A Theoretical Framework for Evaluating Government Open Data Platform

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ABSTRACT

Regarding Information and Communication Technologies (ICTs) in the public sector, electronic governance is the first emerged concept which has been recognized as an important issue in government's outreach to citizens since the early 1990s. The most important development of e-governance recently is Open Government Data, which provides citizens with the opportunity to freely access government data, conduct value-added applications, provide creative public services, and participate in different kinds of democratic processes. Open Government Data is expected to enhance the quality and efficiency of government services, strengthen democratic participation, and create interests for the public and enterprises. The success of Open Government Data hinges on its accessibility, quality of data, security policy, and platform functions in general. This article presents a robust assessment framework that not only provides a valuable understanding of the development of Open Government Data but also provides an effective feedback mechanism for mid-course corrections. We further apply the framework to evaluate the Open Government Data platform of the central government, on which open data of nine major government agencies are analyzed. Our research results indicate that Financial Supervisory Commission performs better than other agencies; especially in terms of the accessibility. Financial Supervisory Commission mostly provides 3-star or above dataset formats, and the quality of its metadata is well established. However, most of the data released by government agencies are regulations, reports, operations and other administrative data, which are not immediately applicable. Overall, government agencies should enhance the amount and quality of Open Government Data positively and continuously, also strengthen the functions of discussion and linkage of platforms and the quality of datasets. Aside from consolidating collaborations and interactions to open data communities, government agencies should improve the awareness and ability of personnel to manage and apply open data. With the improvement of the level of acceptance of open data among personnel, the quantity and quality of Open Government Data would enhance as well.

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CCS Concepts

• General and reference~Surveys and overviews.

Keywords

E-government, Open Government Data (OGD), Performance Assessment, Open Data platform, Content Analysis.

INTRODUCTION 1.1 The definition and trends of Open Government Data

During the 2007 Open Government Working Group Meeting held in Sebastopol, eight Open Government Data (OGD) Principles were defined, i.e., complete, primary, timely, accessible, machine processable, non-discriminatory, non-proprietary, and license-free [1]. According to the principles, all public data that are not subject to valid privacy, security or privilege limitations should be available as quickly as necessary.

The concept of OGD would trigger a greater transparency, participation, accountability, and access to public information [2]. and it has become the key point of electronic governance worldwide after the publication of the OGD principles. For instance, the U.K. government issued the document "Power of Information Taskforce Report" [3]. Nowadays more than 31,000 datasets have been published on the U.K. open data website (data.gov.uk). The United States adopted the Open Government Directive in 2009 [4] and issued the Open Government National Action Plan in 2015. Since then, more than 181,000 datasets have been published on the US website (Data.gov). The G8 leaders have involved in approving the Open Data Charter and international platforms since 2013, such as the Open Government Partnership (OGP). On one hand, governments worldwide are increasingly releasing non-personal data open, data that can be used freely, re-used, distributed by anyone, and machine-readable to public users (i.e., JavaScript Object Notation (JSON) file) [5]; on the other hand, governments are also encouraging the public to make the value-added applications of open data in order to develop innovative business models, provide creative public services, and support transparency [6].

Until 2015, World Wide Web Foundation had published an annual report, providing an aggregated ranking of 86 countries performance on OGD readiness, implementation and impact, and pointing out that just over 10% of the 1,290 different datasets surveyed for the Barometer met published in bulk, machinereadable formats, and under an open license criteria [7]. There is still a long way to go to achieve the goal of a greater transparency, participation, accountability, and put the power of data in the hands of citizens. The objective of this research is to provide a robust assessment framework that provides both a valuable understanding of the development of OGD and an effective feedback mechanism for mid-course corrections.

1.2 Open Government Data in Taiwan

After passing an executive resolution in favor of promoting government open data in 2012, the National Development Council (NDC) established the Government Open Data Platform (data.gov.tw), which brings together open datasets, providing a one-stop contact for inquiry services. The framework and promotional strategies for open data policy in Taiwan are based on three principles and four strategies (see Figure 1). The three principles are: (1) open data for public and enterprise use; (2) free in principle, charging as the exception, and (3) automatic and systematic release and exchange of large volume of data. The four strategies are: (1) proactive release of data and people's welfare first, e.g., consumer data as priority; (2) drafting regulations for open data, e.g., Direction for Electronic Data Exchanging and Circulation, The Freedom of Government Information Law, and Open Government Data Principles; (3) promotion of public use platform, i.e., the Open Data Platform (data.gov.tw); and (4) demonstration, advocacy, and promotion of services, e.g., define scope for trial and encourage value addition and application [8]. In 2014, the promotion of open data was expanded. Civil groups (e.g., g0v, Taipei Computer Association, and the Open Data Alliance) worked with domestic governments in a spirit of interactive participation and cooperation to promote open data. Aside from public use, government agencies also use the open data provided by other bureaus for networking and cooperative purposes. Nowadays the OGD platform has more than 16,800 datasets and 362 Application Public Interfaces (APIs). Most datasets on the OGD platform are 3-star, which means datasets are available as machine-readable structured data plus non-proprietary format (e.g. CSV instead of excel).



Figure 1 Strategies of Open Data Promotion in Taiwan

An international survey held by the Open Knowledge Foundation (OKFN) in 2015, ranked Taiwan as No.1 among 122 countries and praised Taiwan for making a significant improvement in the areas of government budget, national statistics, legislation, election results, national map, pollutant emissions, company register and government spending [9]. Especially in national statistics (including gross domestic product and population information), both the Executive Yuan and civil groups play the critical roles in promoting open data.

2. THEORETICAL AND PRAGMATIC APPROACHES TO OGD

Open government data becomes more and more important nowadays, so does the need for effective ways to evaluate its quality. Several international organizations, such as the Open Data Barometer (www.opendatabarometer.org), Open Data Index (https://index.okfn.org), Open Data Census (http://national.census.okfn.org), European PSI Scoreboard (http://www.epsiplatform.eu), and Open Data Compass (http://compass.arachnys.com), all start to evaluate the quality of open government data and its portals with various systematic methodologies to see whether open data increase government administrative efficiency and transparency or not. The Open Data Barometer has started to evaluate open data readiness, implementation, impacts on national scale, especially central governments with expert survey and secondary data since 2013. Adopting the method of ongoing crowdsourcing with expert review, Open Data Index has created an annual index and conducted both county-level and township-level assessments. The Open Data Index ranked 122 countries based on the availability and accessibility of data in fifteen key categories, including national statistics, government budgets, legislation, procurement tenders, election results, national map, weather forecast, pollutant emissions, company register, local datasets, water quality, land ownership, transport timetables, government spending, and health performance. European PSI Scoreboard, using seven indices, i.e., implementation of the PSI directive, the practice of re-use, formats, pricing, exclusive arrangements, local PSI, and events and activities, also adopts a crowdsourced platform to measure the status of Open Data and PSI re-use throughout the EU.

Researchers also provide insights to evaluate the quality of OGD datasets and platforms. For example, Ubaldi [10] summarized the main principles, concepts and criteria framing OGD initiatives and the issues challenging their implementation. Kostovski et al. [6] analyzed Open Data Portal of UK, US, and World Bank, and proposed a prototype Open Data Portal. Open Data Portal should allow users to publish, manage and consume data in machine-readable formats, interlink their data with data published elsewhere on the Web, publish applications build on top of the data, and interact with other users. Moreover, Veljković et al. [11] presented a conceptual model of open government, in which five constructs were included, i.e., open data, data transparency, government transparency, participation, and collaboration.

To sum up, an OGD platform should consist of at least three major elements: general status, metadata, and interaction/collaboration [6, 10, 11]. General status includes data management system, search engine, application programming interface, hashtag function, and an introduction or open procedure for users to get familiar with. Metadata includes data title, format, description, publisher information, and universal resource locator (URL). Interaction/collaboration includes data visualization and stakeholders are allowed to discuss or exchange ideas about datasets

3. METHODOLOGY

Through literature review, this research proposes an assessment framework with three dimensions and sixteen indices to evaluate OGD platforms:

(1) Accessibility conducts six indices, i.e., Open to use, Automatic reading, Category, Search, Format, and License free.

(2) Quality of Data conducts five indices, i.e., Primary, Timely, Accuracy, Integrity, and Abundance.

(3) Platform Function conducts five indices, i.e., Discussion, Score and rank, Demand unpublished datasets, Total number of

downloads by categories, and Total number of downloads of each dataset.

To evaluate performance on each dimension, we first developed our conceptual framework based on the literature review. A codebook for content analysis was developed afterwards. Appendix 1 presents the definitions of all codes applied. Take the "open to use index at accessibility dimension" as an example, "datasets have no limit on users to use" scores 10, "datasets with limitations on use" scores 5, and "datasets not open to use" scores 0 on this index. Second, we held a coder workshop, and conducted the inter-coder reliability assessments.

4. RESULTS

Table 1 shows the numbers of total OGD datasets (over a hundred), count of visits and number of downloads of the datasets of the central government authorities in Taiwan, before 1st September, 2016. Ministry of Justice, with 1,911 datasets, has the highest total number of datasets, followed by Ministry of Finance, with 1,882 datasets. OGD datasets of Ministry of Economic Affairs and Financial Supervisory Commission have the highest count of visits, with 1,506,537 and 1,387,134 count of visits, respectively. Ministry of Transportation and Communications and Ministry of Culture have the highest number of OGD downloads, with 902,005 and 220,781 downloads, respectively. With the highest number of total datasets, the count of visits and downloads of datasets from Ministry of Justice are low because most of these datasets are law documents or Act explanations. On the contrary, datasets of Ministry of Transportation and Communications and Ministry of Culture are more daily related: therefore, their datasets are more popular and easier to re-use.

Table 1 Upload/down	iload OGDs of	f the central	government
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Authorities	number of total datasets	count of visits	number of downloads
Ministry of Justice (MoJ)	1,911	1,175,352	62,769
Ministry of Finance (MoF)	1,882	939,879	93,810
Ministry of Economic Affairs (MoEA)	1,798	1,506,537	183,760
Financial Supervisory Commission (FSC)	1,187	1,387,134	209,653
Ministry of Transportation and Communications (MoTC)	998	1,301,061	902,005
Ministry of Health and Welfare (MoHW)	968	1,166,485	173,441
Environmental Protection Administration (EPA)	925	435,594	126,038
Directorate-General of Budget, Accounting and Statistics (DGBAS)	896	512,741	48,037
Ministry of the Interior (MoI)	741	1,221,116	178,314
Ministry of Education (MoE)	667	556,331	58,714

Council of Agriculture (CoA)	550	496,448	47,920
Ministry of Labor (MoL)	346	574,193	63,537
National Development Council (NDC)	301	440,525	55,941
Central Bank (CB)	262	246,025	19,967
Ministry of Culture (MoC)	251	373,945	220,781
Directorate-General of Personnel Administration (DGPA)	237	292,547	21,632
Ministry of National Defense (MoND)	221	231,155	17,439
National Communications Commission (NCC)	197	186,238	21,879
Veterans Affairs Council (VAC)	152	179,393	12,862
Council of Indigenous Peoples (CoIP)	150	227,714	27,854
Public Construction Commission (PCC)	149	241,973	20,820
Ministry of Foreign Affairs (MoFA)	123	183,043	9,101
Ministry of Science and Technology (MoST)	123	214,144	20,477
Fair Trade Commission (FTC)	122	113,287	9,252
Mainland Affairs Council (MAC)	117	140,597	17,297
Atomic Energy Council (AEC)	112	145,015	50,793
Coast Guard Administration (CGA)	101	122,129	7,237

According to Gerbner [12], the inter-coder reliability should be higher than 0.8 to have good inter-coder reliability. Considering the facts that some central government authorities in Taiwan have not yet opened enough datasets and most datasets of Ministry of Justice are law documents or Act explanations, we chose to evaluate nine ministries with the largest count of visits and downloads. In the end, we analyzed 7,986 datasets from the OGD platform, and the average inter-coder reliability in our research was 0.93.

Table 2 shows the number of datasets analyzed under these authorities. It is worth noting that Ministry of Economic Affairs consists of 28 sub-institutions/bureaus, and Ministry of Culture has no other institution or staff unit. The results reveal that the number of datasets opened is related to the size of the government authority.

Authorities	Bureaus	Total Datasets	Analyzed Datasets
MoEA	28	1,798	1,538
MoTC	16	998	896
MoF	26	1,882	1,714
MoI	9	741	697
MoHW	11	968	944
MoE	9	667	579
MoC		251	218
FSC	6	1,187	1,107
EPA		925	293
Total	121		7,986

Table 2 Numbers of datasets analyzed under each authority

Table 3, 4, and 5 were evaluated according to Appendix 1. Table 3 shows the results of data accessibility of the nine authorities. The accessibility dimension consists six indices, open to use, automatic reading, category, search, format, and license free, and its total score is 95. On the accessibility dimension, Financial Supervisory Commission has the highest score among the nine authorities, followed by Ministry of the Interior and Ministry of Education. However, the total accessibility score of these nine authorities range from 55.2 to 59.6, which means the quality of their data accessibility is equally poor. Speaking of the data format, most datasets from Financial Supervisory Commission are in 3-star format. In many cases, data are released in pdf format, which are not immediately applicable. Most authorities provide license-free and creative commons data, except Ministry of Culture. Ministry of Culture has some particular restrictions, due to the copyright concern.

Authorities	Open to use (10)	Automatic reading (15)	Category (20)	Search (15)	Format (25)	License free (10)	Sum (95)
MoEA	10	5	10	10	10.6	10	55.6
MoTC	10	5	10	10	12.2	10	57.2
MoF	10	5	10	10	11.7	10	56.7
MoI	10	5	10	10	13.9	10	58.8
MoHW	10	5	10	10	13	10	58
MoE	10	5	10	10	14	9.8	58.8
MoC	9.7	5	10	10	14.4	6.1	55.2
FSC	10	5	10	10	14.6	10	59.6
EPA	10	5	10	10	12.8	10	57.7

Table 4 shows the results of the quality of data dimension. Five indices consist of the quality of data dimension, primary, timely, accuracy, integrity, and abundance, and the total score is 55. In this dimension, the score of most authorities was higher than 26, except Ministry of Transportation and Communications and Ministry of the Interior. Ministry of Culture has the highest score

among the nine authorities, followed by Ministry of Education. Due to the lack of timely function, the particular time of data collection or the latest update time and the frequency of updates, the score on this index were low. With the lack of data visualization and preview function to support data analysis, platforms get zero scores on the abundance index.

Table 4 Results of Quality of Data dimension on nine aut	horities
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Authorities	Primary (5)	Timely (15)	Accuracy (5)	Integrity (20)	Abundance (10)	Sum (55)
MoEA	4.7	9.3	3	10	0	26.97
MoTC	3.2	8.6	1.4	10	0	23.2
MoF	4.7	7.7	3.6	10	0	26
MoI	4.2	6.9	1.3	10	0	22.41
MoHW	4.4	8.9	2.3	10	0	25.69
MoE	4.8	9.8	4.2	10	0	28.91
MoC	4.6	9.7	4.7	10	0	28.96
FSC	4.7	9.4	4.5	10	0	28.6
EPA	4.49	8.6	4.6	10	0	27.69

All authorities use the same OGD platform, so they have the same scores on the platform function dimension. However, the OGD platform is lack of discussion function to allow users to give feedback or make remarks on the datasets. This important function should be enhanced in the future.

Table 5 shows the results on the overall performance of the nine authorities. The Financial Supervisory Commission performs

better than other agencies, especially in terms of the accessibility. FSC mostly provides above 3-star dataset formats, and the quality of metadata of the datasets is significantly better than others. It should be noticed that FSC is also the top three authorities that have high total count of visits and downloads. Moreover, authorities with large number of datasets, for example, Ministry of Finance and Ministry of Transportation and Communications, have to review and re-design their management on datasets significantly to improve their overall performance.

Authorities	Accessibility	Quality of Data	Platform Function	Sum	Ranking
MoEA	55.6	27.0	40.0	122.6	7
MoTC	57.2	23.2	40.0	120.4	9
MoF	56.7	26.0	40.0	122.7	6
MoI	58.9	22.4	40.0	121.3	8
MoHW	58.0	25.7	40.0	123.7	5
MoE	58.8	28.9	40.0	127.7	2
MoC	55.3	29.0	40.0	124.2	4
FSC	59.6	28.6	40.0	128.2	1
EPA	57.8	27.7	40.0	125.5	3

Table 5 Results on overall performance of nine authorities

5. DISCUSSIONS

Open Government Data is expected to enhance the quality and efficiency of government services, strengthen democratic participation, and create interest for the public and enterprises. The success of Open Government Data hinges on its accessibility, quality of data, security policy, and platform functions in general. This article provides a robust assessment framework that not only provides a valuable understanding of the development of OGD, but also provides an effective feedback mechanism for mid-course corrections.

The findings reveal some authorities still provided non-structured data, which makes users unable to conduct value-added application services, are regulations, reports, operations and other administrative data, which are not immediately applicable. Since data, information, and knowledge are critical to the functioning of public administration, effective management and use of data help government to deliver citizens and business a better service and further prosper the society. Regardless of civil servants' job title and professional label, they all need the information competencies such as using appropriate data analysis, text analysis, and visualization to manage and apply data, information, and knowledge to accomplish their work. Naturally, many of them specialize, and they do not all possess each competency to the same degree. Notwithstanding these differences, the first step to make OGD successful is to provide a common platform in which each civil servant is able to find his or her unique competencies represented. This step could be completed both with the counsel of scholars and experts and by considering the nature of different tasks in the civil service workplace.

As for the openness of OGD platform, the function of participation or discussion is another important design. The Administrative Yuan added discussion sections to every dataset, which allows the users to make feedback to the content of datasets; also, users could demand datasets through certain mechanisms, and the institution could release related datasets based on the demand from the users. However, most of the institutions are passively connected to the public opinion system. Most of all, some civil servants are even unwilling or incapable of following the OGD principles to provide applicable data. This fact highlights the importance of advancing civil servants' awareness, ethics and data competencies in order to improve their information skills as a whole. Presently, in terms of the acquisition of data skills, most civil servants self-learn and half of them have once participated in unit-organized training programs. Therefore, the manner in which to improve the quality of advancement measures within units is a very important issue, and training programs aiming at these issues should be in place.

As the government is promoting large-scale OGD measures, the advancement in technologies puts confidential government information at risk. Some of this confidential information may be prone to inspection or stealth by people with malign intentions. According to Solarwinds [13], some civil servants still consider it feasible to alter the data saved in the database of their agencies or reveal certain information to outsiders in private. In the future, the government needs to adopt new data approach such as blockchain technology and formulate fundamental laws regulating data/information security so that when property rights ownership is clearly stated, security of the information can thereby be ensured. Overall, government agencies should enhance the amount and quality of OGD positively and continuously, strengthen the functions of discussion and linkage of platforms, and the quality of datasets.

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Appendix 1	An assessment	framework for	OGD	platforms
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Dimension	Indicator	Question	Score	Description
Security	Information	Is there an information security	0	There is no information security policy
	Safety	management mechanism in the OGD	5	According to the level of information system and
	Policy	platform?		the standard of information security of the Administrative Yuan, relatively 50% of the standard of information security is operated
			10	According to the level of information system and
				the standard of information security of the Administrative Yuan, relatively 75% of the standard of information security is operated \circ
		15	According to the level of information system and	
			the standard of information security of the Administrative Yuan, the standard of information security is fully operated	
			20	Already passed the verification of information security management such as ISO/IEC 27001,
				CNS 27001 and so on.
Accessibility Open	Open to use	en to use There is no limit on users to use the data	0	Not open to use (need to apply to the responsible department
			5	Use the data with limitations
			10	The data is open to use without limitations
	Automatic	The data could be read by database	0	Automatic reading language or API format is not provided
	reading	languages or other methods	5	The proportion of datasets with APIs to the total number of datasets: 0%< The proportion of datasets with APIs<50%
			10	50% < The proportion of datasets with APIs<75%
			15	75% < The proportion of datasets with APIs <100%
	Category	According to the 2015 ODB, there	0	None of the datasets match
		are 15 categories of datasets. (map data, public transport timetables,	5	Match 1-5 category(categories) of the datasets
		crime statistics, international trade data, health sector performance,	10	Match 6-10 categories of the datasets
		primary or secondary education performance data, national	15	Match 10-14 categories of the datasets
		environment statistics, detailed census data, land ownership data,	20	Match all 15 categories of the datasets

Dimension	Indicator	Question	Score	Description
		legislation, national election results, detailed government budget, detailed government spend, company register)		
	Search	The users could search datasets easily through the platform	0	With the "search" button, but couldn't find the subject matter
			5	There are matching datasets, but still some irreverent datasets.
			10	key-in the name of the subject matter and we could search the datasets successfully by clicking the "search" button. \circ
			15	Besides what mentioned above, the function of word association enables users to search efficiently
	Format	Does the dataset match Berners- Lee's "linked data principles"?	0	None of the datasets is downloadable
		Lee's mixed duta principles .	5	Datasets that are in PDF, JPEG, or other specific format
			10	Users could use the application to read structured
				data such as EXCEL files
			15	Users could get access to the datasets that are non- proprietary such as CSV or XML files.
			20	Users could use the format standard; for example, URIs are used to express data in order to let users understand the location of data in the data network, also people/ machines could directly access, save, apply every single data in the datasets
			25	Besides 4-star, users could link the data to other people's data as an extension of related content
	License free	Does the dataset release under an	0	There is no regulation about open licenses
	open license?	open license?	5	There are regulations about open licenses to a certain extent.
			10	There are regulations about open licenses
Quality of	Primary	The institution provides raw data for	0	Raw data is unavailable
data		Apps or Internet websites for the users to browse.	5	Raw data is available
	Timely	The description of the datasets includes the particular time of data collection, the latest update time, and the frequency of updates.	0	None of the three is included. (1) the particular time of data collection; (2) the latest update time; (3) the frequency of updates.
			5	One of the three is included. (1) the particular time of data collection; (2) the latest update time; (3) the frequency of updates.
			10	Two of the three are included. (1) the particular time of data collection; (2) the latest update time; (3) the frequency of updates.
			15	All of the three are included. (1) the particular time of data collection; (2) the latest update time; (3) the frequency of updates.
	Accuracy	The description of metadata matches	0	There are mistakes in descriptions
		the content of datasets	5	The description is correct
	Integrity	There are enough data content and	0	Only match 0-5 category (categories)
		metadata (According to the standard regulation on the metadata of	5	match 6-10 categories
		datasets, which was issued by the	10	match 11-15 categories
		National Development Council in	15	match 16-20 categories
		information of contents, information	20	match over 20 categories

Dimension	Indicator	Question	Score	Description
		of datasets and so on)		
	Abundance	Help the data conduct use analysis	0	None of any assistance for use
			5	The data could be presented in a row or column
			10	There is a visualized design for the data
Other function	Discussion	Provide users communities, forums, feedback or remark mechanism	0	None of any mechanism for users to discuss
			5	Provide remark or feedback mechanisms
			10	Provide forums
			15	Provide data communities
	Score and rank	Enable users to score or rank the quality and availability of the data	0	Without score or rank mechanism
			5	With score or rank mechanism
	Demand unpublished datasets	Users could apply the already-set mechanism on the platform to demand the government to provide datasets	0	Without data-demanding application
			5	With the data-demanding application
			10	With the responsive data-demanding application
	Total number of	Total number of downloads of every category (divisions/ values)	0	Neither the total number of downloads nor the total number of visits
	downloads by categories		5	Either the total number of downloads or the total number of visits
			10	Both the total number of downloads and the total number of visits
	Total number of downloads of each dataset	Total number of downloads of every dataset	0	Without the total number of downloads
			5	Either the total number of downloads or the total number of visits
			10	Both the total number of downloads and the total number of visits