source report

■ GA Export function and Application Programming Interface (API)

Due to its privacy concerns, GA does not provide raw data to the site owner. But administrator are allow to use the GA function called Export to extract the statistics from GA for further integrations or analysis. Shown below the icon for exporting data are located on the top left of the timeline graph, next to other options of email, add to dashboard or visualize the graph as other forms. This option allows report reader to generate a separate report of the current reporting webpage into formats of PDF, XML, Excel spreadsheet or Tab Separated Values (TSV).

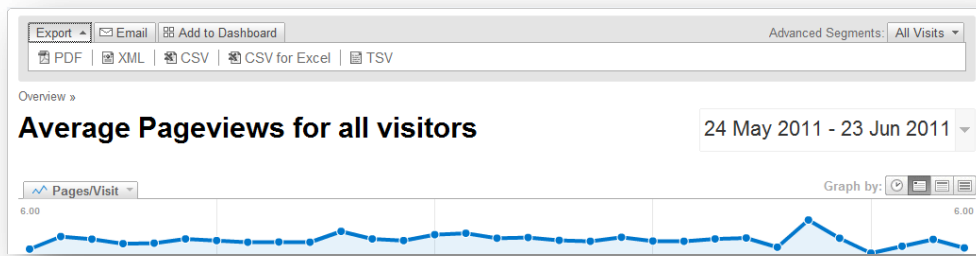


Figure 4-12 Export option (top left) above the Timeline Graph

However, as the above mentioned function could be limited to the display the 500 rows of data, another possibility of getting statistics from GA is through the use of any given GA Export API. For example an application called Excellent Analytics is a free application that administrator could download and integrate with his or her Microsoft Excel. Once being successfully installed, the administrator could use its Graphic User Interface (GUI) shown as follow, to querying specific dimensions of metrics under the given period of time from GA into the Excel spreadsheet. Though all the GA Export API are limited to 5000 rows of export, with pre-filtering and data cleaning within the GA report page, using any of the Export API would be the more optimal solution for obtaining data for its full list of record.

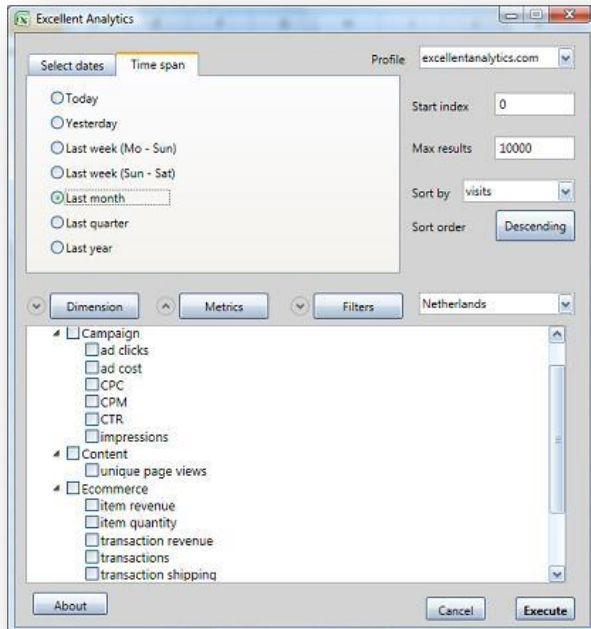


Figure 4-13 Excellent Analytics Configurations

4.2.3.2 Considerations for Purpose #7

■ Branding awareness in digital libraries

Branding marketing is a common activity in the business industry. The assessment of such efforts are often used to justify the spending of certain digital branding spending such as buying keywords in search result advertisements or paying to post marketing banners.

The terminology related to branding marketing may be less mentioned in the digital library environments. But in fact, looking at the literature review in chapter two, many digital libraries aim for “increasing publicity” of its overall brand or certain collection and services in its marketing efforts. For digital libraries, assessing such activity effectiveness may not seem as pressing as those in the e-commerce industry where there is a urgent need for monetary justification. Many still find it useful and beneficial as a support of accomplishment during planning of the budget or HR allocation.

In addition to justifying resources usage and cost, branding is also highly related to the online reputation management. For example, branding efforts in those libraries such as the British Library has most likely built up its positive impression and its high level of public awareness as well as recognizing of its users already. Since image possession is especially valuable to those which has established for a while, the significance in monitoring its branding performance to them has much to do with watching over its reputation and popularity in trends. As since a large amount of users of digital libraries are expressing, sharing and reading opinions on the internet, it is important to take advantage of positive comments as well as watching over signs of negative sentiment to prevent further spreading.

As for those digital libraries which just recently launch a new feature or even newly-established, observing how people are getting the news and accepting the service of the digital library would be valuable in assessing the marketing efficiency or even its service quality.

■ Applying basic Keywords report

Evaluation for branding effectiveness could be rather tangible and even through user surveys such result of success could be hard to estimate sometimes. Such evaluations are often carried out through various methods and channels, including looking at the branding ranking in the industry, collecting news and PR appearing as evidence or looking at the basic metric such as the increase number in number of visits, etc.

Among them, looking at the Keywords online users input in the Search Engine has become one of the most direct evaluation evidence for branding effectiveness. No matter the business is online or offline, visitors nowadays utilize the power of online information exchanging more than ever. Especially for digital library which based itself on the virtual world, to track search engine keywords would be a valid proof for evaluating branding impact.

Such information can be seen in GA with its Keywords report. Librarians could first view keywords ranked by different metrics. Then using Advanced Segments as well as Advanced Table Filter, one can focus the observation and analysis on a specific keywords such as the overall branding or product branding.

For example, the British Library can input its overall branded keyword “British Library” to look at its variations and found that many people search with a query of “British Library Catalog”, “British Library Learning” or “British Library BL” to find out that the most recognizable or popular service to the British Library is its “Learning Website”. Moreover, looking at how users search could also give an idea of whether the intents or the users are in line with the intended image and goals of the digital libraries.

■ Applying Keywords report for investigation

As shown above, using the keywords report, libraries can not only observe the trends of keywords but also use it for inferring user intents. However, to measure the real branding successfulness, it is perhaps even more important to look at the performance of those traffic.

Mentioned in purpose #6, most of the GA report table come with the ability to display basic metrics along with each result in the report list such as Pages/Visit, Avg. Time on Site, % New Visits, Bounce Rate, etc. In the Keywords report, it is also advised for libraries to look at those basic metrics attaching to each keyword.

For example, to look at whether the keyword “British Library Learning” is really bringing quality visitors matching to its content. Are those visitors lower in bounce rate? Are they more engaging in the use of online collections? Do they have a higher percentage to become the member of the library? What is the percentage of visits from this keyword that eventually sign up one of the activities hold by the library? And do these visitor, over the time, shows a higher loyalty as well as recency?

The above questions are all possible for investigation as well as being the proof for evaluating the effectiveness of branding strategy. It is of course most optimal when there is a specific goal to

achieve as the success or failure would be more obvious and measurable. However, throughout the literature review, most of the branding objectives are more on the side of “comparatively speaking”. And for those branding efforts, the more evidences the library pushed to gather, the stronger and more accurate the support for assessment could be.

■ Over- time observation

The importance of using time as a variable for comparison and impact assessment has already been stressed in purpose #5. But when conducting impact assessment or marketing effectiveness, one should also realize that the accomplishment of such may not always appear immediately. For activities such as library-held conferences or advertisement campaigns which aim to promote a particular keyword or product, the surge of traffic may correspond more or less with the activity period.

However, for a concept building or to measure a long term success, digital library should use the Date Range function in GA to observe the trends with a bigger time span. For example, include an earlier historical statistics to enable the observation of growth over time, collect statistics two weeks to one month after the campaign to track possible impacts, or check performance regularly for measuring the sustainability of success.

Libraries could also utilize some software for such observation. Shown below, Google Alert is a free tool that one can use to have email updates of the latest relevant Google results on a particular query or topic. For example, the British Library may subscript to a weekly alert on the branded keyword of its latest conference for monitoring any related news or PR mentions on the internet, or observing how the crowd on Facebook or Twitter is catching up the information and whether the sentiment toward is more positive or negative.

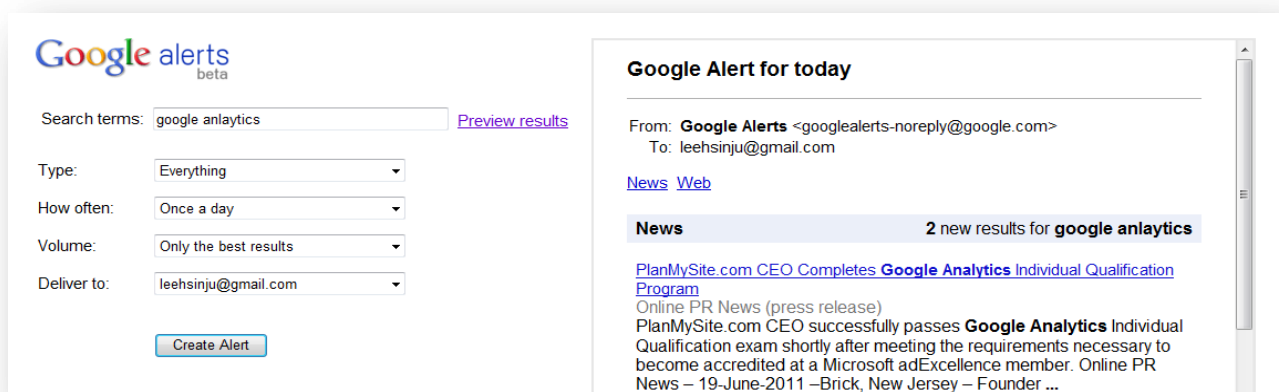


Figure 4-14 Google Alert set up and preview

4.2.4 Purpose #8 – Assessing Performance from Other Channels

The most common and basic web property for a digital library is its main website where visitors come to find materials or use the services. However, many of the digital libraries have also adopted the use of other online channels or communication means to engage its users. In a wider definition, this could be the digital library blog, its RSS Feed, or its profiles in the social media networks such as Twitter account or a Facebook group.

There are two common methods in measuring the performance of other online communication means. One is by looking at all the factual statistics which is obvious in figures, such as the number of followers on Twitter, fans on Facebook, subscriber to its RSS feed. The other one is through looking at the user behavioral aspect, such as investigating which of the social media marketing efforts is driving the biggest traffic, whether the channels are providing high quality visits, what are the difference in usage patterns and user characteristics from different online platforms.

And in terms of evaluating the effectiveness of online platforms, one can either look at the overall contribution of the channels to the digital library traffic, or the impact of the marketing efforts set up by the digital library on those channels. For example, a digital library may create a fan group on Facebook to engage conversations with its user or register for a Twitter account to provide the latest updates. Those efforts are initiated by the digital library and can be seen as part of the marketing strategy activities. However, traffic could also occur when a user made a positive comment on his or her own Facebook wall, or when someone retweets the Tweet of the digital library. In those cases, the result would be considered as more organic in oppose to the purposive activity effort of the digital library.

In the following section, the author will look at some of the possibilities and limitations of GA in the purpose of using it to provide insights into the impact of the aforementioned online channels for digital libraries evaluation.

4.2.4.1 Metrics for Purpose #8

- Referral Sites report

Apart from the other two reports, Direct Traffic and Search Engines reports, that were introduced respectively in purpose #3 and purpose #7, Referral Sites report is another report apart from the within the Traffic Sources Overview. The Referral Sites report shows a list of websites which drives

the traffic to the website. This include the non-defined marketing links, the traffic from the other sister libraries, from people’s blogs, from all the social networking websites, etc.

As shown below, the report format is the same with its counterpart, with the graph telling the overall trends by timeline and a table of list showing the result of the sites. Following each Referral Sites, one can see the default combination of the five basic metrics. However, using the various functions such as Advanced Segments as well as the Advanced (Table)Filter at the bottom, one can slice and dice the data by different dimensions and metrics, or by showing different metrics instead of the five default attributes, such as the library-configured Goals.

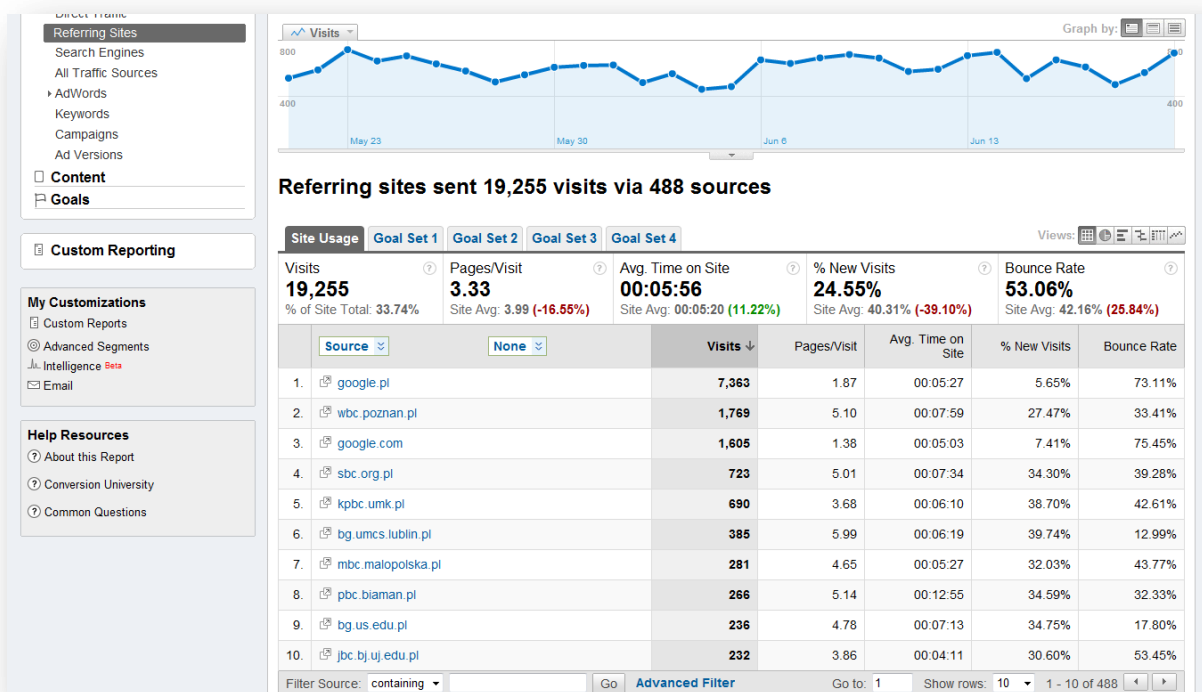


Figure 4-15 Referral Sites report

■ Custom Reports

Custom Reports is a report section which is separated independently from the other part of the report in the Dashboard. Before setting up any custom reports, one can use the Custom Reporting to start the process. As one of the functions for user customizations, custom reporting in GA allows users to build custom report to display the dimensions and metrics that applied to one’s specific situation.

In the definition of GA Custom Reports, metrics , which is presented at the column of the custom report, would be better referred to as the measure on how visitors interact with the site. And dimensions, which will be the rows of the report, is more for describing the characteristics of a

visitor or the characteristics of the site which the administrator can use to organize the metrics.

Shown in the following screenshot, when building a custom report, libraries can drag and drop several different Metrics such as Unique Visitors, Bounce Rate, Goal Completion, etc. and then slice and dice the metrics by different layers of Dimensions such as by Visitor Type (New or Returning Visitors), Traffic Source, Country/Territory or any other custom variables. Moreover, for a higher perspective, each customized report page can be seen as a separate report under different Report Tabs.

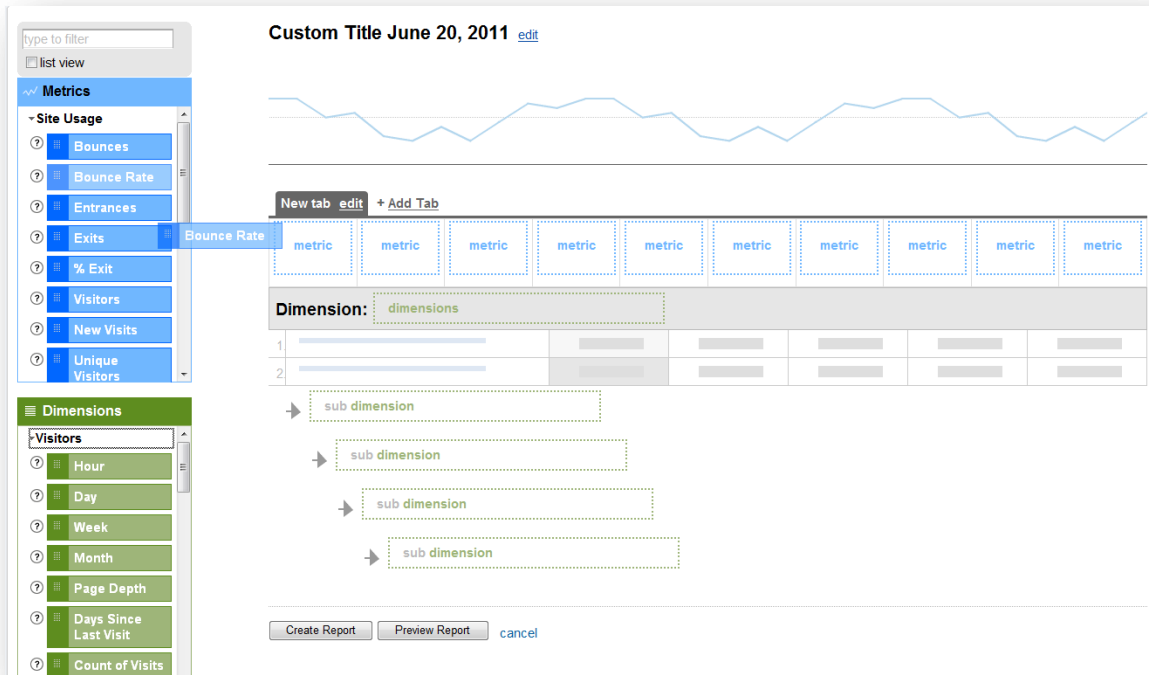


Figure 4-16 Custom Report configuration page

4.2.4.2 Considerations for Purpose #8

■ Applying results from Referral Sites report

The simplest way for starting the investigation on the overall contribution of a specific website such as the Facebook, Twitter, Wordpress blogs, StumbleUpon, Delicious, etc. is by looking at the records in the Referral Sites report. But instead of looking at all the results, using the Advanced Filter under the report table, libraries can isolate one or more specific traffic sources. This practice is similar to the Advanced (Table) Filter which applied to the Service Providers report discussed in purpose #6.

Specifically, to look at the traffic from the above mentioned media sources, libraries can create a table filter called “**Filter Source: containing Facebook | Twitter | Wordpress | Stumbleupon | Delicious**” to see only the traffic from those websites in the Referral Sites report. And since the table would display the basic metrics with each result line, libraries should once again segment and drilldown for better insights and explanations.

For example, after the filtering, the digital library could first look at the percentage of contribution from social media to the overall traffic for understanding the traffic driven ability of the social media website. Then by looking at the basic performance such as the bounce rate, the number of total goal conversion, the average time on site and pageviews per session, one can grasp the rough impression of the traffic quality.

■ Utilizing Custom Reports

The function of Advanced (Table) Filter mentioned above only allows the resulting report page to last within the report viewing session. So to see the same filtering report, administrator would have to utilize the function again at the next visit. The other on the fly function, Advanced Segments, works in the same way. On the other hand, Custom Reports give a longer lasting result as such practice basically create another customized type of report for the profile. Therefore it could be convenient to the libraries when there is a need for a regular reporting on some specific metrics.

For a clear walkthrough of this function, imagine an educational digital library wishing to know how its academic visitor (university and college users) perform and interact with the website. For fulfilling this purpose, the author has created a report named “Traffic Performance for DL” with a specified tag called “Academic Traffic Source”.

The screenshot displays a Google Analytics report interface. On the left, there is a sidebar with a search bar and a list of metrics and dimensions. The main area shows a report titled "Traffic Performance for DL" with a line chart for "Visits" and a table for "Academic Traffic Source". The table has columns for "Visits", "Bounce Rate", "Total Goal Completions", and several "metric" columns. A dimension "Service Provider" is selected, and a drill-down path is shown: "Service Provider" -> "Site Search Status" -> "Search Term" -> "sub dimension".

Figure 4-17 Example of a Custom Reports configuration

As shown above, the primary dimension here is the service providers as it includes the traffic from academic traffic source in its resulted list. And for monitoring the performance of these traffic, the author has picked to observe the number of traffic each source has brought in for the digital library (Visits), the quality of its traffic (Bounce Rate) and the outcome of its visits (Total Goal Completions).

In addition, beneath the primary dimension, the author has placed the sub-dimensions of Site search Status and Search Term. This means by drilling down to the Service providers, the administrator would be able to see how many visit has or has not use the internal site search facility on the digital library website, and if they did, what are the queries they inputted.

Shown below is the screenshot of the resulted report of such settings. And as the original primary dimension includes all the Service Providers, to see those particularly from the university of college, the author has also applied a Advanced (Table) Filter mentioned in purpose #6. It is possible, however, for one to use a customized dimension of just the academic traffic, instead of the Service Provider dimension. But as the creation of a customized dimension would involve the profile-based filter setting, the author would leave it to the discussion of purpose #11.

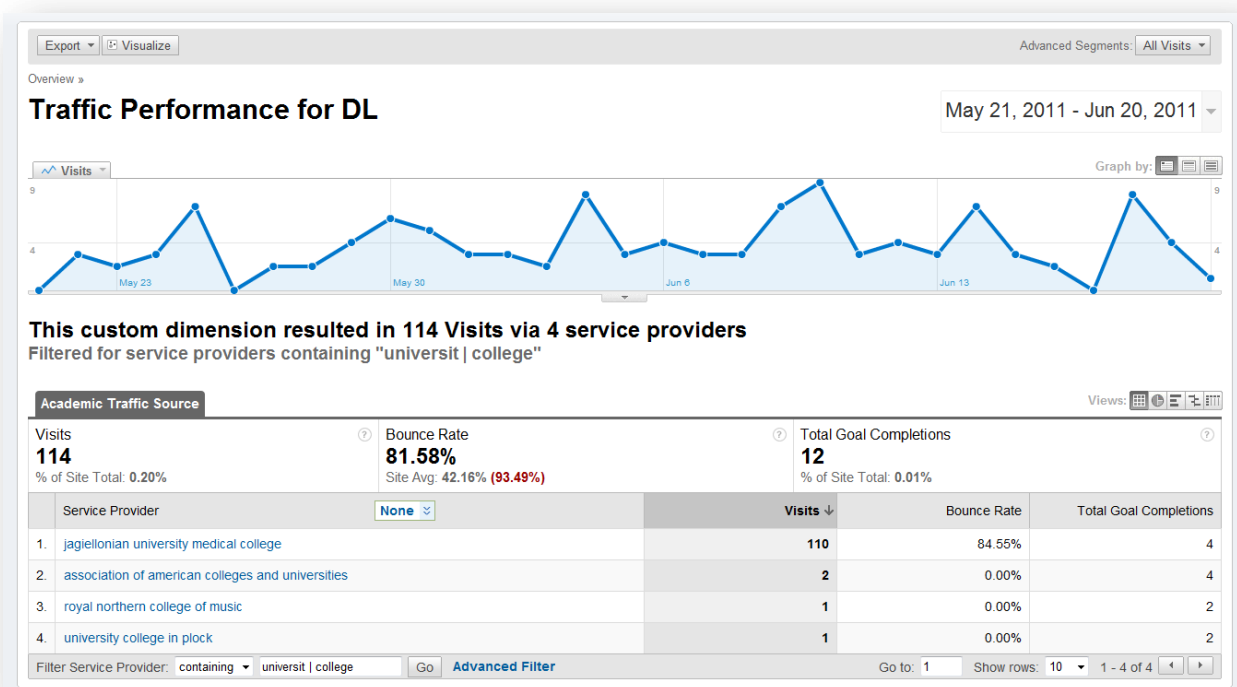


Figure 4-18 Example of a Custom Report

- Link tagging for different channels

As mentioned in purpose #2, the use of creating Virtual Pageview as well as activate Event Tracking on the digital library website could help tracking the number of clicks on a specific link. For example such technique can be used to track the click through number of the social network sharing links such as the “follow us on twitter”, “join us on Facebook”, “subscribe to our YouTube channel” icons.

Nevertheless, there are also some other forms of activity related to the social media that a digital library wish to track. Found in the literature reviews, many digital libraries which devoted its marketing through other social networking channels often want to find out the effectiveness of such endeavor. For example, how many visits of the sites are coming from the link posted on Facebook, or from the links within the Tweet.

To track down the source of traffic from the links of a specific Tweet or Facebook post, libraries can use another type of link tagging technique. It is performed by putting extra tags to the same URL for different online channels where the links are located. Literally speaking, the tags are several parameters which could be added to the same URL for recognizing its channel. The extra parameters will not make a difference to the resulted webpage of the URL, yet in the report of GA, one can see the different tags in the results. Such technique has some advantages compared to using the Referral Sites report. First, such tracking is focusing on tracking the efficiency of the efforts done by the digital library, instead of counting also the organic power of the crowd. Moreover, one is only tracking the users coming from the web interface with Referral Sites report, those from the desktop API or phone applications would be categories into the Direct Traffic source. With tagging technique, one can at least track users who click the links with the _utm variables through other devices more accurately.

In GA, the parameters are utm_source, utm_medium, utm_campaign, utm_term and utm_content. The first three parameters are mandatory while the latter two are optional. Respectively, Source can be the name of the platform, such as Facebook, Twitter or Wordpress. Medium refers to the type of platform such as social media, blog, website, etc. Campaign is a name assign by the administrator about a specific activity effort such as 2011BookClub, 2010ReadingList, or any given name from the digital library. To give an example, a link created for Facebook post which leads to the new collection webpage could look like:

```
http://www.digitallibrary.com/new-collection?utm_source=Facebook&utm_medium=SocialMedia&utm_campaign=2011Example
```

However, as such link can look messy on the Facebook post and its length would definitely exceed the word limitation of Twitter. For solving such problem, libraries can use one of the URL shorteners available on the internet. In addition, for e-commerce websites which use the service of Google AdWords, the creation of such links are automatically done by the system. As for digital

libraries, one can also try to use the Google Link Tagging tool to make the process easier and faster.

Finally with the All Traffic Sources report, libraries would be able to view the result coming from those tagged links. And using the Advanced Filter at the bottom of the table, one can input a specific source/medium combination for segmenting the dataset. This allows one to analyze flexibly on a single or more tagged links in the report.

■ Social Media Tracking Tools

As mentioned in the beginning of purpose #8, one can look at the web analytics data as well as the factual statistics of the online channels such as the number of subscribers of the RSS feed. And as more and more websites now utilize multiple channels, the need of keeping all the evaluative measurement statistics in one place is getting stronger and stronger.

For such issue, there are software available such as Twenty Feet, Media Watch or Next Analytics which allows administrator to look at all the basic data together, including the number of Facebook fans, twitter follower, total tweet count, twitter new followers, Facebook active users, Facebook wall posts, Facebook comments, new tweets on Twitter, etc.

In addition, some of the tools even provide simple analytics ability and automatic alert. For example, Twenty Feet uses different colors on icons in the dashboard information to represent 4 status of the data trends (greatly upward, slightly upward, slightly downward and greatly downward). This not only gives site owner the ability to quickly feel the overall performance of all channels, but Twenty Feet also use the category to send out automatic notifying email. For example, when the system detect a significant drop of the statistics number, the email would urge and request the administrator to conduct further investigation and give extra attention to the area.

However, as users most likely have to pay a monthly fee for the access of such service. For digital library, the more optimal solution would probably be to isolate and limit its tracking attributes to the critical few. Libraries can also use the simple EXCEL spreadsheet to record the factual number from the social media regularly and use the historical record for creating the trend lines over time for observation.

■ Web analysis for blog

Another commonly found web property for many organizations are the company blog. For digital library nowadays, blog may also seem to be one of the first steps many take apart from building its original digital collection website. Besides (a) looking at Referral Sites report for its contribution to the main site traffic, or look at the factual numbers such as (b) the number and content of the post

comments, (c) the number a post being reposted in another blog, Tweet on a Twitter or paste to a Facebook wall, one can also use (d) web analysis statistics to draw performance insights.

However, given the very different nature of a blog to a website, when applying web analysis statistics for interpreting blog performance, one should also have different considerations and use different measuring methods. For example, librarians could look at the New and Returning Visitors separately in terms Time on Site and Pageviews. As new visitors need to explore the blog, returning visitors may already read all the previous posts. In that case, a good traffic from new visitors could indeed result in longer Time on Site and several Pageviews on many historical posts, while for some of the returning visitor, the one-page view behavior or a shorter Time on Site metric could also be acceptable, since they may be just one the site to look at the latest post.

Libraries may engage in many different activities to increase the user engagement level on its blog, such as inserting hyperlinks to a certain terms, given extra incentives for the readers, embedded more rich media experiences such as adding a YouTube videos, etc. For measuring those efforts, libraries can compare the performance before and after, or look at the metrics of those specific elements or webpage to the overall site average to see if the endeavor is making the significant different that the libraries was hoping for.

Moreover, sometimes drilling down the report may reveal additional information or unexpected insights. For example, by looking at the peak hour of visiting plus the visitor quality in that hour, one could maybe result in a range of better hours for updating the content of the blog. Libraries should also integrate local knowledge into report reading. For example, by looking together and comparing the Visitor Recency data with library's frequency of post update on the blog and see whether the Recency data is healthy and optimal.

Finally, besides (1) Time on Site and (2) Pageviews metrics, librarians could also establish Goals for blogs just like the examination of websites. For example, a goal can be when a user (3) subscribe to the RSS feed, (4) leave a comment about the post, (5) click on the social media sharing icons, (6) register to a conference through the announcement post, or any other libraries-defined purposes. And depending on the information architecture of the blog, some of the goal tracking may need the set up of the Virtual Pageview (purpose #2), some may need to utilize the GA Goals function (RUL Destination, Time on Site, Pages/Visit) mentioned in purpose #5.

4.3 Theme # 3 – Assisting Decision Making

Illustrated in the literature review, digital libraries may utilize the evaluative data from its web analysis for diverse directions of purposes. Among them, the most commonly seen and mentioned deployment is perhaps for the inspection of a certain performance related to a past effort. An example of such evaluation would be comparing the final achievements of a endeavor with digital library's original expectations.

Besides such evaluative purposes, another common practice of many digital libraries is to take the web analysis statistics as evidence or hint for making inferences, or for assisting future planning on the aspect of interface or content development. In addition to that, one can also see the need of reporting for different level of authorizations and customizations.

The discussions for evaluative theme one and two have already examined GA's ability for making user satisfaction inferences as well as for impact assessment and performance evaluation. In the following discussions, GA would be reviewed and analyzed by its capabilities of assisting decision making as well as its flexibility of reporting to different levels of authorizations in the digital library. Such discussions are presented under the 9th, 10th and 11th evaluative purposes within this final evaluative theme.

4.3.1 Purpose #9 – Assisting Decision Making on User Interface

Pointed out in the first evaluative theme, it is crucial and standard for digital library to measure its user satisfaction. In addition to all the possibilities presented previously, another yet to be mentioned element that effects the user satisfaction is the “ease of use” of the user interface. And measuring such attribute about the website would not only help assuming the user satisfaction, but it could also be used to assist digital libraries in its interface designing or redesigning.

In the use of web analysis, such measurement can be looked at by the study of navigation analysis. Look into the relationship between the user usage data and their path of experience can help pointing out the weak spots in the navigation way as well as provide the potential insights into the solution of improving the interface.

In the following paragraph, the author will introduce some of the functionalities found in GA which help administrator to observe, record, and track user navigation information. And a discussion on the use and concerns of those metrics and statistics would be discussed subsequently.

4.3.1.1 Metrics for Purpose #9

■ Navigation Summary report

In terms of tracking user usage paths, there are many related reports in GA that support the analysis of navigation. The most commonly used are the Navigation Summary within the Content Detail report, the Top Landing Pages report and the Top Exit Pages report. All the functions are located under the report section of Content (Figure 3-2) with multiple possible paths.

As shown below, the Navigation Summary report is an overall review of the navigation paths of the user to and from a specific web page. It shows the percentage of visits that enter the website by landing on this page (% Entrances) and the percentage of visits exit the website from this page (% Exits), giving a general sense of whether the page is a common Landing/Exit page. The previous and next pages indicate the webpage within the website that the visits view before and after this specified URL. As URL can be difficult to reflect its actual page content sometimes, the link “Visit this page” in the report is a function that takes the administrator directly to the page by a pop out browser window.

In addition, there are also other reports such as the Entrance Paths, Entrance Sources and Entrance

Keywords reports, which is selectable by the drop-down menu shown in the figure as well.

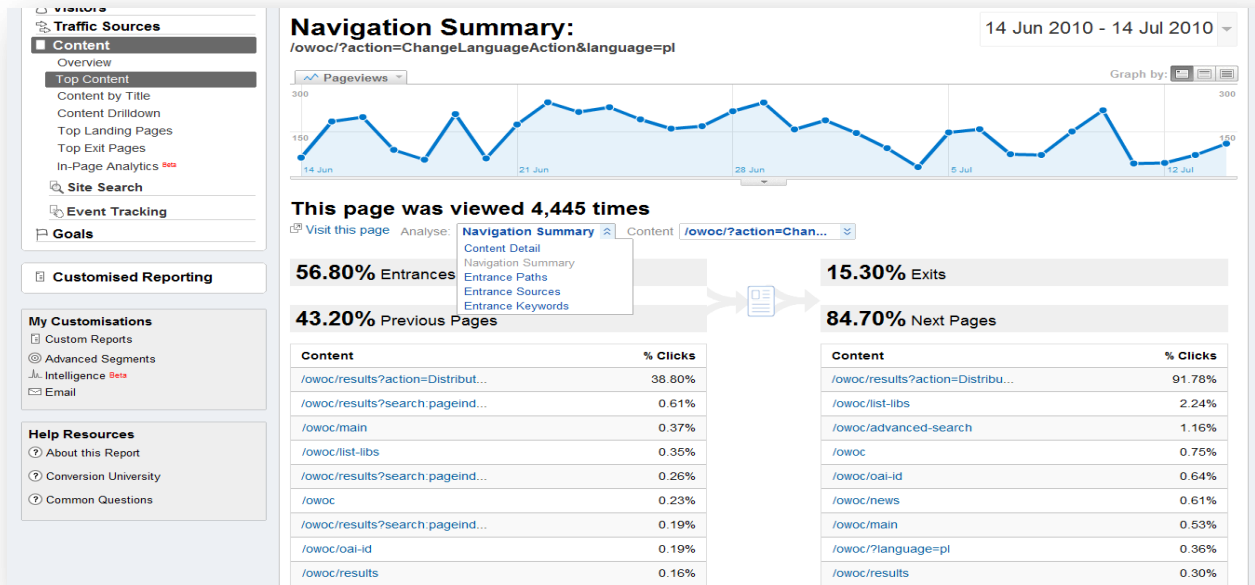


Figure 4-19 Navigation Summary and its drop-down menu

■ Top Landing/Exit Pages report

The two reports independently show a list of URLs of the first and last webpage that most visitors see on the website. By default the Top Landing Pages report ranked the URLs by the number of entrances it gets, and the complementing metrics are the number of the bouncing visit (Bounce) as well as the its bounce rate.

On the other hand, Top Exit Pages report is ranked by the number of visits that exit from this page (Exits), and the metrics that show along with it are the percentage of visits that exit from the page (% Exit) and the number of times that this page was viewed in all visits (Pageviews).

An issue worth noticing is the difference between Exits and Pageviews in the Top Exit Pages report. As Exits is a visit-based metric, one visit can only generate one exit counts. Pageviews of each exit page, on the other hand, is calculated as pageview-based so each visit can repeatedly generate more than one pageview for the specified URL.

In addition, besides the Advanced (Table) Segmentation, both tables also has another drop-down menu that allows report readers to add another dimension for further segment the results. For example, by choosing “Source”, the administrator are breaking each entrance page result further by looking at whether the traffic source of the visits are from direct traffic, search engine or referral sites.

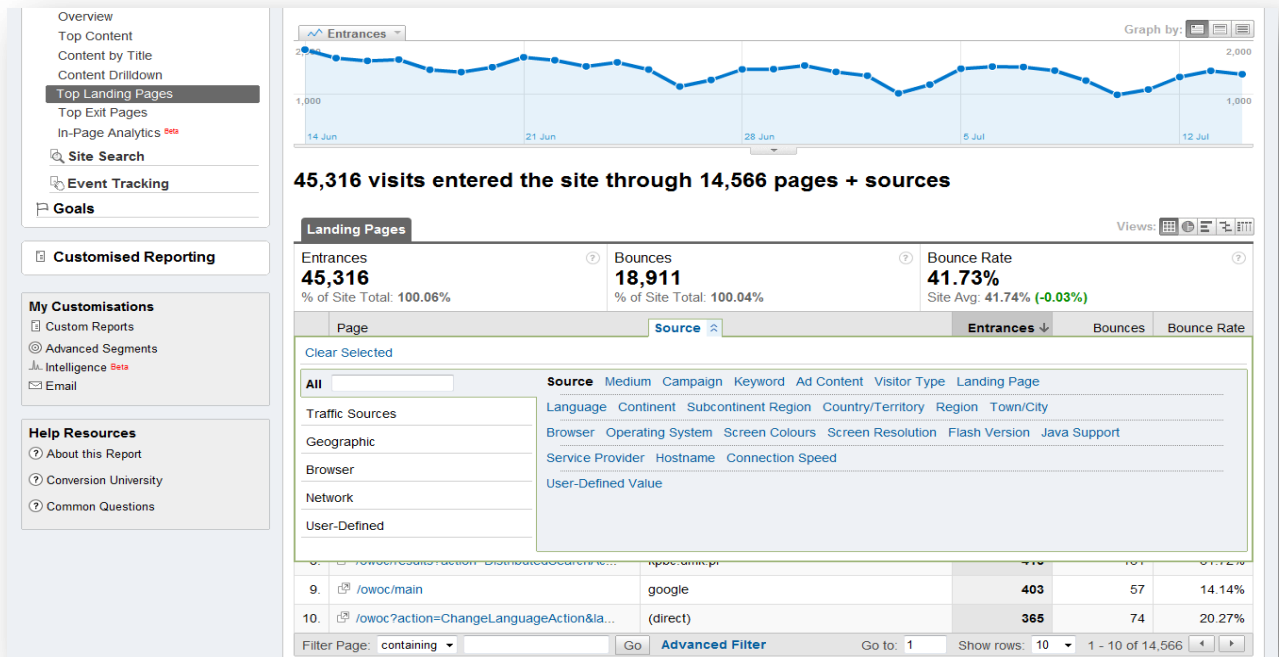


Figure 4-20 Top Landing Pages report and its table drop-down function

■ In-page Analytics

Previously named as the “Site Overlay” report, the In-page Analytics is a beta function that allows administrator to walk through the path and experiences of an users. Shown as below, the in-page analytics window first displays a specific webpage within the site. Within the window, each link within the page is shown with a sign containing the percentage of clicks that visitors made. For example, if there are a total 100 clicks within the page, a link which receive 4 clicks would account for the 4% of the total clicks.

Within the window of this report, one can navigate through all links and pages just like visiting a website. GA In-Page Analytics also divides the clicks of the whole page into “the upper folder” and “the lower folder”, referring respectively to the top section of the page and the lower part of the page. As most of the time when visitors enter a page, it is the upper part of the webpage that one would be seeing. Showing the number of the clicks in the lower side of the page shows the clicks are done by visits which is willing to scroll down the page and look at more of the content of the website. Such percentage, as shown in the figure below is demonstrated in the orange bar at the bottom of the window.



Figure 4-21 Example of an In-Page Analytics report

Further details of each clickable link can also be shown by clicking through the percentage signs and besides the click-stream statistics within the webpage, on the left of the window, GA also displays some extra webpage-level information. Each metrics could also be further drilldown by clicking on the mini-graphs. Such page analytics also has the common function of Advanced Segments and Advanced Filter. For example, administrator may apply such function to see only the links that account for 5 or more percent of the total clicks.

■ Browser Capabilities and Network Properties reports

Known as one of the most commonly collected information, the metrics data under both reports are all related to the hardware and software that the visitor possess on the accessing device. For example, the Browser Capabilities report shows all the collectable data about the browser that the user is using, including percentage of visits from each type of browser (Firefox, Internet Explorer, Opera, etc.), screen resolution, the Flash version it has installed, whether JavaScript is supported or not, etc. Compared with collecting information on browsers, the Network Properties report provides everything that is related to the user IP, including the name of its Service Providers, Hostnames, and its connection speeds.

4.3.1.2 Considerations for Purpose #9

■ Utilizing Navigation Summary report

Traditionally, libraries often devote a great amount of efforts into building collection development strategy. And after creating a focus and clearly-defined policy, the procurement staff also need to go through a selection process which involves all the necessary considerations such as provide a creditable grounds for purchase decision. With so much efforts and care in the collection building operation, one of the next required elements would be to ensure the effectiveness of content delivery process to the targeted users.

In the environment of a physical library, it is almost impossible to study users' "paths" of finding the borrowing items. But in terms of digital libraries, as online visitors do leave their digital footprints to some extends when interacting with the website interface, it is possible to reconstruct the experience with the use of web analysis.

In GA, the function of Navigation Summary is a supplementary reports to the Content Details report. Though listed not in the most obvious location, it is a fundamental metric for understanding at the navigation page of the users on the webpage base. And though there is no "Top Paths" report in GA, but by clicking through the pages with the highest percentage of clicks, one could indeed compose his or her own "Top Paths Report".

For some examples of how to utilize such report, libraries could first identify some of the pages that is performing significantly poor or well in their basic metrics. And by locating the Navigation Summary report for those specific pages, one could probably use the before and after webpage viewed by the visitors to draw insights and explanations. For example, libraries may look at the Navigation Summary report of a page with the highest bounce rate and realize it is a common Landing Page. And another look into its Entrance Sources report shows that most of the traffic is from the Referral Sites. With this piece of information, libraries could investigate further and maybe one would see the top contributor of the Referral Sites has a description that is irrelevant to the content of the digital library. Therefore, inferring to the explanation for why most traffic resulted in bounce.

To correct the above situation, digital libraries may have to ask the site to take down the link or provides it with the applicable description. However, sometimes the problem may be casued by the website design of the digital library. For example, libraries can identify web pages with a suggesting element of any significant call to action, such as the page designed for the users to "start the registration as a library member", to "begin the placement of a donation" or a page showing "the list of available activities" before event signup, etc.

By looking at the user paths of those pages, libraries can see how many users are actually following the suggesting routes. And if the route is not followed or even maybe users are dropping out of the process in a certain pages, one should investigate better into the cause on the specific page. This

examination can not only help in evaluating the design of the original intention, but one may also gain some unexpected information about how users are actually navigating the site.

■ Utilized Reverse Goal Path report

Another functionality that also enables the tracking of user paths is the Reverse Goal Path report. This is provided under the section of Goals (Figure 3-2). And as shown below, one can see the paths that users take to reach a specified goal. This could probably be another substitute for the absence of “Top Paths” report in GA, but the scope of its reporting is only focus on the Goals that has been defined by the administrator, not on all the web pages like the Navigation Summary report. In addition, compared to the Funnel Visualization report introduced in purpose #5, Reverse Goal Path report is limited to showing only the paths of those which successfully reach the goal.

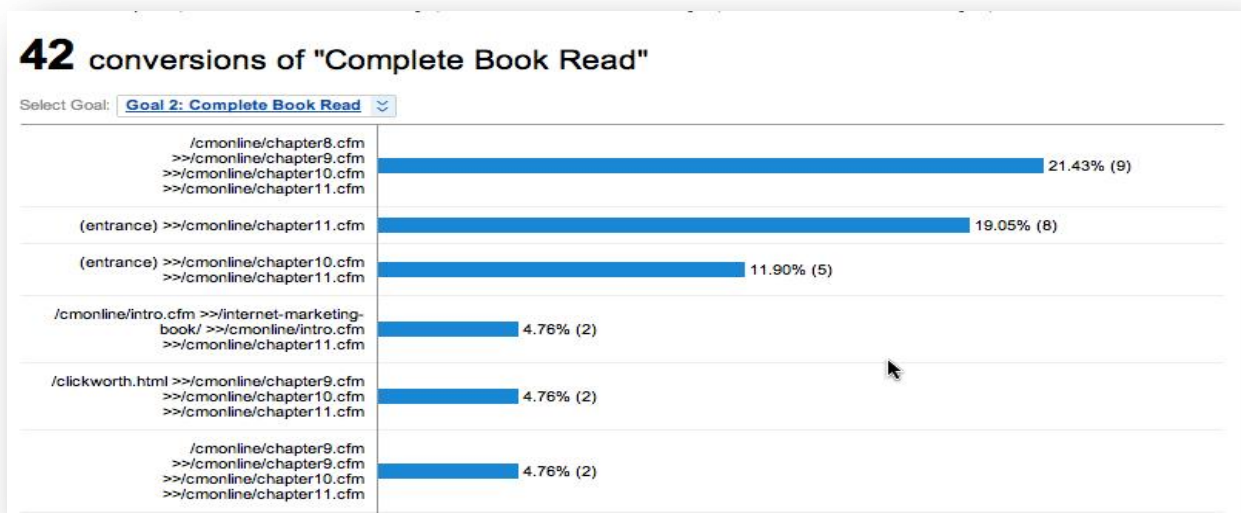


Figure 4-22 Reverse Goal Path report

And though Funnel Visualization in a sense provides more information, since as long as a user started the steps in Funnel, its counting would start. And with Funnel Visualization report, one can also see the abandon rate of users in each step of the path. However, as the backfill function could really post a big hindrance to websites that has not a clear structured one-way navigation path to the goal. Digital libraries could maybe benefit better from looking at the Reverse Goal Path.

For example, for determining the effectiveness of functions to support its redesigning planning, a digital library may like to track whether the basic or the advanced search function is resulting to more DPF downloads. And for such purpose, one can first set up a goal to track such downloading action and by looking at the Reverse Goal Path of the goal, one can reconstruct the user paths for reaching a download action and as a result establish the comparison of effective between the two search functions.

However, as there is no function such as the Advanced (Table) Filter that comes with the Reverse Goal Path report. To perform such task, libraries may have to look through all the records and do the calculation for the comparison between basic and advanced search manually.

■ Utilizing Top Landing/Exit Pages report

As explained above, the Top Landing Pages report shows the first page a visitor see when entering the website. And as the first impression, the image of this page as well as its effectiveness in performance would inevitably effect the whole user experience. Moreover, in a digital environment which every alternative is just a few clicks away, the landing page of the digital library also plays a crucial role in retaining its visitor.

Looking at the bounce rate of each URL in the report is probably one of the easiest ways to infer user retention ability. However, as illustrated in purpose #2, for digital library it is very common that users to find a specific metadata page of the content form the search engine result. And such practice by default, without a virtual pageview tracking to the link, would often result as a Bounce. Digital libraries should therefore look deeper into the type of the particular Landing Page as well as its Traffic Sources report before concluding whether the high bounce rate is a negative indicator or not.

In addition, to exclude those potential visit in the above mentioned situation, one can apply the Advanced Segments to show only the Non-bounce Traffic and once selected, administrator can start the investigation on its pageviews, time on site, goals completion rate, etc. of each pages.

Similar to its analysis and interpretation, the Top Exit Pages report always needs some further investigation. It is important to see the real content of the page to determine the possible reasons for users to exit. Libraries could look through the report for finding the page URLs that are not suppose to be as the Exit Page. For example if the page just before the completion of a specific goal has a high exit rate, one may investigate on why most of the visitors drop off from that page in the process. Maybe the message for the next step is not clearly presented, maybe the navigation or the design of the page is too complex, or maybe the registration form in the page is too long.

■ Utilizing In-Page Analytics function

The uniqueness of In-Page Analytics lies in its ability to provide the exact context and content in analysis. As mentioned above, such function creates almost an independent browser window that allow visitor to see all the data and statistics linking to its actual content and its presentation format. Such function is closed to the “Visit this page” link in the Navigation Summary report, but

even more user-friendly and apparent.

It is very important to have the “Visual Context” during evaluation of the statistics, as the authentic context often offer more explanation and insights than its click stream statistics. And similar to the technique Navigation Summary, libraries could first indentify through looking for the links that perform outstandingly well or usually poor, and by looking at the context it fit in to infer the effectiveness of its page design. Or by clicking through the link to see where the users are going if click through the link. Maybe the link does lead to a content that belongs to the niche market, therefore it could be acceptable when the number is not as high as the others, such as the site average shows in the aggregated statistics within the left column of the In-Page Analytics.

If there is a desired user navigation path in the digital library, one should also try clicking and walking through those “primary route” to decide on its performance based on the statistics in the context. Maybe the usage number is following the expectation at the beginning of the route, but the number drop dramatically at one point. And this phenomenon could lead to a investigation to reasons. And as for the function of showing the percentage of clicks in the “upper and lower fold” of the page, since many digital libraries’ pages have the actionable element on the upper fold of the page, like the “download this material” link in the metadata pages, such proxy may be have more immediate insights to other web environments such as blog sites.

One of the drawbacks from the report is that for two independent links which lead users to the same next page within the same page would have the identical percentage of clicks in the In-Page Analytics report. For those who wish to see whether the RSS Feed button works better at the bottom of the webpage or on its sidebar, the report would not provide the answer. Therefore, for such measurement to the question, one can utilize the function of Virtual Pageview of Event Tracking. And since Virtual Pageview would inflate the pagview, for the pure purpose of comparing location performance, the author will discuss the method using Event Tracking.

■ Deciding link position by experimentation

Introduced in purpose #2, Event Tracking is a function that one can utilize to track the click action of an in-page element. And in terms of website interface designing, digital library can also utilize such possibility to inform its decision maker. Looking through the literature, one of the most obvious and common examples is the question of whether a link would work better when it is placed at the top of the webpage or at the bottom. And such dilemma can solved by doing a web analysis traceable experiment.

Following the same example, imagine a digital library that has two identical RSS feed buttons placing separately at the bottom and the left navigation column of the webpage. For each

individual link, the library can create an Event Tracking tag that named with its specific position, and use the differences to track its usage for determining which is more effective. As a specific instance, the Event Tracking tag for the icon at the bottom can be set as:

```
<a href="http://feeds.feedburner.com/digitallibrary" onClick="_gap.push(['_trackEvent', 'footer', 'follow', 'RSS']);"></a>
```

, while the icon in the column can look like:

```
<a href="http://feeds.feedburner.com/digitallibrary" onClick="_gap.push(['_trackEvent', 'sidebar', 'follow', 'RSS']);"></a>
```

.

Such example shows the possibility of getting more out of GA using the power of experimenting. Indeed, one of the biggest advantage of online statistics is the speed for gathering enough sample is way faster compared to the traditional environment. However, as experimenting is an advance practice of using GA, there could be more to consider in reality, depending on the type of implementations. And in this specific case, the differences in the result could also be not significant enough for making a valid decision for the digital library.

■ Browser and Network statistics for accessibility

There is a general sense of “lack of actionable information” in the report related of user browsers and networks. It is often referred to as the information which is nice but not so necessary to have. However, with all the discussions above tackling the issue of usability, such information does offer web designer into the insights related to accessibility issue. The report lists many aspects from the Flash version, to the screen resolution and the internet connecting speed of users.

This consideration and checkup is especially essential for libraries with Flash element or other plug-ins. It is also a best practice for estimating the impact to its majority users before launch a newer version of a website element. And instead of assuming or even guessing the technology that a typical user browser is able to support, a look at the statistics would help to better define the current picture for the digital library.

4.3.2 Purpose #10 – Assisting Decisions on Collection Content

As expressed above, it is necessary and vital to evaluate the effectiveness of user interface in digital libraries. However, throughout the literature review as well as the process of analyzing interface-related data, the importance of the content within the particular context was mentioned equally frequent and strong.

To be precise, it is practical or even considered necessary to cross-reference to the collection content during the evaluation of user interface. Moreover, compared to leaving a negative impression on its impression, the image of the business would be even more damaged by a frustrated user experience where the user fall short to see the real content or the essential service that the website promised.

Such situation in a digital library scenario would be to build an interface which seems promising and trust-worthy at the first glance, but yet over and over fails to deliver a matching collection item to the users' queries. The practice of prioritizing context before content could be even more destructive to a digital library, as the primary aims and central products for the business are to provide the relevant and useful information material or services.

Therefore, the evaluation of whether the content in store is in the real use of the visitor can not only assess the collection's performance and impact, the same information could also go for the use of adjusting and planning for digital library's collection development strategy.

4.3.2.1 Metrics for Purpose #10

■ Top Content report

Grouped under the report section of Content (Figure 3-2), the Top content reports a list of the most commonly viewed URLs of the site and how those pages are used by the visitor. The reported URLs are listed without the domain of the website. For example, if "www.dl.com/home" has the highest viewing numbers, then in the report the first entry would be "/home". Similar to other table report, GA also shows the basic metrics such as time on site, bounce rate, % exit, etc. of the top content.

By default, the report displays 10 results at one table and at the bottom there is the total number of the unique URL. By using the table adjustment below, one can also change it to show 500 rows

of results within the same table or jump freely to any result in the ranking list. For example, the report below shows the 60800th – 60811st record in the total 60811 unique URL records, using a displaying mode of 500 rows at a table.

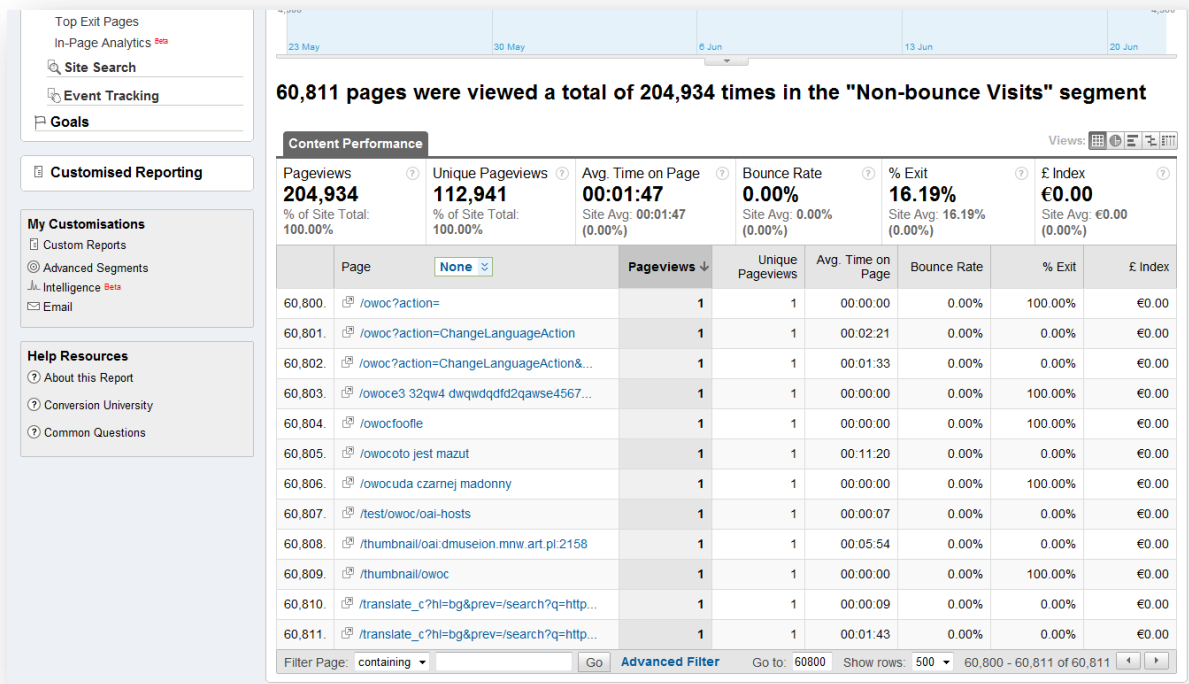


Figure 4-23 Top Content report

■ Content by Title report

Using the same statistics as the Top Content, the Content by Title report also shows the most viewed webpage of the websites as well as its usage, only the result is shown as page titles instead of in URLs. For example, for the Content by Title report, a pageview of “www.google.com/analytics” would be recorded as “Google Analytics | Official Website”, instead of “/analytics” in the Top Content report.

This report is often shorter than the Top Content report, since many of the websites could have different URLs that leads to the same webpage. For example, in the Top Content report, the pageviews of “www.dl.com”, “www.dl.com/index”, “www.dl.com/index/html” would be reported separately as three individual entry point. But since all of them in reality all lead to the homepage of the fictional digital library that has the Page Title of “DL Homepage”, all the record would be grouped under the entry point of “DL Homepage” in the Content by Title report.

■ Internal Site Search Analysis

Site Search is a major function under the Content report section in GA (Figure 3-2). It focuses on

the analysis of the website’s internal search engine and it is not a report that come with default setting. To activate such function, one needs to click the “Do Track Site Search” checkbox in the profile information editing page. And depending on the Information Architecture of the website, one needs to define the specific query parameter of the website. A query parameter is the string that contains the search term of the visitors in the search result URLs. For example, if the search query is included in a form of www.dl.com/search?h1=en&search=searchkeyword or www.dl.com/search?q=searchkeyword, then the parameter names will be “search” or “q”.

After activation and correct set up, the report will start collect the information and the report will be able to show all the search queries from the visitor. As shown below, the graph indicates that the Internal Search Analysis was only activated since March, 2009 and some basic metrics are also included in the Site Search Overview report such as the number of visits which use the search facility, the average time visitor spend after the search, the number of pageview from the search results, etc.

Besides the overview report, there are also other related statistics. For example, report that show the percentage of users using and not using the search facility (Usage), the URLs of the webpage where the search starts in the website (Start Pages), which webpage the search most likely lead to (Destination Pages), and if there are different categories in the in-page search engine such as “search only in category A”, “Advanced search function”, what is the percentage of usage for each of them?

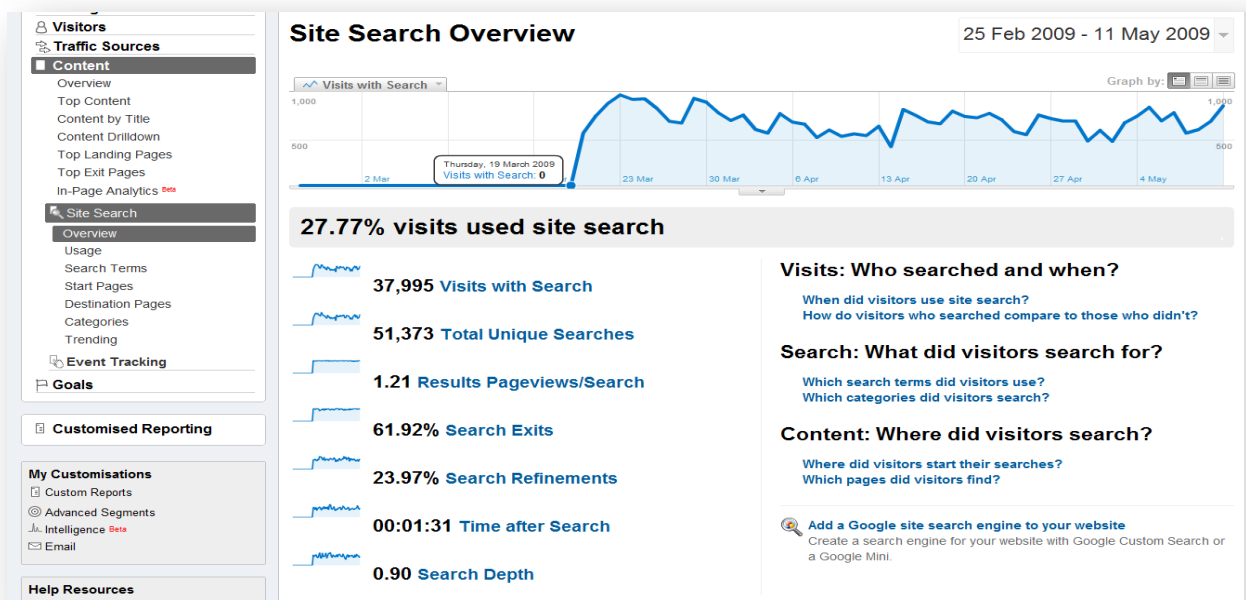


Figure 4-24 Site Search Overview report

In addition, clicking through each search term on the report, one can also get a term-level detailed

information like the number of total unique searches conducted in the given period on this search term, the percentage of search exits, the number of result pages viewed by the user, the percentage of the search refinements of the users, and the search depth.

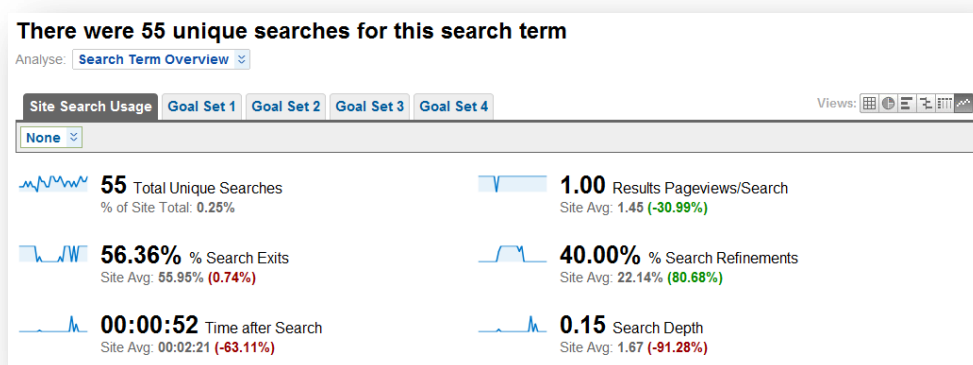


Figure 4-25 Site Search report on the search term-based level

4.3.2.2 Considerations for Purpose #10

- Considerations for using Top Content and Content by Title report

Differences between two reports

Depending on the Information Architecture (IA) of the website, it could be possible that the digital library has more than one dynamic URLs that lead to the same page, as situation illustrated above. Or the same duplicated page titles for different URLs, such as when a digital library is using Content Management System (CMS) like Drupal which assigns automatically the page titles for the common template if the user didn't specify. And since there could be many different situations, it is important for each specific digital library to first understand the relationship between its URL construction and its page titles before choosing the situation for the appropriate report.

For most websites and especially digital libraries, the query parameters are often used in the creation of the dynamic URLs of search result, the Top Content report would first seem rather clustering and confusing as many of the unique URLs may actually lead to the same page. Looking at the Content by Title page would give administrator a look from the higher aggregated level, as all the unique URLs of the dynamic page could be just called as the "Search Result" in the report.

Overall, in terms of when to use which, digital libraries would have to match the situation to the right report depending on its needs. However, based on the general purposes and its difference,

the author believe the best practice for the digital library would be to first look at the Content by Title report, then using the Top Content report for details drilldown.

Utilizing the report information

In GA, both the Top Content report and Content by Title report provide administrator a look into the most viewed webpages within the site and their performance metrics such as the Bounce Rate, Time on Site, etc. of each page

Besides comparing with the site average to look for pages which has the distinctively good or bad metric performance, libraries should also look through the record for changes over time. For example, it would be understandable if the homepage is one of the most commonly viewed page in a digital library. But if a specific webpage for the new coming digital library activity is scoring the highest in the record, maybe the event is really appealing to the genuine interest of the public or the marketing strategy is working splendidly. By recognizing such phenomenon, libraries could go deeper into the real cause and maybe reproduce or copy the success for future activity planning.

Another important element for reading the report is to recognize the differences in the type of those pages since this information should be used as judgments to infer explanation about the popularity. For example, maybe the page is popular because it ranks high in the Search Engines search results to a specific keyword. Or maybe it is just a gateway page which many visitors pass for other purpose located in another page in the digital library.

In addition, libraries can also utilize the report to check and fix pages with error or broken links. The practice would be carried out depending on the design of the error pages in the specific digital library. For example, libraries may possibly use Advanced (Table) Filter to isolate the results and by clicking further into the Content Details Page to identify the exact error right away. Or if the page is not regenerated, libraries could try applying the Navigation Analysis instead to reconstruct the possible situation of the error.

It is important for digital libraries to regularly check and correct the technical mistake since not only the content of such page would not be delivered to the users, but also the negative experiences is damaging to the user satisfaction as well as the image of the library.

Possible limitations for applying in digital library

Similar to Event Tracking, libraries can also use the whole Top Content report as the usage records for the collection materials. However, there are some certain limitations of GA when used to fulfill such purpose. For example, facing the same issue mentioned in Purpose #2, the content report has the inflexibility of reflecting the dynamic categorization structure of a digital library in its reporting

system.

In addition, it is not possible to track the record with 0 pageview as GA uses JavaScript for making a record and the JavaScript embedded in an unread page or unclick link, in the case of download link, would not be ever fired therefore never be reported or shown in the GA report. And for the same reason, it is not so optimal for digital library to use such information for its long-tail strategy as many of the records at the end of the Top Content report would most likely be a collection item related page with just one pageview. It would therefore be more optimal and comprehensive if libraries cross-reference such reports with the statistics in the collection databases.

■ Utilizing Internal Site Search report

Compared to looking through pages viewed and recreating usage paths, studying the search queries users input into the search facility of the website may be one of the most direct methods of understanding and inferring user intents and interests. Different from the search engine keywords report, libraries could assume users who take the efforts to search in the website have stronger motives and higher engagement level. However, depending on the context of the search, this could also happen when users can't find the required services by its landing page.

Besides looking at the Search Terms report for the most commonly used queries, libraries should also go in to the individual search term for deeper insights. For example, how many result pages was browse in average for this search term? The percentage of searches that exit immediately after seeing the first result page? The percentage of searches that lead to another search, and what are the proceeding search term? Maybe they are the refinement of the original search? How much longer users stay on the site after the search in average? And including the results as well as the potential metadata content, how many pages do the users viewed afterward?

In addition, it could be even more insightful when looking at the Site Search Terms Navigation Summary. Shown as below, administrator could see where the searches start and which pages it resulted in with each search term. Such navigation report gives another context to the above mention search term metrics, allowing the inferences to be confirmed or investigated further.

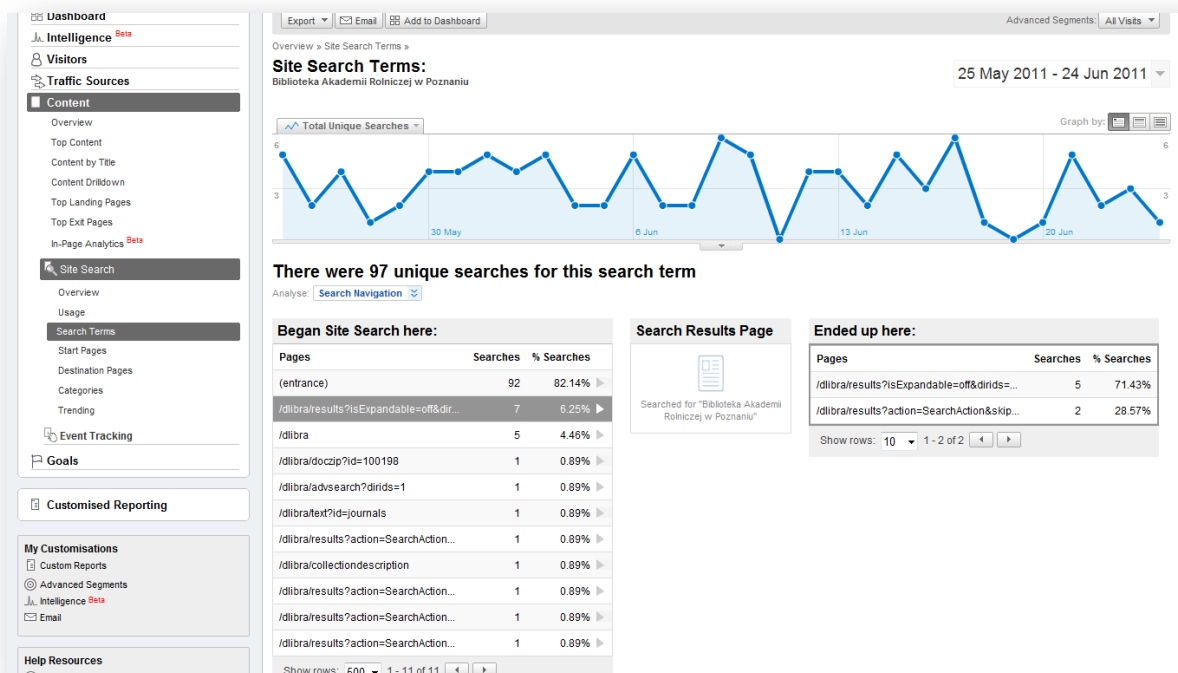


Figure 4-26 Site Search Terms navigation summary

One useful information for the digital libraries is the list of user search terms which result in zero item return. For collection development, such information could be useful for patching up the gap in collections or identifying potential topic of interest for the future. Moreover, it also has other purposes such as checking the completeness of metadata of the correctness of its search engine performance. For example, a user could type in a search term which is the equivalent to a topic of the digital library, but due to incomplete metadata or poor search engine quality, the query may resulted in 0 return. As there is no default report for this function, digital library which has to ensure there is a special page created with distinctive naming convention in the URL or page title before using keyword in the table segmenting.

Finally, GA does provide an abundant of information in terms of tracking user's internal search behaviors at the first look. And in theory, there are many insights a digital library can draw from looking at those data. However, for a blog or e-commerce website that has a rather obvious content focus, it could be easier to tell how "closely" the user search terms are to its provided content and therefore making it possible to isolate the true actionable results.

However, for digital libraries, it is quite possible that the search terms are rather scattered and only with one or two searches on its record. Therefore, libraries should perhaps try proactively search for the usage data of a specific set of terms that are related to its recently promoted collection and see whether the searches and the usage of the material has changed for the getting out the more immediate usefulness.

■ Uncompromised principles in digital libraries

Investigation into the content consumption of users would not only offer the necessary support for inferring user interest but also allows libraries to examine the usage of its collection and the effectiveness of its content delivering process. More commonly, however, such information is also used for the content development plan.

For example, a blog which aims to increase the level of user engagement will take the most popular article in the blog as inspiration or direction for its future content building. A commercial website would optimize each web page to provide the content that would most interest its visitors.

Such way of molding the content to attract crowd and improve metric performance may seem tempting at the first sight. Nonetheless, it is important to understand that the fundamental reasons for listening to the audience is not only for boosting the traffic or increasing the goal conversions but also to provide the needed services to its visitors.

And due to the different natures of digital libraries, one should be very cautious when taking such approach in its collection building policy. For instance, if the purpose of the digital library is to provide high quality, professional information to the elites in the academic field, it would be inappropriate to devalue a certain collection just because it is not in the most viewed record. Similarly, a collection aiming for the niche market should never try to aim for getting a higher total viewed.

In both cases, instead of changing the collection policy, libraries could also review its approaches in marketing and some other aspects for finding ways to enhance the usage performance. Or instead of focusing on the number and figures, it would be a better benchmark if one compare the trends with its own usage data from the historical statistics.

4.3.3 Purpose #11 – Assisting Reporting of Different Levels

Found in the literature review as well as through author's internship experience with Poznan Supercomputing and Networking Center (PSNC), many digital libraries were identified to have the need for multi-level reporting as they exist not only by themselves but also with the related institutes or organizations.

For example in the case of NSDL depicted in the chapter two, the level can be many and the hierarchy structure could be complex. Each party that involved in the project may all need some part but not all of the statistical information. In addition, even for an individual digital library, there could be many stakeholder involved which not only have different information needs but also different authorizations to the data.

It is therefore important to have the flexibility to choose the reporting when evaluating the appropriateness of a web analysis tool. In GA, there are certain functions which enables users to provide reports in different levels and with its customization, there are many possibilities in reporting content and format that one could produce. In the following section, the author take those which is potentially useful to the digital libraries and illustrated its potential usage as well as the consideration that digital libraries should take into account when utilizing such features.

4.3.2.3 Metrics for Purpose #11

■ Profile-based Filters

By default, each GA account would have at least one GA profile and each profile actually represents how the data from a specific web domain would appear in the report. That is to say, to have different ways of data presenting, one may create more than one profile for the same web domain with different settings in their profile-based filters. For example, one profile can be the gateways for collecting all data, and another profile is only used to track certain sub-domains of the same website. Or one profile is used to collect only the traffic from Europe, another used for traffic coming from Asia.

Such function is done by different set ups at the Edit Filter page for each profile. And as demonstrated below, one can set up either a predefined filter or a custom filter. With different types of filter, one can choose different functions such as to include, exclude or search and replace, etc. And each filter created is applicable and reusable to any other GA profile within the same GA

account.

For applying a filter to a profile, the predefined filters gives the administrator a quick choice on some of the most common deployed filters such as to include or exclude specified domains, IP addresses or domain subdirectories. And with the other type of filter, the custom filter setting, administrator would have more alternatives for data manipulation beyond just IP address or web domain. For a better explanation, one can not only specify the particular area or pattern that one wish to filter, but the applicable functions also come with more than just include and exclude.

For example, one can change an area in reporting to all uppercase or lowercase (uppercase/lowercase), search for a specific pattern in the report and replaced it with a desired form (search and replace), or create and build a specific attribute (output to → constructor) by using two specified attributes that already exist (Field A/B → Extract A/B).

The screenshot shows the 'Edit Filter' interface with the following configuration:

- Filter Information**
 - Filter Name: Set Medium Social Media (labeled 'Name the Filter')
 - Filter Type: Custom filter (labeled 'User Custom filter')
 - Advanced filter selected (labeled 'Set an "Advanced" filter')
 - Field A -> Extract A: Campaign Source, stumbleupon.com/facebc (labeled 'Filter social media sites')
 - Field B -> Extract B: -
 - Output To -> Constructor: Campaign Medium, social media (labeled 'Rename as social media')
 - Field A Required: Yes
 - Field B Required: No
 - Override Output Field: Yes
 - Case Sensitive: No
- Apply Filter to Website Profiles**
 - Available Profiles: (empty list)
 - Selected profiles: Samir Balwani (labeled 'Add the profile you want')
 - Buttons: Add, Remove
- Buttons: Save, Cancel

Figure 4-27 Profile-base Filter

■ Email Reports

Besides the already introduced customized Dashboard in chapter three and the Export function in Purpose #3, there is also another function that enables users to perform customized reporting. This specific function, Email, is often seen at the top left of the Timeline Graph (Figure 3-3). And with this, one can set up a report with one or more set of chosen statistical contents and schedule a time for it to be automatically sent to the specified email address.

Shown as below is an example of sending a report of the visitors overview statistics. As the options in the Export function, one can chose the format of CSV, PDF, TSV, etc. And depending on different needs, administrator can choose to send the report now, schedule a certain time in the future or added the report to the already existing scheduled report. Such function can be applied not only to any of the GA default report, its Dashboard, but also to the custom reports mentioned in Purpose #8.

The screenshot shows the 'Set Up Email: Visitors Overview' interface. On the left is a navigation sidebar with sections like 'Dashboard', 'Intelligence', 'Visitors', 'Traffic Sources', 'Content', 'Goals', 'Customised Reporting', 'My Customisations', and 'Help Resources'. The main form area has three tabs: 'Send Now', 'Schedule', and 'Add to Existing'. The 'Send to others' field contains 'clovej03241@yahoo.com.tw' and has a 'Send to me' checkbox checked. The 'Subject' field contains 'a test example'. The 'Description' field contains 'this is a weekly report on the visitor statistics'. The 'Format' section has radio buttons for CSV, PDF (selected), TSV, XML, and CSV for Excel. The 'Word Verification' section shows a captcha image with the word 'kubik' and an empty input field. On the right, a 'Preview' box displays the email details: To: clovej03241@yahoo.com.tw, leehsinju@gmail.com; From: leehsinju@gmail.com; Subject: Analytics fbc.pionier.net.pl 20110524-20110623 (a test example); Attachment: PDF; and the body text: 'this is a weekly report on the visitor statistics'. A 'Send' button is at the bottom right.

Figure 4-28 Email function example

■ Intelligence Alerts

Besides schedule reports to be emailed, the function Intelligence Alerts use the ability of Google algorithms to alert administrator when there is a significant change in the statistics. For instance, the changes can be a specific peak in the number of visits, a threshold value such as when the average time on site has exceed three minutes, percentage changes in the Traffic Sources proportion, or any of the user-defined variables and values.

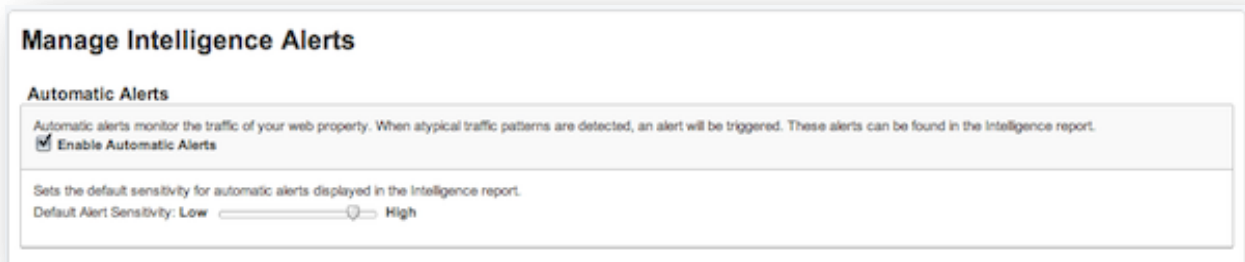


Figure 4-29 Intelligence Alerts

Using the ability of Google algorithms, Intelligence Alerts is a function to alert report readers when there is a significant change occurred in the statistics. Such changes are for instance a peak in the visits number, time on site, pageviews, changes in Traffic Sources percentages. You can be alerted when a significant change has occurred in your statistics.

4.3.2.4 Considerations for Purpose #11

- Filters and segments by different levels

Before applying any changes such as segmentation or filter to the profile or its data, administrator must first understand the level of effect such action may result in. As mentioned in the previous discussion, GA allows a user to perform many on the fly report-based segmentations or filters such as the use of Advance Segments and Advanced (Table) Filter, or by clicking different time divisions to change the timeline graph from hourly to monthly.

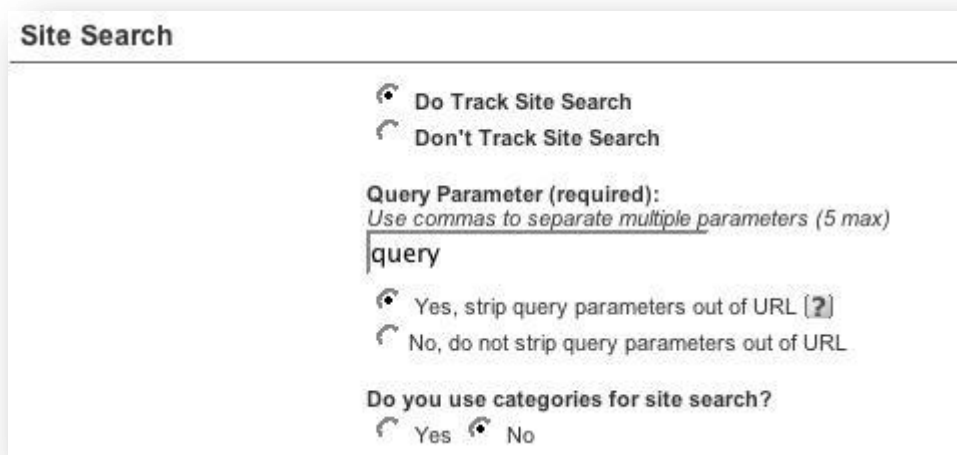
With these functions, report readers could change the data presentation immediately, but since it is report-based, no fundamental dataset will be altered. Namely the customization would not affect the way Google processes the raw data and in most cases, such change would only last within the particular login for the specific report reader, making it achievable by a report reader with restricted access.

Besides the report-based segmentations, there is also the long lasting profile-based filtering. Such a setting is powerful yet potentially risky as the adjustment would indeed permanently alter the way GA process the data and as a result affect the data one gets in the report. For example, if one has utilized the profile-based predefined filter while building the profile to exclude the traffic coming from the company's internal employees, this excluded traffic would not be re-collectable since the filter would be applied during the report generating of Google.

■ Utilizing Profile-based Filters

Despite its riskiness, profile-based filters are actually vital for many purposes. For example, for security and authoritative reasons, a mother institution will only allow each digital library to generate its own statistics and maybe the overall performance of the whole entity, but not the data of another digital library on the same hierarchical level.

In another example, a profile-based filter can also be used to prevent the Google Analytics Tracking Code (GATC) hijacking. As a website's GATC is visible to any user in its source code, a third-party person could easily copy the unique number that links to this specific website and copy it to another domain, corrupting the statistics with traffic of another source. Therefore, using the profile-based filters to limit the traffic from specific domain being reported would be a necessary practice to prevent such hacking for all websites.



Site Search

Do Track Site Search
 Don't Track Site Search

Query Parameter (required):
Use commas to separate multiple parameters (5 max)

query

Yes, strip query parameters out of URL [?]
 No, do not strip query parameters out of URL

Do you use categories for site search?

Yes No

Figure 4-30 Excluding query parameter from the reported URLs

To give a specific example, libraries could actually use the profile-based filter to clean the data of the Top Content report mentioned in purpose #10. Since the included parameters in the dynamic URL such as the queries in the search results is making an un-user-friendly Top Content report, libraries can first use the Site Search set up page to exclude the query parameters from the reported URLs as shown above, and then use the Profile Settings to exclude the other potential clustering parameters identified by the libraries, such as “sid” and “param” in the exemplified screenshot below.

Edit Profile Information

Profile Name:	<input type="text" value="Example"/>	
Website URL:	<input type="text" value="http://www.example.com"/>	(e.g. http://www.mysite.com/)
Default page [2]:	<input type="text"/>	(e.g. index.html)
Time zone country or territory:	United States	
Time zone:	(GMT-05:00) Eastern Time	
Exclude URL Query Parameters:	<input type="text" value="sid, param"/>	(e.g. sid, sessionid, vid, etc...)

Figure 4-31 Excluding redundant parameters

Finally, as mentioned in purpose #8 about utilizing the Custom Reports, libraries could also use the profile-based filter to create another customized dimension for composing the Custom Report. In this specific example, the digital library would like to have a Custom Report which only shows the data from the academic users.

In this case, instead of creating a custom report showing the relations between usage data and its visitors' Services Providers so one can later search for data that contains that keyword "university" or "college" as proposed in purpose #8, digital libraries can also utilize the profile-based filter to first create a customized dimension that only contains traffic from academic sources and then replace it to the role of Services Providers when making the Custom Report.

■ Data tracking within multi-institute entity

To illustrate the possibilities and drawbacks of the solution provided by GA, the author will use a fictional setting to exemplify a multi-institute digital library entity. Imagine a mother institute that sponsor three separate digital libraries, each having its own website of "www.dl1.com", "www.dl2.com" and "www.dl3.com".

And within the first digital library website, there are different sub-domains for different purposes, each named according to its functionality as "new.dl1.com", "blog.dl1.com" and "library.dl1.com". The structure and the goal of the reporting would be to allow the individual digital library to have their own statistics but at the same time, the mother institute would wish to have aggregated data from all three separate domains.

First the mother institute can create a GA account for the whole entity. And within it, each digital

library could have its own GA profile for its own website domain. And since the mother institute is the account owner, it can assign the authorization as report reader or administrator to the relevant stakeholders. It can also use [Email](#) and [Intelligence Alerts](#) for regular checkup or sending secure, relevant and focused information to other stakeholders which occasionally need notification from the statistical trends.

And since the first digital library has its own sub-domains and by default such differences would be regarded as separate websites for GA, administrator would have to input a line of `_gaq.push(['_setDomainName', '.dl1.com']);` to set a consistent general domain for all sub-domains in order to track all using one profile.

Last but not the least, for the purpose of the mother institute, the aggregated information for all the separate domains could be solved by two methods. The easier one is simply by creating a roll-up profile using the same account to have a fourth unique GA tracking code. And by tagging this fourth tracking code to all the three domains, on top of their original tracking code, the fourth profile would be able to act as the gateway that track it all.

However, there is an issue in terms of identifying unique visitor and passing cookies in this method. As GA only uses first-party cookies, namely they can not track multiple domains by default, all the data would be seen only as the sum of the three profile statistics. For digital libraries to completely tackle this problem, one would have to resolve in passing on the cookie by its outbound links. Unfortunately, such implementation can be tedious and often complex, a digital library wishing to implement such technique would most likely need a high expertise in technical support.

5. Research Conclusions and Future Development

5.1 Research Conclusions

This study is focusing on the examination of the appropriateness of using GA for the purpose of digital library evaluation. In order to achieve this goal, this paper has conducted a comprehensive literature review to investigate on the purposes and the e-metrics used in the previous digital library web analysis.

Based on the findings of the literature review, the study has selected eleven evaluative purposes grouped under three themes to analyze and discuss the possibilities and the limitations of GA.

Following is a review of the research objective and the summary of the findings.

- What is the purpose of conducting web analysis evaluations in digital libraries?

The literature review has shown that the main purpose for digital libraries to conduct a web analysis evaluation is to provide a satisfying user experience. In addition to that, it is also quite often for a digital library to assess its performance. Ultimately, digital libraries are using the statistics found in the web analysis report to assist and support its decision making process.

- What are the e-metrics used to conduct such evaluations in digital libraries?

Besides the commonly seen web analysis metrics such as the time on site, number of page viewed in session or user bounce rate, one of the core practices of the digital libraries is to track how visitors use the collection materials. Moreover, the literature also indicates other specific needs in the individual cases such as flexible reporting capabilities to help aggregate statistics through different institutions, or identify source of traffic to compare collection usage of different user groups.

- What are the advantages and disadvantages of using GA for digital library evaluation?

After discussing the pros and cons of using GA to fulfill the eleven evaluative purposes, the study has concluded that the analytics tool can indeed achieve most of the statistical needs of

digital libraries. In addition, throughout the analysis of its appropriateness, the tool has also repeatedly demonstrate its potential of finding additional insights.

However, as some of the statistic for digital libraries do not come with GA's default report, one may need to go through some configuration before getting the result. Also, there are some fundamental issue that a digital library should be concerned about. For example its high inaccuracy of counting the unique visitor from public computers or its limitation to reflect the dynamic metadata categorization of digital library in its report structure.

The dissertation started by viewing GA as an evaluative tool for the digital library. However, after concluding its key findings, it becomes apparent that there are more to be gain from the experience:

First and foremost, it is important to interpret statistics according to the specific environment. For example, depending on the definition of an ideal user experience, a longer time on site could indicate user engagement but may also be used to demonstrate poor navigation design.

Digital libraries should also remember that the web analysis is only a part of the whole evaluation cycle. GA is also just a tool for collecting behavioral statistics. It is up to the digital libraries to perform other necessary qualitative evaluation for finding the "why" behind the phenomenon and trends.

In addition, primarily designed for helping online marketing, GA may not seem optimal for digital libraries at the first look. However, this outcome-driven analytics approach can actually put digital library into a fresh perspective to rethink its operational conventions. For example, instead of giving the visitor a perfect dead end to leave the site, digital libraries could try offering alternatives in the zero result pages. Non-profit can also learn from the business-oriented industry to be more proactive and persistent in pursuing its goals.

Last and most importantly, it is the services and content that a digital library will always need for a long-term sustainability. No amount of Google Analytics or any web analysis can help with this fundamental ground work. It is by putting real effort into the essential product and its continuous pursue of improvement that could secure the user as well as ensure the quality of service of digital libraries.

5.2 Future Development

Due to the scope and limited time, the paper has look at the appropriateness of Google Analytics only theoretically. Future researchers in the same field should try using a real digital library website to experiment and further discuss the possibilities presented in this study. There could be many differences between theory and real practice.

In addition, researcher can also experiment and try working on the drawbacks of Google Analytics to increase the applicability for digital libraries. For example, a software which makes the process of integrating data from GA with data from OPAC would be optimal.

Yet another approach for the researchers could be to focus on a single or few evaluative purpose. Then by taking many different types of digital library cases into the experiments, one may see additional insights from a larger variety of scenarios.

In conclusion, it is the recommendation of this dissertation that digital libraries should be involved in the development of applying web analysis. For example, one should try being ingenious and creative in data interpretation to uncover the hidden possibilities for digital libraries.

Moreover, with each assumption, administrator should try to verify the interpretation using robust examination to gain insightful experiences.

Most importantly, one should initiate discussions within the community to promote active sharing of experiences and best practice. It is through continuous improvement and evolution of the mindset that a digital library can receive the maximum benefit.

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