[The chapter summarizes significant contributions and key findings of the research study. An attempt is made to answer and justify the research questions raised in the thesis. Here some areas have been identified to for further research. Finally, overall summing up covering the salient findings with novelty of research have been highlighted].
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Chapter—8

Summary and Conclusion

8.1 Introduction

A conclusion is the final chord in a song. It brings the feel that the work is concluded. The conclusion is the point where the research starts: looking back the objectives, hypotheses and research questions, and finally summarizes the salient points of evidence. This chapter deals with the finding of the whole research work. It helps to review on whether or not the research hypotheses and research questions are answered properly. The novelty of the research project is addressed on the basis of certain criteria. Finally, it raises some issues to point out the possibilities of further research in the area of webometrics. It also tries to establish new domains of academic endeavour through novelty of research.

8.2 Key Findings

The findings of the research may be summarized against the stated objectives and hypotheses as mentioned in chapter 1.

8.2.1 Findings Related to Web Presence

*Objective-1:* To find out various types of hyperlinks, explore the web presence and calculate various web impact factors for selected Indian universities:

*Hypothesis-1:* There is a high degree of web presence of Indian universities.
The web presence implies that the universities or institutions have their own valid domain names and websites through which the information of a particular university can be accessed at any point of time. The web presence of Indian universities has been conducted through webometric tools and techniques. The verification and existence of domain names, categorization of domain names such as academic, research, commercial, and government have been done to understand the web presence more exhaustively. The various types of hyperlinks i.e. inlinks, self-links and total links have been retrieved using webometric query and the detailed results are presented in chapter 4. Findings related to web presence may be summarized as follows:

i. The complete list of Indian universities along with number of webpages, inlinks and total links has been given in Annex-1. Also, various types of WIFs (i.e. WIF-inlinks, self-links and overall) for the selected Indian universities have been calculated to show the relative impact of websites.

ii. The high level of web presence of Indian universities implies that at least 75% of universities have valid and functional domain names with adequate webpages and inlinks. One important research result is that the average webpage and inlinks of Indian universities are 4230 and 2777 respectively (in table 4.24). If IITs, IIMs, NITs (under INP category) are excluded from the related table (vide table 4.24), the average webpage and inlinks decreases sharply:

iii. Another major finding is that 94.27% of universities are having webpages less than 10000; 65.82% of universities are having webpages less than 1000; 22.51% of universities in India are having webpages less than 100; 12.53% of universities are having webpage less than 50 (under table 4.21 in chapter 4):

iv. The study reflects that 36.73% of universities have average inlinks less than 1000; 97.03% of universities average inlinks are less than 10000 whereas only 2.97% of universities inlinks are more than 10000 (under table 4.22 in chapter 4):

v. Only 10% of Indian universities occupy 82% of webpages and 39% of inlinks; whereas remaining 90% of universities occupy only 18% of webpages but 61% of inlinks. This means that the distribution of webpage is more skewed than the distribution of inlinks;

vi. From annex-1, it is calculated that inlinks and selflinks for Indian universities are 58.02% and 41.98% respectively;

vii. One of the major finding is that the number of webpages under Pre Republic Era and Decade I are above 5500 per website, whereas the same figure is below 3500 for remaining Decades; average inlinks are lowest in Decade III and highest in Decade 1 (under table 4.28 in chapter 4);

viii. The study reveals that more than 98% of universities are having valid domain names. Only 52 (11%) universities are having webpages more than average webpage (i.e. 4230) and 419 (89%) universities have webpage less
than the average. On the other hand, 174 (37%) universities have their inlinks less than average inlinks (2777) and 297 (63%) universities have inlinks more than average inlinks (average figure, under table 4.24 in chapter 4 and percentage of universities is obtained after arranging them in ascending order based on webpages and inlinks vide annex-1):

ix. The web presence of India as a whole has been studied and found that the growth of web presence during 2009-11 has increased 10.57% with respect to number of webpages and 27.58% of in terms of inlinks (under table 4.4 in chapter 4):

x. The number of inlinks received by Indian domain (.in) from commercial domain (.com) is higher than other TLDs such as .gov. .org etc.; and

xi. The region-wise web presence for Indian universities has been studied and the result found that universities under Southern and Western Region do better than Eastern and Northern Regions (vide table no.4.31 in chapter 4).

This shows that the distribution of webpages for Indian universities is highly skewed whereas the same for inlinks are moderate. It implies that there is an uneven growth of web presence of Indian academic web space. Even 50.53% of Indian universities have webpages less than 500 and 32.7% of universities has inlinks less than 500. Hence, the hypothesis “There is a high degree of web presence for Indian universities” may partly be rejected and the alternative hypothesis i.e. “Indian universities have moderate degree of web presence” may be accepted.

8.2.2 Findings Related to Ranking of Indian Universities

**Objective-2:** To develop a new method of ranking using appropriate webometric indicators to rank the Indian universities at the state, regional and national level.

**Hypothesis-2:** *It is feasible to rank Indian universities by the application of appropriate webometric indicators.*

Based on the analysis of existing university ranking methodologies and critical analysis of indicators in each method with regard to its suitability of indicators for the inclusion in the new method of ranking. New ranking method has been developed using 10 most suitable indicators with appropriate weightage to get an index score and based on ascending order of magnitude of index value, universities are assigned a rank. In case of two universities having same index value, the equal rank has been assigned to both of them. The new method of ranking is named as Webometric Ranking of Indian Universities, in short, WRIU. Findings related to ranking of Indian universities may be summarized as:

i. Various ranking approaches have been discussed exhaustively under section 5.5.1 to 5.5.6 in chapter 5 and the suitability of indicators are judged towards developing new ranking approach in context of Indian universities;
ii. The complete ranking of Indian universities based on WRIU has been appended in Annex-II and results of top 20 universities are given in table 5.21 under chapter 5:

iii. The present research work has designed and developed Webometric Ranking of Indian University (WRIU) System and it is proved an efficient and significant ranking system. The results have been verified by ANOVA test and Multivariate Regression Analysis (under table 5.25 and 5.26 in chapter 5); and

iv. The regional level ranking has been done by sorting in ascending order by regions and then by WRIU index, as shown in Annex-II.

Therefore, the hypothesis, "It is feasible to rank Indian universities by the application of appropriate webometric indicators" has been proved through various tables in chapter 5.

8.2.3 Findings Related to Comparison of Ranking Approaches

Objective-3: To compare and correlate the existing ranking approaches (e.g. NAAC, RWWU, THE) with the newly developed ranking approach.

Hypothesis-3: Webometric techniques are helpful to compare and correlate newly developed Indian university ranking system with other quality ranking systems e.g. ranking as given by NAAC, 4ICU and RWWU.

Indian universities have been ranked based on new set of webometric indicators as developed and explained in chapter 5 in detail. Comparisons of ranking between (a) WRIU with NAAC Ranking (using CGPA method) (b) WRIU with 4ICU. (c) WRIU with QS-WUR (d) WRIU with RWWU are performed comprehensively. The validity of new method of ranking Indian universities is judged through calculation of Spearman’s rank correlation method and Pearson’s correlation coefficient, wherever applicable. The main findings are:

i. There is a strong correlation between WRIU with all other popular ranking methods such as RWWU, 4ICU, QS-WUR, etc. Out of 471 universities, only 256 universities have been ranked by RWWU; Therefore, using Spearman’s rank correlation formula, it was found that there is a strong correlation i.e. 0.75 (under section 5.7.2.2 to 5.7.2.4 and table 5.23 in chapter 5);

ii. The comparison between WRIU with 4ICU ranking for the case of 387 Indian universities (out of 471 universities) shows that there is strong correlation (i.e. 0.81) between these two approaches (under section 5.7.2.3 in chapter 5); and

iii. For the case of NAAC accredited universities, only 74 universities have been accredited through CGPA method with 4-point scale. Based on the scale, it is found that many universities have same point and grade. This low value of correlation i.e. 0.24 (under table 5.23) may be due to two
reasons. (a) the objectives of NAAC are not basically to rank the universities but at the same time it assigns some score, which indirectly helps to rank the universities and grade them. (b) secondly, it is purely, non-webometric ranking system, where 40% of weightage has been assigned to four indicators like infrastructure and learning resources, student support and progression, governance and leadership and finally innovative practices (under table 5.9 in chapter 5).

The comparison among Webometric Ranking of Indian Universities (WRIU), as designed and developed in this study, with other existing popular webometric and quality ranking systems has been made to achieve the above objective using webometric and statistical tools.

8.2.4 Findings Related to Link Analysis

Objective-4: To identify the patterns of hyperlinks and to find out the existence and nature of link topology in the web space of selected Indian universities.

Hypothesis-4: The websites of Indian universities have well-structured pattern. The topology of Indian academic web space as constituted by the selected Indian universities can be structured through the application of webometric tools and techniques.

The hypothesis stated above needs to be explained before proceeding further. Here, the well-structured pattern of websites implies that at least 75% of universities should have domain names; average number of webpages and inlinks are above 500. The distribution of webpages, inlinks, selflinks should support normal distribution.

Link topology means the graphical representation of hyperlink structure of group of universities having similar goals. There is a well-developed link topologies formed for IITs and NITs as experienced in 2010 (Jalal, Biswas and Mukhopadhyay, 2010a). Similarly, the state universities are not having well-developed micro link topology with respect to link analysis (figure 6.13 in chapter 6). Link topologies have been formed well for the case of NITs, IITs and Agricultural universities in India (figure 6.5, 6.9 and 6.12 respectively).

i. Various types of link data e.g. inlinks, self-links and total links, co-inlinks etc. have been collected for all Indian universities. The analysis shows three major facts: average webpage (4230.49), average inlinks (2777.39) and average self-link (2009.48) under table 4.24 in chapter 4. The detailed findings regarding web presence of Indian universities have been mentioned in chapter 4;

ii. The inter-connected topological structure and respective link pattern for the case of universities across the neighbouring states (e.g. West Bengal, Jharkhand, Bihar and Orissa) have been identified. The link topology is not quite prominent for the cases of inter-state universities whereas it is more prominent amongst universities in a given state (vide figure 6.15 in chapter 6);
iii. In cases of agricultural universities, IITs, and NITs, well-developed and prominent inter-connected topological structures have been identified (figure 6.12, 6.9 and 6.5 in chapter 6):

iv. There is a micro-link topology found for different categories of universities in general but the depth of inter-connection amongst these entities varies quite a lot with compared to other categories such as CU, INP, DU and OU, as discussed under section 6.7.3.1 to 6.7.3.10 in chapter 6; and

v. It is found that state universities’ link pattern is comparatively less prominent than technological universities’ link pattern (under figure 6.13 for SU, figure 6.12 for agricultural universities), 6.5 for NITs and figure 6.9 for IITs).

Therefore, it has been found from the study that the topologies of selected Indian universities (including category-wise) within the Indian academic web space have been constituted using webometric tools and techniques. More specifically, the topologies for the cases of IITs, NITs, agricultural universities, and central universities have witnessed well-developed topological structure whereas the same for the cases of state universities, deemed universities and universities in neighbouring states (West Bengal, Orissa, Jharkhand and Bihar) are moderate ones.

8.2.5 Findings Related to Motivation of Hyperlinks

Objective-5: To identify the motivational factors for the creation of hyperlinks in the websites of the universities.

Hypothesis-5: Classification and categorization of hyperlinks help to understand the motivational factors for the creation of hyperlinks.

It is difficult task to classify the hyperlinks because there is no existence of automatic classification process of hyperlinks. Hence, selected sample websites (table 7.2 in chapter 7) and sample hyperlinks have been visited manually. These hyperlinks have been grouped into six broad categories based on the content and type of information available. Various motivational factors have been identified through the content analysis of websites of Indian universities. Counting of inlinks and their classification and categorization process help directly or indirectly to identify the reasons of hyperlinks and thereby to identify the motivational factors, which were mentioned under table 7.3, 7.4 and 7.5 in chapter 7. The main findings related to motivation of hyperlinking are as follows:

i. The link classification process led to formulation of five broad categories of hyperlinks based on the process of classification and categorization;

ii. The present study reveals that only 7% and 12% of links (under table 7.3 in chapter 7) are related to the category of “research” and “teaching-learning-process” respectively. This result is quite matching with the earlier result as reported by Chu (2003), wherein
she pointed out that only 12% links are either under research or teaching learning: and

iii. It is found that 53% of links are in some way or rather falls under the category of “services”, which includes activities like announcement, scholarship, job, news and events, library, WebOPAC, sitemap, search facilities and quick links (under table 7.3 in chapter 7).

8.3 Contributions of the Research

This section recapitulates the research questions as mentioned in chapter 1 and tries to answer those questions with some justifications.

**RQ-1: What is the status of the web presence of Indian universities? How can it be measured?**

The web presence of a university is judged through several web-based indicators, some of which include number of webpages, number of inlinks, number of outlinks (directory outlinks, page outlinks, site outlinks), selflinks and total links. The connectivity between universities within regions, nations and world-wide may also be considered as an indicator for judging the web presence. The web presence of any country or institute can be judged through its valid domain name and the web space occupied. This can be measured through hyperlinks analysis and its relative ranking in the region or country or world-wide. For instance, in Asian webspaces, India occupies sixth position based on the assessment of number of webpages and inlinks (Jalal, Biswas & Mukhopadhyay, 2010b). For the case of Indian universities, it is observed that more than 98% of Indian universities are having their valid websites and average number of webpage is 4.230. Average number of inlinks and selflinks for Indian universities excluding private universities are 2777 and 2009 respectively (under table 4.24 in chapter 4). The calculations of various WIFs using search engines have been shown in Annex-1.

Chapter-4 concentrates on the web presence of Indian universities through the indicators like webpages, inlinks, selflinks and total links. To know the impact of websites, various types of WIFs were calculated (in Annex-1). SocSciBot3.0 and SocSciBot tools are used to crawl the university websites to get the data on directory outlinks, site outlinks and page outlinks. Besides, link topologies for selected universities through these datasets collected through from web crawler have been constructed.

**RQ-2&3: Is it possible to rank Indian universities at the national, regional and state levels by applying appropriate webometric indicators? Is there any correlation amongst web rankings of Indian universities? If so, what is the degree of correlation?**

Yes, it is possible to rank Indian universities at the regional, national and state level using webometric indicators. The tremendous effort has been made to
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develop a new methodology, based on 10 indicators, which have been chosen from the suitability analysis from the indicators of other internationally recognized and popular university ranking systems as well as adding a few indicators based on suggestions from experts and results related research works carried out by the researchers for this study. The ranking system is called Webometric Ranking of Indian University (WRIU).

The degree of correlation can be measured through the coefficient of correlation. With regard to the third question, there is definitely a strong correlation between (i) WRIU and 4ICU (0.81); and (ii) WRIU and RWWU (0.75) (reported under section 5.7.2.3). The value of rank correlation for 388 Indian universities between WRIU and 4ICU is found to be 0.81. The degree of correlation for WRIU and NAAC ranking system for 74 NAAC accredited universities under CGPA method is found to be 0.24 (table 5.23), whereas there is a strong correlation (0.75) for the case of such top 20 NAAC accredited universities. The detailed discussion on comparison is made under section 5.7.2.2 to 5.7.2.4 in chapter 5.

**RQ-4: Is it possible to identify link topology for selected Indian academic webspace? What factors are associated with the formation of such link topologies?**

In our research study, Indian academic webspace is constituted with selected Indian universities. Many link topologies have been formed using the personal web crawler i.e. SocSciBot3.0 (detail given in chapter 6). In the given set, link topologies amongst the IITs, NITs, Agricultural universities are quite mature and densely linked whereas similar patterns have not been observed in the categories of state universities and central universities. Inter-connection among the top 20 deemed universities shows that there is a strong relationship in academic activities.

There are some factors, like universities locating within a reasonable distance, academic exchange programmes, collaborative projects, similar departments and sharing the expertise of the faculties etc that may increase the degree of interconnection in the pattern of link relationships. On the basis of hyperlink classification exercise (in chapter 7) especially analysing the inlinks and outlinks, following factors have been identified: (i) The number of inlinks depends on the qualitative contents the Indian universities website; (ii) Frequency of updation; (iii) Number of webpages uploaded; (iv) Relevancy of webpages; (v) Exposure of e-resources.

**RQ-5: What are the possible reasons for hyperlink among the Indian academic web space?**

The present thesis deals in detail with this particular issue in chapter-7. The hyperlink classifications of 4871 inlinked pages are carried out and finally by summing up all sub categories, five broad categories have been identified. The analysis has shown that 53% of hyperlinks are generated from commercial (.com) sites. On the other hand, education (.edu.in, .ac.in) and research (.res.in) related
webpages contribute only 9% for Indian universities. More specifically, the reasons for hyperlink within Indian academic webspace are research and educational (9.69%), governmental (4.15%), commercial (53.97%), organizational (20.59%), and personal (11.60%), as reflected through Table 7.4 in Chapter 7. The general reasons for the creation of hyperlink are professional, research oriented, informative, educational, administrative, technical, social, navigational etc.

8.4 Novelty of the Research

The novelty of the present research project may be discussed, verified and judged using the guidelines as mentioned by Phillips (1992).

(i) Carrying out empirical works, which has not been done before.

The present study is basically exploratory study. In this thesis, a new webometric ranking system suitable for Indian universities environment is designed and developed. This has not been done previously. Secondly, there are no uniform link patterns among different categories of Indian universities as reflected through link analysis. The current study mainly uses empirical methods and the findings of the study are innovative and original.

(ii) Using already known material but with a new interpretation.

The concept of co-citation (Small, 1973) as developed by Henry Small was extended by White and Griffith (White & Griffith, 1981) to find out authors co-citation analysis. The same concept is applied here to universities’ websites to find out co-link analysis between websites. Another application is the use of WIF, as proposed by Ingwersen (1997), to apply in the Web environment to evaluate, interpret and compare the websites of Indian universities.

(iii) Trying out something in this country which has previously only been done in other countries.

Although webometric ranking of universities is not a new phenomenon, but the critical analysis of various webometric ranking methodologies and developing new ranking methodology (named as WRIU1) for Indian environment in particular, and for developing countries in general, as mentioned in Chapter 5, is a novel one. This research also claims novelty in relating webometric-based ranking system (i.e. WRIU) with non-webometric quality indicators like CGPA scoring system of NAAC through statistical techniques.

(iv) Taking a particular technique and applying it to a new area.

Some well-known statistical techniques have been applied in the research project as mentioned below:

- **Cosine technique,** being the popular similarity measure has been applied in the field of webometrics especially in Indian universities. For example, the technique has been applied to IIMs and it is found that 0.46 degree of similarity has existed;

---

1 WRIU is the acronym for Webometric Ranking of Indian Universities, as proposed here.
Zipf’s law has been applied in Internet and found it is still valid. The same law is also tested for SLDs and found that it is reverse-J shaped; and

Distribution function: The distribution function for webpages and inlinks are found to be highly skewed.

(v) Looking at areas that people in the discipline haven’t looked at before.

It was found that a strong correlation exists between age of website of university and number of inlinks. On the basis of this finding, the suggestion has been placed to incorporate the age of website as one of the indicators in the formula for webometric ranking of universities.

(vi) Adding to knowledge in a way that hasn’t been done before.

The approach for classification and categorization of hyperlinks and finding out the reasons for the creation of hyperlinks will definitely be food for thought for the future researchers in the field of webometrics for exploring new possibilities in this facet of webometrics research.

(vii) Being cross disciplinary and using different methodologies.

The current research project is definitely cross disciplinary in the sense that it not only belongs to library and information science but also equally relevant in the domain of network analysis and scholarly communication process. Being cross disciplinary, the study has a sound fundamental basis not only from the library and information science especially from bibliometric and informetric laws (e.g. Zipf law, Bradford’s law) but also from web technologies i.e. PageRank algorithms, improving search engines performances. Besides, there is a wide application of power laws, distribution functions, probability theory, and correlation analysis in this project. Many statistical techniques, data collection methodologies, data analysis techniques have been employed to reach the objectives.

8.5 Limitations of the Study

Research is a relay race. Every research starts with the aim to solve a set of problems and often ends with a new set of problems. This research is no exceptions. Though the present study made an attempt to undertake a comprehensive hyperlink analysis of Indian universities using webometric tools and techniques, yet the study may not fully free from limitations. Some of the limitations of this research, as identified during the courses of actions, are given below:

(1). The present study covers all the state universities, deemed universities, institute of national importance, open universities in India but private universities have not been covered;

(2). There are no adequate webometric tools for link analysis. Difficulties during the study were encountered when all of a sudden AltaVista was acquired by Yahoo!, but Yahoo! did not support to get the co-outlink data. Therefore, there is no commercial search engine on which
webometric research can rely fully and get an assurance of perpetual support for webometric investigations:

(3). There are some web crawlers, which are available freely from the web for webometric research. Even, there are limitations of personal crawlers regarding the scope of searches (e.g. SocSciBot3 covers only 5000 link search of a domain);

(4). For designing the webometric ranking of Indian universities, this research encounters insufficiency of data against some indicators. For example, using Scopus, citation data collected for 137 (out of 471) universities are either zero or one during last five year (2006-2010), whereas publication data for 85 universities are either zero or one. Google Scholar database reflects that 31 universities do not have value for publication of the universities;

(5). Yahoo! withdrew all supports for automatic searches in April 2011 and so webometric analyst (i.e. LexiURL Searcher) now uses only Bing and uses URL citation instead of hyperlink searches but all the original functions are still available. Windows Live Search (Bing) disabled link searches in March 2007 except for linkfromdomain (e.g. linkfromdomain:D where D implies domain name). Unfortunately, Google, AltaVista and Yahoo! do not support linkfromdomain (as special keyword); and

(6). Another limitations of the webometric research, as the case may be for hyperlink analysis of Indian universities is the change of the domain name of the university itself, having more than one domain name representing the same university, change of server hosting the website, change of policy for updating, removing webpages etc.

8.6 Further Research

It is the duty of a researcher to identify potential areas of research that can be explored by future researchers. Some of these areas are discussed in brief here:

(i) The web is vast and complex. The complexity of web is required to be explored through studies. There exists mathematical tool for measuring complexity i.e. fractal theory, invented by Mandelbrot (Mandelbrot, 1977). Measuring the fractal dimension of the Web is required attention of webometric researchers.

**Theorem (Egghe):** Let \( N \) denote the total number of webpages and let \( \mu \) be the average number of hyperlinks per page, then the fractal dimension \( D \) of this hypertext system is given by (Egghe, 2000):

\[
D = \frac{\log N}{\log N + \log \left( \frac{1 + \mu}{\mu} \right)}
\]

This theorem has not been applied to any specific country or to a vast domain or to the web as a whole. Therefore, there is a possibility to
explore the complexity of the web space of Indian academic domain or to any such entity. Apart from domain specific application, fractal dimension study may be applied to subject specific or discipline specific or department specific, where further concentration can be given in terms of ranking departments at the local, region-wise or globally:

(ii) The webometric specific search engines need to be developed to get more un-biased result. Besides, there is a need to develop web crawlers, which will take care of language related and use related study. Besides language analysis, automatic identification of hyperlinks and identification of image tag etc. are also to be taken care of for the success of webometric research:

(iii) There is a need to develop more balanced webometric ranking formula keeping in mind the developing countries. The decision regarding the choice of indicators and their respective weights is a vibrant issue and needs attention from researchers;

(iv) There is a lack of language specific webometric study especially Indic languages. Web presence with respect to various Indian languages is still at an infant stage (Nandasara et al, 2008). So, some concentration on linguistic-based metrics needs to be developed;

(v) The judicious determination of the quality of inlinks can be an area of further research because inlinks from academic webspace are more valuable and justifiable than inlinks from non-academic webspace. Similarly, inlinks to homepage of host from foreign countries may be given more weightage than inlinks from the host country;

(vi) The concept of $h$-index may be applied for web-based ranking of the universities because it is calculated on the basis of number of publications and number of citations;

(vii) Automatic classification and categorization of hyperlinks in order to find out the reasons of hyperlinks may be an area of research in the field of webometric research; and

(viii) Development of Comprehensive University Ranking System (CURS) for Indian Universities may be undertaken to provide more realistic results.

8.7 Conclusion

In this stage, it is customary to conclude the study conducted so far. The evaluation of academic institutions is essential in the competitive environment. Due to the advancement of ICTs, the mode of scholarly activities of academic institutions has undergone a paradigm shift. The Web opens up the opportunity to know the activities, facilities, opportunities, present status and situations of higher academic institutions especially universities. More and more information are available through their websites. Therefore, the evaluation of universities through the analysis of their websites has drawn an attention to the researchers. There are techniques both qualitative and quantitative for the evaluation of universities. In our study, webometric tools and techniques have been applied to evaluate the
websites. As we all know that bibliometric and scientometric indicators are used for long time (and even today) to evaluate the contribution of individuals or institutions of their research output in the area of scientific and technological innovation. Webometrics is the extension of Bibliometrics and Informetrics laws, tools and techniques. In recent times, Web indicators like size, as measured by number of webpages; visibility, as measured through number of inlinks, Web Impact Factors (WIF), ratio between inlinks to webpages; Web Use Factors (WUF); and Link Propensity (LP) play the dominant role in the evaluation of academic performances of an institute (Ingwersen, 1998; Thelwall, 2004). The knowledge gained during the experiences of research study through conceptualizing and interpreting new phenomenon has helped to develop new ranking model (i.e. WRIU) using ten indicators through eliminating the shortcomings of existing ranking systems. The idea is to know the relative position of each university at the state level, regional and national level. The WRIU system is dynamic and prompt having the capability to provide the result in a short time as compared with other existing system. It has also been proved that the result drawn from this ranking system is highly correlated with other popular ranking system. Therefore, Webometric Ranking of Indian Universities (WRIU) could be supplement to the existing ranking approach. On the other hand, the analysis of hyperlinks for Indian universities has exhaustively been made in general as well as category specific (Chapter 6). Inspite of this, some suggestions are given for the improvement of each university's web presence and rank not only at the national level but also at the global level.

i. As reflected in the study vide table 4.18 that there are 25 .com TLD domain representing Indian universities as on April 2011. Therefore, it is suggested to re-register their domain names under .ac.in sub-level domain:

ii. Many Indian universities are not having their own web servers. Therefore, they mostly depend on the rented server. As a result, the space is not sufficient or the authority faces inconvenience to update the web contents frequently. So, it is suggested to have own web server for each university for smooth functioning of websites;

iii. While developing the websites, the content selection should be given more importance. It is a general practice that webmasters select contents by their own and choose keywords of preference while coding for hyperlinks but here it is recommended that in such cases subject experts may be consulted;

iv. There should have a committee for website development, updation, maintenance and management;

v. Faculty members should archive their article or technical reports in institutional digital repositories for online presence (online or perish); and

vi. Faculty members and researchers need to be encouraged to write sponsored projects from UGC, ICSSR, CSIR etc and the results can be made available in the website.
It is a fact that as hyperlinks explore the similar information, analysis of hyperlinks in the higher educational system is a research area in the field of library and information science to study institutional collaboration, performance evaluation through the analysis of their websites. The present study achieved some fruitful results in this direction for the cases of Indian universities through the application of webometric tools and techniques. Finally, the study contributed to some extent new knowledge in the field of webometrics and of course in library and information science.

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