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Academic Visibility for Urban Planning and the Webometric Future

Abstract

This paper argues that the traditional emphasis of scholarly communications, citation analysis, and faculty evaluation, limited to books, book chapters, and journal articles is out-moded and fails to capture a significant share of scholarly activity that is now being posted online. Planning academics, as social scientists, should value the extended range of dissemination provided by the web, and should also leverage its inherent functionality to evaluate scholarship. Scholarly output is further characterized relative to productivity, visibility, reputation, and impact for the purposes of a new evaluation paradigm. An example shows that both individual and faculty metrics can be used as a meaningful element of scholarly assessment. The implications of this approach touch on issues of scholarly communications and the promotion and tenure process.

The role of the internet for academic research cannot be overstated. Both as a source and destination for scholarship, the internet acts as a market for consumers of research, especially for disciplines with popular appeal. Urban planning is a good example of such a discipline. With its professional orientation focusing on the well-being of neighborhoods, cities, and regions, planning research is shared among academics and has practical implications that are debated and ultimately implemented (or not) by the public (Stiftel and Mogg 2007). A public well informed about local and regional policies and planning activities can be a desirable end in itself and has an international scale as well (Stiftel and Mukhopadhyay 2007). The internet is and will increasingly be the means by which planning academics communicate their ideas to the profession and the public.

A primary activity of academics is discovery through their research. New concepts or perspectives first take place in the mind but must be expressed in a tangible way to be useful to others. Marchionini (2010) describes this process as converting the mental to the physical in the form of useable information. For social scientists, we commonly see the physical expression of these "artifacts" as books, book chapters, journal articles, and other types of reports and documents. More recently these artifacts are in electronic form as blog entries, online articles, electronic multi-media, and other web-based products. As Stiftel and Mogg (2007) argued, the electronic realm has revolutionized scholarly communications for planning academics.

In addition to being a source of research information and a means of dissemination, the internet also serves as a vehicle for scholarly evaluation. Traditional quantitative measures of academic output have been used to assess performance, especially in terms of academic promotion and tenure. The refrain of "publish or perish" within academia stresses the importance of scholarship for maintaining professional status. Productivity is a critical factor when arguing for scarce resources, comparing academic programs, and competing in global education and research markets (Goldstein and Maier 2010; Arimoto 2011; Linton, Tierney, and Walsh 2011). Measures of productivity are frequently debated and have been used to analyze salary differences between males, females, disciplines, and specialties. Perspectives on productivity are rapidly changing as new modes of electronic research formats and electronic dissemination increase. The internet has created opportunities for extending the reach of academic communications, and at the same time presenting challenges for assessing quality and value.

The traditional means of assessing academic productivity and reputation has been citation analysis. Citation analysis for scholarly evaluation has an extensive literature that weighs appropriateness within and across disciplines as well as offering nuanced discussion of metrics (see for example Garfield 1972; Garfield and Merton 1979; MacRoberts and MacRoberts 1989, 1996; Adam 2002; Moed 2005). Recently, popular metrics like the h-index, g-index, and e-index have been adopted by Google Scholar (GS) to provide web-based citation analysis previously limited to proprietary citation indexes like Thomson Reuters (formerly ISI) Web of Knowledge (WoK) and Sciverse Scopus. This is the likely trajectory of citation analysis as open access scholarship becomes more pervasive. There is some debate, however, that GS's inclusion of gray literature citations (discussed later) means its analyses draw from a different universe of publications to assess citation frequency and lineage. This paper does not dwell on the heavily debated tradition of citation analysis techniques because it proposes an expanded approach that moves beyond the bounds of citation indices for assessing overall academic visibility and web impact. In short, traditional citation analysis focused on approximately one-third to one-half of faculty activity to assess academic productivity and value, ignoring teaching and outreach/service activities – which can also be important expressions of scholarly activity.

The web serves as a dynamic archive for artifacts of scholarly information, a forum for discussion, and also provides a market for ideas with a system of feedback about the relevance, reliability, and value of information posted there. Demand or value is expressed through user behavior that generates "reputation" similar to how eBay customers score sellers and buyers, "Likes" on Facebook or social bookmarking, consumer comments, or ratings on product reliability, and page ranking methods like that of Brin and Page (1998). These mechanisms can act to evaluate many types of academic research. Planning is well-suited to this model because demand for research extends beyond just researchers in the discipline to the public who are involved in urban planning processes and decision-making.

Planning and Gray Literature

The paradigm suggested by this paper extends beyond that of citation analysis or bibliometrics on the web. The standard citation analysis metrics (number of citations, h-index, g-index, etc.) stay within the bounds of the WoK, Scopus, and GS domains. I argue that the web (i.e., webometrics, discussed later) can be used for books, book chapters, and journal articles, and also extended to academic gray literature that is produced and consumed by planning academics and planning practitioners. This includes the rest of the academic footprint such as research reports, conference presentations, conference proceedings, and funded research grant materials. Course syllabi are an additional source that are available on the web and frequently cite not only academic work but also gray literature on planning topics. Other examples of gray literature for planning academics include studio or workshop projects that are posted to the web and may take the form of professional consulting reports.

It is very likely that blog posts and web mentions will become accepted forms academic output to be evaluated along with other scholarly artifacts. In their discussion about blogging for untenured professors, Hurt and Yin (2006) mention that blogging represents a form of "pre-scholarship" where the contents may be the kernels of future articles (Hurt and Yin 2006, 15). Some planning academics already report contributions to sites such as Planetizen.com on their curriculum vitae (CV) as "other publications". The value of these postings is evidenced by the citation, download, and amount of forum discussion that appears from a mix of planning academics and practitioners. It is likely that the non-publishing planning academics that Stiftel, Rukmana, and Alam (2004) refer are producing worthy gray literature that is a valuable part of planning pedagogy but goes unnoticed by citation analysis and bibliometrics.

Webometrics

The field of webometrics grew out of citation analysis, bibliometrics, and scientometrics (also referred to as cybermetrics and informetrics). Webometrics is "the study of web based content with primarily quantitative methods for social science research goals using techniques that are not specific to one field of study" (Thelwall 2009, 6). Drawing from the early citation analysis work of Garfield (1972) for journal evaluation, Almind and Ingwersen (1997) are credited with the term "webometrics" and illustrated how scholarly web artifacts can be assessed in terms of visibility and relationships to each other – much like that of traditional citation analysis (Thelwall 2009; Björneborn and Ingwersen 2001; Björneborn and Ingwersen 2004). This literature includes extensive discussion of web impact analysis, search engine optimization, link analysis, and tools like SocSciBot, web crawlers, LexiURL Searcher (now Thelwall's Webometric Analyst), web traffic rankings, page ranking, and citation networks. The web has become a global publishing platform with very sophisticated indexing and citation analysis capabilities (Jalal, Biswas, and Mukhopadhyay 2009; Kousha and Thelwall 2009).

The interconnectedness of internet information is especially suited to scholarly communications where web mentions (i.e., citations), types of links between web pages (relationships), and resulting network dynamics produce quantifiable metrics for scholarly impact, usage, and lineage (Kousha 2005; Thelwall 2009; Bollen, Rodriquez, and Van de Sompel 2007). Webometrics can be used to analyze material posted to the internet and the network structure of references to academic work by not only determining the frequency of citation, but also rank or score of these mentions by the weight or popularity of the referring hyperlinks. The resulting metrics (linkages, citations, mentions, usage, etc.) are analogous to reputation systems derived from traditional citation analysis procedures. This has since been operationalized for citation analysis with web-based tools such as Harzing's "Publish or Perish" and the University of Indiana's "Scholarometer." These tools have leveraged the power and accessibility of GS to exceed that of proprietary indices like WoK and Scopus (see Hoang, Kaur, Menczer 2010; Harzing and van der wal 2009; Moed 2009; Falagas, Pitsouni, Malietzis, and Pappas 2008; Neuhaus and Daniel 2008; and MacRoberts and MacRoberts 2010).

The literature on webometrics related to scholarly evaluation parallels the traditional citation analysis process. Much of this research explores whether open-access indices, especially GS, can produce similar citation metrics as that of WoK and Scopus citation indices (see Harzing and van der Wall 2009; Kousha and Thelwall 2009; Meho and Sugimoto 2009). When GS was launched in 2004, it did not have the coverage of WoK or Scopus. That has since changed, and with GS being the most "democratic" of the three, it has shown to produce comparable results to the other two for many disciplines (Harzing, 2010).

Some of the initial applications of webometrics were focused on assessing hyperlinks to estimate "web impact factors" for web sites of scientific research as well as universities as a whole (Mukhopadhyay 2004). By analyzing both outlinks and inlinks (i.e., backlinks and co-linking), the volume, reach, and hierarchy of web sites through the structure of the Domain Name System (DNS), for instance, the top-level domains, sub-level domains, and host (or site) level domains can determine the country , organization type, and page context of these links (see Thelwall 2004 for further discussion). This information can be extracted to derive the network relationships among the many web sites much like a social network. This network approach to web site relationships can also be applied to scholarly artifacts that appear or are referenced on the web, and indices or search engines navigate databases of link structures, much like that proposed by Garfield (1955) for citation indexing (Neuhaus and Daniel 2006).

Thelwall, Klitkov, Verbeek, Stuart, and Vincent (2010) point out the challenge faced by including gray literature stating, "A big disadvantage of link analysis webometrics, in contrast to citation analysis, is that web publishing is heterogeneous, varying from spam to post-prints. As a result, the quality of the indicators produced is typically not high unless irrelevant content is manually filtered out, and the results also tend to reflect a range of phenomena rather than just research impact" (p.2). Because there are no standardized citation-like databases for gray literature, in particular, there is not the same level of control over how artifacts are cited on the web. This issue will be solved as the web evolves for these purposes.

Unlike citation analysis and bibliometrics which mainly focus on references to books, chapters, and journal articles by a small academic audiences, this approach encompasses a greater portion of the scholarly footprint by including some of the gray literature and non-refereed output of faculty members. The metrics that will be discussed delineate four dimensions implicit to the spirit of citation analysis. These are productivity, visibility, reputation, and impact. Each of these has been discussed either directly or indirectly in the scholarly communications and citation analysis literature, but not explicitly in terms of faculty evaluation criteria. This is primarily due to the fact that the application of webometrics departs from the control and domains of academic publishing companies as sources of reputational metrics. The following is a brief discussion of each.

Productivity

Academic "productivity" typically only refers to research and refereed publication activities, not to teaching or outreach. As a simple quantitative measure (i.e., numeric count) of artifacts, including books, chapters, articles, presentations, grants, etc., productivity is the traditional method of evaluating academic output (Leahey 2007; Adkins and Budd 2006). There are few reliable metrics for ***productive*** teaching or outreach other than the output or count of activities – like student credit hours, contact hours, or listing internal or external committee/board memberships (Massy 2010). Productivity is easily derived from a CV by simply counting each of the artifacts or activities listed. In some cases, the number of journal article citations (and more recently this has included books and book chapters) and journal impact factors (JIF) to convey the weight, importance, or recognition of the work are included within CVs. However, these metrics only apply to published materials that are indexed by citation databases. While traditionally important, these products only account for a portion of what is commonly expected of tenure track faculty, missing the rest of the academic footprint which includes: their dissertation, book reviews, conference presentations (and proceedings), research reports, grant activity, and teaching activities (Youn and Price 2009). There are subjective ways to evaluate the quality and importance of these works, but not in ways similar to bibliometrics. Counting these products is a very limited way to assess academic output.

The meaning of "productivity" is also discipline specific, where expectations for research activity, scholarly publication, and other creative works vary (Dewett and Denisi 2004). Some disciplines have devised weighting systems used to show how specific activities or outputs are counted relative to promotion and tenure, or merit-pay evaluation (see for example Davis and Rose 2011; Mezrich and Nagy 2007). While controversial, academic activities and productivity have funding implications for public universities in the eyes of state legislatures and the public, especially during challenging economic times (see Musick 2011; Townsend and Rosser 2007; Webber 2011; O'Donnell 2011). As public universities become increasingly more self-reliant for funding, they may need to adopt more of a private business model for accountability (Adler and Harzing 2009). Pressure to dissolve tenuring systems that protect "unproductive" faculty members should be confronted constructively and creatively instead of being dismissed out of hand.

Visibility

Traditionally, academic visibility was assumed to be a function of productivity. As Leahey (2007) argues, like productivity, visibility is also a form of social capital. If an academic is prolific, then there is a greater likelihood more academics will be aware of them, leading to other opportunities for professional gain. Pre-internet visibility included the number of books sold, journal or publication impact based on where an article appeared, or through conference presentations with large attendance (depending on the prestige and popularity of the conference). Visibility could also include newspaper, radio, or even television references, but not too common for the typical academic. On the other hand, the web provides visibility and the ability to reach far beyond traditional academic borders. And as an electronic archive, web visibility can be measured through searches that count the number of web mentions, web pages, or web links to an academic product. Academics who strategically publish their work on the internet (personal pages, blogs, institutional repositories, etc) will have greater visibility (Beel, Gipp, and Wilde 2010). Self promotion can benefit an academic's discipline, institution, and academic unit. However, visibility is distinct from productivity and reputation because it provides little indication about the quality of the work.

Leahey (2007) finds that productivity is positively correlated with visibility and that visibility in turn has a positive personal impact in the form of compensation for faculty members. There are other benefits to academic visibility as well, including attracting good students, internal and external financial support for research, and departmental growth because of increased enrollments and additional departmental resources (Baird 1986). The link between productivity and visibility is also expressed through, and motivated by, the promotion and tenure process which secures lifetime employment and other benefits. But once tenure is granted, the challenge for some departments is to have faculty continue to be productive and be creative in promoting their work for the benefit of academic units.

Reputation

Web 2.0, or social web, provides the means for generating reputation metrics through online user behavior (Priem and Hemminger 2010). This includes social bookmarking (Taraborelli 2008), social collection management (Neylon and Wu 2009), social recommendations (Heck, Peters, and Stock 2010), publisher-hosted comment spaces (Adie 2009), microblogging (Priem and Costello 2010), user edited references (Adie 2009), blogs (Hsu and Lin 2007), social networks (Roman 2011), data repositories (Knowlton 2011), and social video (Anderson 2009). All of these modes rely on users to view, tag, comment, download, share, or store academic output on the web whereby usage metrics can be tracked. This requires meaningful interaction with the content, for which there is not a clear incentive structure for users (Cheverie, Boettcher, and Buschman 2009).

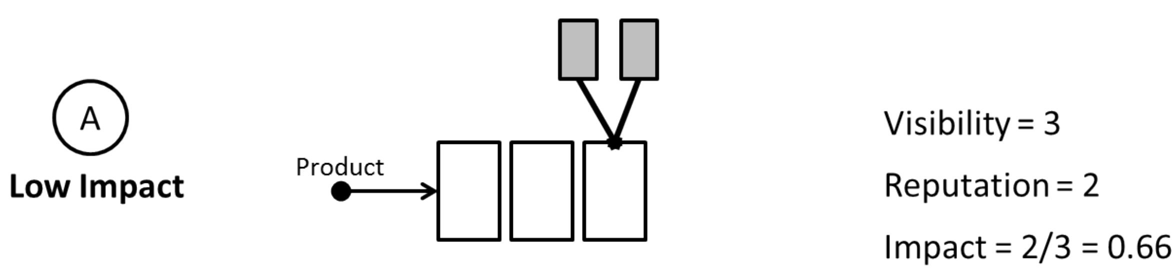
Benefits include potentially faster feedback and broader assessment of impact on audiences (Priem and Hemminger 2010). However, these “audiences” may not have any particular level of validity or authority. In terms of webometric analysis, reputation, recognition, and prestige are related. These refer to the number or rank of sites that mention an academic's work. While the total number of links or mentions indicates the level of visibility or accessibility of scholarly artifacts, being recognized by esteemed researchers and institutions is a measure of value in the academic information market. This same concept is used in citation analysis where more weight and value is placed on citations, where the authors of citing articles have themselves been cited often. Just as in the traditional tenure review process, positive external reference letters carry more weight when they come from well known and respected individuals in the discipline. Popularity and respect are manifest on the web by the amount of attention gained either through back links or traffic. It can be argued that the amount of attention gained by a person does not reflect the quality of their work within their disciplines; however, positive citations and positive book reviews have been relied upon for years, for lack of other metrics.

Impact

Along with productivity, visibility, and reputation, impact is the fourth dimension. The impact measure takes into account reputation per academic product or artifact. In other words, "*impact*" expresses the amount of attention generated by an article, chapter, report, presentation, etc. across an academic's career. One could assume that impact is always higher for senior faculty because their work has been in circulation for a longer amount of time compared to younger faculty. But time likely has a bigger effect on visibility and not necessarily reputation. High visibility (i.e., wide availability) can influence reputational characteristics, but in ways different than positive reviews from respected colleagues. In cyberspace, reputation is gained by having others express interest in an academic product by referring (or linking) to it.

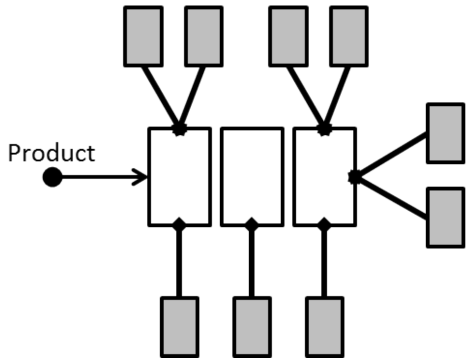
Kousha, Thelwall, and Rezaie (2010) refer to formal and informal online impact. Formal impact being that measured by sources such as GS for citations and informal impact being associated with gray sources such as online course syllabi, scholarly presentations (conference or seminar presentations), and blog impact. They also conclude that informal online impact is significant and increasing in several disciplines. Another approach, "altmetrics" (see altmetrics.org) is "the creation and study of new metrics based on the social web for analyzing, and informing scholarship" (Priem, Taraborelli, Groth, and Neylon 2010, 1). To assess scholarly impact, including measures of usage (downloads and views), peer-review (expert opinion), citations, and alt-metrics (storage, links, bookmarks, conversations). Kousha et al (2010), Priem et al (2010), and Bollen Rodriguez, and Van de Sompel (2007) make strong cases for usage-based metrics, but do not emphasize the full range of academic outputs as suggested in this article.

Figure 1 Diagram of Web Impact Types



B

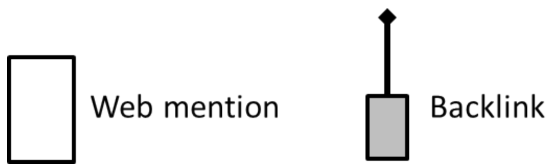
High Impact



Visibility = 3

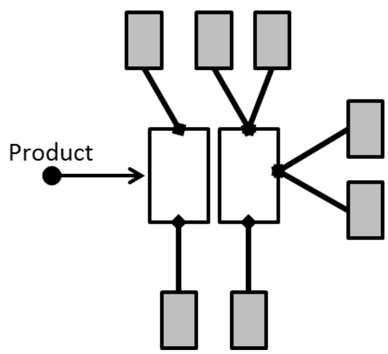
Reputation = 9

Impact = 9/3 = 3.0



C

Low visibility / High Impact



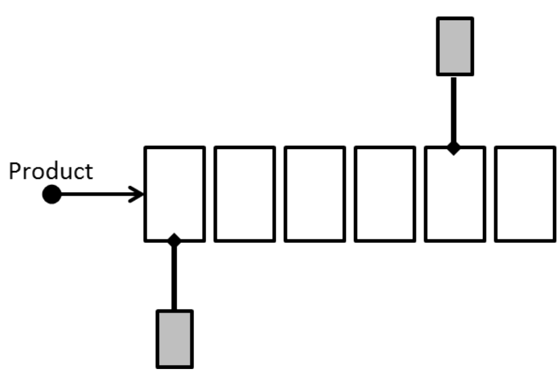
Visibility = 2

Reputation = 7

Impact = 7/2 = 3.5

D

High visibility / Low Impact



Visibility = 6

Reputation = 2

Impact = 2/6 = 0.33

An academic product (e.g. journal article mention) may appear on three web pages, and in Case A only one of these pages has backlinks (links from other web pages) and in another Case B the same product, the same visibility, with nine backlinks. So while in both cases a product has the same amount of visibility, but Case B expresses a higher level of reputation, and hence, impact. It can also be possible that lower visibility products can actually have a higher impact than a higher visibility product (see Cases C and D). It is unclear at this point if there is a relationship between measures of visibility and reputation due to the lack of empirical data. A product needs to first be available and visible to gain attention and be valued by peers or the public. However, low quality, very visible work will not have high impact as described here. The point is that visibility is not an end in itself (see Franceschet 2010; Dewett and Denisi 2004) and that mentions or linking are a better measures because they signify high quality and impact.

The key points thus far are that, a) the web contains far more types of academic output compared to traditional citation databases, b) planning and other social sciences should recognize the value of gray literature to their disciplines and pay attention to these for faculty evaluation through webometrics, and c) expect that a web presence and visibility will increase in importance over time as academic programs compete for increasingly scarce resources. Planning academics should see the advantages of web visibility and use it to more broadly for scholarly communications while at the same time use it to assess scholarly impact.

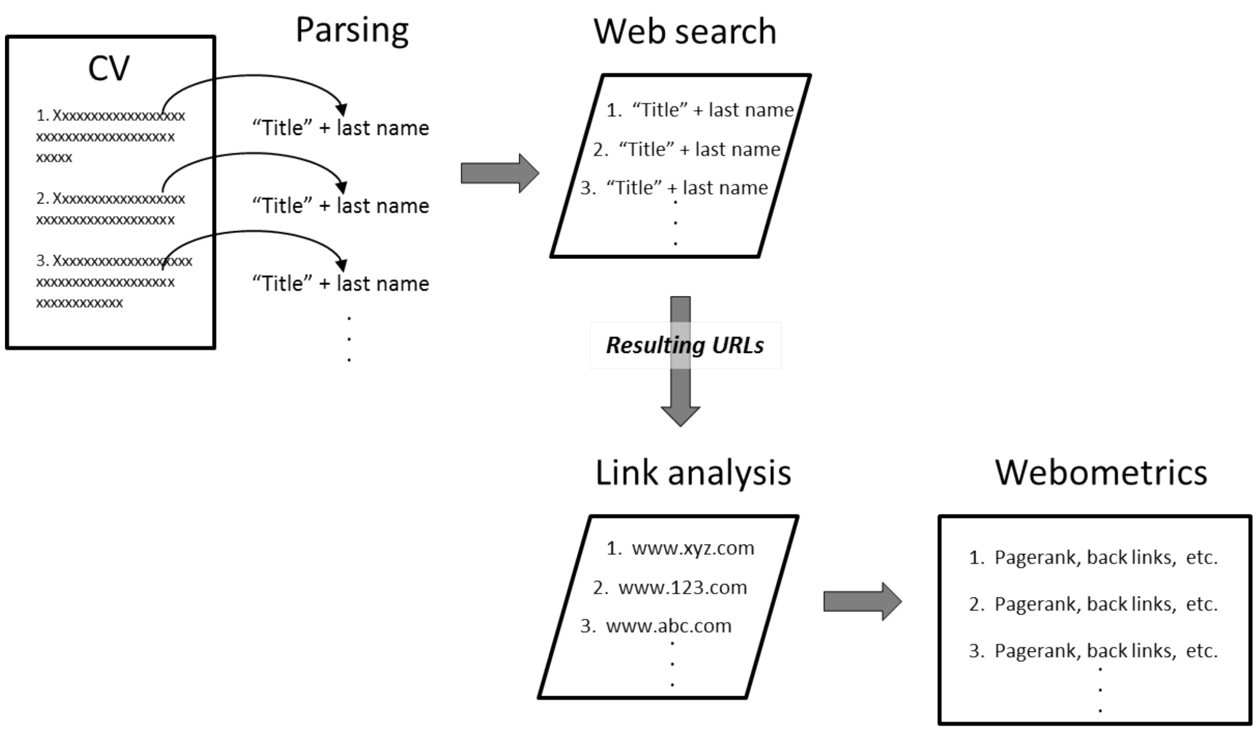
Case Study of a Planning Faculty

Using the concepts of productivity, visibility, reputation, and impact, the following is an example to illustrate webometric analysis for an individual faculty member, and then for an academic department. The process is especially useful to not only assess faculty activities but also for comparisons in the context of promotion and tenure. The analysis integrates academic visibility and impact by years of experience and also by tenure status. It is important to note that the academic webometrics can be a tool for promotion and tenure review, and not a substitute for a complete review. There are several other criteria that can and should be used to assess faculty productivity, contributions, and reputation as previously discussed such as research funding levels, funding sources, impact on students, and service activity.

Web Search Methodology

One of the challenges in conducting web impact analysis for faculty activity is that often titles of publications, and other artifacts are not unique and the way they are posted on a website may not include complete information including name (or names in the case of co-authors/partners), the year completed, the publisher or sponsor name, and author(s) affiliation. The way a product appears on a CV is not likely the way it will be cited or referenced on the web. Only using a string of words (such as from the title) may result in finding random and unrelated web pages that happen to contain these same words. To increase the likelihood of making accurate matches, the exact title enclosed in quotes is used so that the exact phrase must be found. In addition, searches also should at least contain the author's name. Web references to projects, reports, presentations, etc. often do not include the year or location, so the method used here for web searches is the title of the work (in quotes), the Boolean operator AND, and the author's (or coauthor's) last name. For a query to be considered a successful match it has to find the exact tile and the last name of the author. All pertinent items from a CV are parsed to obtain this information, and stored in a spreadsheet or text file for batch queries. This process is shown in Figure 2.

Figure 2 Process Diagram



Search engine optimization (SEO) tools are used to conduct batch searches because most web browser-based search engines only handle single search terms at a time. Batch queries greatly enhance the speed of processing the items from a CV that would otherwise be extremely time-consuming to search individually. Applications like Webometric Analyst (see http://lexiurl.wlv.ac.uk/) are critical for this step of the process. At the time of this analysis, only Bing currently allowed multiple web searches and resulting URLs for web mentions to be aggregated and stored in output files. The next step is to conduct a query of resulting URLs where academic artifacts have been mentioned. This involves search engine optimization (SEO) web tools like SeoQuake (see http://www.seoquake.com/), to search for all of the URLs and provide measures of page traffic, site ranking, and the number of indexed backlinks (e.g., indexed links/pages by Google or Yahoo, the most inclusive web page indices currently). The primary metrics generated by this process (besides productivity) are visibility (number of associated URLs), reputation (number of backlinks), and impact (ratio of backlinks and web mentions).

The Case of Professor X

Professor X is an associate professor who has both professional and academic research experience after receiving his doctorate degree in city and regional planning. Considering his overall production of 4 chapters, 27 journal articles, 28 other publications, 54 conference presentations, 14 research reports, 17 funded grants, and 7 teaching assignments resulted in 151 total unweighted productivity generated 281 web mentions or total URLs. These 281 mentions also generated 325 backlinks (an average of 1.16 per mention) referencing their work. This results in an impact score of 2.15 as shown in Table 1.

Table 1. Professor X

Type of Artifact	Number	Visibility	Backlinks	Impact
Books	0	0	0	0.00
Chapters	4	8	13	3.25
Articles	27	93	113	4.19
Other	28	78	96	3.43
Reports	14	16	16	1.14
Grants	17	24	41	2.41
Presentations	54	50	40	0.74
Classes	7	12	6	0.86
	151	281	325	2.15

As might be expected, teaching activities and conference presentations had the lowest impact because they tend to be the least promoted on the web (and elsewhere). Classes may have web sites but do not draw much attention from non-students and often are hidden from web crawlers when they are posted on protected course management systems like Blackboard or Scholar. Conference presentations may only be in the form of Powerpoint files which are not always posted either by conference websites or by the author because much of the relevant content is missing (i.e., the oral portion of the presentation). In these cases, links to class titles are found on mainly department web sites that list course offerings unless syllabi happen to be posted to other public sites like www.authorstream.com, www.slideshare.net and www.scribd.com. Conference presentation titles are often only found on CVs posted to the web, faculty profiles, and department news and announcements. The low impact scores for these items represent opportunities for Professor X to increase his visibility which may lead to greater levels of recognition.

The items with the highest impact for Professor X were articles (4.19), other publications (3.43), and book chapters (3.25). Impact scores are not necessarily a function of elapsed time or years of service, even though it would seem that academic artifacts would accumulate mentions over time. This is true in the case of journal, book, and book chapter citations under traditional citation analysis because they are cumulative, but may not hold for web mentions because web sites come and go, both where academics post their work as well as web sites that are backlinking. In addition to web pages and links fading over time, the amounts of traffic to web sites will also fluctuate over time, which effect metrics like Pagerank and Alexa rank. Overall, what this means is that web-based visibility, impact, and reputation is dynamic and reflects current demand or interest in academic products. Because webometric analysis (especially academic visibility) is new, there are currently no historical data to examine what these variations look like over time.

It is important to consider each of the dimensions of productivity, visibility, reputation, and impact when using the webometric approach for faculty assessment. In addition, all of these are relative measures that should be used in comparison to academics in similar disciplines due to differing emphases within the promotion and tenure process as well as university types. As previously discussed, some disciplines or programs have heavier teaching loads and therefore expectations around scholarly output can be less. Some disciplines place more weight on the amounts and sources of grant funding. In addition, the role of completed books within the tenure process also differs among disciplines.

Errors

It is also important to account for errors that occur in the web search process resulting from similar word combinations and author name matches. This will be more common for artifacts with short and indistinct titles and authors with common last names. Each of the 281 URLs generated by searches for the work of Professor X were manually reviewed, of which 9 were found to be inaccurate matches. This produced an error rate of 3.2 percent and in the case of Professor X, none of the 9 matchs added backlinks to the SEO analysis. Again, the error rate will vary based on research topics, titles, and disambiguous author names.

In addition to search errors, titles may also be an issue. For instance, the titles of conference papers, research reports, and journal articles may be the same because they are derived from the same or related research activities. These would be shown as multiple artifacts on a CV and result in identical searches with identical webometric outcomes. While an academic should receive credit for all of these in terms of search results, the similar title and name searches may not correctly distinguish a conference presentation title, a report title, or journal article title from each other. In the case of Professor X, 19 URLs were duplicates that had 10 backlinks associated with them. This means that 6.7 percent of URLs and 3.1 percent of backlinks were potentially duplicates. Most of these sources are lists of references that show multiple artifacts from the same academic, so it difficult to say whether these should be counted as duplicates or not.

Faculty Analysis

The same process shown for Professor X can be applied to academic departments or programs. Webometrics can be used to illustrate the productivity, visibility, reputation, and impact to help promote their work as well as being used to compare programs or groups of faculty within the same discipline. The following is an example of a department-wide analysis that compares the metrics discussed here against faculty rank, years of experience, and citation analysis metrics which have traditionally been used to measure academic productivity and reputation.

The methodology previously discussed was applied to fifteen faculty members in the Virginia Tech, Urban Affairs and Planning program. Table 2 shows a summary of faculty webometric measures along with other individual characteristics mentioned above.

Table 2. Faculty activities (as of Fall 2011)

Name	**GS Cites**	**H-Index**	**Years**	**Output**	**URLs**	**Ylinks**	**LinkRatio**	**Impact**	**Rank**
Professor 1	296	7	2	84	382	14950	39.1	178.0	Asst
Professor 2	33	2	1	25	38	13	0.34	0.52	Asst
Professor 3	12	2	4	20	59	365	6.19	18.25	Asst
Professor 4	65	4	4	51	56	369	6.59	7.24	Asst
Professor 5	92	4	5	63	188	2596	13.81	41.21	Assoc
Professor 6	80	6	7	73	103	237	2.30	3.25	Assoc
Professor X	315	10	19	153	281	325	1.16	2.12	Assoc
Professor 7	111	6	23			No data			Assoc
Professor 8	51	4	24			No data			Assoc
Professor 9	66	2	25	96	240	1072	4.47	11.17	Assoc
Professor 10	570	14	15	195	463	5448	11.77	27.94	Full
Professor 11	1334	20	24	142	269	1133	4.21	7.98	Full
Professor 12	175	7	31	95	138	579	4.20	6.09	Full
Professor 13	280	6	34			No data			Full
Professor 14	3082	21	38	223	597	2109	3.86	9.46	Full

Examining the bivariate correlations for the 15 regular (i.e., tenure track) faculty across the eight metrics for productivity, visibility, reputation, and impact shows some interesting relationships. As expected the number of GS citations and H-index are positively correlated because they are a function of each other, and the number of citations and H-index being closely related to measures of visibility and overall output. The years of service are positively associated with citations and overall output, which also is as expected. However, years of service is not associated with web presence or overall impact. While visibility is related to citations and output, it is not correlated with other webometrics for reputation (i.e., backlinks), link impact (link ratio), or artifact impact. Reputation is related to link impact and overall impact. This suggests is that the webometric results are independent from the traditional citation analysis metrics and are perhaps detecting the other types of academic activity besides peer-reviewed publications. This is precisely the purpose of including webometric analysis, otherwise, there would be no value added if webometrics and citation analysis were measuring the same, or similar characteristics.

Table 3. Correlation matrix

Correlations

		Cites	H-Index	Years	Output	URLs	Ylinks	LinkRatio	Impact
Cites	Pearson Correlation	1	.864**	.525*	.758**	.756**	.029	-.105	-.042
	Sig. (2-tailed)		.000	.045	.004	.004	.928	.745	.881
	N	15	15	15	12	12	12	12	15
H-Index	Pearson Correlation	.864**	1	.488	.871**	.762**	.097	-.060	-.018
	Sig. (2-tailed)	.000		.065	.000	.004	.763	.854	.949
	N	15	15	15	12	12	12	12	15
Years	Pearson Correlation	.525*	.488	1	.736**	.558	-.236	-.361	-.403
	Sig. (2-tailed)	.045	.065		.006	.059	.461	.250	.136
	N	15	15	15	12	12	12	12	15
Output	Pearson Correlation	.758**	.871**	.736**	1	.895**	.132	-.056	-.076
	Sig. (2-tailed)	.004	.000	.006		.000	.682	.864	.815
	N	12	12	12	12	12	12	12	12
URLs	Pearson Correlation	.756**	.762**	.558	.895**	1	.482	.315	.305
	Sig. (2-tailed)	.004	.004	.059	.000		.112	.318	.336
	N	12	12	12	12	12	12	12	12
Ylinks	Pearson Correlation	.029	.097	-.236	.132	.482	1	.965**	.966**
	Sig. (2-tailed)	.928	.763	.461	.682	.112		.000	.000
	N	12	12	12	12	12	12	12	12
LinkRatio	Pearson Correlation	-.105	-.060	-.361	-.056	.315	.965**	1	.985**
	Sig. (2-tailed)	.745	.854	.250	.864	.318	.000		.000
	N	12	12	12	12	12	12	12	12
Impact	Pearson Correlation	-.042	-.018	-.403	-.076	.305	.966**	.985**	1
	Sig. (2-tailed)	.881	.949	.136	.815	.336	.000	.000	
	N	15	15	15	12	12	12	12	15

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

In the case the Virginia Tech, Urban Affairs and Planning faculty, years of service was not positively correlated with these metrics, rank (assistant, associate, and full professor), as shown in Table 4. It should be noted that the metrics for one assistant professor (Professor 1 in Table 2) had to be omitted because they substantially skewed the results.

Table 4. Average metrics across faculty rank

Rank	Cites	H-Index	Years	Output	URLs	Ylinks	LinkRatio	Impact
Assistant	36.7	2.7	3.0	32.0	51.0	249.0	4.4	8.7
Associate	119.2	5.3	17.2	96.3	203.0	1057.5	5.4	14.4
Full	1088.2	13.6	28.4	163.8	366.8	2317.3	6.0	12.9

Academic Visibility

Across the faculty, the artifacts that were most visible on the web are journal articles, books, book chapters, and conference presentations as shown in Table 5. Compared to reputation metrics, articles contribute about one-third of links, with "other" publications, and presentations representing about one-quarter and one-fifth respectively. As can be seen, besides journal articles, other publications and presentations receive a significant amount more attention than do chapters or books. This suggests that artifacts other than those included in traditional citation analyses (articles, books, and chapters) play an important role in the attention that planning academics receive on the web.

Table 5. Academic visibility and reputation

	% of Total	
	URLs	Ylinks
Articles	32.9%	34.2%
Chapters	15.0%	3.0%
Books	16.3%	8.5%
Grants	5.5%	0.9%
Other publications	8.0%	26.6%
Presentations	15.0%	21.0%
Reports	2.8%	0.6%
Teaching	4.4%	5.4%

Table 5 can be analyzed to detect opportunities for generating more academic visibility – potentially contributing to future recognition, reputation, and impact. Gray literature products stand out in this respect. Grant information and research results should be more widely accessible not only for the academic to receive recognition, but also for the grant sponsor. Public agencies and foundations should be interested in communicating the results of the work they support so that donors and tax payers can better appreciate the importance of the work that was supported. In addition, more visible course materials may serve valuable purposes as faculty portfolios and potentially attract students based on specific course content, activities, and examples of student work. More visible, grants and teaching information, for example, thus far has been significantly undervalued by academic evaluation.

Discussion

Besides the relationship with promotion and tenure review, academics should be thinking about the larger implications of academic visibility and reputation. Increasing visibility serves other very important purposes like attracting prospective students, promoting important work being done to the university community and the public at large. Many students search for degree programs and research faculty backgrounds online. Faculty visibility focusing on productivity can help promote faculty areas of expertise in terms of research, outreach, and instruction – which can extend beyond potential students. Planning programs benefit from promoting their activities within their own universities to show productivity and justify budget requests and other resources to support program growth and associated activities. Finally, university faculties can benefit from working harder at making the public and boards of visitors (trustees, governors, etc.) aware of the breadth and depth of their productivity. These activities go far beyond the classroom. Criticisms of academics are often due to misunderstanding the job responsibilities of university professors, especially related to the value generated by scholarly activities, funded research, community outreach, etc.

So Why Does it Matter?

So why does productivity, visibility, reputation, and impact matter? In the case of academics it can be assumed that they are trying to meet the expectations of their institutional constituency relative to promotion, tenure, and salary (Dewett and Denisi 2004). On the other hand, others may argue that scholars should be driven to meet the expectations of multiple constituencies, including the public which historically funded a significant portion of their research activities through federal and state taxes. However, state support of higher education has been on the decline and many universities are nearing private status because operating budgets are relying more heavily on tuition dollars (Kelderman 2011). If so, how does research productivity pay returns to students (and parents) burdened by escalating tuition and fees?

I would argue that visible and impactful scholarship may be more important than ever. As visibility increases, so do reputation and impact which implies that scholars and their institutions gain prestige – thereby increasing the number of opportunities for funded research, sponsored projects, and availability of student research funding opportunities. For the individual academic, notoriety through increased visibility can also lead to increased funding opportunities brought to their institution, but also for speaking invitations, publishing royalties, and private consulting opportunities. These activities and benefits are difficult to prove empirically because they often go unreported to the institution and not consistently included in the academic record. Anecdotally, however, we see this to be the case for particular disciplines.

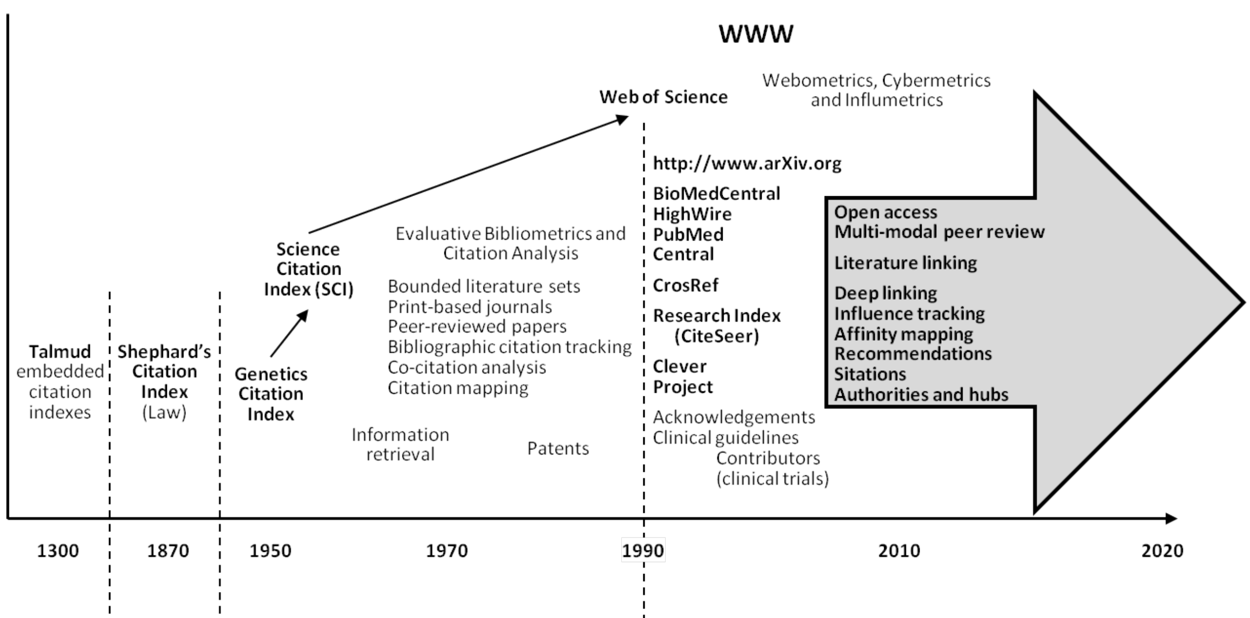
Faculty members should be encouraged to make their work visible for reasons already mentioned. This is particularly true for junior faculty establishing themselves in their discipline and working their way toward promotion and tenure. This means that self-promotion is important because academic programs typically devote little resources to scholarly communications. There are many tools that can be used to make scholarly work known including, personal blogs, personal web sites, department faculty web sites, research repositories such as Community of Science (COS), Google Scholar, and Social Science Research Network (SSRN). Online reference managers like Zotero and Mendeley allow users to post their work and make it visible to web searches. These types of services allow CVs to be post as part of user profiles, which again increases potential visibility.

Academic visibility can be increased in several ways, having a variety of benefits. There are few bad examples of academic departments (or individual faculty) that over-promote themselves because few have the time, resources, or inclination to do so. Increased visibility, highlighting faculty productivity, reputation, and impact can improve both internal and external communications if done on a consistent basis.

The Future is Now

In 2001, Cronin provided an excellent mapping for the future of web-based scholarship and webometrics (see Figure 3). "Open access" overcomes many of the obstacles to a true and dynamic web-based research archive. Multi-modal peer review increases access to scholarship as well as potential for collaborative and crowdsourced contributions. The benefits of hyperlinked literature through citations (at multiple levels) and influence tracking can speed the process of accessing related scholarship. The ability to instantly access all referenced material in an article including references to referring articles is only available on a limited basis currently because of copyright and publisher control. Open access means that not only will cited materials be available in full text to web pages or with deep links, but also in a single click with webometric and bibliometric data attached.

Figure 3. The evolution of web-based citation analysis



Source: Adapted from Cronin (2001)

The approach described here can be greatly enhanced through a much larger and comprehensive dataset across faculties and universities. This would allow deeper analyses to be performed that better illustrate relationships between academic productivity, visibility, reputation, and impact. While some faculty openly despise and discourage "scorecards" for their activities, analytics for performance evaluation including services like Total-Impact (total-impact.org), Altmetrics (altmetrics.com), and Mendeley's research analytics (Mendeley.com) are gaining rapid momentum. The webometric future will be uncomfortable for some academics because it means they will need to be more accountable for how they spend their time and institutional resources.

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