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WEBSITES OF INDIAN INSTITUTES OF TECHNOLOGY: A WEBOMETRIC STUDY

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ABSTRACT

The study explored different characteristics of linking analysis of sixteen IIT websites. All the IITs have their own websites and all websites working under homogeneous Domain Name System (DNS) ".ac.in". The comparisons of ranking of Indian Institutes of Technology (IITs) have been done using WISER, WIF (inlink) and World Rank. The WISER ranking and WIF (in-link) is having correlation i.e. +0.0558824 which implied that there is much association or closeness between two ranking methods. WIF (in-link) rank gave much closer value to the world rank. Hence, the IIT Bombay and IIT Madras secured 1st position and 2nd position respectively in WIF (in-link) as well as in world rank; whereas, WIF (in-link) position of IIT Rajasthan shows one position better rank than the world ranking i.e. 15th position.

The findings of the study will guide to webmasters and library professionals, so that they can overcome the limitations faced by the users and improve their websites. This study will also help the newly established IITs to improve the world rank with other reputed and older IITs. All the websites of IITs may prepare their world rank to compete with other top institutions websites, like Harvard University and Massachusetts Institute of Technology.

Key words: Webometrics, Evaluation, Indian Institute of Technology Websites, India

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1 INTRODUCTION

The growing demand for education, fundamental changes in higher education in India, and enhancing value system needs the creative coordination of world universities on the basis of a constant exchange of experiences among them. The easiest and the effective way to operational exchange of information is publication on the website. Enhancing a web policy expands the dialogue between the universities, contributes to the formation of new communications in the scientific community, and helps in realization of innovative development. Thus, it sheds some light on the use of key communication medium and may lead to more effective academic use of the web. "The World Wide Web (WWW) has now become one of the main sources of

information on academic and research activities, and therefore, it is an excellent platform to test new methods of evaluating webometric activities" (Babu, Jeyshankar and Rao, 2010).

Web resources are apple of information professional's eye due to its value added services to meet their current and diversified information needs. In the WWW, the web pages are the entities of information, with hyperlinks from them acting as citations. Quantitative analysis on the WWW is being carried out in the same way, as is tradition in citation databases. As information on Web increases towards entropy, it is needed to apply some theory/ metrics (measurement) to develop new methods, modeling techniques and metaphors to examine this emerging complex network. Through webometric study one can observe that how users actually react and use specific web document. The web is beyond control in growth, which means opportunities exist where good system architecture and diligent analysis can be applied for everyone's benefit. On the basis of the study and conception, the definition of webometric is given, "the webometric study is based on quantitative measurement – indirectly includes the qualitative aspect also of structure, use of information resources and technologies on WWW drawing on bibliometric and infometric approach" (Goswami, 2007).

2 STATEMENT OF THE PROBLEM

Development of the new information technologies, web emergence and unique features of the web environment, such as hypertext and hyperlink, have led to a big revolution in the information science area which, in turn, puts emphasis on the necessity of studying various aspects of the web to make better and more use of today's important phenomenon. This has been frequently confirmed by researchers (Noruzi, 2005).

The WWW has now become one of the main sources of information on academic and research activities, and therefore it is an excellent platform to test new methods of evaluating webometric activities. However, the world scientific community has not yet accepted the Web as a full supplement or a complement to traditional scientific publishing. The increase in the use of the web for research has led to the evolution of web bibliometric, popularly referred to as webometric. Webometric analysis show nature, structure, content features of websites as well as links structure to understand virtual highways and their interrelations (Bjorneborn and Ingwersen, 2001).

Websites of IITs are important communication tools. The roles that these institutions have undertaken, have become more important, necessary and expanded in today's time and for near future. However, the quality or reputation of IITs cannot be precisely measured by mere numbers. It would be impossible to have a comprehensive qualitative and not quantitative ranking of IITs, because of the huge differences in IITs and the technical difficulties in obtaining comparable data across world universities. On the other hand, there is no ranking of IITs using multiple criteria. It is used as a national measure of research productivity among IITs in India.
Studying websites of IITs quantitatively and qualitatively demonstrates their impact rate and visibility rate by webometric method. One of the criteria evaluating websites, is to calculate web impact factor (WIF) of inlink, Web Indicators for Science, Technology and Innovation Research (WISER) and compare their WISER, WIF (inlink) and World Rank which can be measured through determining number of web pages, total number of link pages, self-link pages, in-link pages or external link pages and WISER Index Value. The paper aims to study the impact rate and visibility of the websites of IITs, using above webometric methods.

3 REVIEW OF RELATED LITERATURE

Webometrics grew out of a realization that quantitative methods originally designed for bibliometric analysis of citation patterns of scientific journal articles could be applied to the Web by using commercial search engines to provide the raw data. Larson (1996) was one of the first information scientists to perform an investigation of link structures in academic web spaces. In his paper 'Bibliometrics of the World Wide Web: an exploratory analysis of the intellectual structure of Cyberspace'.

The scope of webometrics is closely associated with the dynamic changing nature of the Web which must be taken into account when carrying out informetric analysis of the Web. Printed documents, the main data source of traditional bibliometrics are relatively more permanent compared to Web documents which are constantly changing in several ways. The contents of webpages change, documents are often removed, URLs change, websites disappear, and some documents are temporarily inaccessible. Search engines are the main sources of webometrics data collection. Therefore, knowledge about the availability of commercial search engines, their performance, coverage of the Web, advanced search query formulation etc. form the core of webometric studies.

The WIF as a useful measure of the overall influence of a web site, using the backlinks or inlinks (links coming into a site from other sites) to the web site, has been proposed independently by two bibliometric researchers (Noruzi, 2005). Ingwersen (1998) introduced the concept of the Web Impact Factor (WIF). The so-called external WIF for a given web site (or TLD, top level domain) was defined by Ingwersen (1998) as the number of external pages (i.e. pages in other sites or TLDs) with links to the given site (or TLD) divided by the number of web pages at the site (or TLD). However, the fluctuating performance of AltaVista at the time of the study yielded problematic variations in the calculated WIF measures.

Inlinks can be seen as an indicator of the overall significance and importance of a site. The number and the source of inlinks to a site are currently being used by Google to rank the relevance of retrieved results to the search queries. Google employs a conventional text-based scan to create an index of the Web's content, but the pages recommended in response to a query are ranked according to information from the link analysis. A page is rated highly if many pages point to it, and if many other pages point to those pages, and so on (Hayes, 2000). Google uses link analysis data in its results ranking algorithm and it appears likely that other search engines include this information in their proprietary algorithms.

The interest in the Web Impact Factor thus catalyzed an avalanche of webometric research, especially into links in academic web spaces. Aguillo (2002) points out that the webometrics is still in its infancy as a scientific domain -"with its own different theories to be built, tasks to be done, units to be defined, methods to be developed and problems to be solved." As stated by Wilkinson et al. (2003), the lack of understanding why web links are created is a major obstacle in webometrics and one "that must be directly addressed in spite of its evident complexity". Further, they state that the study "has really only scratched the surface of the topic of academic linking motivations". Using a random sample of 414 inter-university links from the UK academic web space, i.e. the ac.uk domain, Wilkinson et al. (2003), investigated web authors' motivations for creating links between university web sites. Subsequently, Thelwall has developed the WIF measure in several papers in order to find possible correlations to traditional

research productivity indicators by Thelwall (2001; 2002; 2003), Smith & Thelwall (2002) and Thelwall & Tang (2003).

Some of the related Indian articles which dealt with the subject are: Jeyshankar and Ramesh Babu (2009), examines and explores through a webometric study the webistes of 45 universities in Tamil Nadu comprising of 27 state and 18 private universities. Reflects that some universities in Tamil Nadu have higher number of web pages but correspondingly their link pages are very small in number and websites fall behind in their simple, self-link and external link WIF.

Another article by same authors (Jalal, Biswas and Mukhopadhyay, 2010) in their article entitled "Web impact factor and link analysis of selected Indian universities", investigates the effectiveness and relevance of web impact factor for Indian universities' websites. Result shows that all the NITs are closely related in the topology framework/their activities whereas nodes are not linked significantly for the case of state universities and central universities. Ratha, Joshi, and Naidu (2012) found significant differences according to some important point of view such as the user supporting services, number of hyperlinks on home pages and whole websites, number of images, location of images, In-active links and web pages, etc. The paper finally looks the design and structure of the library websites of IITs. Shukla and Poluru (2012) analyze web presence of Indian State Universities (173) on the World Wide Web (WWW) and also to find ways to get high web links that further help to improve presence on Web. Vijayakumar, Kannappanavar, and Santosh (2012) focuses on the identification of web presence and their links among SAARC countries.

Evidence has been found to indicate that web sites with more content are more visible in that they attract more links and therefore potentially more traffic to the sites. Web site age has been shown to affect site visibility: older web sites are more visible. It could be reasoned that changes of URL are not desirable because they can have a negative effect on web site visibility and thus reduce visits to the site (Vaughan & Thelwall, 2003).

4 OBJECTIVES OF THE STUDY

The primary objective of the study is to examine critically the effectiveness and efficiency of the use of web impact factor. The other inter-linked objectives are to:

i) identify and analyze links of websites of Indian Institutes of Technology;
ii) find out the link patterns among the websites of IITs under study;
iii) investigate relevance of Web Impact Factor (WIF) with reference to Top Level Domain (TLD), Second Level Domain (SLD) and Webpage Second Level Domain (WSLD);
iv) to calculate the simple Web Impact Factor (WIF), self-link WIF and in-link or external WIF;
v) compare various ranking approaches among websites of IITs;
vi) compute the correlation between ranking of WISER and WIF(inlink), and
vii) rank the IIT websites under study as per WIF, WISER index value, and world rank.

5 SCOPE OF THE STUDY

The scope of the study confines to webometric study of sixteen (16) IITs in India, aimed to establish a kind of ranking of websites of IITs in India, using webometric study by measuring their WIF (inlink) and WISER. The study of the ranking will help the reader to compare and

identify the websites of IITs by their WISER WIF (inlink) and World rank.

6. DATA ANALYSIS AND INTERPRETATION

6.1 Top Level Domain of websites of IITs

Top Level Domains **(**TLDs) of IITs, Second Level Domains (SLDs) related to education and research domain under the TLD for India (.in) and the Universal Resource Locators (URLs) of 16 IITs have been collected by conducting Internet searching. The selected search engine is then searched against all the domain names and URLs to check whether the AltaVista databases include these domain/sites or not. Each URL has been checked by visiting at least twice daily during the period of searching. The TLDs, SLDs under .in and domain name of hosts of IITs are shown Table – 1 through Table-3.

Table - 1: Top Level Domain of Websites of IITs (Group-I)

TLD of IITs	
India	.in

Table-2: Second Level Domain of Websites of IITs (Group-II)

SLD related to education and research activities under TLD for India	
Academic activities	.ac.in

Table - 3: Domain name of hosts of IITs (Group- III)

Sl.No.	**Domain name of hosts of IITs**	**URL**
01	Indian Institute of Technology (BHU) Varanasi	iitbhu.ac.in
02	Indian Institute of Technology Bhubaneshwar	iitbbs.ac.in
03	Indian Institute of Technology Bombay	iitb.ac.in
04	Indian Institute of Technology Delhi	iitd.ac.in
05	Indian Institute of Technology Gandhinagar	iitgn.ac.in
06	Indian Institute of Technology Guwahati	.iitg.ac.in
07	Indian Institute of Technology Hyderabad	iith.ac.in
08	Indian Institute of Technology Indore	.iiti.ac.in
09	Indian Institute of Technology Kanpur	iitk.ac.in
10	Indian Institute of Technology Kharagpur	iitkgp.ac.in
11	Indian Institute of Technology Madras	.iitm.ac.in
12	Indian Institute of Technology Mandi	iitmandi.ac.in
13	Indian Institute of Technology Patna	iitp.ac.in
14	Indian Institute of Technology Rajasthan	iitj.ac.in
15	Indian Institute of Technology Roorkee	iitr.ac.in
16	Indian Institute of Technology Ropar	.iitrpr.ac.in

6.2 Use of Appropriate Query Syntax

The Webometric analysis is based on the data collected from the Web using various search engines. In each search engine there are some specific search keywords assigned by the search engines to retrieve the required information from the Web. These specific search keywords along with search syntax have been presented (Table-4).

Table - 4: Webometric query syntax with results

Search Command	Results	Supported By
domain:~abc	Total number of WebPages	AltaVista, Yahoo!
site:~abc	Total number of WebPages	Google
domain:~abc NOT linkdomain:~abc	Total number of external links or inlinks	AltaVista, Yahoo!
site:~abc NOT linkdomain:~abc	Total number of external links or inlinks	Google
domain:~abc AND linkdomain:~abc	Total number of selflinks	AltaVista, Yahoo!
site:~abc AND linkdomain:~abc	Total number of selflinks	Google
linkdomain:~abc	Total number of links	AltaVista, Yahoo!, Google
site:~abc filetype:pdf	Report total number of pdf files	Google
domain:~abc fileType:pdf	Report total number of pdf files	Yahoo!

Note: *~ denotes space to use various commands in the search engines.*

6.3 Data Collection through Searching

A series of online snapshot searches over one month (25/10/2012 to 25/11/2012) have been performed on the selected search engines by keeping the various search conditions constant. The three search statements that have been used to collect various data for each TLD, SLD and Webpage Second Level Domain (WSLD) or URL may be illustrated with one example from each group in the Table-5 and Table-6.

Table - 5: SLD ac.in under TLD .in (Group- I)

domain: ac.in	It will report number of web pages under *ac.in* domain (SLD under .in) included in the AltaVista/Yahoo databases that provide number of webpages.
linkdomain: ac.in	It will report number of web pages in AltaVista/Yahoo databases that provided total number of links to *ac.in* domain (SLD under .in)
(domain: ac.in AND linkdomain: ac.in)	It will report number of web pages under *ac.in* domain (SLD under .in) included in the AltaVista/Yahoo databases that provided hyperlinks i.e. selflink pages
(domain: ac.in NOT linkdomain: ac.in)	It will report number of web pages not under *ac.in* domain but provided hyperlinks to *ac.in* domain (SLD under .in) included in the AltaVista/Yahoo! i.e. external link pages or inlink.

Table - 6: WSLD iitd.ac.in under SLD ac.in (Group-II)

domain: iitd.ac.in	It will report number of web pages under *iitd.ac.in* domain (SLD under .in) included in the AltaVista/Yahoo databases that provide number of webpages.
linkdomain: iitd.ac.in	It will report number of web pages in AltaVista/Yahoo databases that provided total number of links to *iitd.ac.in* domain (SLD under .in).
(domain: iitd.ac.in AND linkdomain: iitd.ac.in)	It will report number of web pages under *iitd.ac.in* domain (SLD under .in) included in the AltaVista/Yahoo databases that provided hyperlinks i.e. selflink pages.
(domain: iitd.ac.in NOT linkdomain: iitd.ac.in)	It will report number of web pages not under *iitd.ac.in* domain but provided hyperlinks to *iitd.ac.in* domain (SLD under .in) included in the AltaVista/Yahoo! i.e. external link pages.

6.4 Calculation of Web Impact Factors (WIF)

WIF is the web versions of impact factor. There are three types of WIFs: WIF (simple), WIF (selflink) and WIF (inlink). The WIF introduced by Ingwersen (1998) is the ratio of the number of backlinks to a site, divided by the number of webpages at the site, as follows:

A = Total number of webpages to a particular site
B = Number of external backlinks to a given site
C = Number of selflinks to a given site
D = Total number of links to a site
Therefore, WIF (simple) = **D/A**; WIF (inlink) = **B/A** and WIF (selflink) = **C/A**

6.5 Measuring Web Presence

Web presence can be measured according to several Web-based indicators, some of which include the number of webpages, number of inlinks or external links, number of selflinks and the number of total links. The data relating to the web presence of IITs have been retrieved using the webometric query syntax (Table-4) as supported by the commercial search engines. WIFs were calculated and reported in order to compare the institutions web influence. Table-7 and Table-8 presents the various types of WIF calculations related to study websites.

Table - 7: Calculation of WIFs for India (i.e. .in) (20th November, 2012)

	Values				Results		
Search Engines	Webpages (A)	Inlinks (B)	Selflinks (C)	Total links (D)	WIF (simple) (D/A)	WIF (inlink) (B/A)	WIF (selflink) (C/A)
AltaVista	34100000	33700000	7200	200000	0.005865	0.988269	0.000211
Google	14100000	1760000	1870000	786	0.000055	0.124822	0.132624
Yahoo	34100000	33700000	7200	200000	0.005865	0.988269	0.000211

Note: *AltaVista and Yahoo search engine giving same result just because of the AltaVista website is up, and it is stated on the website that they are using the Yahoo search engine.*

Table 7 reflects that India as a whole is having strong value of WIF e.g. 0.988269 through AltaVista search engine. This unexpected result is due to the fact that lower value of webpages as compared to external links or inlink.

Table - 8: Calculation of WIFs for Indian Academic Web Space (i.e. .ac.in)

	Data				Result		
Search Engines	webpages (A)	inlinks (B)	selflinks (C)	total links (D)	WIF (simple) (D/A)	WIF (inlink) (B/A)	WIF (selflink) (C/A)
AltaVista^	2450000	141000	1890000	141000	0.057551	0.057551	0.771428
Google	1370000000	1160000000	414000000	1020000	0.000744	0.846715	0.302189

^**Note**: *Since AltaVista and Yahoo search engine giving same result that is why we have taken only AltaVista not Yahoo! Search engine in Table - 8.*

Table-8 reveals that Google search engine reported very higher result than AltaVista. This unexpected result is due to the fact that higher number of webpages, huge value of inlinks and around 15 times higher value than AltaVista search engines generated.

6.6 Measuring Web Impact Factors of Websites of IITs

WIF for each TLD, SLD and WSLD have been calculated on the basis of formula given in Sec.6.4 for various groups. WIF for each selected web space is calculated in three different ways. These are WIF (simple) – a ratio of number of total link pages and number of web pages; WIF (selflink) - a ratio of number of selflink pages and number of web pages and WIF (inlink) - a ratio of number of selflink pages and number of web pages as it is the true reflection of the degree of impact of the domain spaces on the WWW. A matrix may represent the calculation of WIF for different web spaces at different levels shown in Table-9.

Table - 9: Calculation of WIFs for IITs based on WIF (Inlink)

	Data				Result	
WSLD	webpages (A)	inlinks (B)	selflinks (C)	Total links (D)	WIF(simple) (D/A)	WIF(inlink) (B/A)
iitbhu.ac.in	131	02	131	00	00	0.015267
iitbbs.ac.in	139	06	139	00	00	0.043165
iitb.ac.in	3630	21500	4400	28	0.007713	5.922865
iitd.ac.in	6390	15600	6600	17	0.002660	2.441314
iitgn.ac.in	153	11	155	00	00	0.071895
iitg.ac.in	12000	03	14500	00	00	0.000250
iith.ac.in	19500	51	20100	00	00	0.002615
iiti.ac.in	370	06	372	02	0.005405	0.016216
iitk.ac.in	3590	10	08	11	0.003064	0.002785
iitkgp.ac.in	10200	05	04	02	0.000196	0.000490
iitm.ac.in	6650	34300	8120	41	0.006165	5.157894
iitmandi.ac.in	109	05	109	02	0.018348	0.045871
iitp.ac.in	141	02	143	04	0.028368	0.014184
iitj.ac.in	43000	13	43400	01	0.000023	0.000302
iitr.ac.in	2390	07	2420	05	0.002092	0.002928
iitrpr.ac.in	121	02	122	02	0.016528	0.016528

Source*: *Yahoo!/AltaVista November 20- 22, 2012

Table 9 reveals that IIT Bombay is having highest WIF (inlink) i.e. 5.922865, due to its least value of webpages with respect to value of inlinks available, but, IIT Guwahati is having least value of WIF (inlink) i.e. 0.000250, because of very largest value of webpages with respect to available inlinks.

6.7 Ranking of Websites of IIT in India

There are various approaches for ranking Institutions. Some of the methods have been explained in detail.

6.7.1 Ranking of IITs through WISER

IIT activity is multi-dimensional and this is reflected in its web presence. So the best way to build the ranking is combining a group of indicators that measures these different aspects. Almind & Ingwersen (1997) proposed the first Web indicator, Web Impact Factor (WIF) based on link analysis that combines the number of inlinks or external links and the number of pages of the website i.e. webpages, a ratio of 1:1 between visibility and size. This ratio is used for the ranking, but adding two new indicators to the size component: Number of documents, measured from the number of rich files in a web domain, and number of publications being collected by Google scholar database. As it has been already commented, the four indicators were obtained from the quantitative results provided by the main search engines as follows:

- **Size (S)** - number of pages recovered from three engines: Google, Yahoo, and AltaVista. For each engine, results are log-normalised to 1 for the highest value. Then for each domain, maximum and minimum results are excluded and every institution is assigned a rank according to the combined sum.
- **Visibility (V)** - the total number of unique external links received (inlinks) by a site can be only confidently obtained from Yahoo and AltaVista. For each engine, results are log-normalised to 1 for the highest value and then combined to generate the rank.
- **Rich Files (R)** - after evaluation of their relevance to academic and publication activities and considering the volume of the different file formats, the following were selected: Adobe Acrobat (*.pdf*), Adobe PostScript (*.ps*), Microsoft Word (*.doc*) and Microsoft PowerPoint (*.ppt*). These data were extracted using Google and merging the results for each file type after log-normalising in the same way as described before.
- **Scholar (Sc)** - Google scholar provides the number of papers and citations for each academic domain. These results from the Scholar database represent papers, reports and other academic items.

The four ranks were combined according to a formula where each one has a different weight:
Webometrics Rank (position) = 4*RankV + 2*RankS + 1*RankR + 1*RankSc; Where**, V=** Visibility**; S=** Size**; R=** Rich Files and **Sc=** Google Scholar**.**

Another formula mentioned below is a modification of the above prescribed in November 2012 by the Webometrics Research Group (www.webometric.info) which has been accessed on 20 November, 2012. The WISER Ranking is presented in Figure-2.

Webometrics Rank		
Visibility 50% *(inlinks or external links)*	**Size** *(Webpages)*	**20%**
	Rich Files *(Adobe Acrobat (.pdf), MS Word (doc, docx), MS Powerpoint (ppt, pptx) and PostScript (.ps))*	**15%**
	Scholars *(Google Scholar database)*	**15%**

Figure - 2: WISER Ranking (http://www.webometrics.info/en/Methodology)

Figure-2 reveals that the above formula will be:

Webometrics Rank (position) = 50%*RankV + 20%*RankS + 15%*RankR + 15%*RankSc; Where, **V** = Visibility**; S** = Size**; R** = Rich Files and **Sc** = Google Scholar**.**
Aguillo, et al. (2008) has given the formula for WISER ranking as:

WISER ranking = log (Visibility 50%) + log (Size 20%) + log (Rich files 15%) + log (Scholars 15%).

The volume of contents is measured by the number of pages freely accessible and their visibility by the number of incoming links. The number of rich files is used as an indicator because rich files are preferred formats for scholarly communications. Total number of documents indexed in Google scholar is also considered as an important indicator for scientific publications on the Web. Each web domain is ranked by the linear aggregation of these indicators for their ranking. Ranking of study institutions have been taken based on the following formula:

WISER ranking = log (Visibility 50%) + log (Size 20%) + log (Rich files 15%) + log (Scholars 15%) as prescribed by the World Webometrics Group (www.webometrics.info). WISER is Web Indicator for Science, Technology and Innovation Research and it is popular for ranking of academic institutions. The ranking of IITs based on WISER indicator is presented in Table–10.

Table - 10: Ranking of IITs based on WISER indicator

Name of IIT	Webpages (A)**[S]**	Inlinks (B)**[V]**	Total links (D)	**Rich Files [R]**					**Google Scholar (F) [SC]**	**WISER Index Value**
				Doc	Pdf	Ps	Ppt	Total		
IIT(BHU) Varanasi	131	02	00	02	02	00	02	06	02	0.849665
IIT Bhubaneshwar	139	06	00	01	00	00	00	01	63	2.072689
IIT Bombay	3630	21500	28	54	131	00	53	238	10600	11.646410
IIT Delhi	6390	15600	17	14	128	00	11	153	2880	10.994891
IIT Gandhinagar	153	11	00	02	05	00	00	07	44	3.066817
IIT Guwahati	12000	03	00	02	02	00	00	04	187	4.782386
IIT Hyderabad	19500	51	0	8	23	0	2	33	204	7.177931

IIT Indore	370	06	02	02	06	00	00	08	47	3.273723
IIT Kanpur	3590	10	11	18	28	00	15	61	8130	7.602697
IIT Kharagpur	10200	05	02	05	16	00	03	24	738	6.308020
IIT Madras	6650	34300	41	77	196	00	37	310	6200	11.994051
IIT Mandi	109	05	02	02	02	00	02	06	24	2.246941
IIT Patna	141	02	04	01	02	00	00	03	191	3.338737
IIT Rajasthan	43000	13	01	04	08	00	03	15	42	5.898934
IIT Roorkee	2390	07	05	03	06	00	03	12	36	4.211162
IIT Ropar	121	02	9790	02	02	00	00	04	63	2.137398

6.7.2 Ranking of IITs through WIF (inlink)

Ranking of IITs can be made based on WIF (inlink) indicator. The result is explained (Table - 9) where it has been reflected that IIT Bombay become the top position with the WIF(inlink) value 5.922865 and IIT Guwahati is the last place with the WIF (inlink) value 0.000250.

6.7.3 Comparison of Ranking of Websites of IIT

The comparison of ranking has been done using WISER, NAAC (National Assessment and Accreditation Council) and WIF (inlink). In NAAC, there is various grading system for ranking the universities based through quality assessment. The latest method is CGPA (Cumulative Grade Point Average) method with 5 point scale, assigned grade A, B, C and D (very good, good, satisfactory and unsatisfactory respectively). For this study, the comparisons of ranking of Indian Institutes of Technology (IITs) have been done using WISER, WIF (inlink) and World Rank (Table-11).

Table - 11: Comparison of Ranking of Indian Institutes of Technology*

Name of IIT	Domain	WISER	WIF (inlink)	World Rank
IIT(BHU) Varanasi	iitbhu.ac.in	16	09	8033(8)
IIT Bhubaneshwar	iitbbs.ac.in	15	06	11357(10)
IIT Bombay	iitb.ac.in	02	01	492(1)
IIT Delhi	iitd.ac.in	03	03	890(4)
IIT Gandhinagar	iitgn.ac.in	12	04	12100(12)
IIT Guwahati	iitg.ac.in	08	16	2485(6)
IIT Hyderabad	iith.ac.in	05	13	8042(9)
IIT Indore	iiti.ac.in	11	08	12936(15)
IIT Kanpur	iitk.ac.in	04	12	614(3)
IIT Kharagpur	iitkgp.ac.in	06	14	2045(5)
IIT Madras	iitm.ac.in	01	02	513(2)
IIT Mandi	iitmandi.ac.in	13	05	12678(13)
IIT Patna	iitp.ac.in	10	10	12032(11)
IIT Rajasthan	iitj.ac.in	07	15	14420(16)
IIT Roorkee	iitr.ac.in	09	11	2720(7)
IIT Ropar	iitrpr.ac.in	14	07	12837(14)

Note: *(i) WISER= Web Indicators for Science, Technology and Innovation Research*
(ii) World Ranking data is retrieved on November 22, 2012 from http://www.webometrics.info/en/Asia_Pacifico/South%20Asia

(iii) Rank is presented in parenthesis of each institution
(iv) Data was calculated in November, 2012.

The correlation between ranking of WISER and WIF (inlink) is presented in Table - 12.

Table - 12: Correlation between ranking of WISER and WIF (inlink)

Name of IIT	WISER (X)	WIF (inlink) (Y)	Square (X)	Square (Y)	XY	x=(X-Xbar)	y=(Y-Ybar)	xy	Square (X)	Square (Y)
IIT (BHU) Varanasi	16	09	256	81	144	+7.5	-0.5	-3.75	56.25	0.25
IIT Bhubaneshwar	15	06	225	36	90	+6.5	-2.5	-16.25	42.25	6.25
IIT Bombay	02	01	04	01	02	-6.5	-7.5	+48.75	42.25	56.25
IIT Delhi	03	03	09	09	09	-5.5	-5.5	+30.25	30.25	30.25
IIT Gandhinagar	12	04	144	16	48	+4.5	-4.5	-20.25	20.25	20.25
IIT Guwahati	08	16	64	256	128	-0.5	+7.5	-3.75	0.25	56.25
IIT Hyderabad	05	13	25	169	65	-3.5	+4.5	-15.75	12.25	20.25
IIT Indore	11	08	121	64	88	+2.5	-0.5	-1.25	6.25	0.25
IIT Kanpur	04	12	16	144	48	-4.5	+4.5	-20.25	20.25	20.25
IIT Kharagpur	06	14	36	196	84	-2.5	+5.5	-13.75	6.25	30.25
IIT Madras	01	02	01	04	02	-7.5	-6.5	+48.75	56.25	42.25
IIT Mandi	13	05	169	25	65	+4.5	-3.5	-15.25	20.25	12.25
IIT Patna	10	10	100	100	100	+1.5	+1.5	+2.25	2.25	2.25
IIT Rajasthan	07	15	49	225	105	-1.5	+6.5	-9.75	2.25	42.25
IIT Roorkee	09	11	81	121	99	-0.5	+2.5	-1.25	0.25	6.25
IIT Ropar	14	07	196	49	98	+5.5	-1.5	-8.25	30.25	2.25
Total	**136**	**136**	**1496**	**1496**	**1175**	**0**	**0**	**-0.50**	**347.75**	**348.00**

Hence, Mean for the variable (X & Y) can be calculated as:

$$\mathbf{Xbar = 1/N \sum_{i=1}^{N} x_i = 1/N(x_1+x_2+\cdots\cdots+ x_N).}$$

In this case mean (X & Y) are same i.e. **Xbar = Ybar = 8.5**. Standard deviation will be calculated with the help of following formula:

$$\mathbf{\sigma x = Sqrt\ [1/N \sum_{i=1}^{N} (X_i - Xbar)^2\ ]}$$

Where N=16.

In such a situation, standard deviations of X (i.e. σ_x) & Y (i.e. σ_y) are 4.6620140 and 4.6636895 respectively.

The correlation coefficient relates the strength and direction of linear relationship between two variables. The coefficient of determination represents the percent of the data that is the closest to the line of best fit. Correlation will always between -1.0 and +1.0. If the correlation is positive, we have a positive relationship. If it is negative, the relationship is negative. The coefficient of determination (i.e. r^2) is such that $0< r^2 < 1$, and denotes the strength of the linear association between x and y. The formula can be given as follows:

$$\mathbf{Correlation(r) = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{Sqrt\ ([N\Sigma X^2 - (\Sigma X)^2][N\Sigma Y^2 - (\Sigma Y)^2])}\ ;}$$

Or

$\mathbf{r^2 = [COV(X, Y)/ \sigma_x * \sigma_y] = [(1/N \sum XY - mean(X) * mean(Y))/ \sigma_x * \sigma_y];}$ Where, N=16; ΣX =136; ΣY = 136; ΣXY =1175; ΣX^2 =1496; ΣY^2 =1496 (For upper one Equation i.e. For **r)**

Or

mean (X) = mean(Y) = 8.5 ; σ_x = 4.6620140 and σ_y = 4.6636895 (For lower one Equation i.e. For $\mathbf{r^2}$)

Therefore, the calculated value of r would be = +0.0558824.

Where, N is the number of pairs of data and r denotes correlation coefficient. σ_x is the standard deviation of X and σ_y standard deviation of Y.

The correlation between WISER Ranking and WIF (inlink) is having correlation i.e. +0.0558824 which implied that there is much association or closeness between two ranking methods. In other words, there is a very less difference between two ranking methods. The reliability of ranking methods in comparison with world ranking for IITs is presented in Table -13.

Table - 13: Reliability of ranking methods in comparison with World Ranking for IITs

Name of IIT	Domain	WISER	WIF(inlink)	Inlinks	World Rank
IIT Bombay	iitb.ac.in	02	01	21500(2)	492(1)
IIT Madras	iitm.ac.in	01	02	34300(1)	513(2)
IIT Kanpur	iitk.ac.in	04	12	10(7)	614(3)
IIT Delhi	iitd.ac.in	03	03	15600(3)	890(4)
IIT Kharagpur	iitkgp.ac.in	06	14	5(12)	2045(5)
IIT Guwahati	iitg.ac.in	08	16	3(13)	2485(6)
IIT Roorkee	iitr.ac.in	09	11	7(8)	2720(7)
IIT(BHU)Varanasi	itbhu.ac.in	16	09	2(15)	8033(8)
IIT Hyderabad	iith.ac.in	05	13	51(4)	8042(9)
IIT Bhubaneshwar	iitbbs.ac.in	15	06	6(9)	11357(10)
IIT Patna	iitp.ac.in	10	10	2(16)	12032(11)
IIT Gandhinagar	iitgn.ac.in	12	04	11(6)	12100(12)
IIT Mandi	iitmandi.ac.in	13	05	5(11)	12678(13)
IIT Ropar	iitrpr.ac.in	14	07	2(14)	12837(14)
IIT Indore	iiti.ac.in	11	08	6(10)	12936(15)
IIT Rajasthan	iitj.ac.in	07	15	13(5)	14420(16)

Note: *(i) Data source are the same with Table-11. The numbers outside the parenthesis were global ranks, those inside were the country ranks as per (http://www.webometrics.info)*
(ii) *The World Ranking each IIT as mentioned in the parenthesis of each IIT.*

Table 13 clearly indicates that the conditions under which it is possible to evaluate in a reliable and valid way the research strengths of IITs will highly automated procedures, within a reasonable time perspective. So the most crucial question came in our mind is one: *how much effort is a reliable evaluation of an entire IIT, and, as a consequence, will such an evaluation be possible for all IITs in India, in a short period of time? Are rankings a reliable means of benchmarking universities against a global standard?*

This finding casts severe doubts on the reliability of this expert-based formula ranking. But, as far as the reliability is concerned, WIF(inlink) rank gave much closer value to the world rank, because, IIT Bombay and IIT Madras secured 1st position and 2nd position respectively in WIF(inlink) as well as world rank, whereas, WIF(inlink) position of IIT Rajasthan shows one position better rank than the world ranking i.e. 15th position. It concluded that the WIF (inlink) value is more reliable than other value like WISER.

7 CONCLUSION

Evaluation of web sites is a formidable but necessary task considering the wide range of choices available. The WIF & WISER, as explained in the above, is a useful tool for evaluation of web sites, but it must be used discreetly. Considerations include the amount of webpages or other

types of material published in a web site, contents, and variations between disciplines. The web sites' status with regard to coverage in the search engines' databases as well as the occurrence of a domain name change is also very important. The WIFs are always approximate and not absolute. The WIF of a site is not stable, because every day some webmasters are deleting the old inlinks to several web sites and others are linking to new ones. The WIF would still be far from being a quality indicator: link impact is primarily a measure of scientific utility rather than of scientific quality. For evaluation of scientific quality, there seems to be no alternative to qualified experts reading the web site resources. All WIF studies should be normalized to take into account variables such as field, or discipline, country, language, and link practices.

Therefore, it seems that IITs have made remarkable progress in developing their websites the study find a good web presence in general, and having a total of 108514 webpages and 100723 self-links, producing web impact factor 0.000055 using Google and 0.005865 using Yahoo as per the adopted methodological approach of WISER Ranking. Having World Rank, IIT Bombay occupied top 492 rank among various reputed institutes websites in the world, but as per IITs, is concerned it occupies top position, followed by IIT Madras occupied 2nd position with 513 rank in World Rank list, whereas, IIT Rajasthan occupied lowest position i.e. 14420. There is very low correlation i.e. +0.0558824 between WISER Rank and WIF (inlink) for the case of Indian Institute of Technology (IITs). Therefore, volume of webpage is an important indicator for influencing WIF as well as WISER Index Value of any institutions. Thus, the earlier established IITs websites secured top position (up to 8 ranks) in the list of 16 IITs just because of older existence of webpages and newer IITs websites could not perform well in ranking list because of newer existence of the webpages or web presence. We hope the ranking will help the users and webmasters to compare and identify IITs by their WIFs.

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