

Article

The Managerial Dimension of Open Data Success: Focusing on the Open Data Initiatives in Korean Local Governments

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Abstract: Open government data (open data) initiatives have been at the forefront of the strategy to make more transparent, responsive, and accountable government, and thereby lead to open innovation across the public and private sector. Governments around the world often understand that open data is disclosing their data to the public as much as possible and that open data success is the result of a data and technology-related endeavor rather than the result of organizational, institutional, and environmental attributes. According to the resource-based theory, however, managerial capability to mobilize tangible and intangible resources and deploy them in adequate places or processes under the leadership of capable leaders during the information technology (IT) project is a core factor leading to organizational performance such as open data success. In this vein, this study aims to analyze managerial factors as drivers and challenges of open data success from the resource-based theory. Findings illustrate that managerial factors are the driving forces that often boost or hinder open data success when institutional, socio-economic, and demographic factors are controlled. Discussion illustrates theoretical and practical implications for the managerial factors as drivers and challenges of open data success in terms of the comparison between technological determinism and the socio-technical perspective.

Keywords: open data; open innovation; managerial capability; technological determinism; socio-technical perspective

1. Introduction

Open government data (open data) initiatives have been at the forefront of the strategy to make more transparent, responsive, and accountable government, and thereby lead to open innovation across the public and private sector such as the optimization of administrative processes and development of new products and services [1,2]. In the United States, President Obama launched the concept of open government to create a transparent and collaborative government through citizen involvement, to make his government more efficient, and to prepare it for the challenges of the digital age in the Memorandum for the Heads of Executive Departments and Agencies in March 2009 [3]. Since he launched the concept of open government, it has become popular in other countries such as South Korea, Australia, and New Zealand.

Governments around the world often understand that open data is disclosing their data to the public as much as possible and that open data success is the result of a data and technology-related endeavor rather than the result of organizational, institutional, and environmental attributes [4,5]. Therefore, governments tend to focus on increasing data compatibility and expanding the technological infrastructure required for releasing more data. According to the resource-based theory, however,

managerial capability to mobilize tangible and intangible resources and deploy them in adequate places or processes under the leadership of capable leaders during the information technology (IT) project is a core factor leading to organizational performance such as open data success [6]. Despite the importance of managerial capability in the literature on IT project management and performance, managerial capability is an often-mentioned, but underexplored research theme in the open data literature when it comes to discussing the drivers and challenges of open data success.

In this vein, this study aims to analyze managerial factors as the drivers and challenges of open data success from the resource-based theory. These managerial drivers and challenges include the leadership-related factor (executive leader's willingness to push forward IT projects), the resource-related factor (human resources and financial resources required for IT projects), and the operation-related factor (operational experience of IT projects). Institutional, socio-economic, and demographic factors are also considered for capturing the independent effect of each managerial factor on open data success in a more valid and accurate way. Institutional factors include the institutional status of chief information officers (CIO) and the institutionalization of informatization. Socio-economic factors encompass financial size and financial independence. Finally, demographic factors include an aging population and population density.

The rationale behind selecting Korean local governments as the subject of analysis is as follows. First, Korean local governments have been enacting local informatization initiatives under the Local Informatization Promotion Initiative of 1997 and the Electronic Government Act of 2001, but are facing many barriers including a lack of demand centricity, low information systems utilization rate, and limitations on informatization workforce and budget [7]. Second, Korean local governments have been endeavoring to vitalize open data initiatives as part of the local informatization project, but are facing many barriers in achieving open data success [8]. Therefore, it is necessary to conduct a study producing implications for improving the local informatization project such as open data initiatives in Korean local governments.

The remainder of this article is composed as follows. Section 2 describes the theory and research on open data, focusing on the definitions and benefits of open data and challenges and success factors of open data success (managerial, institutional, and environmental factors). Section 3 illustrates the research model, research hypothesis, data measurement, and method. Section 4 explains the research findings from the statistical analysis including the descriptive analysis, correlation analysis, and multivariate regression analysis. Based on the research findings from the statistical analysis, Section 5 discusses the implications for open data initiatives in Korea and other areas of the world. Section 6 summarizes the research findings and illustrates the implications and limitations of this study.

2. Theory and Research on Open Data Success

2.1. Defining and Explaining Open Data

Researchers and practitioners have understood and defined open data from diverse perspectives. Basically, open data is based on the notion that certain data should be present beyond the limitation of copyright or other constraints placed on data [9]. Data are disclosed to the public so that it is open to transform into new services or products. In the context of the public sector, open data creates opportunities for stakeholders such as private sector organizations and non-profit organizations to discover new insights and generate new products and services from the data. Hence, open data is often understood as the only non-privacy-restricted and non-confidential data which is produced with public money and is made available without any restrictions on its usage and distribution [1,10,11].

The open data initiative has been understood as a substantial part of the e-government project [9]. According to Gil-Garcia, e-government is the selection, implementation, and use of IT in government to provide public services, improve managerial effectiveness, and promote democratic values. E-government success factors encompass data, information, and technology factors, as well as organizational, institutional, and contextual factors [5]. Open data is the selection, implementation,

and use of IT or information systems in government to provide public services and promote democratic values (e.g., transparency) and publishing open data requires technical aspects (e.g., suitable web services, data accessible via Application Programming Interface), as well as organizational aspects (e.g., the presence of accurate metadata, adherence to data standards, updating datasets) and legal aspects (e.g., is there a legal basis for publishing the specific dataset; is the specific dataset suitable to be published as open data; has the dataset passed the 'sensitive data' test?) [1], which bears a relation to e-government and its success factors.

With regard to the scope of open data in this study, the authors focus on how each government shares data and information with citizens in general rather than how data and information are shared across departments of each government. The government IT project that aims to promote data and information sharing among departments of government at a central and local level is often called inter-organizational or inter-agency information sharing and integration [12], which is beyond the scope of this study due to the absence of empirical research data. Therefore, open data defined in this study is similar to open data noted previously, which refer to non-privacy-restricted and non-confidential data which is produced with public money and is made available without any restrictions on its usage and distribution or a government's efforts to disclose public data so that citizens can view and modify them freely.

The benefits of open data can be clustered in (1) political and social ones, (2) economic ones, and (3) operational and technical ones [1]. First, political and social benefits, which are regarded as the most important category, encompass more transparency, democratic accountability, more participation and self-empowerment of citizens, creation of trust in government, public engagement and scrutinization of data, equal access to data, and new governmental services for citizens. Second, economic benefits include economic growth and stimulation of competitiveness, stimulation of innovation, contribution toward the improvement of processes, products, and services, development of new products and services, and use of the wisdom of the crowds. Third, operational and technical benefits encompass the optimization of administrative processes, improvement of public policies, access to external problem-solving capacity, fair decision-making by enabling comparison, and easier access to data and discovery of data.

In particular, open data is emerging as a fundamental condition for realizing 'smart government' solving or alleviating various social problems. According to the e-government and information policy scholars, the widespread use of open data sheds light on the unprecedented opportunities for igniting efforts to provide smart solutions to wicked problems that cannot be solved by straightforward and well-known prescriptions [5,9,13]. They illustrate coordination, communication, constant involvement, access to open data, and shared information as essential components for realizing 'smart government' that can handle the complexity and uncertainty of social conundrums. Therefore, shared, timely, and acquirable information is a fundamental basis of 'smart government'.

2.2. Determinants of Open Data Success

Since the open data initiative has been understood as a substantial part of the e-government project, open data challenges and success factors can be understood in the context of e-government challenges and success factors. According to the e-government literature, open data challenges and success factors can be categorized into managerial, institutional, and environmental factors. Open data challenges and success factors have been explored through an analysis of direct relationships between a dependent variable and diverse independent variables [14–20]. Managerial factors are composed of organizational characteristics, processes, structures, and relations which have an influence on open data success [5,12,21–23]. For instance, open data success depends on organizational structure (e.g., centralization as a barrier of information stream, inter-agency communication channel), leadership, external advisors' involvement, and size of financial resources. In addition, necessary conditions for the sharing of information systems (full support and willingness at the top management executive, capacity to use information and communication technologies with related agencies, vocational education and

training, the degree of user-centric business computerization, business cooperation system among related agencies) affect open data success.

The resource-based theory captures the significance of managerial factors for open data initiatives and the e-government project in a broader sense. According to the resource-based theory, organizational IT capability is a core factor leading to an increase in organizational performance. Bharadwaj categorizes IT-based resources into tangible resources (IT infrastructure, IT human resources) and intangible ones (knowledge asset, customer orientation, synergy), and defines organizational IT capability as the ability to mobilize and deploy IT-based resources or the ability to process both IT-based resources and abilities and other types of resources and abilities [6]. Similarly, Ross et al. categorize information systems (IS) resources into human resources (e.g., problem-solving orientation), technology resources (e.g., hardware and software), and relational resources (e.g., risk management), and define organizational IT capability as the ability of the organization for planning, cost-effective operations, and responsiveness [24].

Institutional factors encompass law, regulation, and norms which guide or constrain individual behavior and thereby affect open data success [5,25]. For example, open data success depends on institutional legitimacy (e.g., high-level political appointees' involvement in IT projects), the way political appointees use their power that affects the formation of trust and respect among project participants, and political environment surrounding public organizations (e.g., conflicting interests among the organizations participating in IT projects). In addition, political and social support, power relations on information possession such as an asymmetric information availability, open investigation and performance evaluation for achieving responsiveness and accountability, and a legal basis for guaranteeing privacy affect open data success.

The institutional theory of information technology captures the significance of institutional factors for open data initiatives and the e-government project in a broader sense. According to the institutional theory of information technology, institutions or institutional arrangements, which are defined as the laws, regulations, and other cognitive, cultural, or socio-structural constraints in the context of the government, as well as constraints with regard to the adoption and use of IT in the public sector, operates as the guidance [26]. According to Fountain, organizations or organizational actors comply with institutional arrangements in order to acquire legitimacy from the environment surrounding them and guarantee long-term survival, which explains how institutional arrangements have an influence on the design, use, and result of IT [25].

Environmental factors include the contextual factors that operate in organizations, which affect open data success [12,27,28]. For instance, open data success relies on political, economic, and social environments (e.g., spatial environment as drivers and constraints of IT projects, demographic characteristics, economic conditions) and a trusted social network which allows the constant involvement of various organizations participating in IT projects. Besides, the culture that recognizes the value of cooperation provides the informal incentive for open data, whereas a lack of culture that recognizes the value of cooperation raises the necessity to provide other types of incentives (e.g., financial motivation) for promoting open data.

Environmental determinism captures the significance of environmental factors for open data initiatives and the e-government project in a broader sense. According to environmental determinism, environmental or contextual factors shape organizational characteristics and thereby have an influence on the ultimate outcome of adoption and use of IT. To an extreme degree, some environmental determinists often argue that environmental factors explain everything and incapacitate managerial and institutional factors [29]. These environmental factors encompass political, economic, social, and demographic factors. In particular, empirical research findings report that economic factors (e.g., economic growth, income) and demographic factors (e.g., age, gender, culture, religion) have a significant impact on the outcome of the government IT project.

According to the literature on the determinants of open data in Korean local governments, managerial and institutional factors are mainly the drivers of open data, while information and technology factors and institutional factors are mainly the challenges of open data [30–35]. For example,

the drivers of the cooperation project are financial benefits, subsidy assistance, a manager's positive values, increase in power, complement of internal capacity, and stipulation of cooperation in law. On the other hand, the challenges of the local informatization project including the open data project perceived by the public officials taking charge of local government's informatization are a lack of information officers' capacity, shortage of evaluation or feedback on information systems construction, and neglect of information systems maintenance and management.

3. Research Design

3.1. Research Model

This study aims to analyze the managerial capabilities, institutional conditions, socio-economic characteristics, and demographic characteristics that affect open data success. First, managerial capability is composed of executive leadership, human resources, financial resources, and operational experience. Second, institutional conditions are composed of institutional status of the CIO and the institutionalization of informatization. Third, socio-economic characteristics include financial size and financial independence. Fourth, demographic characteristics are composed of an aging population and population density. Figure 1 illustrates the analytical framework in this study.

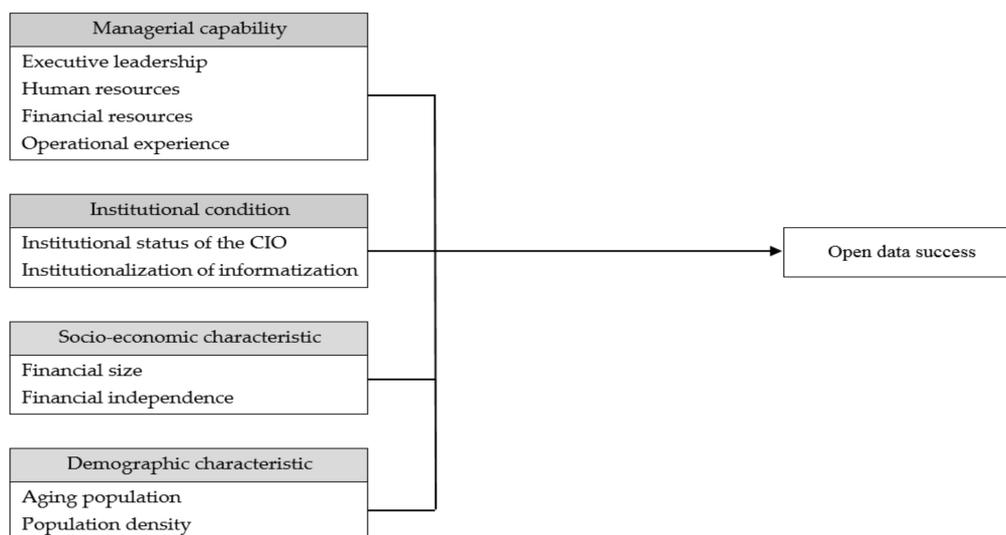


Figure 1. Analytical framework.

3.2. Research Hypothesis

The leadership for an organization's IT capability refers to the influential process of the leaders and followers within a government organization for achieving the organizational goal through change [36]. In order to enact the IT project successfully, leaders should connect the government IT service with the goal of good governance (e.g., rule of law, accountability, transparency, equity), find out how to communicate with followers with regard to ideas, and thereby promote the acceptance of vision and strategy. On the one hand, it is probable that public organizations under a leader with a strong willingness to push forward the IT project and mobilize the required resources vigorously develop an overcomplicated IT service which tries to serve many goals and ends up with a low-quality IT service. On the other hand, many e-government scholars and practitioners state that these public organizations are likely to provide a high-quality IT service [5,27]. Therefore, the local governments under the governor with strong willingness to push forward the IT project and mobilize the required resources vigorously will lead the open data initiatives to success.

Hypotheses 1 (H1). *Executive leadership has a significant influence on open data success.*

Human resource management for organizational IT capability is associated with the ability to identify, recruit, and train the human resources required for government IT project success [5,37]. It is particularly important to identify the cost accrued to the stakeholders involved in the IT project. Organizations with an effective human resources management ability manage their human resources through the training and education required for job performance. It is highly likely that public organizations with abundant human resources provide high-quality IT services [5,38]. Therefore, the local governments with abundant human resources will lead the open data initiatives to success.

Hypotheses 2 (H2). *Human resources have a significant influence on open data success.*

Financial resource management for organizational IT capability is associated with the ability to identify, acquire, and manage the financial resources required for government IT project success [39]. It is particularly important to identify the cost accrued to the stakeholders involved in the IT project. Organizations with an excellent financial resources management ability manage their financial resources on the basis of high-level financial analysis techniques and the authority to employ the techniques. It is highly likely that public organizations with abundant financial resources provide high-quality IT services [12]. Therefore, the local governments with abundant financial resources will lead the e-government project's open data initiatives to success.

Hypotheses 3 (H3). *Financial resources have a significant influence on open data success.*

The project management for organizational IT capability is associated with the ability to manage the IT project within an organization or across many organizations effectively [39,40]. It includes technical tools, an organizational structure for guiding and evaluating project performance, a more comprehensive perspective on governance and policy goals. In addition, the ability to manage the IT project across many organizations effectively requires consensus among stakeholders of the IT project and the implementation of an adequate project management process. It is highly likely that public organizations under sufficient operational experience through IT project management provide high-quality IT services [39]. Therefore, the local governments under sufficient operational experience through IT project management will lead the open data initiatives to success.

Hypotheses 4 (H4). *Operational experience has a significant influence on open data success.*

3.3. Data and Measurement

The dependent variable is open data success and it is measured by the total score of evaluation on the degree to which open data are used by the public in 2018. Data on open data success were collected from the score of evaluation on local governments' open data initiatives. The Ministry of Interior and Security evaluated the degree to which open data are used by the public in each local government based on the following criteria: (1) whether the open data registered in the official open data portal were actually disclosed; (2) whether each local government tried to discover new data (identification of other datasets within their own organization that may be suitable to be published as open data) and disclose such data to the public; (3) whether open data requested for disclosure by the public were registered in the official open data portal; (4) the ratio of open-format data to the total in the official open data portal; (5) whether each local government complied with the cyclical and periodic provision of open data in the official open data portal. These criteria reflect the demand-side of open data in that they consider not only the government's own internal efforts to disclose data, but also its proactive efforts to disclose data for citizens' convenience (e.g., discovery of new data, registration of data requested by citizens), which is in accordance with many open data scholars and practitioners' norm that open data initiatives aim at making governments more transparent, responsive, and accountable to the public [1,3,9,14,22]. Since the total score is the only source that the authors can get access to and each score on the five criteria is a source that the authors cannot get access to, the total score is adopted as the measurement variable of open data success.

The independent variables are classified into managerial capability and are composed of executive leadership, human resources, financial resources, and operational experience. According to the resource-based theory, managerial capability to mobilize tangible and intangible resources and deploy them in adequate places or process under the leadership of capable leaders during the IT project is a core factor leading to organizational performance such as open data success [6,24]. First, executive leadership is measured by whether the incumbent governor expresses a willingness to push forward IT projects in the inaugural speech. Data on executive leadership were collected from each local government's official website and diverse portal websites. This measurement variable would be more valid and reliable if whether the incumbent governor expresses willingness to push forward IT project at a later date were also considered, but this study only measured whether the incumbent governor expresses a willingness to push forward IT projects in the inaugural speech due to constraints on availability of empirical research data. Second, human resources are measured by the ratio of IT-related employees to total employees in 2017. Data on human resources were collected from a white paper on local informatization. This measurement variable would be more valid and reliable if it considered the qualitative aspects of human resources such as expertise and career, but this study only measured the quantitative aspects of human resources due to constraints on the availability of empirical research data. Third, financial resources are measured by the total amount of the IT-related budget in 2017. Data on financial resources were collected from a white paper on local informatization. Fourth, operational experience is measured by the number of IT-related projects being in progress in 2015. Data on operational experience were collected from the outcome of information disclosure request to each local government. Operational experience with open data requires more than carrying out many IT projects such as experience with legal aspects (e.g., is there a legal basis for publishing the specific dataset?), but this study only measured the number of IT-related projects due to constraints on the availability of empirical research data.

The control variables are classified into institutional conditions, socio-economic characteristics, and demographic characteristics. According to the institutional theory of information technology, institutions or institutional arrangements, which are defined as laws, regulations, and other cognitive, cultural, or socio-structural constraints in the context of the government, operates as the guidance, as well as constraints, with regard to the adoption and use of IT in the public sector [25,26]. The institutional condition is composed of the institutional status of the CIO and institutionalization of informatization. First, the institutional status of the CIO is measured by whether the position of the CIO is the same as or higher than the third rank in terms of the government officials' position in 2015. Data on institutional status of the CIO were collected from the outcome of information disclosure request to each local government. Second, institutionalization of informatization is measured by the number of IT-related laws and rules in 2017. Data on institutionalization of informatization were collected from a white paper on local informatization.

According to environmental determinism, environmental or contextual factors shape organizational characteristics and thereby have an influence on the ultimate outcome of the adoption and use of IT [29]. Socio-economic characteristics are composed of financial size as an absolute entity and financial independence. First, financial size is measured by the total amount of the financial expenditure budget in 2017. Data on financial size were collected from a local administration integrated information system. Second, financial independence is measured by the financial independence rate of each local government in 2017. Data on financial independence were collected from the Korean statistical information service. Demographic characteristics are composed of an aging population and population density. First, the aging population was measured by elderly ratio of each region in 2017. Data on the aging population were collected from a local administration integrated information system. Second, population density is measured by population density of each region in 2017. Data on population density were collected from the Korean statistical information service. Table 1 shows data sources of the variables selected in this study.

Table 1. Data sources.

Variables		Operational Definition	Source
Dependent Variable	Open data success	The degree to which open data are used by the public	Ministry of Interior and Security
Independent variables	Managerial capability	Executive leadership	Whether the governor expresses willingness to push forward IT project in the inaugural speech
		Human resources	(IT-related employees/total employees) * 100
		Financial resources	The total amount of IT-related budget
		Operational experience	Number of IT-related projects being in progress
		Institutional condition	Institutional status of the CIO
Control variables	Socio-economic characteristic	Institutionalization of informatization	Number of IT-related laws and rules
		Financial size	The total amount of financial expenditure budget
	Demographic characteristic	Financial independence	Financial independence rate of each local government
		Aging population	Elderly ratio of each region
		Population density	Population density of each region

3.4. Method

This study employs multivariate regression analysis to examine the managerial, institutional, and environmental factors that affect open data success. The several methodological issues of this study are as follows. First, the scope of this study is 226 Korean local governments. 17 Korean metropolitan governments are excluded from the scope of this study because there are essential differences between Korean metropolitan governments and the rest of the Korean local governments in terms of size, role, and function. In Korea, 17 metropolitan governments are first-tier administrative divisions and these are subdivided into a variety of lower-tier administrative divisions including cities (si), districts (gu), and counties (gun), which constitute 226 local governments. Second, 226 Korean local governments are classified into three administrative divisions (city, district, and county), and the dummy variable for these administrative divisions is included in the research model in order to capture the independent effect of each managerial factor on open data success in a more valid and accurate way. Third, the log value of the continuous variables is applied in the statistical analysis since the difference among numerical values of each variable is great. Fourth, the unit of measurement variable for financial resources is 100 won, while that of variable measured for financial size is 100,000 won.

4. Research Findings

4.1. Descriptive Analysis Results

As noted previously, the dependent variable is open data success in this study. The independent variables are categorized into managerial capability and the control variables are categorized into institutional conditions, socio-economic characteristics, and demographic characteristics. Table 2 shows the descriptive analysis results for the entire variables included in the research model. According to the descriptive analysis results for the dependent variable, the measurement variable of open data success (the score of the degree to which open data are used by the public) ranges from 3.2 to 19.2. Jongno local government located in Seoul (the capital of Korea) received the lowest score of 3.2, whereas Suncheon local government located in Jeollanamdo received the highest score of 19.2. Mean and standard deviation of the dependent variable are 9.3 and 2.9, respectively. It is notable that Suncheon local government located far from Seoul and the Korean metropolitan area and with a relatively sparsely populated area and moderate economy received the highest score, whereas Jongno local government located in Seoul and the Korean metropolitan area and with a relatively densely populated area and vigorous economy received the lowest score. It suggests that open data success is a dynamic phenomenon as the result of various hard-to-expect factors, not the result of taken-for-granted factors such as the vicinity of the metropolitan area, dense population, and vigorous economy in Korea. The descriptive analysis results for the dependent variable indicate that it is not skewed to the right or to the left and evenly distributed to a certain degree.

Table 2. Descriptive analysis results.

Variables		Mean	Standard Deviation	Maximum Value	Minimum Value	
Dependent variable	Open data success	9.3	2.9	19.2	3.2	
Independent variables	Managerial capability	Executive leadership	0.1	0.3	1	0
		Human resources	2.8	0.8	6.4	0.7
		Financial resources	2,994,063.1	2,846,673.5	18,915,147.0	1,916.0
		Operational experience	31.2	24.9	161	2
		Institutional status of the CIO	0.4	0.5	1	0
Control variables	Institutional condition	Institutionalization of informatization	3.7	2.4	18	1
		Socio-economic characteristic	Financial size	483,779.1	305,313.1	1,966,700.0
	Financial independence		27.4	13.9	72.2	8.6
	Demographic characteristic	Aging population	19.5	8.0	38.2	7.0
		Population density	3,942.8	6,245.0	27,840.8	20.2

In the research model, there are eight continuous variables among ten independent and control variables. Table 3 illustrates correlation analysis results for these continuous variables. The results indicate a relatively high correlation between financial independence and two variables (financial size and aging population). The authors include financial independence, financial size, and an aging population in the research model despite a high correlation since not only is correlation between financial independence and two variables (financial size and aging population) high to the degree that it does not raise the possibility of multicollinearity seriously, but these variables are categorized into control variables. Except for the cases noted previously, correlation between two variables is generally low.

Table 3. Correlation analysis results for continuous variables.

	1	2	3	4	5	6	7	8	9
1	1	-0.071	0.167 *	0.129	0.218 ***	0.157*	0.100	-0.061	-0.305 ***
2	-	1	0.061	0.129	-0.026	-0.068	-0.048	0.027	-0.004
3	-	-	1	0.603 ***	0.117	-0.065	0.046	-0.037	0.041
4	-	-	-	1	0.064	-0.053	-0.076	0.042	0.026
5	-	-	-	-	1	0.369 ***	0.397 ***	-0.257 ***	0.007
6	-	-	-	-	-	1	0.532 ***	-0.407 ***	0.008
7	-	-	-	-	-	-	1	-0.721 ***	0.264 ***
8	-	-	-	-	-	-	-	1	-0.409 ***
9	-	-	-	-	-	-	-	-	1

*: $p < 0.1$, ***: $p < 0.01$. 1: open data success, 2: human resources, 3: financial resources, 4: operational experience, 5: institutionalization of informatization, 6: financial size, 7: financial independence, 8: aging population, 9: population density.

In the research model, there are two discrete variables among ten independent and control variables. Table 4 illustrates frequency analysis results for these discrete variables. First, the number of governors who expressed willingness to push forward IT projects in the inaugural speech is 32, whereas that of governors who did not express willingness to push forward IT projects in the inaugural speech is 194, which suggests that most governors do not mention IT-related issues in their inaugural speech in Korean local governments. Second, the number of the CIOs with the third or higher rank is 79, whereas that of the CIOs with lower than the third rank is 147, which indicates that the position of many CIOs is lower than the third rank in Korean local governments.

Table 4. Frequency analysis results for discrete variables.

Variables	Category	Frequency	Portion (%)	
Managerial capability	Executive leadership	Applicable	32	14.2
		Not applicable	194	85.8
Institutional condition	Institutional status of the CIO	Applicable	79	35.0
		Not applicable	147	65.0

4.2. Multivariate Regression Analysis Results

This study conducts a multivariate regression analysis to examine the factors that affect open data success. As noted previously, this study aims to analyze the managerial capabilities, institutional conditions, socio-economic characteristics, and demographic characteristics that affect open data success. First, managerial capability is composed of executive leadership, human resources, financial resources, and operational experience. Second, institutional condition is composed of institutional status of the CIO and institutionalization of informatization. Third, socio-economic characteristic includes financial size and financial independence. Fourth, demographic characteristic is composed of aging population and population density. Table 5 demonstrates the multivariate regression analysis results in this study.

Major research findings are as follows. First, financial resources have a positively significant influence on open data success. The rest of the managerial factors do not have a significant influence on open data success. Second, the institutionalization of informatization also has a positively significant influence on open data success, whereas the institutional status of the CIO does not have a significant influence on open data success. Third, both financial size and financial independence do not have a significant influence on open data success. Fourth, an aging population and population density have a negatively significant influence on open data success.

Table 5. Multivariate regression analysis results.

	Variables	B	S.E.	t	VIF
Managerial capability	Executive leadership	−0.090	0.502	−0.179	1.072
	Human resources	−0.365	0.533	−0.685	1.068
	Financial resources	0.407 *	0.222	1.836	1.482
	Operational experience	−0.188	0.276	−0.679	1.439
Institutional condition	Institutional status of the CIO	0.227	0.363	0.627	1.047
	Institutionalization of informatization	0.534 *	0.287	1.862	1.180
Socio-economic characteristic	Financial size	−0.555	0.466	−1.190	1.847
	Financial independence	−0.531	0.647	−0.821	3.412
Demographic characteristic	Aging population	−2.357 ***	0.822	−2.868	4.027
	Population density	−0.366 *	0.203	−1.807	6.616
	F-statistic	6.677 ***	-	-	-
	R ² (Adjusted R ²)	0.524 (0.233)	-	-	-

B: coefficient, S.E.: standard error, t: t-value, VIF: variance inflation factor, *: $p < 0.1$, ***: $p < 0.01$.

5. Discussion

The research findings from the statistical analysis above suggest that open data researchers and practitioners shed more light on the managerial dimension of open data success. First, this study shows that financial resources have a positively significant influence on open data success. It is consistent with theoretical and empirical explorations on financial resources as critical success factors of the government IT project. According to Gil-Garcia and Sayogo, failure of the government IT project is mainly attributed to a lack of financial resources, and an abundance of financial resources is particularly important when public organizations initiate the government IT project within a single organization or across many organizations [12]. Therefore, local governments need to give priority to guarantee the sufficient financial resources required for initiation and constant implementation of open data initiatives.

Second, this study does not show the evidence that executive leadership, human resources, and operational experience have a significant effect on open data success. Moreover, these factors have a negative influence on open data success when statistical significance is not considered. It is not consistent with theoretical and empirical explorations on executive leadership, political support, the presence of open data champions and having sufficient capacity, human resources, and operational experience as critical success factors of the government IT project [5,27,37–39,41]. According to Pardo et al., the leadership of capable and respected leaders, employees' expertise, and organizations' ability to mobilize and deploy tangible and intangible resources for an effective job operation are the managerial factors that should be involved in the government IT project success [39]. Therefore, open data researchers and practitioners need to consider if there are some constraints that hinder the operation of executive leadership, human resources, and operational experience in open data initiatives.

Third, this study shows that institutionalization of informatization has a positively significant influence on open data success, whereas an aging population and population density have a negatively significant influence on open data success, which might be an important reference for managerial capability. According to environmental determinism noted previously, environmental or contextual factors shape organizational characteristics and thereby have an influence on the ultimate outcome of adoption and use of IT. To an extreme degree, some environmental determinists often argue that environmental factors explain everything and incapacitate managerial and institutional factors. From the perspective of environmental determinism, it is probable that an aging population and high population density hinder managerial capability for open data initiatives because the elderly residents

and those living in a densely populated area might demand other managerial capabilities for other kinds of public services such as healthcare and transportation. In turn, the environmental factors such as an aging population and high population density may limit the influence of managerial capability for open data initiatives and thereby influence on open data success. Therefore, open data researchers and practitioners need to be cautious about the possibility of overlooking the impact of environmental characteristics on managerial capability and need to consider managerial capability and environmental characteristics in an integrative way when it comes to initiating and enacting open data initiatives.

Putting the above-mentioned discussion together, this study shows the contrasting theoretical view between technological determinism and the socio-technical perspective. Governments around the world often understand that open data is disclosing their data to the public as much as possible and that open data success is the result of a data and technology-related endeavor. Therefore, they tend to focus on increasing data compatibility (availability of data across devices and systems with different specifications, formats, and styles) and expanding the technological infrastructure required for releasing more data, which reflects the theoretical expectation of technological determinism. On the other hand, this study shows that managerial, institutional, and environmental factors do affect open data success, which indicates that the outcome of open data initiatives might not depend on technology-related factors entirely and could significantly or partially depend on society-related factors.

In a broader sense, this study ultimately contributes to theoretical and empirical explorations on the interactive relationship between technology and society. The interaction between technology and society is the intertwined process through which one changes the other. New technology is designed and used by various social components and it alters the present technological environment, which in turn changes society. As noted previously, technological determinism highlights the effect of technology on society, stating that the design and use of technology (e.g., open data initiatives and other kinds of e-government projects) acts autonomously upon social components (e.g., individuals, organizations, institutions, and environments) [5,25]. Therefore, technological determinism underestimates the effect of society on technology or how social components (e.g., managerial, institutional and environmental factors) influence on the design and use of technology (e.g., open data initiatives and other kinds of e-government projects). In this sense, this study brings about the necessity of a balanced perspective between technological determinism and theoretical discussions on the effect of society on technology through empirical findings, and thereby contributes to theoretical discussion on the interactive relationship between technology and society.

6. Conclusions

This study aims to analyze the managerial drivers and challenges of open data success from the resource-based theory. These managerial drivers and challenges include the leadership-related factor (executive leader's willingness to push forward IT projects), the resource-related factor (human resources and financial resources required for IT projects), and the operation-related factor (operational experience of IT projects). Institutional, socio-economic, and demographic factors are also considered for capturing the independent effect of each managerial factor on open data success in a more valid and accurate way. Institutional factors include institutional status of the CIO and institutionalization of informatization. Socio-economic factors encompass financial size and financial independence. Finally, demographic factors include an aging population and population density.

The major research findings are as follows. First, financial resources have a positively significant influence on open data success. The rest of the managerial factors do not have a significant influence on open data success. Second, the institutionalization of informatization also has a positively significant influence on open data success, whereas the institutional status of the CIO does not have a significant influence on open data success. Third, both financial size and financial independence do not have a significant influence on open data success. Fourth, an aging population and population density have a negatively significant influence on open data success. These research findings have some implications on the relationship between managerial capability and open data success. First, local governments

need to give priority to guarantee the sufficient financial resources required for the initiation and constant implementation of open data initiatives. Second, open data researchers and practitioners need to consider if there are some constraints that hinder the operation of executive leadership, human resources, and operational experience in open data initiatives. Third, open data researchers and practitioners need to be cautious of overlooking the impact of environmental characteristic on managerial capability and need to consider managerial capability and environmental characteristics in an integrative way when it comes to initiating and enacting open data initiatives. Putting the above-mentioned discussion together, this study shows the contrasting theoretical view between technological determinism and the socio-technical perspective, indicating that the outcome of open data initiatives might not depend on technology-related factors entirely and could significantly or partially depend on society-related factors.

On the other hand, this study has limitations and necessitates follow-up studies. First, this study does not guarantee external validity because the scope of this study is limited to Korean local governments. Therefore, follow-up studies need to have more generalized research findings through replication studies on other public organizations. Second, this study does not capture each score on the five assessment criteria for open data success, which might have influenced the overall research findings from statistical analysis. Therefore, follow-up studies need to find a breakdown or weighting of the assessment criteria for open data success and check if the overall research findings from statistical analysis are consistent with those from the statistical analysis in this study. Third, this study does not provide a comparison between Korean local governments' open data efforts and other international open data efforts. Therefore, follow-up studies need to provide a description of the characteristics and uniqueness of Korean local governments through comparison with other international open data efforts. Finally, this study adopts e-government challenges and success factors as theoretical evidence on open data challenges and success factors under the premise that open data initiatives are an essential part of e-government projects. However, not only is it difficult to identify open data initiatives with e-government projects, but it is also probable that the definition of open data can be understood in multiple ways according to scope of data open to the public and skills or resources required to open data. Therefore, follow-up studies need to conduct empirical research underpinned by theoretical evidence on open data-specific challenges and success factors.

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