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ARTICLE

Comparison of Websites Employing Search Engine Optimization and Live Data

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ABSTRACT

This study compares websites that take live data into account using search engine optimization (SEO). A series of steps called search engine optimization can help a website rank highly in search engine results. Static websites and dynamic websites are two different types of websites. Static websites must have the necessary expertise in programming compatible with SEO. Whereas in dynamic websites, one can utilize readily available plugins/modules. The fundamental issue of all website holders is the lower level of page rank, congestion, utilization, and exposure of the website on the search engine. Here, the authors have studied the live data of four websites as the real-time data would indicate how the SEO strategy may be applied to website page rank, page difficulty removal, and brand query, etc. It is also necessary to choose relevant keywords on any website. The right keyword might assist to increase the brand query while also lowering the page difficulty both on and off the page. In order to calculate Off-page SEO, On-page SEO, and SEO Difficulty, the authors examined live data in this study and chose four well-known Indian university and institute websites for this study: www.caluniv.ac.in, www.jnu.ac.in, www.iima.ac.in, and www.iitb.ac.in. Using live data and SEO, the authors estimated the Off-page SEO, On-page SEO, and SEO Difficulty. It has been shown that the Off-page SEO of www.caluniv.ac.in is lower than that of www.jnu.ac.in, www.iima.ac.in, and www.iitb.ac.in by 9%, 7%, and 7%, respectively. On-page SEO is, in comparison, 4%, 1%, and 1% more. Every university has continued to keep up its own brand query. Additionally, www.caluniv.ac.in has slightly less SEO Difficulty compared to other websites. The final computed results have been displayed and compared.

Keywords: Search engine optimization; Live data; Off-page SEO; On-page SEO; SEO Difficulty

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1. Introduction

Presently, search engines act as a centralized focus for all information, including those related to business, education, research, services [1,2], and so on. The patterns of searching have been substituted by search engines [3,4]. A lot of companies, organizations, banking industries, and educational establishments rely on search engines to bring people, students, and users [5]. These organizations need not spend cash on advertising by publishing ads in newspapers, magazines, television, radio broadcasting, etc. Most clients utilize search engines to find information when they make their business [6-8]. This search yields a list of URLs at which relevant information is probably present as a search result. The webpage link for the organization or institute will pop up in the search results to attract individuals for their purposes and revenue [9]. The positioning of the website link within the search result is another crucial factor related to search results. Being found on the top page of search results is preferable [10,11]. Website URLs must be search engine optimized in order to show up in results pages. SEO is the systematic technique of upgrading the internal and external characteristics of a website in order to maximize the number of exposures obtained from search engines [12-15]. SEO providers differ throughout their focus; some are highly specialized, while others take a more broad and general strategy. Many SEOs feel themselves to be in the broad subject of Web site optimization because optimizing a Web site for search engines can require examining so many factors. Websites have a variety of features such as content, links, structure, social networking sites, reputation, etc. These characteristics are crucial for making websites compatible with search engines [16]. Search engines rank web pages based on how relevant these characteristics seem to be. Here are some characteristics and their functions: The content exerts a strong influence on a one- or two-sentence description of the webpage's content. Keywords that are frequently used by internet users when searching should be the highlight of every website content. One factor used mostly by search engines for ranking is the prominence of a keyword. Trust is a fascinating characteristic of a website. Every company wants to boost the number of website visitors, or "traffic", to their web pages. A webpage develops a value based on its contents if it attracts a significant number of visitors. Webpage links might display in a favorable position in search engine results if the information is acceptable. The website may receive direct or referred traffic. The layout and development of a website are covered by web design characteristics. Since website speed is one of the factors considered by the search engine, websites should be developed to boost website performance. Websites should be developed for better accessibility [17,18], meaning that it should not take forever to start. Archiving a website is one method to accelerate loading. A web server's speed may be enhanced by writing good programming. URLs cannot be overcrowded; it should be simple and free of underscores [19,20]. **Table 1** lists the significant contributions of several authors to SEO and its applications.

Here, we investigated four websites' real-time data to see how the SEO technique might be used for things like brand queries, removing page difficulty, and website page rank. In every website, selecting relevant keywords is also essential. The right keyword could help to lessen the page difficulty for both on and off the page while also increasing brand query. In order to calculate Off-page SEO, On-page SEO, and SEO Difficulty in this article, we have considered live data. For illustrative purposes, we looked at the websites of four reputable Indian universities. Using live data and SEO, we were able to determine the Off-page SEO, On-page SEO, and SEO Difficulty. Finally computed results have been presented and compared.

2. Some technical preliminaries

To set up the rest of the work, various technical terms have been discussed in this section.

(i) Domain Authority

Domain Authority (DA) is a search engine ranking score developed by Moz that reflects how often

Table 1. Significant contributions of different authors to SEO and its applications.

References	Year	Significant contributions
Thatcher [21]	2008	The impact of web experience and task type on web search strategies
Monchaux et al. [22]	2015	Effects of prior domain knowledge and the challenge of the information problems to be solved on query techniques during information search
Kutlwano et al. [23]	2018	As indicators of search intent in sponsored search, keyword length and matching choices
Vyas [24]	2019	Analyzing state tourism websites with search engine optimization techniques
Mata et al. [25]	2020	Digital marketing and SEO: Current Situation and Future Prospects
Nadeem et al. [26]	2020	An innovative method of ranking without Off-page SEO
Varsha et al. [27]	2021	Search Engine Optimization: A Quick Overview
Saura [28]	2021	Framework, procedures, and performance measures for the use of data sciences in digital marketing
Lambrecht [29]	2022	Recommendations for Voice Search Optimization under the Influence of Digital Assistants on Search Engine Strategies
Erdmann [30]	2022	The long-term plan for choosing keywords in search engine optimization
Maitra et al. [31]	2022	Considering and analyzing the Amazon A10 and A11 search algorithms
Maitra et al. [32]	2022	Search engine optimization strategies and techniques
Maitra et al. [33]	2023	Selection of an Online Learning Platform during the COVID-19 Pandemic Using Multi-Criteria Decision Making and the TOPSIS Method

a website may rank in search engine result pages (SERPs). Domain Authority scores vary from 1 to 100 and higher values of DA reflect a higher probability of ranking.

(ii) Open Page Rank

The goal of the Open Page Rank effort was just to revive Page Rank measures such that different domains could have been compared easily. This is accomplished with the use of open-source data through Common Crawl and Common Search.

(iii) Off-page SEO Difficulty

The Off-page SEO Difficulty is a grade out of 100 that evaluates the link equity of the top ten results on Google's first page for a specified search query. It is calculated using the following formula:

$$\text{Off-Page SEO Difficulty} = 0.75 \times \text{Moz-DA Score} + 0.25 \times \text{Ten times of Open Page Rank Score}$$

(iv) On-page SEO Difficulty

The On-page SEO Difficulty is a grade out of 100 that shows how often the top 10 results for a specific search query are optimized. It can be scored using the set of rules as follows:

Rule 1: If the exact search query or its plural matches the page title then the score will be 15 points.

Rule 2: If the exact search query or its plural is present in the URL then the score will be 5 points.

Rule 3: If the exact search query or its plural is present in the description then the score will be 15 points.

Rule 4: If a comprehensive search query or its plural matches the page title then the score will be 25 points.

Rule 5: If a comprehensive search query or its plural is present in the URL then the score will be 10 points.

Rule 6: If a comprehensive search query or its plural is present in the description then the score will be 10 points.

Rule 7: If Google highlighted keywords present in the description, then the score will be 30 points.

Generally, the On-page SEO Difficulty score is ranging from 90 to 100.

(v) Brand Queries

Brand Queries are search keywords that include a brand's name. In such scenarios, Google will prefer displaying the brand's website and social media backlinks over any other website. As a result, ranking for brand queries is significantly more difficult. Search query as a brand query may be viewed in the following scenarios:

(a) For the first relevant result, Google displays site links.

(b) The top three responses all come from the same website.

(c) Two or more results on the first page of Google have come from social platforms like Twitter, Facebook, Linkedin, Instagram, etc.

(v) SEO Difficulty

The On-page Difficulty, Off-page Difficulty, and Brand Query Difficulty each contribute to the SEO Difficulty score. It is calculated using the following formula:

$$\begin{aligned}\text{SEO Difficulty} = (&0.65 \times \text{Off-Page Difficulty} \\ &+ 0.35 \times \text{On Page Difficulty}) \\ &+ 20\% \text{ bonus from branded quaries}\end{aligned}$$

2.1 Cost for search engine optimization

Search engine optimization (SEO) is a collection of techniques aimed at enhancing a website's positioning and usability in natural search results. These SEO techniques include On-page, Off-page, Technical, Mobile, and Content strategies, among others. Simply described, search engine optimization (SEO) is the process of making a website more effective so that it appears higher in search results on engines like Google, Bing, Yahoo, and others. When a user searches for a word or phrase related to the website, this will help the audience find the website on search engines. To assist customers in improving the search engine rankings of any website, the in-house professionals develop the full SEO strategy and also carry it out for customers. The in-house SEO specialists work nonstop to improve customer results on search engines. Putting the concept into action is a group of highly skilled SEO specialists who rank websites for the keywords that matter most to organizations.

Different SEO companies have different cost models but here are the four most common SEO cost models viz. (i) Hourly Rate, (ii) Project-Based, (iii) Monthly Retainer and (iv) Self-service.

Hourly Rate: When an SEO company or consultant charges by the hour for SEO work, this is known as hourly rate pricing. The hourly rate option enables one to contract with an SEO firm for a predetermined number of hours and pay them in accordance with those hours. It is suitable for small businesses with limited budgets.

Project-Based: When an SEO business charges a defined sum to accomplish a particular project, this is known as project-based SEO pricing. It helps businesses that have clear SEO goals.

Monthly Retainer: When a client pays a monthly charge for a predetermined set of SEO deliverables, this is known as a monthly retainer. It is helpful for all businesses that want to scale their SEO consistently.

Self-service: Self-service is exactly what it sounds like. One can visit the website of an agency, select the SEO work, and pay for it with a few clicks. It helps small and medium businesses who are happy to take more control of their SEO.

2.2 Uniform distribution

A random variable r is said to have a uniform distribution if its probability density function is given by:

$$f(r) = \begin{cases} \dfrac{1}{b-a} & \text{if } a \le r \le b \\ 0 & \text{otherwise} \end{cases}$$

We have denoted this distribution as $U(a,b)$, where a and b are two real-valued numbers such that $a < b$.

In Excel, we have generated random numbers using ***RAND ( )*** function, which returns random values between 0 and 1.

Therefore, any random values between a and b with $a < b$ can be generated using the following algorithm.

Algorithm 1

Step-1: Read as a,b inputs

Step-2: $m = \text{RAND}()$

Step-3: Return $a + m(b - a)$

3. Calculation of different SEO parameters

In this section, we have determined the Off-page SEO, On-page SEO, and SEO Difficulty of a few renowned Indian educational institutions, including the University of Calcutta (CU), Jawaharlal Nehru University (JNU), the Indian Institute of Management, Ahmadabad (IIM-A), and the Indian Institute of Technology, Bombay (IIT-B).

3.1 For Calcutta University

We have set the lowest and maximum limits of the MoZ DA for the University of Calcutta as 48.00 and 55.00, respectively. We considered the data over a 15-day period, and we generated 10 floating point values with a uniform distribution over the range [48.00, 55.00]. **Table 2** contains the computed 10 MoZ DA values. **Table 2** details University of Calcutta's Off-page SEO, On-page SEO, and SEO Difficulty. **Table 3** presents the details of Off-page SEO, On-page SEO and SEO Difficulty for University of Calcutta.

From Google Page Rank Checker (http://www.sitecheckers.pro/page-rank/) live data of Calcutta University we have taken Open Page Rank of University of Calcutta as 4.4. Top pages by linkings of this University are given in **Table 4**.

Table 2. 10 MoZ DA values for University of Calcutta.

No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
MoZ DA	52.02	49.47	51.54	48.80	51.83	53.49	53.95	51.25	48.98	53.42

Table 3. Off-page SEO, On-page SEO and SEO Difficultyfor University of Calcutta.

WEBSITE	**Off-page SEO**	**On-page SEO**	**SEO Difficulty**
www.caluniv.ac.in	50.00	94.88	65.70
	50.91	92.36	65.41
	50.34	91.69	65.48
	50.44	91.27	65.65
	50.27	92.14	65.58
	50.10	91.85	65.64
	50.48	93.48	65.65
	50.17	96.28	50.46
	50.15	98.77	50.50
	50.81	90.19	50.58

Table 4: Top pages by links of University of Calcutta.

Page/URL	**Page Authority (PA)**
https://www.caluniv.ac.in/	56
https://caluniv.ac.in/	49
https://www.caluniv.ac.in/About%20the%20university/university_frame.htm	46
https://www.caluniv.ac.in/about/vc.html	46
https://www.caluniv.ac.in/convocation-2012/hony_degrees.htm	45
https://www.caluniv.ac.in/university_campuses/university_frame.htm	45
https://www.caluniv.ac.in/student/student.html	44

Domain Authority (DA) of University of Calcutta in different search engines has been presented in **Table 5**. Graphical representation of discovered and lost linking domain of University of Calcutta has been shown graphically in **Figure 1**. Green for discovered linking and red for lost linking.

Table 5. Domain Authority (DA) of University of Calcutta in different search engine.

Domain Name	Domain Authority (DA)
https://en.wikipedia.org/	98
https://sites.google.com/	97
https://plus.google.com/	97
https://europa.eu/	97
https://github.com/	96
https://bbc.co.uk/	95
https://fr.wikipedia.org/	95

3.2 For Jawaharlal Nehru University

For Jawaharlal Nehru University, the MoZ DA lower and upper limits are 60.00 and 70.00 respectively. We considered the data throughout a 15-day period and we have considered 10 values using uniform distribution in a range of [60.00, 70.00]. **Table 6** contains the computed 10 MoZ DA values. Details on Jawaharlal Nehru University's Off-page SEO, On-page SEO, and SEO Difficulty are shown in **Table 7**.

We have collected the Open Page Rank of Jawaharlal Nehru University 4.5 from Google Page Rank Checker's (www.sitecheckers.pro/page-rank/) live data for the university. **Table 8** presents the Domain Authority (DA) of Jawaharlal Nehru University in different search engines. **Table 9** lists the top pages of this university that have links to them.

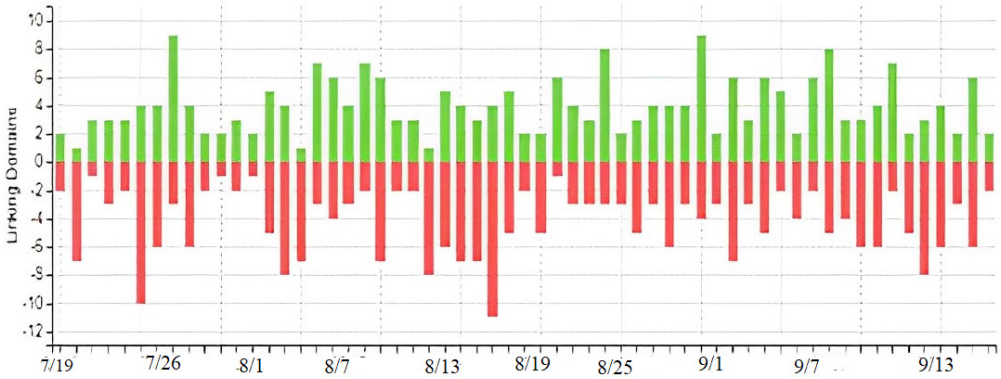

Figure 1. Diagram of discovered and lost linking domain of Calcutta University.

Table 6. MoZ DA for Jawaharlal Nehru University.

No.	1	2	3	4	5	6	7	8	9	10
MoZ DA	66.65	64.52	65.88	63.17	68.72	60.94	69.24	64.6	68.22	69.39

Table 7. Off-page SEO, On-page SEO and SEO Difficulty for Jawaharlal Nehru University.

WEBSITE	Off-page SEO	On-page SEO	SEO Difficulty
www.jnu.ac.in	61.28	98.84	74.42
	59.68	95.42	72.18
	60.21	95.73	72.71
	59.82	95.15	72.47
	60.34	98.12	74.25
	60.95	99.15	72.37
	60.72	98.91	73.86
	61.03	99.67	73.46
	61.09	98.02	73.95
	50.81	97.10	72.55

Table 8. Domain Authority (DA) of Jawaharlal Nehru University in different search engine.

Domain Name	Domain Authority (DA)
https://microsoft.com/	99
https://docs.google.com/	98
https://en.wikipedia.org/	98
https://sites.google.com/	97
https://plus.google.com/	97
https://europa.eu/	97
https://github.com/	96

Table 9. Top pages by links of Jawaharlal Nehru University.

Page/URL	Page Authority (PA)
https://www.jnu.ac.in/	60
https://jnu.ac.in/sites/default/files/Court.pdf	56
https://www.jnu.ac.in/main/	53
https://jnu.ac.in/	52
https://www.jnu.ac.in/career	51
https://www.jnu.ac.in/Career/currentjobs.htm	51
https://admissions.jnu.ac.in/	50

Figure 2 displays a graphical representation of Jawaharlal Nehru University's discovered and lost linking domain. Red for lost linking and green for discovered linking.

3.3 For Indian Institute of Management, Ahmadabad (IIM-A)

The MoZ DA lower and upper limits for IIM-A are 54.00 and 61.00 respectively. We took into consideration the data during a 15-day timeframe, computing 10 values with a uniform distribution over the range [54.00, 61.00]. **Table 10** contains the computed 10 MoZ DA values. Details on Off-page SEO, On-page SEO, and SEO Difficulty for IIM-A are provided in **Table 11**.

The Open Page Rank of IIM-A is 4.26 based on live data from Google Page Rank Checker (www.sitecheckers.pro/page-rank/). **Table 12** displays the Domain Authority (DA) of IIM-A across several

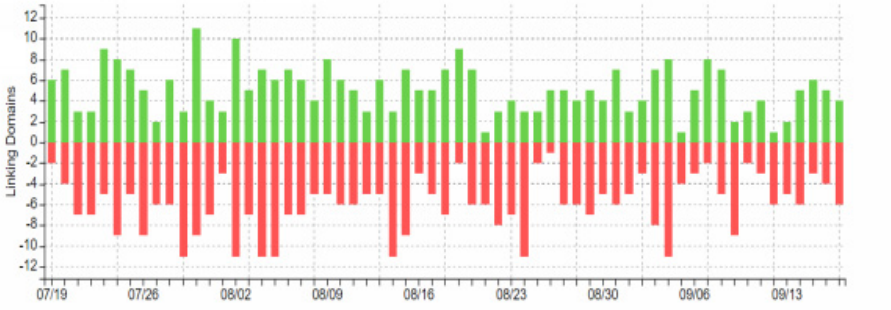

Figure 2. Diagram of discovered and lost linking domain of Jawaharlal Nehru University.

Table 10. 10 MoZ DA values of IIM-A.

No.	1	2	3	4	5	6	7	8	9	10
MoZ DA	55.51	54.98	60.63	56.99	60.22	59.8	59.82	55.78	55.81	59.83

Table 11. Off-page SEO, On-page SEO and SEO Difficulty for IIM-A.

WEBSITE	Off-page SEO	On-page SEO	SEO Difficulty
www.iima.ac.in	52.28	99.48	68.79
	51.88	99.26	68.46
	52.28	99.59	68.48
	52.32	97.67	68.40
	52.59	98.67	68.22
	52.36	97.33	68.98
	52.28	97.10	68.40
	52.31	98.71	68.44
	52.34	98.72	68.91
	52.44	98.49	68.09

search engines. **Table 13** lists the top pages of this university that have links to it.

Table 12. Domain Authority (DA) of IIM-A in different search engine.

Domain Name	Domain Authority (DA)
https://en.wikipedia.org/	99
https://sites.google.com/	97
https://adobe.com/	97
https://cnn.com/	95
https://bbc.co.uk/	95
https://fr.wikipedia.org/	95
https://wikimedia.org/	95

In **Figure 3**, the discovered and lost linking domains of IIM-A are represented graphically. Green indicates a discovered link, whereas red indicates a lost link.

3.4 For Indian Institute of Technology Bombay (IIT-B)

The lower and upper limits of the MoZ DA are 55.00 and 63.00 respectively for IIT-B. We also included the data throughout a period of 15 days, and we estimated 10 values using a uniform distribution mostly in spectrum [55.00, 63.00]. **Table 14** contains the computed 10 MoZ DA values. Details on Off-page SEO, On-page SEO, and SEO Difficulty for IIT-B are provided in **Table 15**. Domain Authority (DA) of IIT-B in the different search engines has been listed in **Table 16**. The top Pages by Links of IIT-B have been presented in **Table 17**.

Table 13. Top pages by links of IIM-A.

Page/URL	Page Authority (PA)
https://www.iima.ac.in/	50
https://www.iima.ac.in/web/iima	48
https://iima.ac.in/	47
https://www.iima.ac.in/web/iima/working-for-us/current-openings	44
https://www.iima.ac.in/web/pgp/apply/domestic/admission/selection-process	42
https://wimwian.iima.ac.in/wp-content/uploads/2019/07/Started-by-Shivendra-Singh-in-2016-in-Dubai-UAE-with-a-mission-to-bring-technology-innovation-in-the-farming-sector-Barton-Breeze-focuses-on-Hydroponics.jpg	41
https://web.iima.ac.in/assets/snippets/workingpaperpdf/72588163220 15-03-07.pdf	41

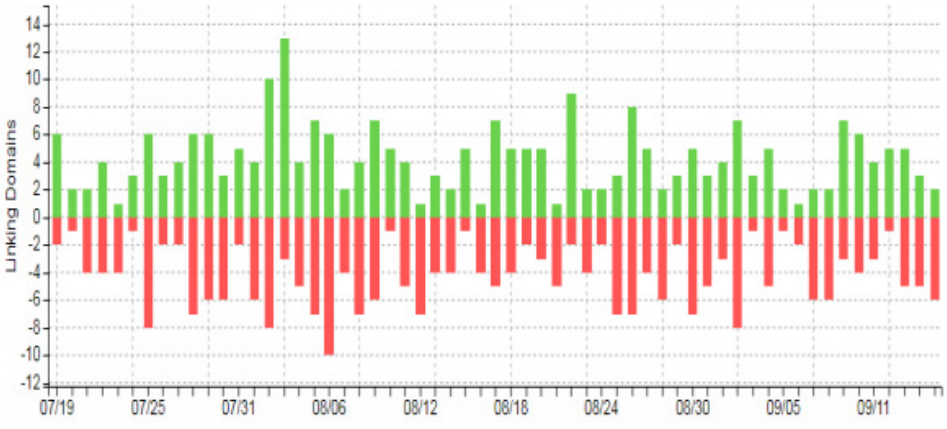

Figure 3. Diagram of discovered and lost linking domain of IIM-A.

Table 14. 10 MoZ DA values for IIT-B.

No.	1	2	3	4	5	6	7	8	9	10
MoZ DA	56.51	55.98	61.63	52.99	59.22	58.8	60.82	61.78	63.81	58.83

Table 15. Off-page SEO, On-page SEO and SEO Difficulty for IIT-B.

WEBSITE	Off-page SEO	On-page SEO	SEO Difficulty
	52.28	99.76	68.79
	51.88	99.55	68.46
	52.28	99.41	68.48
	52.32	97.42	68.40
www.iitb.ac.in	52.59	98.89	68.22
	52.36	97.35	68.98
	52.28	97.75	68.40
	52.31	98.72	68.44
	52.34	98.77	68.91
	52.44	98.40	68.09

Table 16. Domain Authority (DA) of IIT-B in different search engine.

Domain Name	Domain Authority (DA)
https://www.google.com/	100
https://youtube.com/	100
https://microsoft.com/	99
https://docs.google.com/	98
https://mozilla.org/	98
https://en.wikipedia.org/	98
https://sites.google.com/	97

Table 17. Top pages by links of IIT-B.

Page/URL	Page Authority (PA)
https://www.iitb.ac.in/	64
https://www.iitb.ac.in/~pge	57
https://www.gymkhana.iitb.ac.in/~smp	57
https://www.civil.iitb.ac.in/~gpatil	57
https://www.ircc.iitb.ac.in/IRCC-Webpage/rnd/HRMSLoginPage.jsp	56
https://www.idc.iitb.ac.in/	56
https://www.gate.iitb.ac.in/	56

In **Figure 4**, a graphical representation of the IIT-B's discovered and lost linking domains is displayed. Red for a lost link and green for a link that has been discovered.

3.5 Expected values of SEO parameters

For the four Indian educational institutions listed here, the University of Calcutta, Jawaharlal Nehru University, the Indian Institute of Management, Ahmadabad, and the Indian Institute of Technology, Bombay; we have presented (see **Table 18**) expected/average parametric values in terms of next integer for Off-page SEO, On-page SEO, and SEO Difficulty out of 100. A graphical representation has been depicted in **Figure 5**.

From **Figure 5** it has been observed that the Off-page SEO of CU, IIM-A and IIT-B are 51.00, 53.00 and 53.00 respectively. While JNU's Off-page SEO score is 60. Simply said, Off-page SEO tells Google or other search engines how other people feel about their website. Search engines will infer, for instance, that they have excellent information that offers users value if they have provided a lot of quality links connecting to the websites. If configured effectively, On-page SEO ranking indicators can have a significant impact on a web page's potential to rank. The higher On-page SEO factors, such as a content page's quality, good content, etc., have an impact on search engine rankings. It is evident from **Figure 5** that four institutes have a higher impact on society. SEO Difficulty is an SEO parameter that determines how challenging it would be to appear on Google's first page for a specific search. On a scale from 0 to 100, with 100 being the most difficult to rank for,

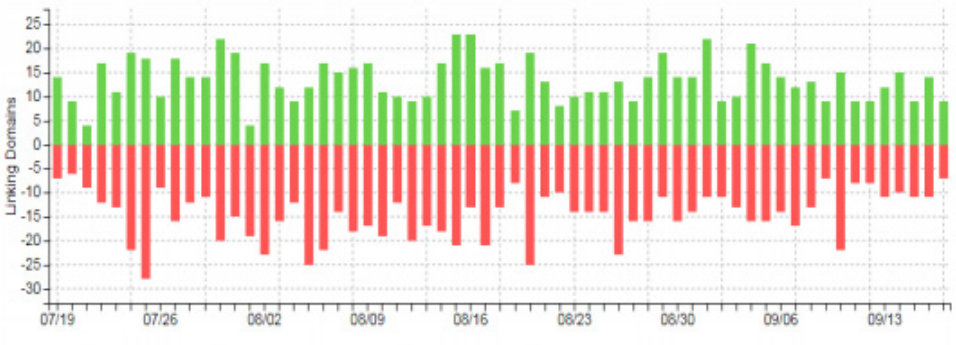

Figure 4. Diagram of discovered and lost linking domain of IIT-B.

Table 18. Expected values of SEO parameters.

Name of the University/Institute	Off-page SEO	On-page SEO	SEO Difficulty	Brand Query
University of Calcutta (www.caluniv.ac.in)	51.00	94.00	62.00	Yes
Jawaharlal Nehru University (www.jnu.ac.in)	60.00	98.00	74.00	Yes
Indian Institute of Management Ahmadabad (www.iima.ac.in)	53.00	99.00	69.00	Yes
Indian Institute of Technology Bombay (www.iitb.ac.in)	53.00	99.00	69.00	Yes

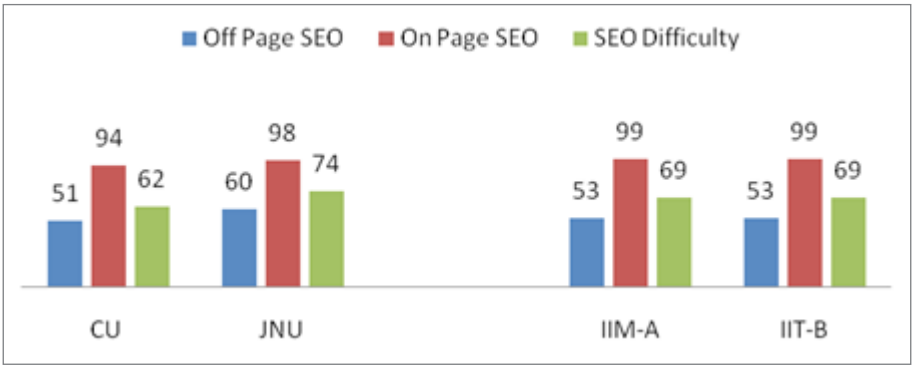

Figure 5. A graphical representation of Off-page SEO, On-page SEO, and SEO Difficulty.

it is evaluated. From **Figure 5** it has been seen that IIM-A and IIT-B have the same values. On the other hand CU has lesser value compared to JNU. But all the institutes have higher SEO Difficulty values.

4. Concluding remarks

In this article, we have examined websites that take live data into account through search engine optimization (SEO). A set of measures considered search engine optimization that can help a website rank highly in search engine results. Here, we have investigated several SEO factors, including MoZ DA, Page Authority (PA), Off-page SEO, On-page SEO, SEO Difficulty, etc. The main problem for all web developers/website owners is their website's poor page rank, congestion, usage, poor look on search engines. As real-time data would show how the SEO strategy may be applied to website page rank, page difficulty removal, and brand query, among other things, we have investigated live data of four websites under this instance. In order to calculate Off-page SEO, On-page SEO, and SEO Difficulty, we relied on live data in this study. For the sake of explanation, we have considered websites of four reputable Indian universities and institutes. Using live data and SEO, we determined the Off-page SEO, On-page SEO, and SEO Difficulty. The estimated outcomes have finally been shown and compared.

Here, we have performed a comparative analysis of websites employing search engine optimization while considering real data and some existing parameters and their relationships. For the calculation of various SEO factors, we have additionally proposed several formulas. Such techniques can be used to explore various websites for further study.

Author Contributions

S.M., L.S., S.S. and K.T. formulate and studied the problem. S.M., L.S., S.S. and K.T. wrote the first draft of the manuscript. All authors have read and agreed to the final version of the manuscript.

Conflict of Interest

The authors declare no conflict of interest.

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