

Full Length Research

EVALUATION OF GSDL ON THE BASIS OF FACTORS USING DEMATEL

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Accepted 25 February 2018

Digital Libraries are becoming the most effective for knowledge management and libraries must endeavor to enrich their knowledge store to fulfill the users' requirement. For the implementation of digital library software successfully for the library system, it is very necessary to identify the decisive factors. These factors are significant and have causal relationship among them, but not necessarily that they have the same importance. A list of such critical factors must be created for the higher success and usefulness of implementing softwares. DEMATEL method provides a favorable solution by simply ranking these critical factors. In this study, the authors evaluate the GSDL using DEMATEL on the selected factors. In library domain this type of study is not so much done, the literature review is done from other areas also. The study is done on the four objectives. INRM is created for the GSDL and to find the factors which effects and which causes. Limitation of the study and future scope is also included.

KEYWORDS: Digital Library, GSDL, DEMATEL, Influential Network Relationship Map

Cite This Article As: Somvir, Kaushik S (2018). EVALUATION OF GSDL ON THE BASIS OF FACTORS USING DEMATEL. Inter. J. Acad. Lib. Info. Sci. 6(1): 17-22

INTRODUCTION

The 'open source' term refers to one that is accessible freely and can be modified as per the requirements. It is also called a set of values in which source of the code is available to all for customization or modification. Most computer users don't even see the part of software, i.e. source code through which computer programmers can change a program or application of software to improve the features. In Open Source the source code is provided to others for learning, altering or sharing by the authors. Dspace, Greenstone Digital Library, Koha, Eprint, Newgenlib are some examples of open source software. As for proprietary software users have to accept the terms of licences, for OSS also have to accept with different legal terms from the proprietary softwares.

Decision Making Trial and Evaluation Laboratory (DEMATEL)

Using the crisp values to analyze the correlations among factors, the Decision making trial and evaluation laboratory (DEMATEL) is a useful tool. Fontela and Gabus employed the DEMATEL technique at the end of 1971. By considering experts' view to solve many global problems in different fields such as scientific, political and economic, this technique has managed (Falatoonitoosi et al, 2012). It is widespread technique to evaluate and formulate cause and effect relationships INRM in each structural model and become most popular in Japan. With the purpose of studying the complex and intertwined problematic group, the Science and Human Affairs

Program of the Battelle Memorial Institute of Geneva used and improved the DEMATEL between 1972 to 1979. (Naser et al 2010). Based on the diagram's calculations the direct and indirect effects are among the factors measured by this method. The intensive effect of direct and indirect impact of the factors in a qualitative way is measured according to the cause and effect relationship analysis.

OBJECTIVES OF THE STUDY

In the current scenario of development of the digital libraries Greenstone is widely being used as free or open source software systems (FOSS). In fact, the aims of the different free or open source software (FOSS) systems are very different, although their domains of application do overlap. For further study these are the main objectives, which are mention below;

1. To find the priority of factors of GSDL on the basis of experts' opinion.
2. To find out the cause and effect groups of factors.
3. To build the influential network relationship map (INRM) of factors.
4. To make the strategy and give the recommendation on the basis of result for future implementation of software.

LITERATURE REVIEW

Mahmoodi and Jahromi (2014) carried out a research work for the evaluation of knowledge management through New Fuzzy DEMATEL-TODIM Hybrid Method. The knowledge management is a process of creating, transferring and distributing information and is the indices according to their importance. Pyrounakis et al. (2014) carried out a comparative study on using open source digital repository software to build digital collections and revealed that in the last decade digital library system and digital repository have been developed in bulks and published as open source software. When an organization is planning to build a repository infrastructure to host its collections, the variety of available software systems are a factor of confusion. The five widely used open source software, Fedora, Greenstone, EPrints and Invenio are compared to simplify the decision process and to describe their characteristics. To select repository software matching the organization's criteria, can be directed by using five collection paradigms that represent case studies of different content and functionality. Zha et. Al (2015) worked out on comparing the flow experience in using digital libraries: web and mobile context and found out

that flow experience is considered as an optimal experience of an activity and described a match between observed challenges and observed skills.

The DEMATEL approach is used in various situations in manufacturing planning and controlling based on multi criteria decision making, such as Customer behavior (Chen-Yi 2007), E learning Program (Chung & Gwo 2009), Quality of Digital Library (Cabrerizo et al. 2010), Material Selection (Shih-Chi et el 2011) Quality improvement (Yang el al 2013), Knowledge Management (Mahmoodi and Jahromi 2014), HR Management (Kashi, 2015) and Customer relationship (Pechová, Hana 2015) etc.

RESEARCH METHODOLOGY

Today a lot of softwares are available for the Digital Libraries. With the aim to establish a Digital Library or Institutional Repository, it is very necessary to find out the suitable software which can fulfill the aims and provide the end user satisfaction. To evaluating GSDL software eight factors are finalized. The responses were taken through a questionnaire from Twelve experts. The experts were from different academic libraries of well-known universities/ institutions having at least 3 years experiences. To determine the causal relations and INRM DEMATEL analytical technique is used after obtaining the completed questionnaires from the experts.

ANALYSIS

After taking the data DEMATEL approached is applied step by step and in the 1st step Average matrix is found out in Table 1, in 2nd step the normalized initial direct-relation matrix is calculated in Table 2, in 3rd step total relation matrix and in 4th step threshold value is calculated in Table 3.

$$\text{Step 1: } \mathbf{A} = [a_{ij}] = \frac{1}{H} \sum_{k=1}^H x_{ij}^k \quad (1)$$

Average matrix (initial direct relation matrix)

$$\text{Step 2: Direct Relation Matrix } \mathbf{D} \text{ by } \mathbf{D} = \mathbf{m} \times \mathbf{A}, \quad (2)$$

$$\text{Where, } \mathbf{m} = \text{min} \left[\frac{1}{\max_i \sum_{j=1}^n a_{ij}}, \frac{1}{\max_j \sum_{i=1}^n a_{ij}} \right], l, j \in \{1, 2, \dots, n\} \quad (3)$$

Each element in matrix \mathbf{D} falls between zero and one.

Table 1. Average Matrix

Strategic Decisions	F1	F2	F3	F4	F5	F6	F7	F8	SUM
F1	0.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	28.00
F2	3.17	0.00	3.00	3.25	3.58	2.33	3.17	3.75	22.25
F3	4.00	4.00	0.00	4.00	4.00	4.00	4.00	4.00	28.00
F4	2.50	3.25	3.17	0.00	3.58	3.17	3.83	3.58	23.08
F5	3.67	3.58	3.00	3.58	0.00	3.67	3.08	2.17	22.75
F6	3.00	2.33	2.33	3.17	3.67	0.00	2.25	1.50	18.25
F7	3.75	3.17	3.75	2.50	3.08	2.25	0.00	3.08	21.58
F8	1.75	3.75	1.75	2.92	2.17	1.50	3.08	0.00	16.92
SUM	21.83	24.08	21.00	23.42	24.08	20.92	23.42	22.08	

Table 2. Direct Relation Matrix D

D =

0.0000	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429
0.1131	0.0000	0.1071	0.1161	0.1280	0.0833	0.1131	0.1339	0.1339
0.1429	0.1429	0.0000	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429
0.0893	0.1161	0.1131	0.0000	0.1280	0.1131	0.1369	0.1280	0.1280
0.1310	0.1280	0.1071	0.1280	0.0000	0.1310	0.1101	0.0774	0.0774
0.1071	0.0833	0.0833	0.1131	0.1310	0.0000	0.0804	0.0536	0.0536
0.1339	0.1131	0.1339	0.0893	0.1101	0.0804	0.0000	0.1101	0.1101
0.0625	0.1339	0.0625	0.1042	0.0774	0.0536	0.1101	0.0000	0.0000

Table 3 Matrix T

Matrix T - INV(I-D)

	F1	F2	F3	F4	F5	F6	F7	F8
F1	1.5068*	0.6782*	0.6153	0.6634*	0.6773*	0.6109	0.6645*	0.6372
F2	0.5139	1.4518*	0.4961	0.5425	0.5626	0.4726	0.5418	0.5366
F3	0.6318	0.6782*	1.4903*	0.6634*	0.6773*	0.6109	0.6645*	0.6372
F4	0.5063	0.5664	0.5110	1.4492*	0.5744	0.5065	0.5713	0.5411
F5	0.5416	0.5764	0.5089	0.5653	1.4645*	0.5250	0.5514	0.5018
F6	0.4478	0.4588	0.4170	0.4742	0.4988	1.3384*	0.4474	0.4052
F7	0.5271	0.5483	0.5140	0.5164	0.5439	0.4669	1.4354*	0.5134
F8	0.3792	0.4678	0.3696	0.4325	0.4198	0.3562	0.4398	1.3250*

* Indicate the value of any element greater then threshold value (α).

0.035714 = $\left[\frac{1}{24.08}, \frac{1}{28.00} \right] = \frac{1}{28.00} =$ $\times n$ identity matrix. The element of t_{ij} represents the indirect effects that factor i had on factor j , and then the

Step 3: Total Relation Matrix (T Matrix).

T matrix is obtained by utilizing Eq. (5), in which, I is an n

matrix T reflects the total relationship between each pair of system factors.

$$T = \lim_{m \rightarrow \infty} (D + D^2 + \dots + D^m) = \sum_{m=1}^{\infty} D^m$$

(4)
Where,

$$\begin{aligned} \sum_{m=1}^{\infty} D^m &= D^1 + D^2 + \dots + D^m \\ &= D(I + D^1 + D^2 \dots + D^{m-1}) \\ &= D(I - D)^{-1}(I - D)(I + D^1 + D^2 \dots + D^{m-1}) \\ &= D(I - D)^{-1}(1 - D)^m \end{aligned}$$

$$T = D(I - D)^{-1} \tag{5}$$

Calculate matrix **T**:

Define **r** and **c** be $n \times 1$ and $1 \times n$ vectors representing the sum of rows and sum of columns of the total relation matrix **T**, respectively, which are obtained by:

$$r = [r_i]_{n \times 1} = [\sum_{j=1}^n t_{ij}]_{n \times 1} \tag{6}$$

$$c = [c_j]_{1 \times n} = [\sum_{i=1}^n t_{ij}]_{1 \times n} \tag{7}$$

Suppose r_i be the sum of *i*th row in matrix **T**, then r_i summarizes both direct and indirect effects given by factor *i* to the other factors. If c_j denotes the sum of *j*th column in matrix **T**, then c_j shows both direct and indirect effects by factor *j* from the other factors. When $j = i$, the sum $(r_i + c_j)$ shows the total effects given and received by factor *i*. That is, $(r_i + c_j)$ indicates the degree of importance that factor *i* plays in the entire system. On the contrary, the difference $(r_i - c_j)$ depicts the net effect that factor *i* contributes to the system. Specifically, if $(r_i - c_j)$ is positive, factor *i* is a net cause, while factor *i* is a net receiver or result if $(r_i - c_j)$ is negative. The sums of rows and columns of matrix **T** are calculated by using Eq. (6) to Eq. (7) as shown Table 4.

Step 4: Set up a threshold value to obtain the digraph.

The threshold value (α) was computed by the average of the elements in matrix T, as computed by Eq. (8).

$$\alpha = \frac{\sum_{i=1}^n \sum_{j=1}^n [t_{ij}]}{N} = \frac{41.428}{64} = \mathbf{0.64732}$$

Where, **N** is the total number of elements in the matrix T. Since matrix **T** provides information on how one factor affects another, it is necessary for a decision maker to set up a threshold value to filter out some negligible effects. In doing so, only the effects greater than the threshold value, would be chosen and shown in digraph. In this study, the threshold value is set up by computing the average of the elements in matrix **T**. The digraph can be acquired by mapping the data set of $(r + c, r - c)$. The threshold value is 0.6473.

RESULTS

Content Acquisition (F1) has the largest $(r+c)$ value = 11.108 and User Friendly Interface (F8) has the smallest $(r+c)$ value = 9.287. Regarding to $(r+c)$ values, the prioritization of the importance of eight evaluation perspective was $F1 > F3 > F5 > F2 > F4 > F7 > F6 > F8$. Content Acquisition is most important and User friendly Interface is least.

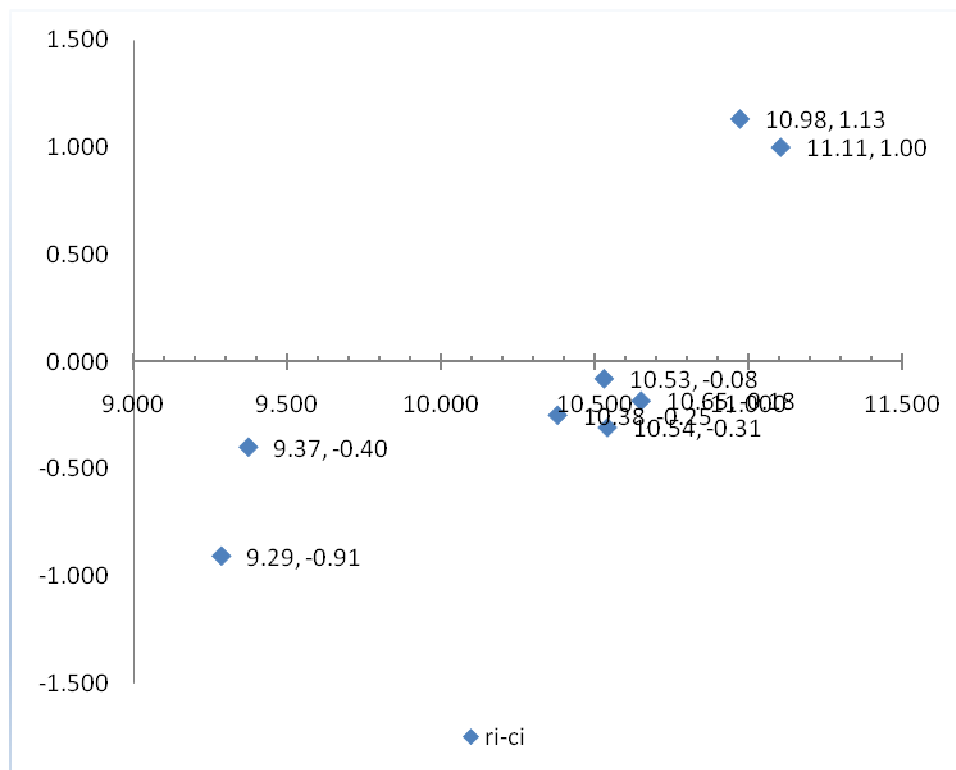
Based on r-c value, the eight factors were divided in (i) cause group and (ii) effect group, the factors, Content Acquisition (F1) and Metadata Submission and Support (F3) were classified in the cause group, having the (r-c) values of 0.999 and 1.132 respectively. The factors Content Management (F2), Classification (F4), Information Search and Retrieval (F5), Access Control, Privacy and Management (F6) and Authentication and Authorization (F7) are categorized in the effect group, have the (r-c) value -0.308, -0.081, -0.184, -0.400 and -0.251 respectively.

Content Acquisition (F1) has five influencing relationships with other factors like Content Acquisition F1, Content Management F2, Classification F4, Information Search and Retrieval F5, Authentication and Authorization F7, in total five relationships the factor one has also the mutual relationship itself. It shows that this factor is the most important factor as compared to other factors. Metadata Submission and Support has five influencing relationships with other factors. While Content Management; Classification; Information Search and Retrieval; Access Control, Privacy and Management; Authentication and Authorization; and User Friendly Interface have only a mutual relationship with Own.

The values of t_{ij} in Table 4, which were greater than α (0.64732), were highlighted and shown as t_{ij}^* , which presented the interaction between perspectives, e.g. the

Table 4. Dimension, Cause & Effect

Factor Dimension	r_i	c_j	$r_i + c_j$	Rank	$r_i - c_j$	Impact
F1	6.054	5.054	11.108	1	0.999	Cause
F2	5.118	5.426	10.544	4	-0.308	Effect
F3	6.054	4.922	10.976	2	1.132	Cause
F4	5.226	5.307	10.533	5	-0.081	Effect
F5	5.235	5.419	10.653	3	-0.184	Effect
F6	4.488	4.887	9.375	7	-0.400	Effect
F7	5.065	5.316	10.381	6	-0.251	Effect
F8	4.190	5.098	9.287	8	-0.908	Effect

**Figure 1:** Influence Relation Map – GSDL

value of $t_{12} (1.5068) > \alpha (0.6743)$. The cause and effect diagram/ INRM of eight perspectives is constructed as Figure 1.

LIMITATIONS OF THE STUDY

There are always several limitations in the studies, in this study the first limitation concerns the representativeness of sample as larger sample size might not be representative of the entire population of library professionals. This study is done only on the GSDL, the popular digital library softwares. For prioritization, data is

calculated of only 20 evaluators on the basis of some certain criteria, but these criteria can vary according to the situation of the problem and the environment. For construction of Network Relationship Map (NRM), this study applied only DEMATEL approach on the selected 12 experts' opinions about GSDL.

SCOPE OF FUTURE WORK

DEMTAL approach is not widely used in the field of Library Science Research. This approach is mostly used in the Management field. There should be proper

utilization of this approach to the research in the field of library science with changing perspectives. It is very useful to make decisions in Management of libraries, selection of different softwares for the implementation in various fields. Different services can be provided in the best way to the users by using experts' opinion views and evaluating them through DEMATEL. In the field of library science, there are a lot of opportunities in research using this approach.

CONCLUSIONS

From a practical perspective, the study found out the priority of the identified factors and their interrelationship i.e. cause and effect relationship within the factors. The study shows that content acquisition is the most important factor and it has five positive relationships with other factors. From a management point of view if we are going to implement the GSDL, we must focus the content acquisition. Second, Metadata submission and support have five positive relationships with other factors. Third, Content Management; Classification and Information Search & Retrieve; Access Control, Privacy and Management; Authentication and Authorization; and User Friendly Interface have a mutual relationship with its own. It is recommended from the management point of view that Content Acquisition and Metadata Submission & Support should be focused if GSDL will be implemented for Digital Library.

REFERENCES

- Cabrerizo et al (2010). A Model Based On Fuzzy Linguistic Information to Evaluate The Quality of Digital Libraries. *International Journal of Information Technology and Decision Making*. 9 (3). www.worldscientific.com Accessed on August 10, 2015
- Chen-Yi et al (2007). FMCDM with Fuzzy DEMATEL Approach for Customers' Choice Behavior Model. *International Journal of Fuzzy Systems*. 9 (4), 236-246
- Chung-Wei, Li and Gwo-Hshiung, Tzeng (2009). Identification of a Threshold Value for the DEMATEL Method: Using the Maximum Mean De-Entropy Algorithm. *MCDM 2009, CCIS 35*, 789–796
- Falatoonitoosi, Elham et al (2013). Decision Making Trial and Evaluation Laboratory. *Research Journal of Applied Sciences, Engineering and Technology* 5(13): 3476-3480. <http://maxwellsci.com/print/rjaset/v5-3476-3480.pdf> Accessed on May 15, 2014
- Kashi, Katerina (2015). DEMATEL Method in Practice: Finding The Causal Relations Among Key Competencies. *The 9th International Days of Statistics and Economics*, Prague, September 10-12, 2015. 723-732
- Mahmoodi, M., & Jahromi, G. S. (2014). A New Fuzzy DEMATEL-TODIM Hybrid Method for evaluation criteria of Knowledge management in supply chain. *International Journal of Managing Value and Supply Chains*. 5 (2), June 2014
- Pechová, Hana (2015). Application of DEMATEL Method in CRM Performance Measurement. <https://www.researchgate.net/publication/275409748> Access on 05 July 2014
- Pyrounakis, G., Nikolaidou, M., & Hatzopoulos, M. (2014). Building digital collections using open source digital repository software: A comparative study. *International Journal of Digital Library Systems*. 4(1), 10-24. https://www.researchgate.net/profile/Mara_Nikolaidou/publication/261961039_Building_Digital_Collections_Using_Open_Source_Digital_Repository_Software_A_Comparative_Study/links/54ad75750cf24aca1c6f58c8.pdf Accessed on May 10, 2014
- Shih-Chi et al (2011). The DEMATEL approach applied to solar cell industry material selection process in Taiwan. *The 14th Conference on Interdisciplinary and multifunctional business management*. 253-267. <http://www.scu.edu.tw/ba/2011conference/pdf/195514-03.pdf> Accessed on August 10, 2015
- Yang et al (2013). Evaluating Influential Factors in Event Quality Using DEMATEL Method. *International Journal of Trade, Economics and Finance*. 4 (3), 92-97
- Zha, X., Zhang, J., Yan, Y., & Wang, W. (2015). Comparing flow experience in using digital libraries: Web and mobile context. *Library Hi Tech*, 33 (1), 41-53. <http://www.emeraldinsight.com/doi/pdfplus/10.1108/LHT-12-2014-0111> Accessed on September 10, 2015