Assessment of Open Government Data Initiative - A Perception Driven Approach

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Abstract. Evolution of Information and Communications Technologies (ICT) and digital governance became the key enablers for open data initiative of the government to become more open, responsive, inclusive, transparent, accountable and efficient. Through the e-governance initiatives governments worldwide are focusing on the concept of open data and its huge potential to bring positive changes to the socio-economic value by developing and disseminating information within a vibrant mixed economy comprising of open source, government bodies, business houses, and hybrid solutions of various forms fueled with the sharp elevation of digitization. This study demonstrates assessment of open government data initiatives by the geometric mean method (GMM) of analytical hierarchy process (AHP). Few key factors i.e. people, technology scope, policy, economic and institution were identified which have a very strong impact for any e-governance initiative.

Keywords: E-governance · Open data · Analytic Hierarchy Process · Impact assessment · Feature prioritization

1 Introduction

The digital space is increasing rapidly throughout the world. Public and organizations are using more and more digital mechanism to interact with each other, and to transact day to day business. Nowadays, the focus of the governments across the world are mainly to develop competences to deliver public services using ICT to various stakeholders [19]. E-governance works as a catalyst to improve the public service quality, effectivity, and efficiency, to improve the decision-making process and to promote citizen centric governance. To promote access of publicly held information, promoting transparency and enabling wider socio-economic gain, need has been realized in India that there must be a mechanism for proactive share and free access of the data originated from public funds and which are available with various government bodies. As a result, in 2012, the open government data initiative in India moved towards a new dimension with the notification of the National Data Sharing and Accessibility Policy (NDSAP), & in pursuance of the policy, the Open Government Data (OGD) platform - India (https://data.gov.in) was developed and launched to facilitate share and free access of data through an efficient and dynamic process.

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Many assessment frameworks have been developed, primarily with an objective to address e-governance initiatives. According to various studies, user perspectives, scope of information technology, government policies and regulations, economic benefit and government are very important parameters to understand any e-governance initiative [22]. In this study, the analytical hierarchy process (AHP) has been applied to assess open government data initiatives by group decision making approach for the prioritization among assessment factors and constructs. This study illustrates the application of the geometric mean method (GMM) and its theories to prioritize the assessment criterions of Indian open government data initiative.

2 Review of Literature

2.1 E-governance Project Assessment

E-governance can have a major impact in socio-economic development by transforming the public administration mechanism. E-Governance is the process to enable government using ICT to make governance effective for citizens in terms of effectiveness and efficiency in public service, decision-making process, transparency, citizen centric governance, socio-economic development and cost-effectiveness [42].

According to reviews of literature on assessment of e-governance projects [22] various constructs may be clubbed in to factor groups like people, technology scope, policy, economic and institution. Within these factors, constructs were identified based on prominence and dominance in existing literature. Clubbing of these constructs were also done within these factors based on having the similar dimensions and characteristics. The Table 1 provide information of each constructs in the factor group.

2.2 Open Government Data Initiative

The concept of open government data has been popularized significantly, with the demand being placed on all kinds of government bodies to release the data for open access [47]. Open access to government data, can help government to become more open, responsive, inclusive, transparent, accountable and efficient, can provide greater returns from the public-sector investment [33], can create new economy through the downstream use of outputs, can help policy makers in data driven decision making [7], and can motivate the citizens in proactive innovation using government data [25] or participate in policy-making [8]. Participatory governance would evolve into a heightened accountability that in result curbs corruption [35]. Open government data has the potential to increase productivity, to improve products and services by value addition to the original open government data and most importantly to make way for the data-driven innovation with new age products and services [34]. Moreover, it galvanizes creation of new firms and companies. In 2012, Indian government had formulated National Data Sharing and Accessibility Policy (NDSAP) [37] and under the mandate of NDSAP, the Open Government Data (OGD) platform - India (https://data.gov.in/) was developed and launched. Though there is a drastic increase in open datasets across the world, it is still a big hurdle to reach to the full potency of this

Table 1. Details of construct groups for e-governance Assessment

Factor group	Construct subgroup	Construct item	Cross-reference of Construct to publications
People	Individual perceptions	Adoption	31
		Ease of use	5
		Perceived usefulness	31
		User satisfaction	2
	Social perceptions	Social benefits and influence	18
	Awareness	User awareness	43
Technology scope	Technological	Accessibility	38
		Infrastructure	44
		Reliability	32
		Technological risks	12
	System maturity	Website maturity	3
Policy	Information governance	Laws and policies	44
		Privacy	16
		Security	43
		Transparency	5
		User trust	39
	Outcome based	Effectiveness	23
		Empowerment	4
Economic	Individual	Affordability	32
		Cost of service	9
		Cost saving	40
	Government	Cost	46
		Funding sustainability	49
Institution	Management	Management support	44
	Operational	Availability	20
		Operational efficiency	43
		Performance	16
	Quality	Information quality	5
		Service quality	2

initiative and actively engage all stakeholders with the initiative [47, 48]. Several factors, including stakeholder engagement, technical scope, regulations and policies, economical and institutional [13], contribute to this obstacle [51].

The factor groups i.e. people, technology scope, policy, economic and institution, which have been emerged for e-governance project assessment have been detailed below in the context of open government data initiative India.

People. India's Open Government Data (OGD) platform has a rich framework for citizen engagement, which could help government bodies to prioritize the release of open government data. The platform also acts as a knowledge-sharing platform through online communities. Citizens with specific interests are encouraged to contribute blogs and join online sector specific forums of their domain of interest, it enables communities to express their requirement for datasets or applications, to rate the dataset quality, provide suggestions and feedbacks, and seek clarification or information. Indian open government data initiative also engaged with various stakeholders through various citizen and community collaboration initiatives by organizing various workshops, hackathons, application challenges, etc.

As per open government data initiative constructs under 'people' group are engagement and adaptation of open government data by civil society, participatory governance for social benefit through collaboration with all stakeholders i.e. government bodies, academia, private organizations and people, awareness of open government data among citizens, user friendly and ease of use of platform, perceived usefulness of open government data among users & user satisfaction on open government data.

Technology Scope. The OGD platform was developed using open source stack, with focus on proactive dissemination of open government resources i.e. data, applications, tools, etc. in open format. The platform has a configurable multilevel workflow module to be used by government bodies to contribute, review, approve and publish open data, it has configurable and scalable modules i.e. data management, content management, visitor relationship management, community, blog, visualization, dataset conversion tool, APIs etc. [34]. The OGD platform is also offering the platform under software as a service (SaaS) model, which has helped states and urban local bodies to create their own open government data portal. As per open government data initiative constructs under 'technology scope' group are accessibility of open government data, infrastructure of Open Government Data (OGD) platform and to build new products/services based on open government data, reliability of open government data, website maturity/stability of Open Government Data (OGD) platform & technological risk for uninterrupted access of open government data.

Policy. Under open government data initiative, the National Data Sharing and Accessibility Policy (NDSAP) was designed to apply to all sharable and non-sensitive data available and generated using public funds by government bodies. Open data & NDSAP implementation guidelines [24] provide guidelines on data, metadata, and implementation methodologies, role of chief data officer (CDO), NDSAP cell, data contributor, publishing & management of resources, etc. [36]. Government Open Data License - India [21] was gazette notified on 10th February 2017, to provide a legal framework to the data users wishing to use and build on top of public data. License also gives assurance of what they legally can and can't do with the data both commercially and non-commercially. In NDSAP and Government Open Data License, special care has been taken to protect privacy, security and sensitive information. As per open government data initiative constructs under 'policy' group are existence of open government data sharing policy and open government data license, policy to empower citizens to take informed and data driven decision, effectiveness of open government data, policy

to make data authentic and reliable to build trust of the users, security policies for website and data, accountable and transparent governance by sharing open government data & protection of privacy and sensitive information in open government data.

Economic. Open data can be described as a data which anyone is free to use, reuse, and redistribute. So, freeness is an integral part of open data, users can easily avail free of cost open government data from OGD platform. Ready availability of open government data in a single centralized platform is not only saving the monetary cost but also the time cost. Following the mandate of the National Data Sharing and Accessibility Policy (NDSAP), in the Government Open Data License - India, all users have been provided a worldwide, royalty-free, non-exclusive license to use, adapt, publish (either in original, or in adapted and/or derivative forms), translate, display, add value, and create derivative works (including products and services), for all lawful commercial and non-commercial purposes. As per open government data initiative constructs under 'economic' group are cost of accessing open government data, affordability of using open government data services, cost saving due to open government data, cost to government for sharing open government data and sustainable funding for open government data initiative.

Institution. To implement NDSAP policy under open government data initiative rich sharing framework has been developed to manage contribution, approval and publishing process of open government data. As per the mandate of NDSAP, a senior officer is to be nominated as the nodal officer or chief data officer from the departments/organizations/states. The responsibility of chief data officer is to spearhead the initiative of the respective department/organization/state. For operation efficiency and for proactive share of the data, there is provision for chief data officer to nominate several data contributors who would contribute datasets along with the metadata on the OGD platform. Special care has been taken in NDSAP guidelines to maintain quality of data and metadata. As per open government data initiative constructs under 'institution' group are management support for open government data initiative, availability of datasets, operational efficiency to share the datasets, performance of open government data sharing mechanism, quality of services provided by Open Government Data (OGD) platform & quality of open government data/metadata.

3 Computational Approach Using Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) is one of the robust multi criteria decision making method, in short, it is a process to derive ratio scales from paired judgments based on psychology and mathematics. The analytical hierarchy process (AHP) has been applied in this study to assess open government data initiatives by providing group decision support [6, 26–30]. This study explores the suitability and applicability of the geometric mean method (GMM) and its theories to prioritize the assessment criterions of Indian open government data initiative.

3.1 Measurement of Individual Decisions

Let B = (b_1, b_2, …., b_5) be the consensus vector where b_i represents the "i_{th}" criterion's priority, estimated as $\sum b_i = 1$. Let V = (v_1, v_2, …., v_n) be the set of n expert decision makers with a relative importance of ϕ_i and $\phi = (\phi_1, \phi_2, \ldots, \phi_n)$ is the weight vector of the decision makers and $\sum \phi_i = 1$ [26].

Shanon function maximization approach for the middle element can be used to optimize the unpredictability of an individual preference as $S(\mu) = \mu \ln \mu - (1 - \mu) \ln (1 - \mu)$ [50]. The pairwise comparison approach [10] has been used for fuzzy set operations and for the operator $\diamondsuit$ used as an illustration, it has been shown for the fuzzy sets

$$\begin{aligned} \tilde{b}_i \text{ and } \tilde{b}_j : \tilde{b}_i \diamondsuit \tilde{b}_j &= \left(\tilde{b}_{i,1}, \tilde{b}_{i,2}, \tilde{b}_{i,3}\right) \diamondsuit \left(\tilde{b}_{j,1}, \tilde{b}_{j,2}, \tilde{b}_{j,3}\right) \\ &= \left(\left(\tilde{b}_{i,1} \diamondsuit \tilde{b}_{j,1}\right), \left(\tilde{b}_{i,2} \diamondsuit \tilde{b}_{j,2}\right), \left(\tilde{b}_{i,3} \diamondsuit \tilde{b}_{j,3}\right)\right) \end{aligned} \tag{1}$$

3.2 Measurement of Individual Condition of Consistency

The pair wise matrix i.e. $K = (\tilde{k}_{ij})_{n \times n}$ is an n × n real matrix, for a decision maker v_i, where n is the number of evaluation criteria considered and $\tilde{k}_{ij} \geq 0$. The entries $\tilde{k}_{ij}$ and $\tilde{k}_{ji}$ satisfy the constraint: $\tilde{k}_{ij} \times \tilde{k}_{ji} = 1$. In the eigenvector method (EVM) it derives values (priorities) (w_1, w_2, …w_n) of comparable elements as the linear solution of the eigenvalue problem [41]:

$$\sum_{i=1}^{n} \tilde{k}_{i,j} w_i = \lambda_{max} w_i, \; e^T w = 1 \text{ where } i = 1, 2, \ldots, n \tag{2}$$

Equation for the individual decision vector:

$$\min \sum_{i=1}^{n} \sum_{j>i}^{n} \left(\ln \tilde{k}_{i,j} - (\ln \tilde{w}_i - \ln \tilde{w}_j)^2\right) \text{ such that } \tilde{w}_i \geq 0 \text{ and } \sum \tilde{w}_i = 1 \tag{3}$$

$$\text{The solution is obtained by } \tilde{w}_i = \frac{\sqrt[1/n]{\prod_{j=1}^{n} \tilde{k}_{i,j}}}{\sum_{i=1}^{n} \sqrt[1/n]{\prod_{j=1}^{n} \tilde{k}_{i,j}}} \tag{4}$$

where $\tilde{w}_i$ is the judgement criteria's weight so that $\widetilde{W}_i = \{\tilde{w}_1, \tilde{w}_2, \ldots, \tilde{w}_7\}$ for i_{th} decision maker.

$$\text{GCI}\left(K^{v_i}\right)[14] = \frac{2}{(n-1)(n-2)} \sum_{j>i}^{n} \left(log\left|\tilde{k}_{i,j}\right| - (log|\widetilde{w}_i| - log|\widetilde{w}_j|)^2\right) \tag{5}$$

Aguarón and Moreno-Jiménez [1] has proposed a corresponding threshold for GCI_n i.e. $GCI_3 < 0.0314$, $GCI_4 < 0.0352$, $GCI_n < 0.037$ (for $n > 4$). The analysis of the Saaty's criterion exhibits that this criterion is not an acceptable EM error indicator [45]. The condition for consistency can be $\text{GCI}\left(K^{v_i}\right) \leq \overline{GCI}$ [11].

3.3 Aggregation of Individual Priorities

$$\text{Aggregation of preferences of individual: } \tilde{k}_{ij}^{(c)} = \prod_{m=1}^{t} \left(\tilde{k}_{ij}^{(m)}\right)^{\phi m} \tag{6}$$

A vector can be formulated by GMM where $w_i^{(c)}$ is the vector such that $w_i^{(c)} = \{\tilde{w}_1^{(c)}, \ldots \tilde{w}_7^{(c)}\}^T$ and ϕ_i is the importance of expert decision maker v_i. The equation of conversion of the fuzzy weights to crisp weights has been shown below:

$$|\tilde{w}_i| = \left[(w_{i,1} \times 0.25) + (w_{i,2} \times 0.50) + (w_{i,3} \times 0.25)\right] \tag{7}$$

3.4 Achieving Consensus in Priorities of User Groups

$$\text{GCCI}\left(K^{v_{(c)}}\right) = \frac{2}{(n-1)(n-2)} \sum_{j>i}^{n} \left(log\left|\tilde{k}^{(c)}{}_{i,j}\right| - \left(log|w^{(c)}{}_i| - log|w^{(c)}{}_j|\right)^2\right) \tag{8}$$

Consensus is achieved if $\text{GCCI}\left(K^{v_{(c)}}\right) \leq \overline{GCCI}$ for, $\text{GCCI}_n < 0.037$ (for $n > 4$) [17]. If $\text{GCCI}\left(K^{v_{(c)}}\right) \geq \overline{GCCI}$, to achieve group consensus following computations need to be completed [15]: Assume $\text{GCCI}\left(K^{v_{(\tau)}}\right) = max_c \left\{\text{GCCI}\left(K^{v_{(c)}}\right)\right\}$ where $z = \max_n z + 1$,

$$\text{Let } K_{z+1}^{(m)} = \left(k_{ij,\ z+1}^{(m)}\right)_{n \times n}, \text{ Where } k_{ij,\ z+1}^{(m)} = \begin{cases} \left(k_{ij,z}^{(m)}\right)^b \left[\frac{\left(k_{ij,z}^{(m)}\right)}{\left(k_{ij,z}^{(m)}\right)}\right]^{1-b} & \text{if } m = \tau \\ \left(k_{ij,z}^{(m)}\right) & \text{if } m \neq \tau \end{cases}$$

1. If $\text{GCCI}\left(K_z^{v_{(c)}}\right) \leq \overline{GCCI}$, $X = K_z^{v_{(c)}}$ else return to 1st process.

4 Data Collection and Analysis

After studying various literatures on assessment of e-governance project important constructs were identified and those have been clubbed in to factor groups like people, technology scope, policy, economic and institution.

The data for AHP for assessment of open data initiatives, were collected from fifty-eight senior government officials, and experienced open data activist, these domain experts were very actively engaged in the open data activities at least for last six years. The priorities of these fifty-eight domain experts had equal importance in decision making. These group of experts were asked to prioritize the, factor groups and, they have been asked to choose the constructs' importance in a 5-point Likert scale, through on line questionnaire. Finally, the priorities were measured using GMM

methodology. GCI of individual responses were also measured to check the consistency. Consensus has been achieved as GCI (K^{v_i}) $\leq$ 0.037. Priority vector has been obtained after aggregating the individual judgements using GMM methodology i.e. (0.4425, 0.2226, 0.1540, 0.1244, 0.0565). In the next level, aggregated judgements were also checked for the consistency and group Consensus has been achieved as GCCI ($K^{v_{(c)}}$) $\leq$ 0.037. All the constructs were also analyzed and weightages within the group and aggregated weightages have been estimated.

5 Results

Based on the individual judgements, weightage of all the factor groups and constructs weightages have been estimated. The result has been provided below in Table 2.

Table 2. Result of group decision on assessment of open government data initiative

Factor groups	Factor groups weight	Constructs	Constructs weight
People	0.4425	Perceived usefulness of open government data among users	0.0749
		Awareness of open government data among citizens	0.0747
		Engagement and adaptation of open government data by civil society	0.0736
		User friendly and ease of use of platform	0.0736
		User satisfaction on open government data	0.0736
		Participatory governance for social benefit through collaboration with all stakeholders i.e. government bodies, academia, private organizations and people	0.0720
Economy	0.2226	Cost saving due to open government data	0.0454
		Cost of accessing open government data	0.0451
		Affordability of using open government data services	0.0449
		Sustainable funding for open government data initiative	0.0437
		Cost to government for sharing open government data	0.0435

(*continued*)

Table 2. (*continued*)

Factor groups	Factor groups weight	Constructs	Constructs weight
Technology scope	0.1540	Accessibility of open government data	0.0325
		Infrastructure of Open Government Data (OGD) platform and to build new products/services based on open government data	0.0313
		Website maturity/stability of Open Government Data (OGD) platform	0.0305
		Reliability of open government data	0.0299
		Technological risk for uninterrupted access of open government data	0.0298
Policy	0.1244	Existence of open government data sharing policy and open government data license	0.0198
		Protection of privacy and sensitive information in open government data	0.0197
		Accountable and transparent governance by sharing open government data	0.0186
		Effectiveness of open government data	0.0175
		Policy to make data authentic and reliable to build trust of the users	0.0169
		Security policies for website and data	0.0164
		Policy to empower citizens to take informed and data driven decision	0.0154
Institution	0.0565	Quality of open government data/metadata	0.0106
		Availability of datasets	0.0106
		Management support for open government data initiative	0.0094
		Quality of services provided by Open Government Data (OGD) platform	0.0092
		Operational efficiency to share the datasets	0.0087
		Performance of open government data sharing mechanism	0.0080

In the above table, factor groups weight column provides the result based on individual prioritization using GMM method and constructs weight column shows the outcome of their weightage based on the factor groups weight and their individual weight. The implications have been discussed in detail in the next section.

6 Conclusions

ICT is the key enabler of open data initiative of the government to become more open, responsive, inclusive, transparent, accountable and efficient. Evidence based planning process is essential for socio-economic development and all this depends on availability of up-to-date and quality government data. In the result of the assessment factor people has the highest weightage on open government data initiative. Apparently, citizen centricity becomes the key factor for determining success of such an initiative. Economy and technology has the second and third weightage respectively. Concerns about policy and institution were found to have lower impact in successful implementation of open government data initiative.

As per the study, foremost priority of the open government data initiative should be on adopting a citizen centric model. This model needs a clear comprehension of human elements to understand why citizens (user groups) would proactively use open data and engage with the initiative. Core-essence of this model is to focus on the requirement of citizens from the perspectives of citizens themselves, on building value & awareness of the people on the importance of leveraging the open data, to enable participatory governance by citizen engagement activities. Second priority should be to build economic model by providing competent and cost effective services i.e. open data and data related services, to the citizens. Focus should also be on sustainable funding for the initiative and economic benefit of the government through participatory governance by sharing open data, and extensive data sharing mechanism across various government bodies, which will automatically save time and cost and will also benefit decision makers to take quick action for nation building. Next priority should be on technology scope, technology plays a major role to provide uninterrupted and quality services to the citizen, special focus should be on accessibility and in developing robust infrastructure to provide uninterrupted services. When data is being made open for public, need is there for implementing a policy & regulatory framework, which grants access, use and distribute the open data without much restrictions. So, there should be a strong policy framework while implementing open government data. Last but not the least there is always a need of positive intent from the government bodies to share the data in open domain, hence availability & quality of data/metadata with management support plays a big role in open government data initiative.

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