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A SYSTEMATIC LITERATURE REVIEW ON OPEN GOVERNMENT DATA: CHALLENGES AND MAPPED SOLUTIONS

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ABSTRACT

Open Government Data (OGD) has grown exponentially in the last few years and has served as the bedrock of a data-driven nation. OGD helps government promotes transparency and foster innovation throughout the nation. As Indonesia promulgated Satu Data Indonesia (SDI) policy in 2019, the country faces challenges in implementing SDI. Using a systematic review method, Preferred Reporting Items for Systematic Review and Meta-analyses Method (PRISMA) 2020, this research aims to uncover the challenges of implementing OGD and map the possible solutions to address the barriers. The authors discover 23 challenges in OGD implementation grouped by the TOE framework and 12 remedies grouped by the UTAUT framework. Organisational barriers become the most common problem in OGD initiatives, while solutions in *facilitating conditions* constitute the most common solution. The authors then mapped the challenges into the solutions. This study therefore could assist other researchers in OGD-related studies and provide governments with an in-depth reference for OGD implementation guidelines in the future.

Keywords: *Open Data, Open Government Data, OGD, Government, Systematic Literature Review, Challenges, Solutions, TOE Framework, UTAUT Framework*

1. INTRODUCTION

Since its inception in 2009 [1], [2], Open Government Data (OGD) has grown exponentially [3] in the last few years and has served as the bedrock for a data-driven nation. In the last decades, governments have collected a plethora of data to perform their tasks, and government data must be made available publicly [4]. OGD therefore holds an increasingly pivotal role [5]. As OGD embodies the value of government [4], the Indonesian government regulated a policy regarding this issue. In 2014, the Indonesian government established the Indonesia data portal, Portal Satu Data Indonesia (data.go.id), to promote and encourage transparency in government data [6].

Nevertheless, inconsistency occurred as there was no legal standing regarding data governance [7]. In 2016, President Joko Widodo coined "Satu Data Indonesia" (SDI), followed by a regulation in 2019: *Presidential Decree Number 39 of 2019*. Unlike the 12 principles of open data by the Open Knowledge Foundation [1] or seven principles by the United Kingdom's Government [8], ministries/agencies must follow four fundamental principles of SDI: *data standard, metadata, interoperability*, and *reference code* [7]. Through these concepts, the Indonesian government intends to deliver accurate, up-to-date, integrated, accountable, accessible, and interchangeable government data for cohesive planning, execution, evaluation, and supervision of the national development agenda [7].

However, only a handful of derivative policies were made to follow up, such as Badan Pusat Statistik (Statistics Indonesia) with three decrees about reference code, data standard, and metadata[1]; Badan Informasi Geospasial (Geospatial Information Agency) with regulation for data standard and metadata[2]. Also, in 2022, the

[1] https://www.bps.go.id/menu/8/Peraturan.html. Accessed: 12 September 2022

[2] https://jdih.big.go.id/id/produk-hukum/47942244. Accessed: 12 September 2022

government commences the OGD journey by finalising an action plan that comprises 618 types of data priority[3]. The OGD initiative's lateness reflected Indonesia's global rank in 61st position[4]. Yet, the Indonesian government joins the global movement to fully adopt and exercise OGD policy in the future [9]; thus, the Indonesian government must prepare and be ready to overcome the upcoming challenges.

Using the Technological, Organisational, and Environmental (TOE) framework, Haini et al. (2020) [10] identify 16 challenges influencing the adoption of OGD, while Bachtiar et al. (2019) [11] pinpoints 19 barriers to Open Government. Okamoto 2017 [2] posits that challenges in the OGD implementation process require specific approaches to solve. Accordingly, Ahn & Chu (2021) [12] underline institutional factors as the success factor for OGD adoption. Roa et al. (2019) [13] also claim that administering the Unified Theory of Acceptance and Use of Technology (UTAUT) framework elaborates the success factors in the OGD implementation phase.

Previous studies in OGD only propose the challenges and issues or discuss the critical success factors. Roa et al. (2019) [13] and Bachtiar et al. (2019) [11] elaborate problems occurred in the process of OGD initiatives without offering solutions. In a similar fashion, Ahn & Chu (2021) [12] only highlight success factors in the implementation of OGD without pinpoint the preceding problems. This study therefore aims to unravel the challenges of OGD implementation in several countries and map the possible solutions. This research can contribute to academics and practitioners in OGD. The mapping of problems and possible solutions may provide government with an in-depth reference for OGD implementation in the future. This systematic review presents the following research questions:

RQ1: What are the challenges of OGD implementation in current references?

RQ2: What possible solutions to overcome the barriers to implementing OGD?

RQ3: What is the relation between the challenges and the solutions of OGD implementation?

The study is organised as follows: Section 2 elaborates theoretical background; Section 3 explains the research methodology; Section 4 presents the results of the research, implications, and limitations; Section 5 closes the research with the conclusion and future works.

2. THEORETICAL BACKGROUND

2.1 Open Government Data (OGD)

OGD is data produced using state funds and made available without restrictions regarding usage or distribution [2]. The presence of OGD unravels many benefits: transparency, democratic control, self-empowerment, improved services, innovation, efficiency and effectiveness in government services, economic growth, engagement of civil society, and the birth of new knowledge [2]–[4]. Negara (2021) [14] argues that open data from the government can be used as a benchmark to measure policies. OGD therefore becomes a government mechanism involving citizens to engage and utilise government data to achieve the government's and citizens' goals [6].

2.2 Technological, Organisational, and Environmental (TOE) Framework

Baker (2012) [15] explains that the TOE framework is an organisation-level theory expounding three unique elements that influence adoption decisions and technological innovation: *technological, organisational*, and *environmental*. The freedom to vary the factors for identifying new research, such as a literature review on OGD adoption [16], makes the TOE framework highly adaptable and is widely used [17]; thus, researchers have successfully mapped the challenges in OGD adoption using this framework [10], [11].

The technological dimension includes internal and external elements relevant to an organisation, including equipment and processes [15]. Some of the identified factors from many studies are *perceived barriers, perceived benefits/advantages, compliance, compatibility, readiness, infrastructure, data governance, complexity, vendor pressure, competency,* and *data quality* [10], [15], [18].

The organisational dimension refers to the characteristics and resources such as the organisation's size, approach (centralised or decentralised), intra-organisation communication processes, and more [15], [17]. As for this dimension, the identified factors are *satisfaction (with existing systems), organisation's size, planning, current infrastructure, centralisation, formalisation, integration, financial cost, technical competence and knowledge, top management*

[3] https://www.bappenas.go.id/id/berita/susun-data-prioritas-2022-bappenas-bidik-percepatan-satu-data-indonesia-oxDfi. Accessed: 12 Septmeber 2022

[4] http://index.okfn.org/place.html. Accessed: 12 September 2022

support, organisational readiness, and *organisational culture* [10], [15], [18].

The environmental dimension, moreover, includes the industry structure, the status of technology service providers, and the regulatory environment [15]. In this dimension, some researchers enlist the following factors: *uncertainty, citizen readiness, citizen demand, social and economic pressure, legislation and political influence,* and *external pressure* [10], [15], [18].

2.3 The Unified Theory of Acceptance and Use of Technology (UTAUT) Framework

UTAUT was established to understand information system/information technology adoption and diffusion and to examine the users' acceptance of new technologies and their intention to use them [15]. UTAUT postulates four core constructs: *performance expectancy, effort expectancy, social influence,* and *facilitating conditions* [19]. Venkatesh et al. (2003) [19] insist that these constructs are predictors of information system/information technology *behavioural intention* and *ultimately behaviour*. In addition, Venkatesh et al. (2003) [19] state that those four constructs are moderated by *gender, age, experience*, and *voluntariness of use*.

According to Abubakar & Ahmad (2013) [20], UTAUT remain the focal point of acceptance models. Taherdoost (2018) [21] also claims that UTAUT possesses high efficiency and explanatory capability. The UTAUT model therefore has proven effective in understanding the acceptance factors in new technological approaches such as e-government adoption [22]. The following are key areas in this framework:

The *Performance Expectancy* construct defines the degree of individual belief in which one feels that using the system will help improve his or her job performance [15], [19]. In the *Effort Expectancy* construct, the concept institutes a degree of ease associated with the use of the adopted technology [15], [19], [22]. In *Social Influence* construct, Venkatesh et al. (2003) [19] expound that an individual perceives people around him or her should use the newly adopted technology or system. As for the *Facilitating Conditions* construct, the concept offers a depiction of the degree to which an individual believes that organisational and technical infrastructure support the use of the system [15], [19].

3. RESEARCH METHODOLOGY

3.1. Methodological Framework

A systematic literature review (SLR) provides syntheses of the state-of-the-art (SOTA) in a field to introduce, examine, and interpret previous studies wholly and transparently [23], [24]. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach has shown to be efficient, trustworthy, and complete since its inception in 1999 [25] and its further developments [26], [27]. The current PRISMA 2020 approach includes reporting instructions, including a 27-item checklist for reporting an SLR, a 12-item abstract checklist, and a flow diagram [27]. All these items help researchers execute original and updated reviews [24]. PRISMA 2020, moreover, also offers a three-step mechanism for conducting original SLR: *Identification, Screening*, and *Included* [28].

3.2. Planning the SLR

To select literature for analysis, the authors plan the strategy: databases, keywords, and search criteria (inclusion and exclusion).

First, *the databases*. The search strategy includes database selection, namely:

- ScienceDirect (sciencedirect.com)
- Scopus (scopus.com)
- ProQuest (proquest.com)
- IEEE Xplore (ieeexplore.ieee.org).

Second, *the keywords*. The search strategy was formulated to find the correct keywords for accurate literature. The first part of the keywords was used to detect and identify the challenges/issues/barriers and solutions/success/solution in OGD; thus, it was defined as (***"CHALLENGE" OR "BARRIER" OR "PROBLEM" OR "OBSTACLE" OR "FACTOR" OR "SUCCESS" OR "SOLUTION"***). The second part was focused on OGD; thus, it was formulated as ***"OPEN GOVERNMENT DATA"***. The combination of the first and second parts became the final query: ***("CHALLENGE" OR "BARRIER" OR "PROBLEM" OR "LIMITATION" OR "OBSTACLE" OR "FACTOR" OR "SUCCESS" OR "SOLUTION") AND "OPEN GOVERNMENT DATA"***. The query was then applied to the publication title, abstract, and keywords to determine the relevant publications from specified.

Third, *the search criteria* (inclusion and exclusion). The inclusion (IN) and exclusion (EX) criteria defined the expected results of the SLR process, as shown in Table 1.

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Table 1: Search Criteria

Type	Criteria	Code
Inclusion	Articles published between 2019 and 2022	IN1
	Articles are written in English	IN2
	Articles related to and focused on OGD	IN3
	Articles published in international journals or conferences	IN4
Exclusion	Articles focused on other than challenges or solutions	EX1
	Full-text access is not available	EX2
	Working papers, presentation	EX3
	Articles focused on private sectors	EX4
	Duplicate studies	EX5
	SLR papers	EX6

Table 2: Quality Assessment Questions

Code	Question
Q1	Are the research objectives clearly stated?
Q2	Does the article discuss real-life problems or solutions?
Q3	Are the presented results unambiguous?
Q4	Are the results interpreted and discussed?
Q5	Does the conclusion answer the research questions?
Q6	Does the article contain future research directions?

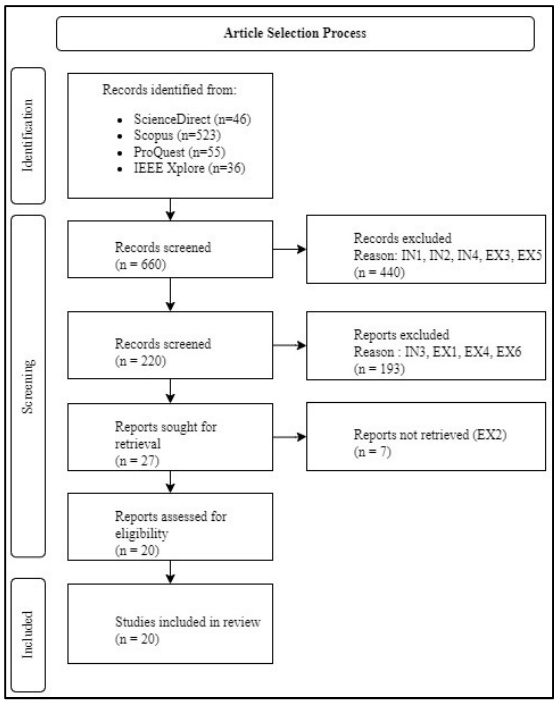

Figure 1: Research Flow Diagram

3.3. Implementing the SLR

The authors initiated the SLR process with the *identification, screening*, and *included stage*, as shown in Figure 1. At the identification stage, WSW administered the query and identified 660 articles from five databases. Then, in the screening stage, the WSW implemented IN1, IN2, IN4, EX3, and EX5 to filter the publications, excluding 440 articles and resulting in 220 studies for further screening. Furthermore, WSW executed IN3, EX1, EX4, and EX6 to refine the search, eliminating 193 publications and resulting in 27 publications for the retrieval process. Finally, WSW applied the final component (EX2), which resulted in 20 final publications.

After the retrieval process, the authors apply quality assessment criteria (QAC) to those articles that could achieve the objectives posed in this study. Table 2 consists of 6 questions to check the quality of the studies with a yes-or-no answer. All authors then review the selected articles. However, the quality review process did not eliminate any publication, as all the articles fit the quality assessment. This process therefore included all 20 publications. WSW, DIS, and SL researchers then analysed the articles to answer the research questions.

4. RESULT AND DISCUSSION

As the final report of this study, the authors categorise challenges based on the TOE framework [15]. In the following subsection, the authors analysed and categorised the solutions based on the UTAUT framework from the selected articles and open data principles [1], [8], [29]. Finally, the authors mapped the challenges to the solutions.

The area of observation from selected publications can be seen in Table 3. Europe becomes the focal point, with seven articles focusing on European public sectors. In addition, five articles opt for observation by taking samples from public sectors worldwide. As for the publication year, these articles have a negative trend, from ten articles in 2019 to one in 2022.

Table 3: Area of Observation

Item	Articles	Total
Area of Observation		
Africa	[30]–[32]	3
Asia	[33]	1
Europe	[34]–[40]	7
South East Asia	[9], [41], [42]	3
Worldwide	[12], [13], [43]–[46]	6

Item	Articles	Total
Published year		
2019	[13], [30], [32]–[34], [36]–[39], [41]	10
2020	[9], [40], [42], [45]	4
2021	[12], [31], [35], [44], [46]	5
2022	[43]	1

Table 4: Classification of Challenges

Code	Challenges	Article	Total
Technological			
p1a	Perceived Barriers	[13], [37], [39], [46]	4
p1b	Perceived Benefits/Advantages	[34], [36], [39]	3
p1c	Compliance	[32], [34], [36]	3
p1d	Compatibility	[13], [30], [46]	3
p1e	Infrastructure	[9], [34], [36]	3
p1f	Data Governance	[9], [13], [30], [32], [35], [36], [41], [44]	8
p1g	Complexity	[30], [32], [37], [45], [46]	5
p1h	Data Quality	[9], [13], [45], [46], [30]–[32], [34]–[36], [39], [41]	12
Organisational			
p2a	Planning	[30], [36]	2
p2b	Current Infrastructure	[13], [30], [37]	3
p2c	Centralisation	[36]	1
p2d	Formalisation	[30]	1
p2e	Integration	[13], [30], [35], [37]	4
p2f	Financial Cost	[13], [30], [33]–[36], [39]	7
p2g	Technical Competence and Knowledge	[13], [30], [34]–[37], [39], [41]	8
p2h	Top Management Support	[13], [30], [39], [41]	4
p2i	Organisational Readiness	[13], [30], [36], [37], [39], [41]	6
p2j	Organisational Culture	[13], [35]–[37], [39], [41]	6
Environmental			
p3a	Uncertainty	[9], [30], [32]	3
p3b	Citizen Readiness	[13], [30], [36], [39]	4
p3c	Citizen Demand	[13], [30], [36], [39], [40], [43], [46]	7
p3d	Social And Economic Pressure	[13]	1
p3e	Legislation And Political Influence	[13], [30], [31], [34], [36], [37], [39], [41], [46]	9

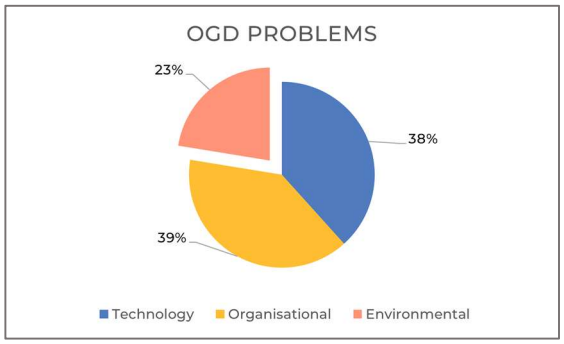

Figure 2: Distribution of OGD-related problems

4.1. Classification of Challenges

***RQ1**: What are the challenges of OGD implementation in current references?*

In this subsection, the authors aimed to answer **RQ1**. The classification process has identified challenges from selected publications in the TOE framework, as depicted in Table 4. The problems are then classified into three categories: *Technological, Organisational*, and *Environmental*. According to Figure 2 and Table 4, the organisational barriers become the most common problem in OGD initiatives as they are mentioned 42 times in 9 articles, with an estimation of 39% of total mentions, and are closely followed by the technological barriers and the environmental barriers, with 41 mentions from 14 studies and 24 mentions from 13 studies respectively.

In the *technological dimension*, problems regarding *data quality* hinder OGD implementation. Out of date, ambiguity, incomplete, invalid, unavailable—these are some of the mentioned conditions related to data quality from the selected studies, both from developed countries [36], [39] and emerging countries [30]–[32]. The issue around the technological dimension also circulates from the *data governance* perspective regarding data standards, interoperability, data life cycles, and the exercise of good data governance [9], [13], [30], [32], [35], [36], [41], [44]. Furthermore, Roa et al. (2019) [13] believe that the concept of transparency and accountability in OGD may lead to compatibility issues against citizens' right to privacy.

The biggest challenges, however, come from the *organisational dimension*, which encapsulates ten types of obstacles. *Technical Competence and Knowledge* factor is referred to in 8 different pieces of literature. These articles pinpoint the problem occurring within the organisation in charge of OGD initiatives. Wang et al. (2019) [39] argue that implementing OGD requires considerable effort

from civil servants, relies on the skills of a few resourceful government employees, and is hindered by technical resources. The *financial cost* factor also burdens the implementation as the organisation gets neither sufficient budget nor access to budget [13], [30], [33]–[36], [39]. However, among selected publications, two articles feature *centralisation* and *integration*. Safarov (2019) [36] weighs the nature of the non-centralisation approach in Swedish public administration affects the OGD initiative, while Donald Shao & Saxena (2019) [30] express that the absence of a legally institutional framework triggers inter-departmental conflicts among government bodies in Tanzania.

The *environmental dimension* is the last concern in OGD implementation, with 24 occurrences from 13 selected articles. The most notable issue raised by these articles is the *legislative and political influence* followed by the *citizen consideration*. Albeit legal frameworks exist, Jacob et al. (2020) [41] and Roa et al. (2019) [13] discover that no specific and integrated OGD policies are promulgated. Donald Shao & Saxena (2019) [30] also discovered that OGD-related policies require substantial revision and may take time to implement. Other articles also cite the privacy concerns which prevent the legislative body from publishing OGD policies. In addition, seven articles mention that citizens also play a crucial role in the OGD initiative: *low demand and usage*, *lack of understanding and awareness*, *difficult access*, and *little to no support* [13], [30], [36], [39], [40], [43], [46].

Given the above, the authors have identified 23 challenges classified into three categories (based on the TOE framework) preventing OGD initiatives in public sectors.

4.2. Classification of Solutions

RQ2*: What possible solutions to overcome the barriers to implementing OGD?*

This subsection expounds on the plausible solutions derived from selected publications and Open Data Principles (ODP) [1], [8], [29]. The authors then map those solutions based on the UTAUT framework seen in Table 5.

Table 5: Classification of Solutions

Code	Solution	Article	ODP	Total
Effort Expectancy				
s1a	Budget Access and Financial Aid	[12], [33], [36], [38], [39], [42]	[8]	7
s1b	Data Quality Improvement	[30], [32], [37], [41], [43], [45]	[1], [29]	8
s1c	Good Data Governance	[36]	[1], [8], [29]	4
Facilitating Conditions				
s2a	Service Improvement	[12], [31], [32], [35], [36], [39], [43], [44]	[1], [8], [29]	11
s2b	Taskforce Assistance	[9], [36], [37]		3
s2c	Supporting Technology and Infrastrcture	[9], [12], [46], [30], [32], [34]–[37], [40], [44]	[1], [8], [29]	14
s2d	Training	[30], [36], [46]		3
Performance Expectancy				
s3a	Organisational Competency	[12], [35], [36], [42], [44]	[29]	6
s3b	Organisational Cultures	[33], [34], [36], [39], [46]	[1], [8], [29]	8
s3c	Stakeholder Initiative and Support	[9], [30], [34]–[36], [38], [42]	[29]	8
Social Influence				
s4a	Compliance to Standards	[12], [31], [35], [39], [42]	[1], [8], [29]	8
s4b	Legal Standing	[30], [36], [38], [39]	[1]	5
s4c	Supportive and Collaborative Ecosystem	[9], [12], [30], [31], [35], [36], [42], [44], [45]	[1], [8], [29]	12

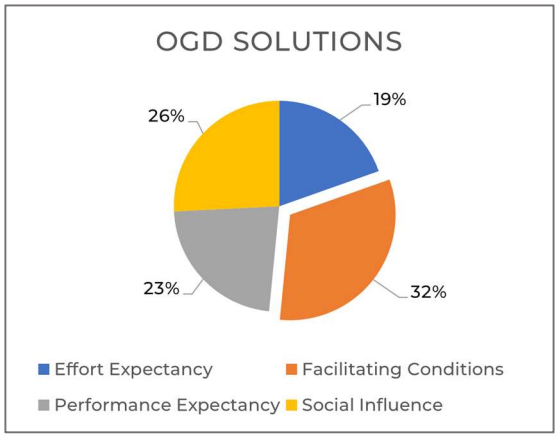

Figure 3: Distribution of solutions

After analysing the selected articles and related works, the authors discover 13 solutions and argue that *Facilitating Conditions* has become the top solution in OGD implementation. Fourteen articles

refer to *Supporting Technology and Infrastructure (s2c)* as the success factor, followed by *Supportive and Collaborative Ecosystem (s4c)* and *Service Improvement (s2a)*. The least mentioned factors among the articles are *Taskforce Assistance (s2b)* and *Training (s2d)*, with three articles each.

In the *Effort Expectancy* construct, *Data Quality Improvement (s1b)* and *Budget Access and Financial Aid (s1a)* become the viable solutions from the study. The European-based public sectors have proven successful in OGD implementation with the provision of access to budget and amended budgets [36], [38]. While Jacob et al. (2019) [41] theorise that *harmonised standards and formats* for data management might be a solution for the Indonesian Government, Nikiforova (2020) [45] posits *that timeliness and regularly updated data* have proven effective. Shepherd et al. (2019) [37] also reaffirm that complete and accurate metadata in the data sets could help establish the context and subsequently assist the interpretation.

The *Facilitating Condition* construct, moreover, proposes *Supporting Technology and Infrastructure* (s2c) as the most critical factor. Open data portals, data processing technology, ICT infrastructure, and semantic technology are some of the indicators from the articles. Elmekki et al. (2019) [32] even specify the need for *Access Dataset Engine, Structure Analyser Engine, Data Transformer engine and Linking Data Engine* to improve the machine readability of OGD. Additionally, *improving services* (s2a) such as data visualisation, feedback and quality rating, and API-based communication may lead to a successful implementation of OGD [12], [31], [32], [35], [36], [39], [43], [44].

In the *Performance Expectancy*, establishing *new organisational cultures (s3b)* and *receiving stakeholders' support (s3c)* become the common ground for OGD implementation. An organisation must change the mental attitude of managers into data-centric and user-centric culture [34], [46]. Information institutionalisation, for instance, has significantly influenced open data's success in Korea [33]. In addition, interests, awareness, support, and participation from stakeholders in public and private sectors can also improve the likelihood of a successful OGD implementation [9], [29], [30], [34]–[36], [38], [42].

The last dimension, *Social Influence*, presents an invaluable insight: *Supportive and Collaborative Ecosystem (s4c)*. The answer leads to a call for the development of an ecosystem that fosters experimentation and co-creation cultures among citizens, industry, and research institutions at all levels: from local to global [9], [35]. The findings from Safarov (2019) [36] highlight the chain event from this solution: public support empowers new users, innovations, and involvement, leading to a push for government entities to strengthen OGD policies and release additional data sets to meet public demand.

4.3. Proposed Relation of Challenges to Solutions

Table 6: Mapping Challenges to Solutions

Challenge	Solution
Technological Dimension	
p1a	s2b, s2c, s3c, s1c
p1b	s2b, s2c, s3c, s4c, s1c
p1c	s4a, s4b, s3a,s1c
p1d	s4a, s4b, s3a,s1c
p1e	s1a, s3a, s3b, s3c, s4b
p1f	s1c, s3a, s3c, s4a, s2b, s2c, s2d
p1g	s2b, s2c, s3a, s4c
p1h	s1b, s1c, s4c, s2d, s2c
Organisational Dimension	
p2a	s3c,s3b,s1c
p2b	s2c, s4b, s3c
p2c	s3b, s3c, s2c
p2d	s4b, s3c, s4c
p2e	s2b, s2d, s3a, s4b
p2f	s1a, s3c, s4b
p2g	s1a, s2b, s2d, s3a, s3c, s4c
p2h	s3c, s3b, s1c
p2i	s3a, s2d. s2b, s1c
p2j	s3b, s3c, s4b, s4c
Environmental Dimension	
p3a	s4b, s4c
p3b	s2a,s2b,s4c
p3c	s4a,s4b,s4c,s2a
p3d	s4c,s1a,s2c
p3e	s3c, s4b, s4c

Before proposing the relationship between challenges and solutions, the authors mapped the location of challenges and solutions from the selected articles in **Appendix A**. The findings from Donald Shao & Saxena (2019) [30] contribute to 16 problems in this study, followed by 14 problems from Roa et al. (2019) [13] and Safarov (2019) [36]. As for the solutions, Safarov (2019) [36] posits eleven success factors in implementing OGD from

the Netherlands, Sweden and the UK. In total, findings from Safarov (2019) [36] and Donald Shao & Saxena (2019) [30] remain beneficial in this study.

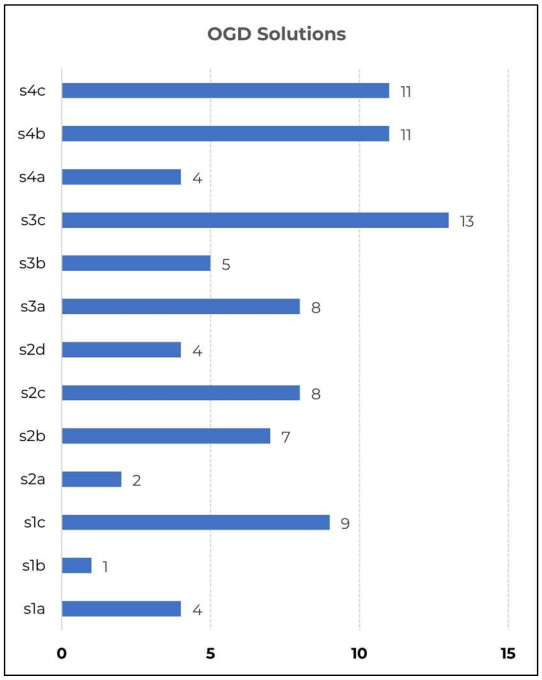

Figure 4: Frequency of solutions in the mapping

***RQ3**: What is the mapping between the challenges and the solutions of OGD implementation?*

To answer the challenges stemming from *Technological Dimension*, the authors insist that using solutions from *effort expectancy* as the foundation will ease the problem as the construct proposes ease of use regarding the newly adopted technology/system. Exercising *good data governance* (s1c) will influence the management of data, in line with the *data quality improvement* solution (s1b) [36]. Data Governance provides a readiness assessment to tackle perceived barriers (p1a) and handle perceived compliance (p1b). The data governance strategy aligns the responsible organisation with selecting appropriate infrastructures (p1e) according to data needs, leading to regulatory compliance (p1c) along with better data dissemination and quality (p1d, p1g, p1h) [1], [45], [47]. An organisation can obtain *supporting technology and infrastructure* (s2c) with adequate data governance to exercise OGD practices [12].

In dealing with the *Organisational Dimension*, the authors pinpoint *facilitating conditions, performance expectancy*, and *social influence* as the base of the solution. The constructs help an individual believe in organisational and technical support, leading to a personal belief that OGD improves their performance and convincing other individuals to participate in OGD practices. Albeit lack of resources, stakeholder initiatives and support (s3c) trigger *a domino effect* [36]. The creation of taskforce (s2b) and training regime (s2d) improves organisational competency (s3a), leading to the development of new culture (s3b). Myeong et al. (2021) [44] find that a high-performing government improves the performance of OGD, while Safarov (2019) [36] attributes technical improvement (s3a) in government bodies that have promoted a successful OGD implementation.

In the *Environmental Dimension*, the *social-influence* solutions play a significant role. These solutions convince others to employ and exercise OGD practices daily. Through collaboration with citizens, other government bodies, and overseas organisations, the presence of this ecosystem resolves citizen readiness (p3b) and demand (p3c) [36], [42]. The presence of legal standing (s4b) has many implications, such as dissolving legislation and political influence (p3e) [38].

Figure 4 also shows the most applicable remedies for the problems. *Stakeholder Initiative and Support* (s3c) becomes the most crucial solution in the proposed mapping. To successfully adopt OGD, an organisation must ensure that top management is present and actively engaged in the process. Then, *Legal Standing* (s4b) and *Supportive and Collaborative Ecosystem* (s4c) must be promulgated and established to follow up, ensuring that OGD adoptions run in the correct direction.

4.4. Implications of Study

This paper has some implications for academic research and practitioners in OGD-related issues. This study offers new literature on OGD challenges and solutions for academic research with a novelty of mapping between challenges and solutions. This study also offers a new perspective on categorising the problems using TOE framework and UTAUT for solutions. As for the practitioners, especially the Indonesian government bodies, this study can be a useful reference before implementing OGD in their organisation for assessing the possible challenges and solutions, as well as how to address those challenges accordingly, increasing the likelihood of a successful OGD implementation. A guideline for the future.

4.5. Limitations of Study

The limitation comes from the access of articles of which the authors were unable to access seven publications, as shown in Figure 1. These articles could uncover new challenges or solutions for OGD

implementation. Also, the selection process might be refined to obtain more samples, such as enlisting more databases, adding reviewers, and improving QAC quality and quantity. This study also yet to separate the problems and/or solutions from country development status (developed or developing). In addition, the solution posed in this study needs to be challenged and reviewed in the future for practical validity. Another limitation arises from the adoption phases; this study focuses on *the pre-adoption* and *adoption* stages.

5. CONCLUSION

This study aims to identify challenges, solutions, and mapping solutions to challenges in OGD implementation. Using PRISMA 2020 methodology, the authors obtained 20 publications and performed quality assurance for further analysis resulting in 20 final publications. In total, Europe remains the focal point in this study with seven publications using Europe as their area of observation. The trend of OGD-related studies also shows a negative trend from 2019 to 2022 where ten publications are found from 2019 and only one study comes from 2022.

For the challenges, the authors then identify 23 problems classified into three categories based on the TOE framework. The biggest challenge arises from Organisational Dimension with ten identified problems. Albeit the organisational area becomes the most common area of problems, the data quality problem in the technological area posits a massive challenge in many countries. Twelve references refer to this problem as a major hindrance in the implementation of OGD.

Furthermore, in classifying the solutions, the authors propose three additional references to 20 selected publications. In return, the authors unravel 13 success factors as feasible solutions to address the preceding challenges; thus, authors then mapped the solutions into four categories based on the UTAUT framework. Facilitating Conditions becomes the most common area in the solutions, meaning that supporting technology and infrastructures are seen as the most critical point in implementing OGD, referred by 14 publications.

Finally, the authors address the challenges by mapping them with feasible solutions. Each category in OGD challenges is mapped accordingly with the solutions based on the UTAUT framework, such as the technological dimension problems that require effort expectancy construct as the base of the mapping process. In the current mapped solutions, *Stakeholder Initiatives and Support* stands as the generic solution for most challenges found from the literature review, meaning that support from top management is paramount as the bedrock of OGD initiatives.

5.1. Future Work

As this study might result in biased results, it can be extended by improving the selection process, for example, by increasing the number of databases, the range of publication's year, and QAC refinement. In addition, the authors recommend to highlight on the post-adoption stage to uncover more challenges and solutions for OGD implementation. According to Roa et al. (2019) [13], using the Expectation-Confirmation Theory and Coordination Theory remains one of the most viable solutions to discover issues in the post-adoption stage. Finally, future studies could administer the relationship between challenges and solutions as the base model for qualitative research.

CONFLICT-OF-INTEREST STATEMENT:

The authors hereby declare that there is no conflict of interest in this study. All co-authors have reviewed and authorised the manuscript's contents; hence, the authors certify that the submission is authentic and is not currently under consideration by another publisher.

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Appendix A: Mapping of Challenges and Solutions

Item	Articles																			
	[9]	[12]	[13]	[30]	[31]	[32]	[33]	[34]	[35]	[36]	[37]	[38]	[39]	[40]	[41]	[42]	[43]	[44]	[45]	[46]
p1a			✓								✓		✓							✓
p1b								✓		✓			✓							
p1c						✓		✓		✓										
p1d			✓	✓																✓
p1e	✓							✓		✓										
p1f	✓		✓	✓		✓			✓	✓					✓			✓		
p1g				✓		✓					✓								✓	✓
p1h	✓		✓	✓	✓	✓		✓	✓	✓			✓		✓				✓	✓
p2a				✓						✓										
p2b			✓	✓							✓									
p2c										✓										
p2d				✓																
p2e			✓	✓					✓		✓									
p2f			✓	✓			✓	✓	✓	✓			✓							
p2g			✓	✓				✓	✓	✓	✓		✓		✓					
p2h			✓	✓									✓		✓					
p2i			✓	✓						✓	✓		✓		✓					
p2j			✓						✓	✓	✓		✓		✓					
p3a	✓			✓		✓														
p3b	✓			✓						✓			✓							
p3c			✓	✓						✓			✓	✓			✓			✓
p3d			✓																	
p3e			✓	✓	✓			✓		✓	✓		✓		✓					✓
P*	**5**	**0**	**14**	**16**	**2**	**5**	**1**	**7**	**6**	**14**	**8**	**0**	**11**	**1**	**7**	**0**	**1**	**1**	**2**	**6**
s1a		✓					✓			✓		✓	✓			✓				
s1b				✓											✓		✓			
s1c										✓										
s2a		✓			✓	✓			✓	✓			✓				✓	✓		
s2b	✓									✓	✓									
s2c	✓			✓		✓		✓	✓	✓	✓			✓				✓		✓
s2d				✓						✓										✓
s3a		✓							✓	✓						✓		✓		
s3b							✓	✓		✓			✓							✓
s3c	✓			✓				✓	✓	✓		✓				✓				
s4a					✓				✓				✓			✓				
s4b				✓						✓		✓	✓							
s4c	✓	✓		✓	✓				✓	✓						✓		✓	✓	
S**	**4**	**4**	**0**	**6**	**3**	**2**	**2**	**3**	**6**	**11**	**2**	**3**	**5**	**1**	**1**	**5**	**2**	**4**	**1**	**3**
T**	**9**	**4**	**14**	**22**	**5**	**7**	**3**	**10**	**12**	**25**	**10**	**3**	**16**	**2**	**8**	**5**	**3**	**5**	**3**	**9**

Note: P sum of problems, S** sum of solutions, T*** total (problems + solutions)*