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Webometric Analysis of Library Websites of Indian Institutes of Technology

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Abstract

The purpose of the study is to analyze the library websites of Indian Institutes of Technology (IITs) through webometric indicators including URL analysis, Web Impact Factor (WIF) calculation, link pattern analysis as well as file formats analysis. The survey was conducted for all IITs library websites for three rounds having the gap of fifteen days in each round. Search engine "Google" has been found suitable for the survey due to its capability to support webometrics search expressions. Very low WIF has been found for all the IITs library websites. Linking pattern amongst IITs library websites is also found very poor. The study is oriented mainly to webometric analysis of library websites. The problems and solutions have been suggested for the increase of web presence of IITs library websites.

Keywords*: Link analysis, Web impact factor, URL analysis, Link pattern, Top level domain*

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INTRODUCTION

Library and Information Science (LIS) is concerned with how different information resources and information structures (inter-relations of information resources) are generated, organized, distributed and utilized by different users in different contexts [1]. Libraries disseminate knowledge and information among users and are local gateways to national and global knowledge [2]. The libraries have applied advanced technologies, mainly computer and information and communication technology (ICT). With the application of ICT, library services become faster and easily accessible [3].

There has been a revolutionary symbiosis between computer and communication technologies over a decade. The invention of the World Wide Web (WWW), a part of the Internet, the mother of networks has practically webbed the information globally less than one roof. There has been a shift in navigational approaches from syntactical to semantic (i.e., from words to concepts). An ever-increasing number of research institutes, universities and business organizations are currently providing information themselves such as their articles, publications, reports, catalogues and other resources on the Internet in general and the WWW in particular. This is now becoming the accepted method of disseminating and sharing information resources in hypermedia. Information Science research has also changed, with much research into how the new technologies are being used, particularly e-mail and the Web. In addition to user studies, there have been attempts to extract new kinds of information from the Web [4]. Being a global document network initially developed for scholarly use and now inhabited by a diversity of users, the Web constitutes an obvious research area for metric studies in the field of Information Science [5].

Webometrics is defined as "the study of quantitative aspects of the construction and use of information resources; structures and technologies on the Web, drawing on bibliometric and informetric approaches" [6]. Webometric analysis generally concentrates on the analysis of websites mainly in the performance of the institutions' Web domains because they are stable and well-defined institutions on the Web for a long time.

Institutional websites are increasingly used for a wide variety of purposes, such as uploading the prospectus, library catalogue, promote achievement of individuals, research groups, new publications, etc.

"A website is an important medium to convey the aim, educational courses run, scholarships, infrastructure, facilities and many more information to the potential students, general public, faculty, professionals, organizations etc." [3].

Websites have many functions and can be used in various fashions; a website can be a personal website, a commercial website, a government website or a non-profit organization website and are typically dedicated to a particular topic or purpose. Any website can contain a hyperlink to any other website, so the distinction between individual sites, as perceived by the user, can be blurred. The websites collectively constitute the World Wide Web, in which the people around the world look for their information regardless of the time and place [7].

Since the evolution of WWW, academic and research institutes have web spaces to disseminate knowledge and information globally [3] and almost all these institutes have websites for themselves as well as for their libraries [7]. Through the WWW, different library services are being provided. Library websites are one source of showcasing the knowledge generated by academic institutions [8]. These academic institution library websites are mostly used and visited by different disciplines especially people who are engaged in research activities. Therefore, the Web is measured to check the effectiveness of various services provided over it [3] which is an area of the webometric study.

In order to measure the Web, various studies have been conducted. The most popular type of measurement of Web is search engine performance, recall and precision of search engines, search engine's query analysis, indexing of search engine's databases, behavior of search engines, website usage analysis, website content analysis, URL analysis, depth of the Web, qualitative analysis of Web documents, etc. Search engines can be used as an important tool for measuring the Web in the field of webometrics. Besides this, search engines are normally used as information retrieval tool for variety of purposes [3]. Search engines are mechanisms that aid user to search the entire Internet for relevant information [9]. The main areas of application of search engine in webometric research are described below:

a) ***URL Analysis***: URL analysis is the study of analyzing the structure and properties of URLs embedded in interlink Web pages (i.e., incoming links or outgoing links) between one website/domain to another website/domain or in any single website. The URL analysis includes study of top-level domains (TLD), country code TLDs (ccTLD), generic TLDs (gTLD) sites/domains, sub-sites/sub-domains, file types of Web pages, structure of URLs, etc. [3, 6].

b) ***Link Analysis***: The Web consists of a number of pages inter-connected with hyperlinks which are usually known as "*outlink*" of the hypertext document. The total number of hypertext documents in any website/domain can be measured by using inbuilt text command (site: website address) in search engines. There are various inbuilt text commands available by which one can measure the total number of Web pages, i.e., *selflinks*, *outlinks*, *inlinks*, etc. [3, 10]. The study regarding *selflinks*, *outlinks*, *inlinks* of websites is known as Web Impact Factor (WIF) analysis. WIF is the quantitative indicator for calculating webometric activities. Ingwersen [11] developed the idea of WIF based on Journal Impact Factor (JIF). WIF is the measurement of average link frequencies and is based on hyperlinks and their citations. According to Shukla [3],

"*Web impact factor (WIF) is the number of outside web pages linking to a website which is divided by the number of web pages in that very website at a time*."

This means, the numerator is the number of link pages made to a website and the denominator is a measure of the size of that very website. There are three types of links,

i.e., *inlinks*, *outlinks*, and *selflinks*. Links coming into a site from another site are *inlinks* (also known as *backlinks*), links outgoing from a site to another site are *outlinks*, and links coming from the same site are *selflinks*. *Outlinks* are used to pointing external sources. The *selflinks* are made for navigational purposes only. More the *inlinks* (also known as inbound links) to a website reveals the impact of the website in that field [12]. WIF is of three types:

1) Overall WIF: It is calculated by the total number of combining *inlinks* pages and *selflinks* pages;
2) Inlinks (Revised) WIF: It is calculated by the total number of *inlinks* pages coming from outside; and
3) Selflink WIF: It is calculated by the total number of *selflinks* pages of the website.

Calculation of Web Impact Factor (WIF)

The WIF can be calculated by using the following formula given by Ingwersen [11] where:

A = Total links to a website (all *inlinks* and *selflink* pages)
B = *Inlinks* to the website (subset of A)
C = *Selflinks* within the same website
D = Total number of Web pages present in the website at a time.

A. Calculation for Overall WIF:

A = Total links to a website (all *inlinks* and *selflink* pages)

_____

D = Total number of Web pages present in the website at a time

Overall WIF = A/D

B. Calculation for Inlink (Revised) WIF:

B = *Inlinks* to the website

_____

D = Total number of Web pages present in the website at a time

Revised WIF = B/D

C. Calculation for Selflink WIF:

C = *Selflinks* within the same website

_____

D = Total number of Web pages present in the website at a time

Selflink WIF = C/D

c) Web Citation Analysis: The term web citation describes the number of Web links that any online article or online journal has received during a given time. Google Scholar is used in extraction of web citation from scholarly resources [3, 6].

d) Web Content Analysis: Content analysis is considered as a scholarly methodology in the humanities by which texts are studied as to authorship, authenticity, and their meaning. Content analysis of web documents is known as Web content analysis which is now prevalent in the area of Web to check the authenticity and quality of information available over the Internet. Recall and precision efficiency of search engines is also one aspect of Web content analysis [3, 6].

REVIEW OF LITERATURE

Turnbull [13] first time used the methods of bibliometrics for information analysis of World Wide Web and suggested to develop new methods, modeling techniques and metaphors to examine the emerging complex network as information on the Web increases toward different measurements. Björneborn and Ingwersen [14] described the areas of webometric research and outlined new

directions of webometrics for performing knowledge discovery on the Web. Further, Björneborn and Ingwersen [6] defined the webometrics within the framework of Informetrics and Bibliometrics, as belonging to Library and Information Science, and as associated with cybermetrics as a generic subfield. The study also stated that citation analysis and link analysis are not analogous to each other. Thelwall *et al.* [15] concentrated on link analysis and other aspects of webometrics, including Web log file analysis. In a study, Thelwall [16] reviewed the journey of bibliometrics since 1958 by comparing early bibliometrics with current practice and future prospects have been discussed with regard to both bibliometrics and webometrics. Thelwall [17] reveals in a study that majority of the webometric research is theoretical and needs to develop some new ways for its survival. Mukherjee [10] concluded that webometrics have established an important independent domain in quantitative research.

Thomas and Willet [18] conducted a webometric analysis of the linkages to websites associated with LIS departments in UK and concluded that citation data were not well-suited to the quantitative evaluation of the research status of LIS departments. Chu *et al.* [19] analyzed the *inlinks* to 53 American Library Association- accredited LIS schools' websites and found that majority of *inlinks* for LIS schools were from .org, .edu, or .net domains. They further, suggested that webometric research must be conducted with caution due to obvious deficiencies found with data source and data collection instruments. Walia and Kaur [20] examined the WIF of Library Association's websites of India with four search engines namely Google, Yahoo, AltaVista, and AlltheWeb. The study concluded that Delhi Library Association and SIS-India have the maximum WIF amongst all library associations' websites. In a study, Shukla and Tripathi [12] presented the scenario of *backlinks* structure of Institutes of National Importance of India by examining the extent of the *backlinks* given by different domains to these institutes and it has been concluded that websites of such institutes attract more citations from commercial Web domains than educational or any other Web domains. Jeyshankar and Babu [21] conducted a webometric study for 47 university websites of Tamil Nadu and concluded that *inlinks* are very few in number for some universities but have more number of Web pages which resulted in very low WIF. In a similar study, Babu *et al.* [22], for 40 central universities of India, examined the various kinds of WIFs and ranked them. In the same kind of studies conducted by Thanuskodi [23], Islam and Alam [24], and Vijayakumar [25] for private engineering colleges of Tamil Nadu, private universities in Bangladesh, and Sri Lankan universities respectively and found that these universities were having very low Web impact factor and were not recognized at international level. Pechnikov and Nwohiri [26] analyzed the webometric indicators for Nigerian university websites and revealed the weak connectivity in the set of official websites of Nigerian universities and suggested to the use of .edu.ng as their top-level domains. A study revealed that IITs websites are rich in content than other institutes amongst selected Institutes of National Importance of India [27].

Henzinger [28] analyzed the link structure of the Web and found that hyperlink structure of the Web is just at its beginning stage and a much deeper understanding needs to be gained. Park and Thelwall [29] examined the connectivity structure of links between university websites in 25 Asian and European countries and found that UK has a high impact on the formation of link-mediated academic networks in Asia and Europe. Mandl [30] analyzed whether the number of links pointing to a Web page is biased by the structure of websites and found that the structure bias and pages on a higher hierarchical level are likely to receive more links than other pages. Onyancha [31] studied selected university libraries' websites of Eastern and Southern Africa in order to measure the libraries' Web structures, content, and visibility/presence and concluded that libraries in Eastern and Southern Africa are well aware of the benefits and opportunities of the Internet and the WWW.

Ingwersen [11] first time calculated the WIFs for seven small and medium-scale national and four large Web domains as well as six institutional websites. Thereafter, Smith [32]

compared the websites between Australasian and Latin American institutions in terms of WIF and found that websites for Australasian institutions have a higher external WIF than the websites for Latin American institutions. Thelwall [33] calculated the WIF for UK universities by specially designed web crawler for the calculation of WIF and concluded that WIFs can be calculated reliably, but it should not be correlated with accepted research rankings. Further in another study, Thelwall [34] compared the domains for counting *backlinks* for UK universities. Noruzi [35] calculated WIF for Iranian universities through AltaVista search engine and found low *inlinks* WIF for Iranian university websites. It has been also identified that due to linguistic reasons, Iranian (Persian-language) websites are not attracting the attention from the World Wide Web. Jalal *et al.* [8] explored the effectiveness of link analysis and WIF of selected Indian universities and findings show that all the NITs are closely related in the topology framework whereas nodes are not linked significantly in case of state and central universities. Kumar and Rabindra [36] conducted a webometric study for National Institute of Technology (NITs) of India using AltaVista and revealed low WIF for NITs. A similar research done by Maharana *et al.* [37] for Indian Institute of Technologies (IITs) websites and found low WIF in case of IITs websites also. Rassi *et al.* [38] analyzed the links for food science and technology institutes websites of Iran and found the high WIF results with high visibility for some institutes. The study also concluded the relation between number of *inlinks* and content of the websites.

SCOPE OF THE STUDY

The scope of the present study is confined to library websites of Indian Institutes of Technology (IITs). Presently there are sixteen (16) IITs in the country which are governed by The Institutes of Technology Act, 1961 and The Institute of Technology (Amendment Act of 2012) [39]. In this Act, IITs are declared as "Institutions of National Importance" (MHRD) [40]. The list of sixteen (16) Indian Institutes of Technology (IITs) and their coded form along with each IIT website is given in Table 1.

OBJECTIVES OF THE STUDY

The objectives of the study are:

1. To study the URL analysis of IITs library websites.
2. To calculate the Web Impact Factor (WIF) of library websites of IITs and rank them as per the WIF.
3. To find out the link pattern amongst the library websites of IITs.

Table 1: *List of IITs (in alphabetical order) with Code Name and Website Address.*

S. No.	Indian Institute of Technology	(Code name)	Website address
1.	IIT (BHU) Varanasi	IITBHU	www.itbhu.ac.in
2.	IIT Bhubaneswar	IITBBS	www.iitbbs.ac.in
3.	IIT Bombay	IITB	www.iitb.ac.in
4.	IIT Delhi	IITD	www.iitd.ac.in
5.	IIT Gandhinagar	IITGN	www.iitgn.ac.in
6.	IIT Guwahati	IITG	www.iitg.ac.in
7.	IIT Hyderabad	IITH	www.iith.ac.in
8.	IIT Indore	IITI	www.iiti.ac.in
9.	IIT Kanpur	IITK	www.iitk.ac.in
10.	IIT Kharagpur	IITKGP	www.iitkgp.ac.in
11.	IIT Madras	IITM	www.iitm.ac.in
12.	IIT Mandi	IITMANDI	www.iitmandi.ac.in
13.	IIT Patna	IITP	www.iitp.ac.in
14.	IIT Jodhpur	IITJ	www.iitj.ac.in
15.	IIT Roorkee	IITR	www.iitr.ac.in
16.	IIT Ropar	IITRPR	www.iitrpr.ac.in

RESEARCH METHODOLOGY

The present study is designed to study URL analysis, calculation of WIF and link pattern amongst IITs library websites. Therefore, the survey method of research has been found appropriate and utilized for conducting the study. For the purpose of study, library websites of IITs have been collected. The Web addresses of the IITs library are given in Table 2.

The URLs of libraries of IITs have been collected by visiting their library websites. The IITs which do not have separate single Web page for library have been excluded from the study. The websites/URLs of libraries which are not easily extractable are also excluded from the study. All the URLs/websites of library are tested through command line textual queries like link, linkdomain, site, etc., inside the preferred search engine's database. For the study, search engine Google is used for webometric data collection and analysis. The data has been collected in three (3) rounds having a gap of 15 days between each round. The months September and October have been chosen for the purpose randomly. By the use of preferred search engine, the following search expressions were used for data collection. The search expressions are:

Site/Domain Coverage: This shows how many Web pages search engine has indexed with a single domain name.
Search Engine: Query: Example
Google:site: site:www.iitbhu.ac.in/library/

Links to Single URL/Webpage: This shows how many webpages are linked with the URL.
Search Engine: Query: Example
Google:link:
link:http://www.iitbhu.ac.in/library/

Links to a Domain: This shows how many links are pointing to a website.
Search Engine: Query: Example
Google:linkdomain:
linkdomain:www.iitbhu.ac.in/library/

For analyzing the WIF, formula given by Ingwersen [11] is used.

Table 2: *List of IITs (coded form) and Their Library Websites.*

S. No.	IITs	Library website/URL
1	IITBHU	http://www.iitbhu.ac.in/library/
2	IITBBS	http://www.iitbbs.ac.in/Library.php
3	IITB	http://www.library.iitb.ac.in/
4	IITD	http://library.iitd.ac.in/
5	IITGN	http://www.iitgn.ac.in/library.htm
6	IITG	http://www.iitg.ernet.in/rs/lib/public_html/index.html
7	IITH	http://library.iith.ac.in/
8	IITI	http://www.iiti.ac.in/Library/about_central_library.html
9	IITK	http://library.iitk.ac.in/
10	IITKGP	http://www.library.iitkgp.ernet.in/
11	IITM	http://www.iitm.ac.in/library
12	IITMANDI	http://www.iitmandi.ac.in/academics/lib/
13	IITP	http://www.iitp.ac.in/index.php/services-and-amenities/central-library/about-iitp-library.html
14	IITJ	http://www.iitj.ac.in/library/
15	IITR	http://mgcl.iitr.ac.in/
16	IITRPR	http://www.iitrpr.ac.in/library

RESEARCH ANALYSIS AND DISCUSSION

URL Analysis of IITs Library Websites

A uniform resource locator (URL), also known as Web address, is a specific character string that constitutes a reference to a resource. The first part of the URL consists of the transfer protocol, the second specifies the domain names [41] which is followed by directory and file name. For studying the URLs of the IITs library websites, the domain names have been taken into account wherein Table 3 represents the most frequently used TLDs by the IITs for their library websites. From the illustration of Table 3, the study reveals the TLDs of IITs library websites are .ac.in and .ernet.in. The TLD .ac.in is used by 87.5% IITs library websites whereas only 12.5% have used .ernet.in. The TLDs are further divided into generic TLD (gTLD) and country code TLD (ccTLD) [42]. The gTLD .ac stands for academic domain which is used by 87.5% (14) IITs library websites whereas .ernet stands for Education and Research Network used only by IITKGP and IITG library websites (i.e., 12.5%). The ccTLD .in, which stands for the country India, has been used by all of the IITs library websites (i.e., 100%). There are six IITs library websites (37.5%) having sub-sites (e.g., http://library.iitk.ac.in/) whereas five IITs library websites (31.25%) are following directory structure (e.g., http://www.iitj.ac.in/library/) and remaining five IITs library websites (31.25%) are following the single page link structure attached with the IITs domain name (e.g., http://www.iitgn.ac.in/library.htm).

Table 3: *TLDs of IITs Library Websites.*

Name of IIT	Uniform resource locator (URL)	Top level domain	
		Generic TLD (gTLD)	Country code TLD (ccTLD)
IITBHU	http://www.iitbhu.ac.in/library/	.ac	.in
IITBBS	http://www.iitbbs.ac.in/Library.php	.ac	.in
IITB	http://www.library.iitb.ac.in/	.ac	.in
IITD	http://library.iitd.ac.in/	.ac	.in
IITGN	http://www.iitgn.ac.in/library.htm	.ac	.in
IITG	http://www.iitg.ernet.in/rs/lib/public_html/index.html	.ernet	.in
IITH	http://library.iith.ac.in/	.ac	.in
IITI	http://www.iiti.ac.in/Library/about_central_library.html	.ac	.in
IITK	http://library.iitk.ac.in/	.ac	.in
IITKGP	http://www.library.iitkgp.ernet.in/	.ernet	.in
IITM	http://www.iitm.ac.in/library	.ac	.in
IITMANDI	http://www.iitmandi.ac.in/academics/lib/	.ac	.in
IITP	http://www.iitp.ac.in/index.php/services-and-amenities/central-library/about-iitp-library.html	.ac	.in
IITJ	http://www.iitj.ac.in/library/	.ac	.in
IITR	http://mgcl.iitr.ac.in/	.ac	.in
IITRPR	http://www.iitrpr.ac.in/library	.ac	.in

File Formats Supported by IITs Library Websites

A file format is a standard way wherein information is encoded for storage in a computer file. The format of a file is based on the end of its name, i.e., the letters following the final period. This portion of the filename is known as the filename extension. For example, HTML documents are identified by names that end with .html (or .htm), and GIF images by .gif. Many formats still use three character extensions even though modern operating systems and application programs no longer have this limitation. Table 4 shows the type of file formats used by IITs library websites which are used for scholarly communication on their websites.

After analyzing all the Web pages (page-wise) inside the IITs library websites, document file formats (.html, .pdf, .doc, .ppt), image file formats (.jpg/.jpeg, .png, .gif, etc.), and audio/visual file formats (.wma) have been used to display the information about library. From Table 4, it has been found that all the IITs library websites are using HTML (100%) followed by PDF (81.25%), MS-Word (56.25%), MS-Excel (37.5%), and MS-PowerPoint (12.50%) under document file formats. In image file format, IITs are using JPG/JPEG (81.25%), PNG (62.5%), and GIF (81.25%) in library websites. Only IITKGP is using audio/visual (.wma) file format in its library website. In another way, IIT Roorkee library website has used maximum file formats (8) to represent the information content of library followed by IIT Hyderabad and IIT Indore (7), IIT Bombay, IIT Gandhinagar and IIT Ropar (6), IIT Bhubaneswar, IIT Delhi, IIT Kharagpur, IIT Madras and IIT Jodhpur (5), IIT Guwahati, IIT Kanpur and IIT Patna (4). The least file formats were used by IIT BHU and IIT Mandi (with 3 file formats) for their library websites.

Table 4: *Types of File Formats Supported by IITs Library Websites.*

Name of IIT	Format supported									
	HTML	PDF	MS-Word	MS-Excel	MS-PPT	JPG/JPEG	PNG	GIF	WMA	Total formats supported
IITBHU	✓	×	×	×	×	✓	✓	×	×	3
IITBBS	✓	✓	✓	×	×	✓	×	✓	×	5
IITB	✓	✓	✓	×	×	✓	✓	✓	×	6
IITD	✓	×	×	✓	×	✓	✓	✓	×	5
IITG	✓	✓	✓	✓	×	×	×	×	×	4
IITGN	✓	✓	✓	✓	×	✓	×	✓	×	6
IITH	✓	✓	✓	✓	×	✓	✓	✓	×	7
IITI	✓	✓	✓	✓	×	✓	✓	✓	×	7
IITK	✓	✓	×	×	×	✓	×	✓	×	4
IITKGP	✓	✓	×	×	×	×	✓	✓	✓	5
IITM	✓	✓	✓	×	×	✓	×	✓	×	5
IITMANDI	✓	✓	×	×	×	✓	×		×	3
IITP	✓	×	×	×	×	✓	✓	✓	×	4
IITJ	✓	✓	×	×	✓	×	✓	✓	×	5
IITR	✓	✓	✓	✓	✓	✓	✓	✓	×	8
IITRPR	✓	✓	✓	×	×	✓	✓	✓	×	6
Percentage	100	81.25	56.25	37.5	12.5	81.25	62.5	81.25	6.25	

Web Impact Factor (WIF) of IITs Library Websites

For calculating the WIF, the links of the IITs library websites were collected using the command textual queries site:URL and link:URL in the search engine "Google." By using these textual queries the number of Web pages and number of links present in the library websites were collected. Then, these links were analyzed based on the formula given by Ingwersen [11].

WIF in First Round

The first round of data was collected on 27th September, 2013 between 02.14 p.m. and 03.55 p.m. from the search engine Google. Table 5 illustrates the WIF of IITs library websites during the first round.

WIF in Second Round

The second round of data was collected on 12th October, 2013 between 12.30 p.m. and 01.32 p.m. Table 6 illustrates the WIF of IITs library websites during the second round.

WIF in Third Round

The third round of data was collected on 27th October, 2013 between 05.01 p.m. and 05.40 p.m. Table 7 illustrates the WIF of IITs library websites during third round.

From the Tables 5, 6 and 7, is has been found that IITB, IITD, IITK, IITKGP, IITM, and IITR library websites have been indexed thoroughly in Google's database whereas the newly established IITs library websites (IITG, IITP, & IITRPR) have not been indexed thoroughly in Google's database till third round of data collection. It has been observed that IITs libraries those having more number of indexed pages in Google, retrieved very less number of links and *inlinks* comparatively (e.g., IITB, IITD, IITK, IITKGP, IITM and IITR). Further, from the Tables 5–7, it can be inferred that more number of indexed Web pages in search engine (i.e. Google) leads to more number of *inlinks* to the library websites (in case of IITB, IITM, & IITKGP).

Average Revised WIF and Ranking of IITs Library Websites

The average revised WIF of the three rounds of data from the study is presented in the Table 8. In order to calculate the average revised WIF, the sum of all three rounds of revised WIFs has been divided by three by using the following formula.

Average revised WIF = 1st + 2nd + 3rd (round revised WIF)/(3)

Table 5: *WIF of IITs Library Websites in First Round.*

Name of IIT (Coded Form)	No. of web pages (A)	Total links (B)	Inlinks (C)	WIF D = (B/A)	RWIF E = (C/A)
IITBHU	62	06	01	0.0968	0.0161
IITBBS	Data not collected due to non-availability of library website during the period of data collection				
IITB	23000	79	11	0.0034	0.00048
IITD	1820	09	01	0.0049	0.00054
IITG	01	05	01	5	1
IITGN	34	0	0	0	0
IITH	22	01	01	0.0455	0.0455
IITI	42	18	0	0.4286	0
IITK	12100	05	02	0.0004	0.0002
IITKGP	432	11	07	0.0255	0.0162
IITM	541	15	05	0.0277	0.0092
IITMANDI	169	02	01	0.0118	0.0059
IITP	01	32	01	32	1
IITJ	61	15	0	0.2459	0
IITR	501	05	01	0.0099	0.0019
IITRPR	06	04	01	0.6667	0.1667

Table 6: *WIF of IITs Library Websites in Second Round.*

Name of IIT (Coded Form)	No. of pages (A)	Total links (B)	Inlinks (C)	WIF D = (B/A)	RWIF E = (C/A)
IITBHU	62	06	01	0.0968	0.0161
IITBBS	Data not collected due to non-availability of library website during the period of data collection				
IITB	20600	78	11	0.0038	0.0005
IITD	1380	53	01	0.0384	0.0007
IITG	01	05	01	5	1
IITGN	33	0	0	0	0
IITH	22	01	01	0.0455	0.0455
IITI	46	18	0	0.3913	0
IITK	13300	05	03	0.0004	0.0002
IITKGP	428	09	06	0.0210	0.0140
IITM	523	72	10	0.1377	0.0191
IITMANDI	161	02	01	0.0124	0.0062
IITP	01	35	01	35	1
IITJ	70	16	0	0.2286	0
IITR	457	05	01	0.0109	0.0022
IITRPR	06	04	01	0.6667	0.1667

Table 7: *WIF of IITs Library Websites in Third Round.*

Name of IIT (Coded Form)	No. of pages (A)	Total links (B)	Inlinks (C)	WIF D = (B/A)	RWIF E = (C/A)
IITBHU	73	06	01	0.0822	0.0137
IITBBS	Data not collected due to non-availability of library website during the period of data collection				
IITB	20400	78	05	0.0038	0.0002
IITD	1070	46	01	0.0429	0.0009
IITG	01	05	01	5	1
IITGN	33	0	0	0	0
IITH	24	01	01	0.0417	0.0417
IITI	51	18	0	0.3529	0
IITK	11500	05	02	0.0004	0.0002
IITKGP	453	08	04	0.0177	0.0088
IITM	521	89	10	0.1708	0.0192
IITMANDI	161	02	01	0.0124	0.0062
IITP	01	33	01	33	1
IITJ	40	14	0	0.35	0
IITR	549	05	01	0.0091	0.0018
IITRPR	06	04	01	0.6667	0.1667

From Table 8, it has been observed that among all IITs library websites IIT Guwahati and IIT Patna ranked first having the highest average RWIF (i.e., 1). IIT Ropar and IIT Hyderabad ranked second and third with RWIF 0.166666667 and 0.044191919 respectively. IIT Bhubaneswar could not be included in the study due to lack of library websites during data collection. From the above ranking and RWIF data for three rounds, it has been inference that *inlinks* of the library websites remains constant during the whole study period and the results based on the RWIF proves that IITs library websites are having a very low visibility on the Web as measured from the link analysis.

Link Pattern among IITs Library Websites

The link pattern among IITs library websites have been analyzed by collecting the data by visiting all the IITs library websites manually from each Web page presents in the library websites. The following Table 9 is displaying the number of outlinks (outgoing) from one IIT library website to other IITs library websites and number of *inlinks* to one IIT library website from other IITs library websites.

Table 8: *Average Revised WIF and Ranking of IITs Library Websites.*

S. No.	Name of IITs (coded form)	1st round RWIF	2nd round RWIF	3rd round RWIF	Average RWIF	Ranking (based on average RWIF)
1.	IITG	1	1	1	1	1
2.	IITP	1	1	1	1	1
3.	IITRPR	0.1666667	0.1666667	0.1666667	0.166666667	2
4.	IITH	0.0454545	0.0454545	0.0416667	0.044191919	3
5.	IITM	0.0092421	0.0191205	0.0191939	0.015852154	4
6.	IITBHU	0.016129	0.016129	0.0136986	0.015318898	5
7.	IITKGP	0.0162037	0.0140187	0.00883	0.013017472	6
8.	IITMANDI	0.0059172	0.0062112	0.0062112	0.006113173	7
9.	IITR	0.001996	0.0021882	0.0018215	0.002001895	8
10.	IITD	0.0005495	0.0007246	0.0009346	0.000736223	9
11.	IITB	0.0004783	0.000534	0.0002451	0.000419113	10
12.	IITK	0.0001653	0.0002256	0.0001739	0.000188255	11
13.	IITGN	0	0	0	0	12
14.	IITI	0	0	0	0	12
15.	IITJ	0	0	0	0	12
16.	IITBBS	Data not collected due to non-availability of library website during the period of data collection				

From Table 9, it has been found that IIT Hyderabad has outlinked to 15 other IITs library websites which is highest in number among all IITs library websites. Then after IIT Madras has six outlinks followed by IIT Roorkee (5), IIT Ropar (3) and IIT Jodhpur (1). Surprisingly, IITs library websites are not linking to each other except five IITs library websites. On the other side, except IIT Hyderabad, all the IITs library websites are having at least one *inlink* from other IITs library websites. It is amazing that most outlinks producing IIT library websites have no *inlinks* from any IIT library. IIT Delhi received five *inlinks* which is the highest among all IITs library websites. From the above link pattern data for IITs library websites, following link pattern diagram has been framed. Figure 1 represents link pattern amongst IITs library websites. Maximum outlinks are originated from IITH to all other IITs library websites while none of the IITs library websites has been linked to IITH. There is only one reciprocal link pattern among all library websites which is established between IITM and IITR. Majority of the library websites are having only one-way link pattern. IITB and IITD library websites have established more number of incoming links among all of the library websites.

Table 9: *Link Pattern among IITs Library Websites.*

S. No.	Names of IITs (in coded form)	No. of outlinks to other IITs	No. of inlinks from other IITs
1.	IITB	0	4
2.	IITBBS	0	1
3.	IITBHU	0	1
4.	IITD	0	5
5.	IITG	0	4
6.	IITGN	0	1
7.	IITH	15	0
8.	IITI	0	1
9.	IITJ	1	1
10.	IITK	0	3
11.	IITKGP	0	3
12.	IITM	6	2
13.	IITMANDI	0	1
14.	IITP	0	1
15.	IITR	5	4
16.	IITRPR	3	1

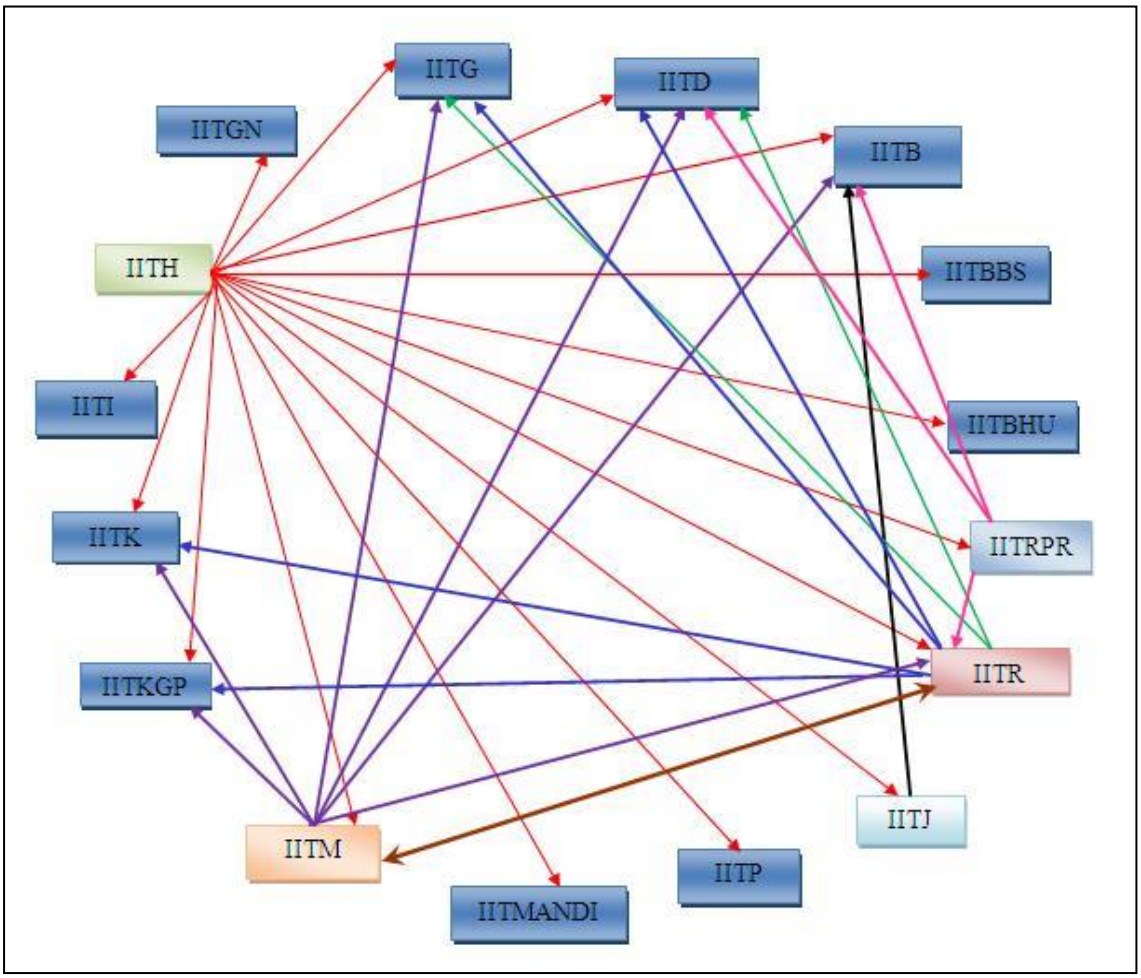

Fig. 1: *Link Pattern among IITs Library Websites.*

CONCLUSIONS

From the analysis of the study, there exists a high percentage on the use of top-level domains (TLDs) by the IITs library websites in which the TLD .ac.in is used by 87.5%. Every IIT library website contains different file formats and from the selected file formats, HTML file is used in all of IITs library websites for representing their content.

The average revised WIF of the three rounds of data has given the result that majority of IITs library websites are not indexed, thoroughly, in search engine's database. IITs library websites which have highest number of indexed pages but less number of *inlinks* to the library websites leads to lower WIF and RWIF.

Those library websites which do not have sufficient number of indexed pages with less number of *inlinks* have higher WIF and RWIF values. From the analysis, no correlation is found that higher number of indexed Web pages leads to higher WIF and RWIF. IITs library websites that are new to the Web presence had higher WIF and RWIF than well-established IITs library websites. Further, the link distribution of IITs library websites has established the relationships between them.

The study reflects that IITs library websites have higher number of Web pages but correspondingly their linking behavior to others websites is very poor. The low presence of IITs library websites on the Web was due to structural problems in library websites, limitation of access to scientific resources, instability of Web servers, less indexing of library websites in Web directories and lack of institutional repositories.

The command textual query enables to give a clear understanding of the performance of the search engine and the main drawback is that they do not cover the entire Web or even the entire publicly indexable Web as Lawrence & Giles [43] proved in their study that only 16% of the Web is indexable. Search engine results have been found to be unreliable and to fluctuate, even over short periods of time also.

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