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Unlocking Data Potential: A Comprehensive Framework for Integrating Open Government Data in Thailand's Public Sector

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Abstract. This study develops an integrated framework for open government data (OGD) in Thailand, addressing the unique challenges faced by developing countries in data integration and utilization. Using a mixed-methods approach, including surveys (n=393), interviews, and focus groups in two Thai provinces, the study identifies key factors influencing OGD implementation. The findings reveal that while legal and infrastructural elements are crucial, human factors such as organizational culture and personnel skills significantly impact OGD success. The proposed framework emphasizes the need for a holistic approach, incorporating technical, organizational, and policy dimensions. This research contributes to the growing body of literature on OGD in developing countries and provides practical implications for policymakers and practitioners in Thailand and similar contexts.

Keywords: government data, open government data, unlock data potential, data exchange

1. Introduction

In an era where data is often likened to oil in its ability to drive modern economies, the strategic importance of effectively managing and utilizing this valuable resource cannot be overstated. The notion of open government data (OGD) has attracted considerable interest as a means of disseminating information from the general public sector to individuals, corporations, and other relevant parties in order to promote openness, stimulate creativity, and improve the provision of services. In order to provide a centralized portal for accessing government datasets, the Thai government has launched initiatives like the Thailand Open Government Data Platform (data.go.th). These datasets cover a wide range of sectors, including health, education, transportation, environment, and public administration. The data is provided by various government agencies and is intended to be used for purposes such as policy analysis, public service improvement, civic engagement, and innovation(Utamachant & Anutariya, 2018). However, while the potential benefits of OGD are widely acknowledged, significant challenges remain in harnessing its full power, particularly in developing countries. This study intends to unlock the potential of open data for societal and economic advantages by creating a thorough framework for integrating government data in Thailand.

The transformative potential of open data is immense. From improving government transparency and accountability to stimulating economic growth through innovative applications, the benefits are substantial (Srimuang et al., 2017). However, the complexity of government systems, the complexity of the data involved, and the complexity of legal and regulatory environments are major challenges. These challenges emphasize the importance of a systematic approach to the integration and management of government data - which is critical in the fast-paced digital age.

The literature on open data is extensive and multi-faceted, focusing on various aspects, including economic implications, technological barriers, policy frameworks, and societal impacts. Studies by Zuiderwijk et al. (2014) and Ubaldi (2013) have provided foundational frameworks that describe the policy environments and technical infrastructures necessary for successful OGD initiatives. Other studies explore the technical issues and offer solutions for data security and interoperability, such as Janssen et al. (2012). Despite these contributions, there are gaps in the frameworks that have focused on the specific challenges of developing countries in integrating and using open data in government processes.

This study proposes a new approach by creating an appropriate framework for government data integration in Thailand with the specific goal of overcoming identified barriers and leveraging local strengths. This framework is designed with a nuanced understanding of the socio-political and technological landscape of Thailand, providing a tailored solution that can be adapted to similar contexts in other developing countries.

2. Research Objectives and Design

The research objective of this study is to develop and validate a comprehensive framework for the integration of government data in Thailand to enhance its accessibility, reliability, and utility for supporting data-driven decision-making and improving public service delivery. Specifically, the study aims to achieve the following objectives:

1. To synthesize guidelines for collaborative government data integration to unlock data potential.

2.To create and design policies that encourage the public use of government data in order to promote public administration and services.

3. To evaluate the impact of the integration framework on improving governmental operations and public service delivery, and to assess its scalability and adaptability for broader national implementation.

These objectives are intended to contribute to the overarching goal of transforming how government data is managed and utilized in Thailand, ultimately leading to more transparent governance, enhanced public services, and stimulated economic development through informed policy-making.

To address the above research objective, this study has conducted several case studies in 2 provinces includes Maha Sarakham Province and Nakhon Sawan Province.These two provinces were chosen due to their readiness to cooperate in data collection and their policies promoting open data to drive the transition towards becoming smart cities.

This research employs a mixed-methods approach, combining qualitative and quantitative research designs in a convergent parallel format. Data is collected through document analysis, observations, group interviews, in-depth individual interviews, and surveys to study the influential factors related to developing a framework for integrating government data to unlock its potential. This research emphasizes the equal involvement and opinions of all participants throughout the process.

The first stage involved a detailed and focused literature review, which led to the development of the preliminary research model representing proactive factors influencing integrating government data to unlock data potential. The researcher conducted fieldwork using in-depth interviews in Maha Sarakham Province and Nakhon Sawan Province. This comprises 112 individuals, including the provincial governor, the director of the strategy and planning division, the director of the welfare division, the director of the education division, the mayor of the local administrative organization, and others. The chairman of the chamber of commerce is also included in this group. Furthermore, 100 participants were chosen from the general public and 100 from private sector organizations. The data analysis was conducted through pattern-matching to identify behavioral patterns and using exploratory methods for providing explanations. The findings or discoveries were analyzed across multiple case studies and then extrapolated to the two population groups. The result of this data analysis step is the development of a framework for integrating government data to unlock its potential. This framework will be empirically tested against quantitative data.

In the second phase, the researcher conducted focus group interviews, selecting the sample using purposive sampling and comprising three categories: 1) providers of open data platforms, 2) providers of open data, and 3) users of open data. The analysis involved the identification of behavior patterns through pattern-matching techniques and the application of exploratory methods to elucidate the data collected from these groups. The outcome of this analytical process is the formulation of a comprehensive framework designed to integrate government data, thereby unlocking its potential. This framework will be subject to empirical validation through quantitative analysis in the subsequent phase, as outlined in the third research objective.

Table 1: General Information of Survey Respondents

Category	**Number of Respondents**	**Percentage (%)**
1. Type of Data Users		
1.1 Public sector	321	81.7
1.2 Private sector	72	18.3
Total	**393**	**100.0**
2. Job Position		
2.1 Senior Executives	112	28.5
2.2 Middle Management	85	21.6
2.3 Supervisors	128	32.6
2.4 Operational Staff	68	17.3
Total	**393**	**100.0**

In the final step, we conducted a survey to validate the framework. The research population consisted of 393 participants show in table 1.

This table provides a summary of the general information of the survey respondents, including their type of data usage and job positions.

This research employs a mixed-method approach, integrating qualitative and quantitative research

methods to provide a comprehensive analysis. The methodology includes:
1. Data Collection: Surveys, interviews, and focus group discussions with stakeholders, including platform service providers, data providers, and data users in Maha Sarakham and Nakhon Sawan provinces.
2. Data Analysis: Statistical analysis of quantitative data and thematic analysis of qualitative data to identify key trends, correlations, and insights.

3. Research Framework

The research framework for developing an integrated national data system (INDS) comprises three key components:
1. Institutional Framework: Government oversight, stakeholder participation in standard setting, and international cooperation on data governance.
2. Legal and Regulatory Framework: National-level data protection laws and international conventions on cybersecurity and data exchange.
3. Infrastructure Policy Framework: Comprehensive broadband networks, local data storage and processing infrastructure, and regional cooperation on data infrastructure.

Table 2 : Factors of Integrating government data to unlock data potential

Components	Factors	Details	Literature Review
Impact	Policy and Plan	Policy and strategy formulation are supported by laws, regulations, and training, with laws and directions established for use by government agencies.	(Zhao et al., 2022; Zuiderwijk et al., 2014; Zuiderwijk & Reuver, 2021)
		Planning and Direction of Open Government Data, Planning and direction for government to achieve goals.	(Zhao & Fan, 2021; Zuiderwijk et al., 2014)
		Vision: Statements or goals of OGD and practices.	(Zhao & Fan, 2021; Zuiderwijk et al., 2014)
	Laws and Regulations	Laws and Regulations: Laws are important as open data must comply with legal frameworks, including regulations on data usage freedom.	(Cahlikova & Mabillard, 2020; Caplan & Gillespie, 2020; Zuiderwijk & Janssen, 2014)
		Government Leadership: Capability to fully lead OGD	(Cahlikova & Mabillard, 2020; Caplan & Gillespie, 2020; Zuiderwijk & Janssen, 2014)
	Organization	Organizational Leadership: Capability to drive OGD leadership within government agencies' processes.	(Przeybilovicz & Cunha, 2021; Shelden et al., 2020; Shepherd et al., 2019; Srimuang et al., 2017)
		Organizational Policy: Internal policies should be related and supported by government agency policies.	(Przeybilovicz & Cunha, 2021; Shelden et al., 2020; Shepherd et al., 2019)
		Commitment: Ability to accept international standards.	(Utamachant & Anutariya, 2018; Zhao et al., 2022)

Components	Factors	Details	Literature Review
	Personnel Skills	Training: Personnel skills training related to OGD work.	(Gascó-Hernández et al., 2018; Zhao et al., 2022)
		Self-assessment: Measurable programs and development related to OGD skills	(Gascó-Hernández et al., 2018; Zhao et al., 2022)
	Technological Infrastructure	Infrastructure: Platforms that provide datasets and fill in all necessary details completely.	(Caplan & Gillespie, 2020; Puad et al., 2022; Samakit et al., 2023; Zuiderwijk et al., 2013)
		OGD Portal: Central government portal that publishes data.	(Izdebski et al., 2021; Samakit et al., 2023; Utamachant & Anutariya, 2018; Wang et al., 2024)
		Interoperability: Systems that work together without any restrictions.	(Izdebski et al., 2021; Samakit et al., 2023; Utamachant & Anutariya, 2018; Wang et al., 2024)
		Network Systems: Essential for organizational competitiveness.	(Izdebski et al., 2021; Samakit et al., 2023; Utamachant & Anutariya, 2018; Wang et al., 2024)
		Data Prioritization: Prioritizing data in public organizations.	(Enders et al., 2022; Green et al., 2023; Zuiderwijk & Reuver, 2021)
	Open Government Data	Completeness: Complete and comprehensive data.	(Ali et al., 2019; Samakit et al., 2023; Zuiderwijk & Reuver, 2021)
		Privacy: Primary and personal data. Timeliness: Automatically updated and current data. Electronic Access: Data access through central data linking.	(Bizer et al., 2023; de Figueiredo Hammes et al., 2022; Nogueras-Iso et al., 2021; Putra et al., 2023; Samakit et al., 2023; Van Bekkum & Borgesius, 2023)
		Electronic Access: Data access through central data linking.	(Bizer et al., 2023; de Figueiredo Hammes et al., 2022; Nogueras-Iso et al., 2021; Putra et al., 2023; Samakit et al., 2023; Van Bekkum & Borgesius, 2023)
		Non-discrimination: Public can access data anytime anonymously.	(Samakit et al., 2023; Van Bekkum & Borgesius, 2023)
		Licensing: Level of impact on agencies in public participation and improvements in data dissemination and use.	(Bizer et al., 2023; de Figueiredo Hammes et al., 2022; Nogueras-Iso et al., 2021; Putra et al., 2023; Samakit et al., 2023; Van Bekkum & Borgesius, 2023)
		Security: Data can be efficiently provided online or on platforms and utilized effectively.	(Samakit et al., 2023; Thota et al., 2018)
		Usage Costs: Open data must not be restricted by copyrights.	(Samakit et al., 2023; Thota et al., 2018)

Components	Factors	Details	Literature Review
		Usage Standards: Data standards for open data to be used as central data that can be utilized.	(Hughes & Kalra, 2023; Salm et al., 2024)
	Participation	Data Access: Defining rights and levels of access for data usage.	(Bizer et al., 2023; Samakit et al., 2023; Utamachant & Anutariya, 2018)
		Complaints and Redressal: Data format usage, recording, and correction must be identifiable for utilization.	(Bizer et al., 2023; Samakit et al., 2023; Utamachant & Anutariya, 2018)
		Citizen-Driven Response: Response focused on citizens' needs according to public demand	(Bizer et al., 2023; Samakit et al., 2023; Utamachant & Anutariya, 2018)
	Communication	Communication	(Utamachant & Anutariya, 2018; Wang et al., 2024; Zhao et al., 2022)
Users	Platform Providers	Platform Providers	(Gebka et al., 2021; Li & Chen, 2021; Zhao et al., 2022; Zuiderwijk & Reuver, 2021)
	Data Providers	Public and OGD: Interaction between the public and open government data.	(Donker & Van Loenen, 2016; Gebka et al., 2021; Hughes & Kalra, 2023; Putchong & Viboon, 2022; Samakit et al., 2023)
	Service Providers	Service Providers	(Donker & Van Loenen, 2016; Gebka et al., 2021; Hughes & Kalra, 2023; Putchong & Viboon, 2022; Samakit et al., 2023)
Data exchange systems	Reference Architecture	Core Data, Reference Data, Reference Architecture, Technical Specification Standards	(Donker & Van Loenen, 2016; Gebka et al., 2021; Hughes & Kalra, 2023; Putchong & Viboon, 2022; Samakit et al., 2023)
	Technical Requirements Standards	Set of Technical Requirements Standards	(Donker & Van Loenen, 2016; Gebka et al., 2021; Hughes & Kalra, 2023; Putchong & Viboon, 2022; Samakit et al., 2023)
Benefits	Innovation	Usage: Open data can help create services and product innovations.	(Bergemann & Bonatti, 2024; Coutinho & Kira, 2021; Del Vecchio et al., 2018; Huber et al., 2020; Samakit et al., 2023)
		Product Innovation: Every product is derived from open data.	(Ghasemaghaei & Calic, 2020; Mergel, 2021)
	Transparency	Transparency of Open Government Data	(Matheus & Janssen, 2020; Ruijer et al., 2020; Wang & Shepherd, 2020)

Components	Factors	Details	Literature Review
	Improved Public Services	Public Trust, Public Engagement	(Matheus & Janssen, 2020; Ruijer et al., 2020; Wang & Shepherd, 2020)
	Economic Growth	Economic Aspects, Enhanced Collaboration	(Matheus & Janssen, 2020; Ruijer et al., 2020; Srimuang et al., 2017; Wang & Shepherd, 2020)
	Policy and Planning	Policy and Planning, Informed Decision-Making, Monitoring and Evaluation, Identifying Trends and Issues	(Antuca & Noble, 2021; Chan, 2013; Huber et al., 2020; Matheus & Janssen, 2020; Ruijer et al., 2020; Wang & Shepherd, 2020)
	Competition	Efficiency Improvement, Market Insights, Market Entry	(Antuca & Noble, 2021; Bergemann & Bonatti, 2024; Chan, 2013; Coutinho & Kira, 2021; Del Vecchio et al., 2018; Huber et al., 2020; Samakit et al., 2023; Srimuang et al., 2017)
	Products	Products	(Bergemann & Bonatti, 2024; Huber et al., 2020; Matheus & Janssen, 2020; Srimuang et al., 2017)

The table provided outlines various influencing factors related to the adoption and operation of open data systems. It categorizes these factors under different headings such as impact, organization, personnel skills, technological infrastructure, open government data, participation, communication, user interaction, data exchange, and benefits. These factors collectively influence how effectively data is exchanged in a system designed to promote open government data (OGD). Additionally, the interaction between platform providers, data providers, and the public is crucial for the success of OGD (Donker & Van Loenen, 2016; Gebka et al., 2021; Hughes & Kalra, 2023; Putchong & Viboon, 2022; Samakit et al., 2023). The service providers must facilitate this interaction effectively (Donker & Van Loenen, 2016; Gebka et al., 2021; Hughes & Kalra, 2023; Putchong & Viboon, 2022; Samakit et al., 2023).

OGD can drive innovation, particularly in the development of new services and products (Bergemann & Bonatti, 2024; Coutinho & Kira, 2021; Del Vecchio et al., 2018; Huber et al., 2020; Samakit et al., 2023). Transparency is enhanced through the availability of open government data, which in turn improves public services and builds public trust (Matheus & Janssen, 2020; Ruijer et al., 2020; Wang & Shepherd, 2020). Moreover, the economic benefits of OGD include enhanced collaboration and market insights (Antuca & Noble, 2021; Chan, 2013; Huber et al., 2020; Matheus & Janssen, 2020; Ruijer et al., 2020; Wang & Shepherd, 2020). Additionally, OGD supports informed decision-making, monitoring, and evaluation, and helps in identifying trends and issues (Antuca & Noble, 2021; Chan, 2013; Huber et al., 2020; Matheus & Janssen, 2020; Ruijer et al., 2020; Wang & Shepherd, 2020).

A data exchange platform's framework is shown in Figure 1, with an emphasis on integrating and exploiting open data from many sectors. It draws attention to a number of important variables, including human potential, organizational participation, global standards, data accessibility, and regulatory requirements. The platform includes essential services for data consumers and providers, emphasizing system components like user authentication and search interfaces. In order to improve data-driven decision-making and benefit the public, private, and nonprofit sectors, it identifies the major players, such as platform providers, data providers, and service users.

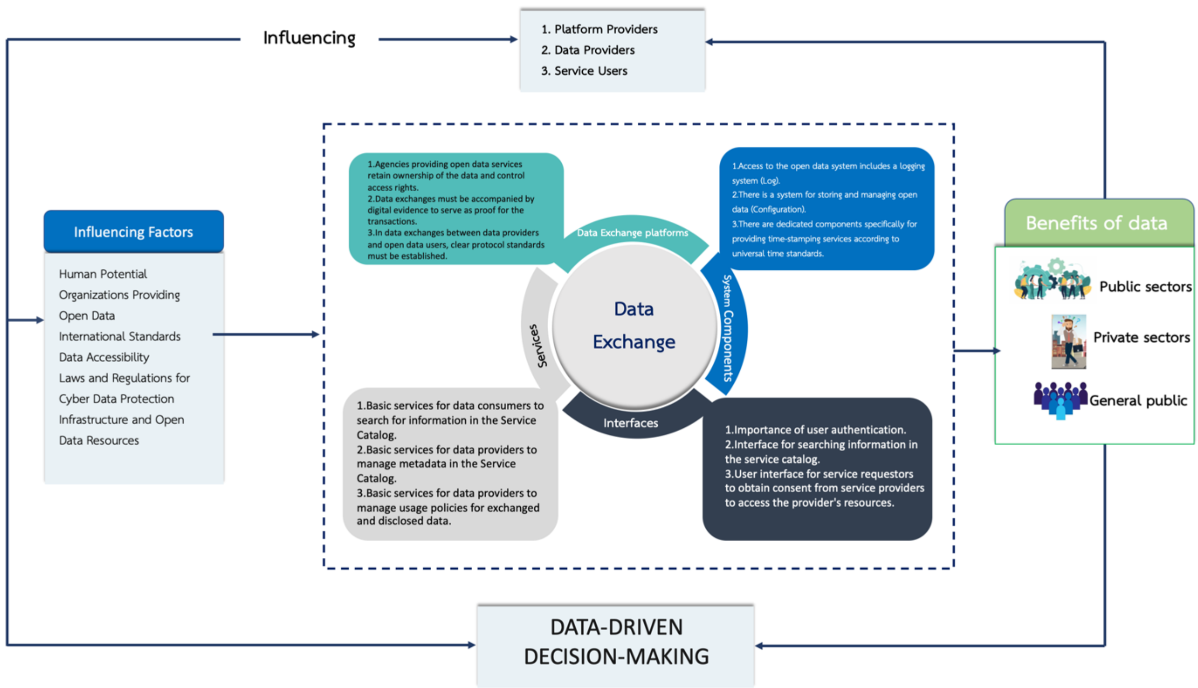

Fig 1: framework for Integrating Government Data to Unlock Data Potential

4. Finding and Discussion

Examples of interview comments from Case A are presented in this paper. A summary table for all case included. For each stage of the factors affecting the development of frameworks for integrating public sector data to unlock data potential (as shown in table 3), there are sub-processes/activities that require adequate factors affecting the development. Due to paper length limitations, only one sub-process from Stage 1 (influencing factors) is presented below:

Table 3: Internal Factors within the Organization

Internal Factors within the Organization	
1. Human Potential	5. Open Government Data
2. Organizational Culture and Society	6. Organizational Policies
3. Participation	7. Infrastructure
4. Communication	

Internal factors affecting the development of frameworks for integrating public sector data to unlock data potential. These internal factors can be summarized as follows:

1) Human Potential

In most organizations, there are issues regarding opportunities for employees to receive training for self-development, both in terms of skills or techniques for operational work and digital technology skills. The training provided does not cover all types of personnel, positions, job lines, and operational levels. This is a significant factor preventing agencies from integrating data into the open data system. This issue is evident from the interview data collected:

"There is encouragement to use government data for decision-making, but it becomes complicated and difficult to request in-depth data. Within the company, the supervisors themselves are not yet proficient enough in searching for data." (Nakhon Sawan Medical Company Limited, Nakhon Sawan Province)

Despite this, both public and private agencies continue to promote data disclosure, though it does not encompass all employees' work. Only some individuals and certain agencies understand how to disclose data, as indicated by the following interviews:

"There is encouragement to disclose data and submit it to the major department for use, but it has not been concretely implemented at the local level due to a heavy workload. The staff are not very skilled in submitting data to open data. Therefore, the local authorities strive to promote and upgrade the submission of central data to the Department of Provincial Administration. In the future, Nakhon Sawan local authorities have plans to drive towards becoming a smart locality to elevate the organization to a standard level." (Local government, Nakhon Sawan Province)

"Sharing data to facilitate various transactions with authorized agencies might have both advantages and concerns. The benefits include convenience and maximizing the usefulness of data. However, there are concerns if some data pieces are ones the organization does not want to share, or if shared data is not adequately secured by the receiving agency. These issues often arise from human error or carelessness in data management and usage." (T.K. Supply, Maha Sarakham Province)

2) Organizational Culture and Society

Allowing civil society, private sector, and the public to participate in governmental processes by disclosing useful information that can be used for various forms of national development includes:

"We have a website where the public can access and download provincial industry data, which is then forwarded to the ministry every six months and annually." (Provincial Industry Office, Nakhon Sawan)

"There are services for the public, such as license renewals, complaints, health information promotion, and public services, focusing on using the information systems of government agencies such as HOSXP and HDC."

(Public Health and Environment Office, Maha Sarakham Municipality, Maha Sarakham Province)

"There is encouragement to disclose data and submit it to the major department for use, but it has not been concretely implemented at the local level due to a heavy workload. The staff are not very skilled in submitting data to open data. Therefore, the local authorities strive to promote and upgrade the submission of central data to the Department of Provincial Administration. In the future, Nakhon Sawan local authorities have plans to drive towards becoming a smart locality to elevate the organization to a standard level." (Local government, Nakhon Sawan Province)

This framework illustrates the data exchange process, emphasizing the factors influencing data exchange, the process itself, the involved users, and the benefits derived from effective data exchange. Below is a detailed explanation of each component in the framework:

In the first stage, 312 participants were interviewed in-depth to gather data. The following outcomes of this data's analysis were obtained:

1. Organizational Factors
    - Human Capacity: The skills and competencies of the personnel involved in data management and exchange.
    - Organizational Culture and Social Aspects: The attitudes, values, and norms within the organization that affect data sharing practices.
    - Participation: The involvement of stakeholders and personnel in data-related activities.
    - Communication: The effectiveness of communication channels within the organization.
    - Open Government Data: Policies and practices related to making government data open and accessible.
    - Organizational Policies: Internal policies that govern data management and sharing.
    - Infrastructure: The technical infrastructure that supports data storage, processing, and exchange.
2. External Factors
    - International Data Exchange Standards: Global standards that guide data exchange practices.
    - Inter-Agency Data Sharing Policies: Policies that facilitate data sharing between different government agencies.
    - Emerging Data Technologies: New technologies that influence data management and exchange.
    - Public Expectations for Data Access: The demand from the public for transparent and accessible data.
3. Legal and Regulatory Factors
    - Data Protection and Privacy Laws: Regulations that ensure the privacy and protection of data.
    - Open Data Policies: Policies that promote the availability of data to the public.
    - Metadata and Data Standards: Standards that ensure data consistency and interoperability.
    - Data Classification Policies: Guidelines for classifying data based on sensitivity and access levels.
4. Data Exchange Process
    - Open Data Platform
        - Ensuring data openness and accessibility.
        - Providing real-time data exchange capabilities.
        - Implementing data protection measures.
    - Interface
        - Standardized protocols for data exchange.
        - Secure mechanisms for data transfer.
    - Open Data Sharing
        - Agreements and permissions for data sharing.
        - Authentication and authorization of data consumers.
        - Management of metadata for data discovery and usage.
5. Users

    1. Data Platform Developers: Individuals who develop and maintain the data platforms.

    2. Data Consumers: Users who utilize the data for various purposes, such as research, analysis, and decision-making.

    3. Data Providers: Entities that supply the data for the platform.

6. Benefits

    1. Improving Data-Driven Decision-Making: Enhancing the ability to make informed decisions based on accurate data.

2. Enhancing Transparency and Accountability: Making data available to the public to increase government transparency.

3. Facilitating Inter-Agency Collaboration: Promoting collaboration between different government agencies through shared data.

4. Reducing Data Duplication and Redundancy: Minimizing the repetition of data collection and storage efforts.

5. Supporting Innovation and Public Services: Encouraging the development of new services and solutions based on available data.

6. Enabling Evidence-Based Policy-Making and Planning: Using data to inform policy decisions and strategic planning.

The framework underscores the importance of an integrated approach to data management, highlighting the need for cooperation among various stakeholders, adherence to legal standards, and the utilization of technology to facilitate efficient data exchange. This integrated approach aims to maximize the value of data in improving government operations and public services.

Table 4: Correlation Coefficients Between Independent Variables and Dependent Variables

	INS	LAW	INF	DX41	DX42	DX43	DX44	DX45	USE51	USE52	USE53
$\bar{x}$	5.156	5.558	4.960	5.218	5.584	5.132	5.170	5.064	5.720	5.042	5.558
S.D.	0.465	0.467	0.548	0.538	0.378	0.461	0.479	0.507	0.478	0.531	0.475
INS	1										
LAW	0.537**	1									
INF	0.203**	0.218**	1								
DX41	0.289**	0.384**	0.242**	1							
DX42	0.156**	0.198**	0.227**	0.469**	1						
DX43	0.242**	0.080	0.177**	0.481**	0.480**	1					
DX44	0.222**	0.116*	0.226**	0.427**	0.421**	0.490**	1				
DX45	0.109*	0.015	0.185**	0.269**	0.318**	0.439**	0.585**	1			
USE51	-0.071	0.071	0.244**	0.227**	0.323**	0.109*	0.300**	0.269**	1		
USE52	0.220**	0.110*	0.058	0.301**	0.326**	0.463**	0.381**	0.262**	0.021	1	
USE53	0.112*	0.131**	0.218**	0.332**	0.453**	0.239**	0.448**	0.380**	0.522**	0.373**	1

* $p < 0.05$, ** $p < 0.01$

From the correlation analysis, it was found that the promotion of open data services by agencies/organizations (INS) has a statistically significant positive relationship with the framework of laws and regulations for cyber data protection (LAW, 0.357), infrastructure and resources used for open data (INF, 0.203), basic data exchange platforms (DX41, 0.289), advanced data exchange platforms (DX42, 0.156), system components (DX43, 0.242), system interfaces (DX44, 0.222), and the benefits of data disclosure to the private sector (USE52, 0.220) at the 0.01 significance level. Additionally, the promotion of open data services (INS) is positively related to basic system services (DX45, 0.109) and the benefits of data disclosure to the public sector (USE53, 0.112) at the 0.05 significance level.

Table 5 : Tests the influence of the independent variable (promotion by agencies/organizations providing open data services) on the dependent variable (the development of frameworks for integrating public sector data to unlock data potential: operational principles of basic data exchange platforms), with a sample size of 393.

Independent Variables	operational principles of basic data exchange platforms					
	B	Std. Error	Beta	t	p-value	VIF
(Constant)	2.058	0.345		5.971	0.000***	
Promotion by agencies/organizations providing open data services (INS)	0.091	0.051	0.097	1.782	0.076*	1.394
Framework of laws and regulations for cyber data protection (LAW)	0.348	0.062	0.302	5.625	0.000***	1.363
Infrastructure and resources used for open data (INF)	0.148	0.047	0.151	3.151	0.002***	1.085

R = 0.424, $R^2 = 0.180$, Adj. $R^2 = 0.174$, Std. Error of the Estimate = 0.488 *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

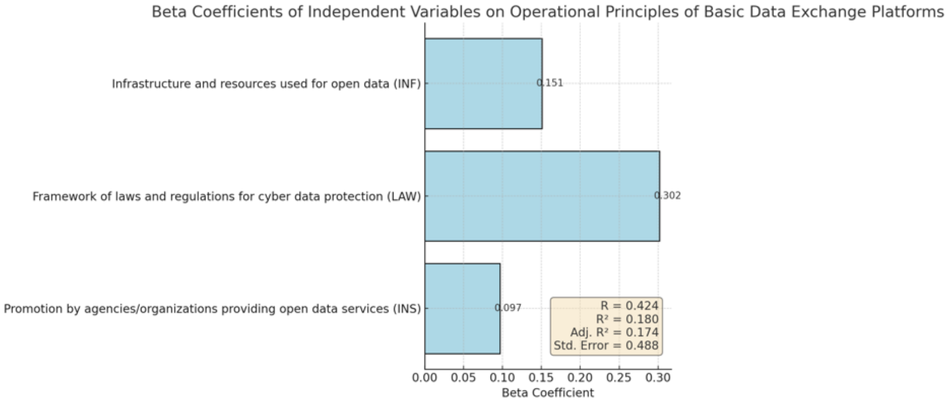

Fig 2. Beta Coefficients of Independent Variables on Operational Principles of Basic Data Exchange Platforms

The analysis from table 5 indicates that the promotion by agencies/organizations providing open data services (INS) influences the operational principles of basic data exchange platforms (DX41) with a regression coefficient of 0.091 at the 0.10 significance level. Meanwhile, the framework of laws and regulations for cyber data protection (LAW) and the infrastructure and resources used for open data (INF) impact the operational principles of basic data exchange platforms (DX41) with regression coefficients of 0.348 and 0.148, respectively, at the 0.01 significance level. The multiple correlation coefficient (R) is 0.424, and the adjusted R Square is 0.174, indicating that 17.4 percent of the variability is predictable.

Table 6 : tests the influence of the independent variable (promotion by agencies/organizations providing open data services) on the dependent variable (the development of frameworks for integrating public sector data to unlock data potential: system components), with a sample size of 393.

Independent Variables	system components					
	B	Std. Error	Beta	t	p-value	VIF
(Constant)	4.017	0.318		12.639	0.000***	
Promotion by agencies/organizations providing open data services (INS)	0.128	0.047	0.159	2.721	0.007***	1.394
Framework of laws and regulations for cyber data protection (LAW)	-0.031	0.057	-0.032	-0.548	0.584	1.363
Infrastructure and resources used for open data (INF)	0.120	0.043	0.142	2.762	0.006***	1.085

R = 0.226, R^2 = 0.051, Adj. R^2 = 0.044, Std. Error of the Estimate = 0.451*p < 0.1, **p < 0.05, ***p < 0.01

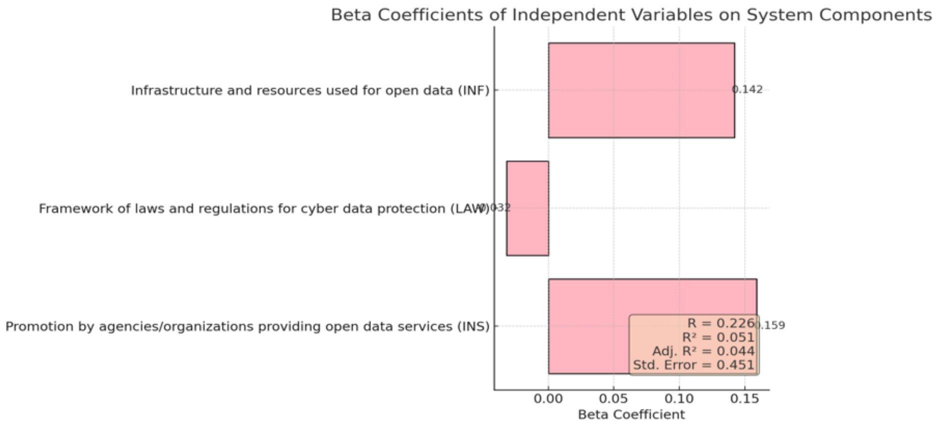

Fig 3. Beta Coefficients of Independent Variables on System Components

The analysis from table 6 reveals that the promotion by agencies/organizations providing open data services (INS) and the infrastructure and resources used for open data (INF) significantly influence system components (DX43) at the 0.01 significance level, with regression coefficients of 0.128 and 0.120, respectively. The multiple correlation coefficient (R) is 0.226, and the adjusted R Square is 0.044, indicating that 4.4 percent of the variability is predictable.

Table 7 : Testing the Influence of Independent Variables (Promotion by Agencies/Organizations Providing Open Data Services) on the Dependent Variable (Development of Frameworks for Integrating Public Sector Data to Unlock Data Potential: System Interfaces), n=393

Independent Variables	System Interfaces					
	B	Std. Error	Beta	t	p-value	VIF
(Constant)	3.766	0.328		11.471	0.000***	
Promotion by agencies/organizations providing open data services (INS)	0.067	0.049	0.079	1.368	0.172	1.394
Framework of laws and regulations for cyber data protection (LAW)	0.033	0.059	0.032	0.557	0.578	1.363
Infrastructure and resources used for open data (INF)	0.173	0.045	0.198	3.876	0.000***	1.085

R = 0.246, R^2 = 0.060, Adj. R^2 = 0.053, Std. Error of the Estimate = 0.465*p < 0.1, **p < 0.05, ***p < 0.01

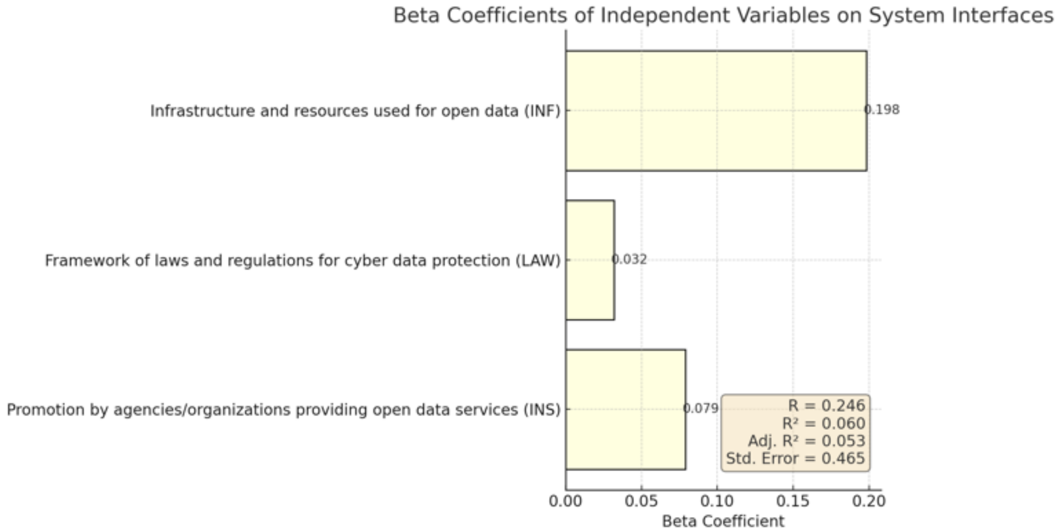

Fig 4. Beta Coefficients of Independent Variables on System Interfaces

The analysis from table 7 reveals that the infrastructure and resources used for open data (INF) significantly influence the system interfaces (DX44) with a regression coefficient of 0.173 at the 0.01 significance level. The multiple correlation coefficient (R) is 0.246, and the adjusted R Square is 0.053, indicating that 5.3% of the variability can be predicted.

Table 8 : Testing the Influence of Independent Variables (Promotion by Agencies/Organizations Providing Open Data Services) on the Dependent Variable (Development of Frameworks for Integrating Public Sector Data to Unlock Data Potential: Basic System Services), n = 393

Independent Variables	Service of system					
	B	Std. Error	Beta	t	p-value	VIF
(Constant)	4.220	0.351		12.031	0.000***	
Promotion by agencies/organizations providing open data services (INS)	0.094	0.052	0.106	1.803	0.072*	1.394
Framework of laws and regulations for cyber data protection (LAW)	-0.083	0.063	-0.076	-1.318	0.188	1.363
Infrastructure and resources used for open data (INF)	0.161	0.048	0.174	3.363	0.001***	1.085

R = 0.207, R^2 = 0.043, Adj. R^2 = 0.035, Std. Error of the Estimate = 0.497*p < 0.1, **p < 0.05, ***p < 0.01

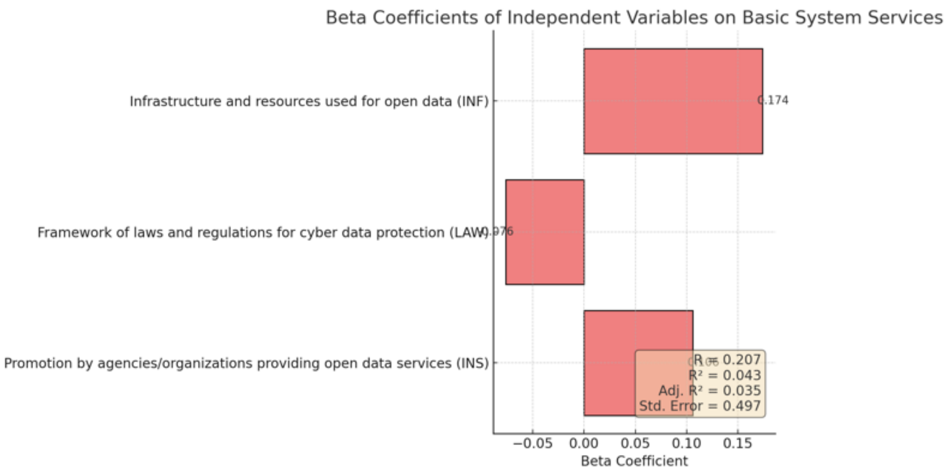

Fig 5. Beta Coefficients of Independent Variables on System Services

The analysis presented in table 8 indicates that the promotion by agencies/organizations providing open data services (INS) has a statistically significant influence on basic system services (DX45) at the 0.10 significance level. In contrast, the infrastructure and resources used for open data (INF) have a substantial influence on basic system services (DX45), with a regression coefficient of 0.161, statistically significant at the 0.01 level. The multiple correlation coefficient (R) is 0.207, and the adjusted R Square is 0.035, indicating that 3.5% of the variability in basic system services can be predicted by the model.

Table 9**:** tests the influence of the independent variable (the development of frameworks for integrating public sector data to unlock data potential) on the dependent variable (the benefits of data disclosure to public sector agencies), with a sample size of 393.

Independent Variables	the benefits of data disclosure to public sector agencies					
	B	Std. Error	Beta	t	p-value	VIF
(Constant)	2.969	0.359		8.268	0.000***	
Basic data exchange platform (DX41)	0.084	0.050	0.095	1.677	0.094*	1.499
Advanced data exchange platform (DX42)	0.331	0.071	0.261	4.637	0.000***	1.487
System components (DX43)	-0.218	0.062	-0.210	-3.525	0.000***	1.667
System interfaces (DX44)	0.159	0.063	0.159	2.539	0.012**	1.839
Basic system services (DX45)	0.150	0.055	0.159	2.720	0.007***	1.601

R = 0.416, R^2 = 0.173, Adj. R^2 = 0.163, Std. Error of the Estimate = 0.437*p < 0.1, **p < 0.05, ***p < 0.01

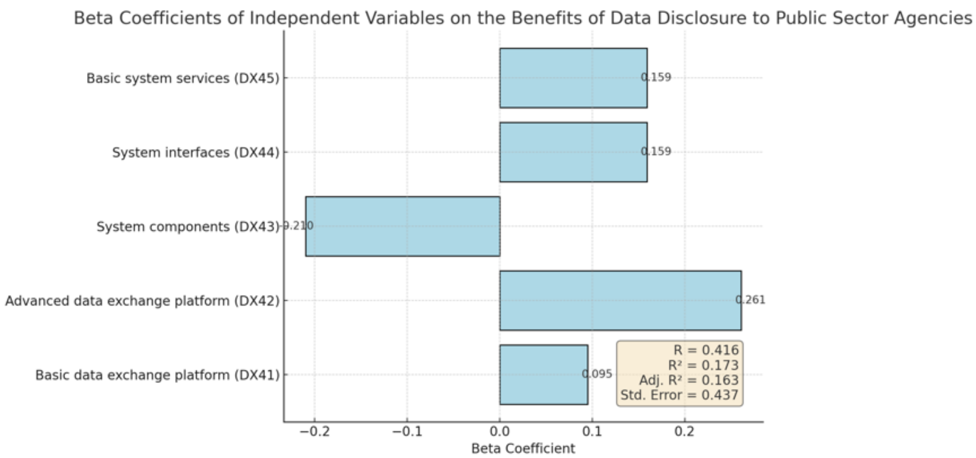

Fig 6. Beta Coefficients of Independent Variables on the Benefits of Data Disclosure to Public Sector Agencies

The analysis from table 9 reveals that the basic data exchange platform (DX41) influences the benefits of data disclosure to public sector agencies (USE51) with a regression coefficient of 0.050, significant at the 0.10 level. The system interfaces (DX44) factor has an influence on the benefits of data disclosure to public sector agencies (USE51) with a regression coefficient of 0.159, significant at the 0.05 level. Meanwhile, the advanced data exchange platform (DX42), system components (DX43), and basic system services (DX45) significantly influence the benefits of data disclosure to public sector agencies (USE51) at the 0.01 level, with regression coefficients of 0.331, -0.218, and 0.150, respectively. The multiple correlation coefficient (R) is 0.416, and the adjusted R Square is 0.163, indicating that 16.3 percent of the variability in the benefits of data disclosure to public sector agencies can be predicted.
However, the negative regression coefficient for the system components factor (DX43) suggests that

the current state of system components lacks readiness for proactive operation. Nonetheless, the ongoing development of open data systems is considered beneficial for the operations of public sector agencies in both provinces.

Table 10: tests the influence of the independent variable (the development of frameworks for integrating public sector data to unlock data potential) on the dependent variable (the benefits of data disclosure to private sector agencies), with a sample size of 393.

Independent Variables	the benefits of data disclosure to private sector agencies					
	B	Std. Error	Beta	t	p-value	VIF
(Constant)	1.355	0.379		3.573	0.000***	
Basic data exchange platform (DX41)	0.031	0.053	0.032	0.586	0.558	1.499
Advanced data exchange platform (DX42)	0.117	0.075	0.083	1.549	0.122	1.487
System components (DX43)	0.378	0.065	0.328	5.786	0.000***	1.667
System interfaces (DX44)	0.208	0.066	0.187	3.138	0.002***	1.839
Basic system services (DX45)	-0.028	0.058	-0.027	-0.482	0.630	1.601

$R = 0.503$, $R^2 = 0.253$, Adj. $R^2 = 0.243$, Std. Error of the Estimate = 0.462*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

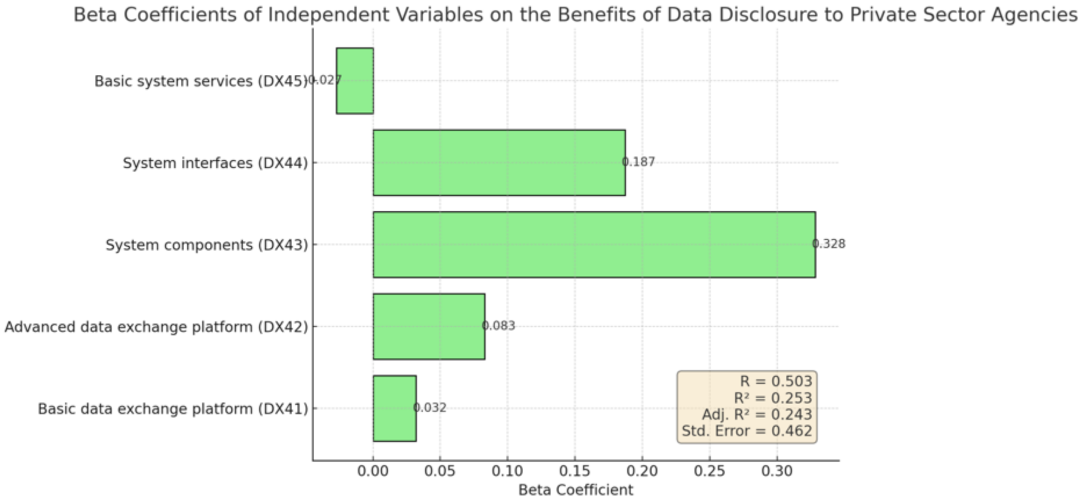

Fig 7. Beta Coefficients of Independent Variables on the Benefits of Data Disclosure to Private Sector Agencies.

The analysis from table 10 reveals that the factors of system components (DX43) and system interfaces (DX44) significantly influence the benefits of data disclosure to private sector agencies (USE52) at the 0.01 significance level, with regression coefficients of 0.378 and 0.208, respectively. The multiple correlation coefficient (R) is 0.503, and the adjusted R Square is 0.243, indicating that 24.3 percent of the variability in the benefits of data disclosure to private sector agencies can be predicted.

Table 11: tests the influence of the independent variable (the development of frameworks for integrating public sector data to unlock data potential) on the dependent variable (the benefits of data disclosure to the public), with a sample size of 393.

Independent Variables	the benefits of data disclosure to the public					
	B	Std. Error	Beta	t	p-value	VIF
(Constant)	1.573	0.324		4.860	0.000***	
Basic data exchange platform (DX41)	0.097	0.045	0.109	2.132	0.034**	1.499

Independent Variables	the benefits of data disclosure to the public					
	B	Std. Error	Beta	t	p-value	VIF
Advanced data exchange platform (DX42)	0.406	0.064	0.323	6.308	0.000***	1.487
System components (DX43)	-0.170	0.056	-0.165	-3.053	0.002***	1.667
System interfaces (DX44)	0.239	0.056	0.241	4.233	0.000***	1.839
Basic system services (DX45)	0.169	0.050	0.180	3.387	0.001***	1.601

R = 0.565, R^2 = 0.319, Adj. R^2 = 0.310, Std. Error of the Estimate = 0.394 *p < 0.1, **p < 0.05, ***p < 0.01

The analysis from table 11 reveals that the basic data exchange platform (DX41) significantly influences the benefits of data disclosure to the public (USE53) with a regression coefficient of 0.406 at the 0.05 significance level. Meanwhile, the factors of the advanced data exchange platform (DX42), system components (DX43), system interfaces (DX44), and basic system services (DX45) significantly influence the benefits of data disclosure to the public (USE53) at the 0.01 significance level, with regression coefficients of 0.406, -0.170, 0.239, and 0.169, respectively. The multiple correlation coefficient (R) is 0.565, and the adjusted R Square is 0.310, indicating that 31.0 percent of the variability in the benefits of data disclosure to the public can be predicted. However, the negative regression coefficient for system components (DX43) suggests that the current state of system components may not be adequately prepared to meet the public's needs. Nevertheless, the public can still benefit from the open data currently available.

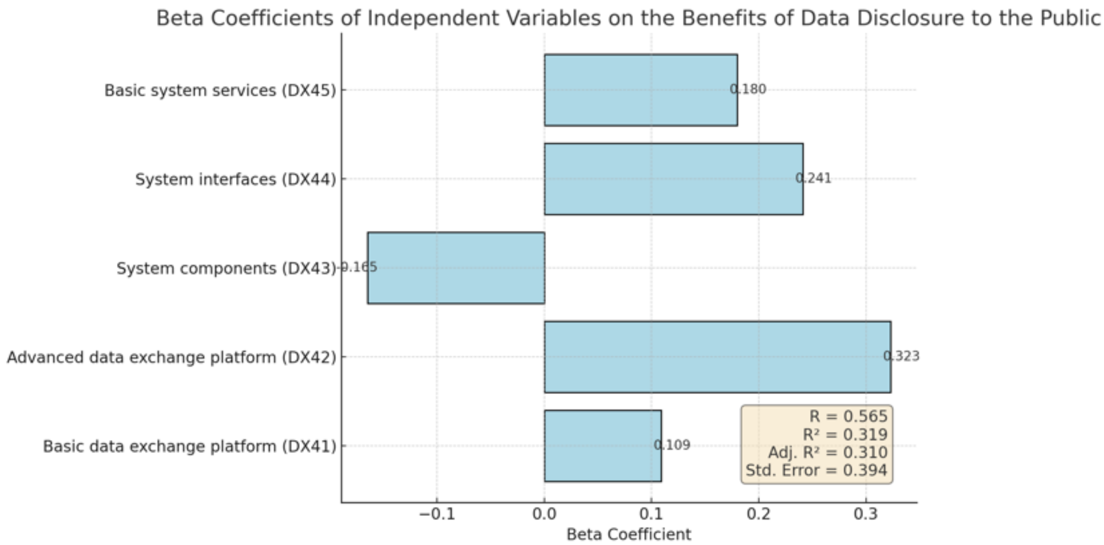

Fig 8. Beta Coefficients of Independent Variables on the Benefits of Data Disclosure to the Public.

5. Discussion and Conclusions

This study developed an integrated framework for open government data in Thailand, addressing a significant gap in the literature on OGD implementation in developing countries. The findings highlight the complex interplay of technical, organizational, and policy factors in successful OGD initiatives. Three categories can be used to analyse how government agencies affect government data linking and exchange standards: data exchange platform providers, data service provider groups, and data service user groups. Key challenges identified include limited personnel skills, inadequate infrastructure, and the need for stronger legal frameworks. The proposed framework provides a roadmap for policymakers and practitioners to enhance OGD implementation in Thailand and potentially other developing countries.

The results of testing the influence of independent variables on dependent variables with statistical significance can be summarized as follows:

1. Framework of laws and regulations for cyber data protection has a positive impact on the operational principles of basic data exchange platforms. This suggests that a robust legal framework enhances the effective functioning of these platforms, ensuring secure and reliable data exchange.
2. Infrastructure and resources used for open data have a positive impact on the design of open data system interfaces. Adequate infrastructure and resources are critical for the development of user-friendly and efficient interfaces, facilitating smoother interactions with open data systems.
3. The interface of the open data system positively impacts the benefits of data disclosure for public sector agencies. A well-designed interface improves accessibility and usability, thereby enhancing the utility of disclosed data for governmental decision-making and service delivery.
4. Advanced data exchange platforms and the interface of the open data system positively affect the benefits of data disclosure for the public. These factors contribute to making data more accessible and useful for citizens, fostering greater transparency and public engagement with government data.

Future research should focus on testing the framework's applicability in different contexts and exploring the long-term impacts of OGD initiatives on government transparency and public service delivery. Limitations of this study include its focus on two provinces, which may limit generalizability, and the cross-sectional nature of the data, which doesn't capture the evolving nature of OGD implementation over time.

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