



Identification of factors for measuring impact of digital repository by factor analysis

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ABSTRACT

KRISHIKOSH (<https://krishikosh.egranth.ac.in/>), a digital repository of M Sc and Ph D thesis/dissertations carried out at different agricultural universities in India, facilitates new ways of sharing institutional knowledge that is leading to new perceptions about research institutions and innovations. The present study was conducted to identify factors that define the impact of digital repository based on the perspectives of the user community. Twenty-two variables measuring e-governance performance selected from literature review are used in designing the questionnaire for conducting opinion survey of researchers using KRISHIKOSH from five agricultural universities in 2019. Factor Analysis performed on the respondents' perception data has resulted in extraction of five factors explaining about 71% of variation in the data. These factors are characterized as efficiency, interactivity, transparency, reliability and feedback, explaining 44.7%, 9.8%, 6.6%, 4.9% and 4.8% of variation in data, respectively. Based on the variables' loading coefficient in each extracted factor, the identified variables can be prioritized and focused for maximizing the impact of digital repository and similar e-governance projects in agriculture sector.

Key words: Digital repository, Efficiency, Interactivity, Reliability, Transparency

KRISHIKOSH (<https://krishikosh.egranth.ac.in/>) is a digital repository of M Sc and Ph D thesis/dissertations carried out in different disciplines of agricultural sciences, technical reports, old books, journals and reprints of research papers under Open Access available with agricultural research and academic institutions. This is one of the components of E-Granth project and had more than 1.12 lakh thesis/dissertations by March 2019. The purpose is to transform knowledge sharing among agricultural user community and to improve re-usability and visibility of research through quality digitization and increased comprehensiveness of published research. Implementation involves institutional collaboration and coordination with librarians, faculties/scientists, researchers/students for digitization of thesis, Meta Data preparation to enable search, categorization of access as per the Intellectual Property Rights policy, and updating the database (Sharma *et al.* 2018).

Impact assessment of Digital Repository like any other e-governance projects helps in measuring the success (or value) accrued to the various user communities and provide crucial learning for taking appropriate interventions to make

them successful towards achieving their planned goals. Several research variables for measuring performance of e-governance projects are reported in the literature which have been identified depending on the nature and operating conditions of the projects studied. However, studies to capture realization of e-governance performance based on the perspectives of key stakeholders belonging to different projects are very few. In order to develop a construct for measuring impact of digital repository, the present study has been taken with the objective of identifying the factors/a set of variables which measure the impact.

MATERIALS AND METHODS

Conceptual research variables for impact measurement:

On the basis of understanding developed through review of literature, project documents and discussions with scientists/ academicians, librarians involved in the implementation of KRISHIKOSH, 22 research variables were conceptualized (Table 1) for measuring impact on the following 4 macro aspects, viz. Efficiency, Transparency, Reliability and Interactivity.

Efficiency: This refers to extent of simplification of access processes, increased efficiency of access/use literature resources from different institutional repositories at one place and resource utilization, easy and fast search, reduced cost on paper material and communication.

Transparency: This refers to the accountability owned by the Institutions related to any deviation from the

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Table 1 Variables included in the study for measuring impact of Digital Repository

Abbreviation of variable	Macro Aspects/Variables (Micro aspects) and References (Adapted from Suri and Sushil (2017) and only references for additional variables are listed here)
<i>Efficiency to access of information and services</i>	
E11	Streamlining and simplification of procedures
E21	Increased efficiency of access/use; Tripathi and Jeevan (2011)
E31	Reduced efforts to access (Easy access)
E41	Reduced time to access (Fast access)
E51	Reduced cost of access through minimizing dependency on printed paper/scanning/photocopy
E61	Reduced cost to access information through minimizing transportation/ communication
<i>Transparency</i>	
T11	Owens accountability in providing/ making available information; Bertot <i>et al.</i> (2012)
T21	Able to provide comprehensive access
T31	Ensuring fairness in providing up-to-date information
T41	Respondent provides feedback; Bhatnagar and Singh (2010)
T51	Implementing institutions act on the feedback received; Bhatnagar and Singh (2010)
<i>Reliability</i>	
R11	Secured access of information/ services; Kalsi <i>et al.</i> (2013)
R21	Quality of information access (digitization and search); Agrawal <i>et al.</i> (2007)
R31	Improved visibility of research/ thesis; Baro <i>et al.</i> (2014)
R41	Meets information requirements for research work: Agrawal <i>et al.</i> (2007), Tripathi and Jeevan (2011)
R51	Improved planning and decision making
R61	Improved monitoring and control decision
<i>Interactivity</i>	
I11	Interactive search; Thomosa <i>et al.</i> (2013)
I21	Re-usability of information; Tripathi and Jeevan (2011)
I31	Capacity enhancement through tutorial/user guides and awareness/ training workshops; Kalsi <i>et al.</i> (2013)
I41	Improved interaction with implementers
I51	Responsive towards advanced features, quality of access through various device layouts and support services; Agrawal <i>et al.</i> (2007), Tripathi and Jeevan (2011)

access policy or discrepancy in the digitization of content and search (metadata), ability to provide comprehensive information, receiving feedback from the users and taking action on feedback towards improved users' satisfaction and realization of impact.

Reliability: This refers to information access services reliable through secured access, quality of digitization and improved visibility/accessibility of research, meeting the user's information needs, helpful in planning and monitoring of research through access of related literature.

Interactivity: This refers to the interactive search, increasing re-usability of information, and users' capability to access, interaction/collaboration among internal and external stakeholders, and responsiveness towards providing advanced features of access including device layouts (Portal, Mobile App) and support services.

Survey of beneficiaries: A questionnaire based survey of beneficiaries using KRISHIKOSH from five agricultural universities (ICAR-IARI New Delhi, ICAR-IVRI Izzatnagar, CCS HAU and LUVAS Hisar, BAU Ranchi) has been

carried out in 2019 to collect their perceptions on the impact through the Snowball sampling method, also known as referral sampling.

Design and testing of questionnaire: Twenty-two variables selected through literature review were used in designing of the questionnaire for beneficiaries on five-point scale varying from Nil, to a small, to a medium, to a large and to a very large extent. The questionnaire was tested by circulating to a smaller group of 12 beneficiaries (research students) before the actual survey. Based on their feedback, the questionnaire was refined in iterative manner.

Reliability analysis of data: A total of 105 responses collected after discarding the incomplete questionnaires have been analyzed. The Likert scale of 1–5 is normalized in to five adjoining intervals as 0–0.2 representing Nil; 0.2–0.4, Small; 0.4–0.6, Medium; 0.6–0.8, Large; and 0.8–1.0, Very Large; respectively. To check relatively internal consistency, reliability test was performed using Cronbach's Alpha statistics.

Factor analysis: Exploratory Factor Analysis (EFA)

using Statistical Package for Social Sciences (IBM-SPSS) has been carried out to identify the factors (latent constructs) at the first stage. Then Confirmatory Factor Analysis (CFA) using Analysis of Moment Structures (IBM-AMOS-25) has been carried out to confirm the structure of factors identified as a set of observed variables.

RESULTS AND DISCUSSION

The respondents from BAU (20) and CCS HAU (21) were from different disciplines of agriculture and animal husbandry whereas, the respondents from IVRI (26) and LUVAS (10) were from different disciplines of animal sciences and the respondents from ICAR-IARI (28) were from different disciplines of agriculture. Out of 105 respondents in the sample, there were 19 scientists (includes 13 Ph D) and 86 students (includes 60 Ph D). In all there were 27 female respondents (scientists-3, students-24) and 78 male respondents (scientists-16, students-62). With respect to extent of frequency of using KRISHIKOSH, number of respondents under small, medium and large categories were found to be 44 (scientist-6, students-38), 39 (scientists-8, students-31) and 22 (scientist-5, students-17) respectively.

Reliability testing: The Alpha value for macro variables measuring impact of e-governance, i.e. efficiency, transparency, reliability and interactivity were found as 0.893 (6 variables), 0.730 (5 variables), 0.853 (6 variables) and 0.834 (5 variables) respectively. These values were observed to be greater than 0.7, which is recommended threshold values for such studies (Hair *et al.* 2006) and are therefore acceptable.

Kaiser-Meyer-Olkin measure of sampling adequacy test (KMO test) has been performed to check whether the sample was adequate or not and to validate the use of Factor Analysis. The value of KMO observed as 0.867 lies in between 0.5–1.0 indicates the appropriateness of Factor Analysis. Bartlett's test of sphericity was used to test the hypothesis that the variables were uncorrelated in

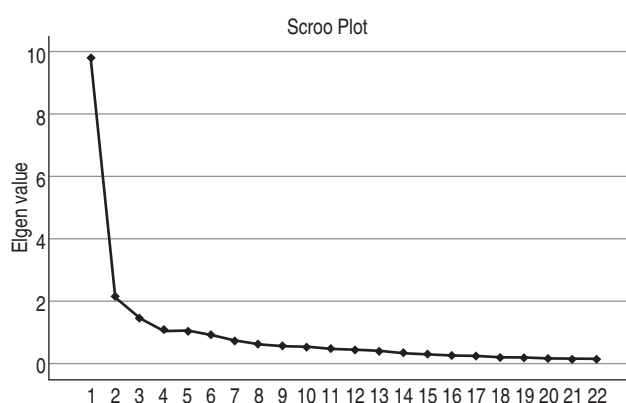


Fig 1 Variables biplot

the population. The value observed of significance level (Approximate Chi Square- 1557.490, DF- 231, Sig.-0.000) was less than 0.05 and indicate that there are probably significant relationships among the variables (Prasad *et al.* 2010).

Identification of factors and variables: EFA using Principal Component Analysis (PCA) as extraction method was performed on beneficiaries' perception data to reduce the variables (22). The observed value of communalities found to be high (>0.5) for all the variables showed that the factors extracted explain most of the variance in the variables being analyzed. The observed value of variance reveals that five factors were extracted and explained 71% of variation in the data. The scree plot (Fig 1) reveals that all the factors have significant loading (initial eigen values greater than or equal to 0.2) except last three factors, having loading between 0.106–0.138.

All the five extracted factors have been considered for further CFA. Rotation of the component matrix with Varimax with Kaiser Normalization is presented in Table 2.

Based on the loading coefficients more than 0.5 in Table 2, the first factor is characterized as efficiency factor

Table 2 Rotated Component Matrixes

	Component					Component				
	1	2	3	4	5	1	2	3	4	5
E11	0.541	-0.010	0.480	0.359	-0.008	R11	0.651	0.368	0.211	0.008
E21	0.746	0.074	0.183	0.252	0.165	R21	0.719	0.414	0.190	0.150
E31	0.687	0.198	0.433	0.064	0.050	R31	0.554	0.466	0.257	0.244
E41	0.758	0.225	0.252	0.014	-0.034	R41	0.371	0.053	0.107	0.701
E51	0.708	0.172	0.085	0.282	-0.048	R51	0.071	0.331	0.227	0.764
E61	0.730	0.168	0.322	0.221	-0.104	R61	0.388	0.314	0.130	0.516
T11	0.382	0.282	0.583	0.249	0.094	I11	0.069	0.697	0.344	0.384
T21	0.349	0.081	0.781	0.166	0.119	I21	0.441	0.658	0.278	0.130
T31	0.279	0.190	0.753	0.057	0.210	I31	0.384	0.602	-0.181	0.340
T41	-0.105	-0.113	0.090	0.181	0.888	I41	0.262	0.614	-0.048	0.294
T51	0.034	0.178	0.156	0.027	0.777	I51	0.303	0.626	0.315	-0.068

Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization; Rotation converged in 12 iterations.

with its 6 variables and 3 variables measuring reliability aspects accounts for maximum variation in data (44.7%). Similarly, the interactive factor with its 5 variables, transparency factor with its 3 variables, reliability factor with its 3 decision support variables and feedback factor with its 2 variables were identified which explain 9.8%, 6.6%, 4.9% and 4.8% of variation in data respectively. These identified factors/variables bring out a construct to measure the impact of digital repository and other e-governance projects in agriculture sector. These identified variables can be prioritized and focused for maximizing the impact of e-governance project. Fast access (E41) was observed as most contributing variable and followed by resource use efficiency (E21), communication cost (E61), quality of digitization (R21), and reduced paper cost (E51), easy access (E31), secured access (R11) and simplification procedures (E11) to efficiency factor. Similarly, the interactive search (I11) contributes maximum, followed by reusability (I21), responsiveness (I51), interaction among users (I41) and competency improvement (I31) to interactive factor. Comprehensiveness of information (T21) contributes maximum and followed by fairness in updating (T31) and accountability (T11) to transparency factor. Decision support variables, viz. planning and decision making (R51) variable contributes maximum followed by Meeting information needs (R41) and monitoring (R31) to reliability factor. The possible reason of forming feedback factor as separate factor may be due to the fact that the large number of the respondents (55%) in sample have offered Nil suggestions but they have similar perceptions (Impact) on all the remaining variables to the respondents who have offered their feedback. Thus fast search, quality of digitization, interactive search, comprehensiveness of repository, are found to be most important variables. It is also important to observe that the purpose of KRISHIKOSH to improve re-usability and visibility of research information, interaction among stakeholders to make the service efficient and enhancing the capacity of users are found to be realized. Information on thesis provided by KRISHIKOSH, one of the sources of literature review, helps the researcher in planning, updating the literature review, avoiding duplication of research and protection from antiplagiarism.

The results of five factors explaining maximum variance in the data have been identified for the use in further analysis. The Path Diagram/Model confirming the structure of identified factors was drawn by performing CFA. Structural Equation Modelling (SEM) using AMOS

(25.0) was carried out to perform the first order CFA on the selected factors and the Factor Plot (Path diagram of SEM for CFA) is presented in Fig 2. The results of model fits obtained are as follows:

CMIN (Chi Square), 422.694; DF, 231; CMIN/DF, 1.830(<2);
P, 0.000<0.05

RMR, 0.018<0.05; RMSEA, 0.089 (>0.08, Good Fit upper threshold value); GFI, 0.631 (<0.9, Good Fit upper threshold value); AGFI, 0.595 (<0.9, Good Fit lower threshold value); PGFI, 0.576

The model indicates an acceptable fit of the data with respect to Model Chi Square (CMIN) and RMR, whereas the model indicated fair fit with respect to RMSEA, GFI and AGFI. Given the often detrimental effect of sample size on these two fit indices (GFI and AGFI) that they are not relied upon as a standalone index, however given their historical importance they are often reported in covariance structure analyses. While no threshold levels have been recommended for the PGFI, Hooper *et al.* (2008) strongly recommend the use of parsimony fit indices in tandem with other measures of goodness-of-fit.

The paper provides an insight into the evaluation of variables and brings out a construct measuring impact of KRISHIKOSH, Digital repository. Five factors (latent

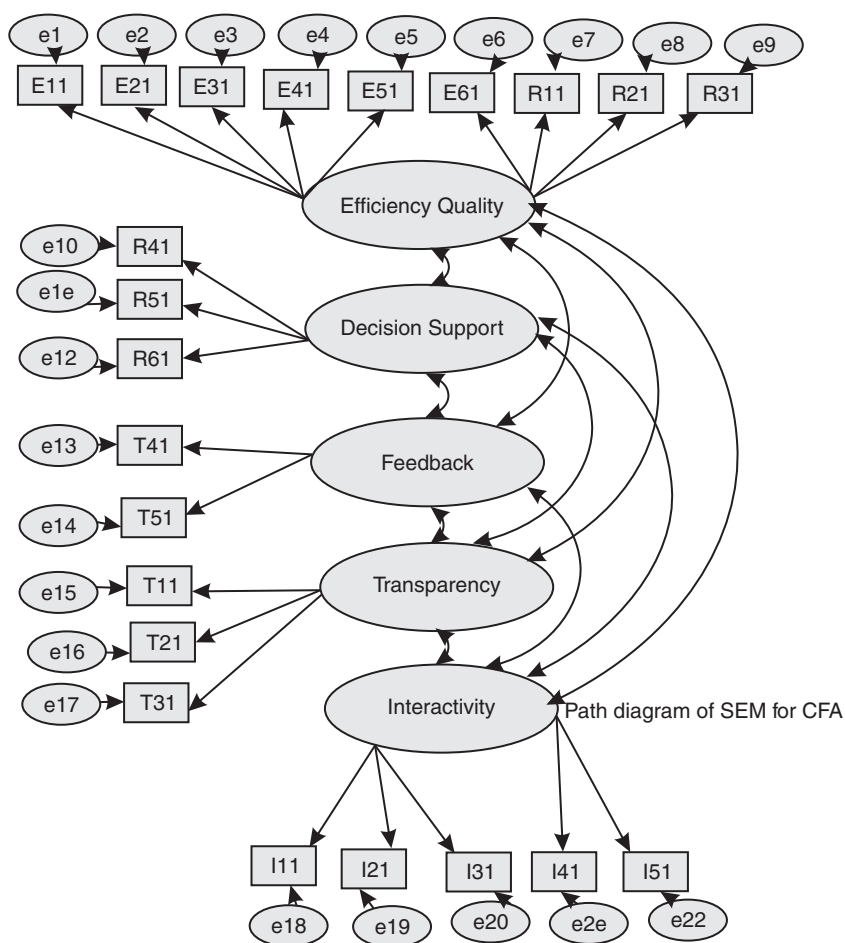


Fig 2 Factor plot from PCA.

constructs) are extracted which explain 71% of variation in data. Focus may be given to all the 22 selected variables, having significant communalities, falling under these five factors for impact assessment. To be more specific it is recommended to focus variables based on their degree of variance explained in each factor such as fast access (E11) and quality of digitization (R21) from first factor, interactive search (I11) and Responsiveness (I51) from second factor, comprehensiveness of information (T21) and fairness in updating (T31) from third factor, planning and decision making (R51) and meeting information needs (R41) from fourth factor, and receiving feedback (T41) and action on feedback (T51) from fifth factor. The composition of these factor's structure reveals that all the conceptual four macro variables (aspects) are identified for measuring impact of digital repository in agriculture sector and may be considered in assessing impact of similar e-governance projects. These factors characterized as efficiency, interactivity, transparency, reliability and feedback are found to explain 44.7%, 9.8%, 6.6%, 4.9% and 4.8% variation, respectively. CFA analysis reveals that the model showing Path Diagram of SEM for CFA is fitted successfully.

The reason for feedback variables forming fifth factor may be due to the fact that small number (45%) of sample respondents have offered their feedback/suggestions and increased percentage of such respondents in sample may result in becoming part of the four factors. Thus the appropriate intervention/pro-active measures may be taken to empower the stakeholders and promote interaction among them towards further improvement in effective metadata preparation, updating content and action on feedback towards enriching the portal and services.

REFERENCES

- Agrawal A, Shah P and Wadhwa V. 2007. EGOSQ-users' assessment of e-governance online-services: A quality measurement instrumentation. (In) *Proceeding of International Conference on E-governance*, Hyderabad, India, December 28–30: 231–44.
- Baro E E and Otiode P G. 2014. Electronic theses and dissertations and institutional repositories: roadmap to research visibility in Africa. *Preservation, Digital Technology and Culture* **43**(3): 114–26.
- Bertot J C, Jaeger P T and Grimes J M. 2012. Promoting transparency and accountability through ICTs, social media, and collaborative e-government. *Transforming Government: People, Process and Policy* **6**(1): 78–91.
- Bhatnagar S C and Singh N. 2010. Assessing the impact of e-government: A study of projects in India. *Information Technology and International Development* **6**(2): 109–27.
- Hair J F, Anderson R E, Tatham R L and Black W C. 2006. *Multivariate Data Analysis*, 5th edn, Dorling Kindersley, Patparganj, Delhi, India.
- Hooper D, Coughlan J and Mullen M R. 2008. Structural equation modelling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods* **6**(1): 53–60.
- Kalsi N S and Kiran R. 2013. E-governance success factors: An analysis of e-governance initiatives of ten major states of India. *International Journal of Public Sector Management* **26**(40): 320–36.
- Prasad S V S R and Reghunath K P. 2010. Empirical analysis of construction safety climate – A study. *International Journal of Engineering Science and Technology* **2**(6): 1699–1707.
- Sharma R, Kumar A, Pandey P S, Himanshu, Gupta M, Kapur S, Sharma A and Jain A K. 2017. KRISHIKOSH: A digital repository to disseminate agricultural knowledge. *Indian Journal of Agricultural Sciences* **88**(5): 757–65.
- Suri P K and Sushil. 2017. Strategic planning and implementation of e-governance. Springer Science and Business Media.
- Thomasa B, Basila M, Christinaa M, Fedraa K and Manuelaa T. 2013. Measuring users satisfaction of an e-Government Portal, Science Direct, *Procedia Technology* **8**: 371–77.
- Tripathi M and Jeevan V K J. 2011. An evaluation of digital libraries and institutional repositories in India. *Journal of Academic Librarianship* **37**(6): 543–45.