

A Critical Success Factors for Data-Driven Decision-Making at Local Government: The Case of Indonesia

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Abstract: A question remains regarding the effective application of data as a basis for decision-making in public sectors. In relation, the objectives of this study are twofold. First, this study identifies factors affecting the local government official's propensity to use data for decision-making. Second, this study outlines the components of the effective application of data-driven decision-making in local government. Extensive in-depth semi-structured interviews with executives at the agencies and offices of the Regency of Bojonegoro, Indonesia, were conducted to gather the data. Our findings demonstrate two predominant institutional factors instigating the officials' inclination to use data in their decision-making: a) the accountability pressures and b) the hierarchical, bureaucratic structure. Our findings further signify the existence of three interrelated building blocks necessary for the practical application of data-driven decision-making: a) transforming quality data into knowledge, b) ardent and perceptive staff, and c) appropriate tools/apps. Furthermore, culture and norms, institutional contexts, rules, and regulations shaped the functioning of the three components mentioned above.

Keywords: data, decision-making, data-driven, data-driven decision-making

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1. Introduction

Advancements in Information and Communication Technologies (ICTs) produce tremendous data growth that, coupled with progress in data science, led to increased interest in deriving insight from data that alter and improve decision making, commonly known as data-driven decision-making (Brynjolfsson & McElheran, 2016; Provost & Fawcett, 2013). The data-driven decision-making is beneficial in high uncertainty situations, such as natural disasters or a pandemic, proven by the case of Covid 19 (Harrison & Pardo, 2020) and the Ebola crisis of 2014 (Grioliopoulos, 2014). It also provides more efficient and effective policy decisions resulting in a trusting relationship with the public (Mandinach, 2012; Hwang, Nam, & Ha, 2021; Matheus et al., 2018; Harrison & Sayogo, 2014).

Despite the potential benefits of grounding decisions on data, an effective application of data as a basis for decision-making is still in question, such as in education (Mandinach, Honey, & Light, 2006). Similarly, government officials are suddenly confronted with large, diverse, and complex data. Hence, the inquiry also remains into how the government uses the data, creates interpretations of the data and uses the interpretations to make applicable decisions. Considering that decision is not made from data per se, as Ackoff (1989) argued, a decision is based on the knowledge generated from the transformation of data. ICTs allowed the officials to use technology-based solutions to help them deal with data effectively (Majchrzak & Markus, 2012) through the tools and apps that fit with the purpose of the official. Thus, there is also a question on the extent to which existing technology tools and apps facilitate government officials in effectively managing data for decision making.

Policy-making and strategic decision processes in Indonesia for each Regency are standardized through Law No. 12 of 2011, article 1 subsection 10, which requires the stages of preparation, planning, design and discussion stage in the Regional People's Representative Assembly. On the other hand, policy making in Indonesia is also afflicted with the evasion of the government officials to base the decision on a comprehensive analysis of data and facts (Pramusinto & Irawati, 2017). Instead, political interest and intuition are more prevalent in Indonesia's public officials' decisions resulting in ineffectual and unavailing policy and administrative decisions (Bachtiar, 2011; Hwang et al., 2021). Recently, the national and provincial government has pushed forward efforts to advocate the use of data analytics for policy works (Hwang et al., 2020). The National government, for instance, strives to provide law and regulation to provide a legal backbone, such as the enactment of Presidential Regulation No 39 of 2019 or the most recently approved personal data protection bill in September 2022. Similarly, provincial government and state-owned companies are promoting the use of data for decision making, such as collecting and analysing real-time bus location data, to respond to citizens inquiring about congestion problems (Hwang et al., 2020).

Given the increasing exploratory efforts by the National and Provincial levels, the propensity and effective use of data for decision-making at the local government level is less known. Therefore, this study has two goals: a) it identifies factors affecting the local government official's propensity to use data for decision-making and b) it outlines the components of the effective application of data-driven decision-making in local government.

This study performed In-depth interviews with top-level executives and middle management from agencies and offices in the Regency of Bojonegoro regency for the data. Bojonegoro is chosen because of its progress in pursuing open government and smart cities in Indonesia. Given the similarity between individual and organizational decision-making (Marchisotti, Domingos, & Almeida, 2018), this study conducted interviews at the individual level.

This paper consists of four sections, including the preceding introduction. Section two, highlights studies evaluating data-driven decision-making and its challenges. Section three, presents a description of the research methodology. Finally, section four discusses the results, the findings and concluding remarks.

2. Building Blocks of Effective Data-Driven Decision-Making

Increasing pressure to use data to support decisions, emerges with the demand to comply with the accountability requirements (Mandinach et al., 2006; Mandinach & Honey, 2008), including in public sectors. The government thus, shifted to a rational approach to using data analysis as a basis for more conscious, precise and planned decisions (Marchisotti et al., 2018). Embracing a data-driven approach requires building the capabilities, changing culture and choosing appropriate tools (Anderson, 2015). From the government's perspective, attention to public demands and politics is also necessary (Aucoin, 2005). In addition, the combination of systematic information, practical experiences and political responsiveness to public demands and needs are the crucial factors for the adoption of data-driven decision-making in the public sector (Aucoin, 2005).

At the practical level, connecting data to decision-making requires transforming data into knowledge (Ackoff, 1989; Mandinach & Honey, 2008; Light et al., 2006). According to Ackoff's (1989) data transformation continuum, the processing of data results in information and the transformation of information results in knowledge (Ackoff, 1989; Mandinach & Honey, 2008; Light et al., 2006). Transforming data by itself or combining it with existing knowledge generates new knowledge, ideas and value proposition, valuable for making decisions (Jetzek, Avital, & Bjorn-Andersen, 2014). Hence, the basis of decision-making is not the data per se but the knowledge generated from data. Government officials need to perform six stages of activities to transform data into knowledge (Mandinach & Honey, 2008; Light et al., 2006). These six steps are: (1) collecting (2),organizing (3), summarizing, (4) analysing (5) synthesizing and (6) prioritizing. The collecting and organizing result in the availability of data; summarizing and analysing create information; while synthesizing and prioritizing generate knowledge (Light et al., 2006).

On the other hand, the six stages to generate valuable knowledge for decision making and using data in meaningful ways, require assessment of the data to ascertain the quality. Therefore, ensuring

proper data collection, storage, access, management, validity, integrity and rules, to use data, is crucial for decision making. A vigilant data assessment to safeguard quality avoids incorrect interpretations of the data that could result in unwanted decisions (Gill et al., 2014). Low data quality affects the analysis results, distorts the inferences and results in misleading decisions (Matheus et al., 2020; Chatfield et al., 2015). Irrelevant and Unreliable data create data overload, tie up the analyst's time and effort and contain lots of random variations and noises that obscure data interpretability (Bulger, Taylor, & Schroeder, 2014). Therefore, ensuring satisfactory data quality early in the process is critical for data-driven public entities (Sutherland & Cook, 2017).

The six stages in the data-to-knowledge continuum also represent a continuum of increasing cognitive complexity in transforming data into a decision (Mandinach & Honey, 2008). Given the constraints of, among others; time, resources and possibly cognitive capability and the affordance of information technologies, public officials turn to use technology-based tools to assist in using data for decision making (Nagy & Neff, 2015; Majchrzak & Markus, 2012). The affordances of technology in terms of characteristics, functions, qualities, features and capacities will facilitate or impede public officials in using it to manage the data for decision making (Light et al., 2004; Graves, 2007). Light et al (2015) propose six functionalities influencing how the users use the technology-based tools and apps: (1) accessibility, (2) length of the feedback loop, (3) comprehensibility, (4) flexibility, (5) alignment and (6) links to instruction (Light et al, 2004). Arguably, the extent to which the six functionalities are used by the users, the types of data, purpose of the analysis and the contextual environments (Mandinach et al., 2006; Mandinach & Honey, 2008).

Decision-making in the public sector is a complex process. Data alone does not generate public values unless supported by other components, such as regulation, leadership, capacity to implement the data and conformance to the surrounding contexts (van Oijen et al., 2019). Institutional contexts and culture can be significant constraints in using data for decision-making (Gill et al., 2014). Cultures influence how public officials use data to create decisions and choose strategies to pursue organizational goals (Rexhepi et al., 2020). For that reason, an effective application of data-driven decision-making requires a well-managed organizational change (Storm & Borgman, 2020). Leadership plays a crucial role in the change (Mandinach et al., 2006; Kennedy, 2009; Gil et al., 2014; van Oijen et al., 2019). Finally, a lack of legal rights, ethics, or politics could inhibit the government officials' inclination to optimize the use of data for policy-making, service delivery, or routine operations. The methods and strategies to protect and secure the privacy and confidentiality of data showcase the legitimacy and trustworthiness of the data-driven efforts (van Oijen et al., 2019), while the ambiguity of legal and policies to safeguard data inhibit the data-driven process (Bulger et al., 2014).

3. Research Design and Methods

3.1. Research Methods

The study conducted in-depth semi-structured interviews to identify and analyse the factors affecting the use of data and its analysis for decision making at the local government level in Indonesia. In-depth interviews with ten executives from top-level and middle-level public managers

of agencies and offices at the Regency of Bojonegoro, Indonesia, were conducted to gather the empirical data (see table 1). The selection of the interviewees was based on the agencies and offices with higher likelihood to use data to support decision making. The information was obtained from the initial interview conducted with the Head of the Bojonegoro's Information and Technology Board.

All interviews were recorded and transcribed, as a whole, to obtain rich empirical data. Interviews were transcribed and analysed following an inductive logic and using grounded theory techniques (Strauss & Corbin, 1997). The analytical processes conducted by the research team were iterative. Each team member analysed the interview transcripts and then discussed them in the group resulting in inductive coding themes related to the elements of the evaluative framework. We conducted validation of the analysis results in two stages: (1) we contrasted the resulting constructs with the previous studies, initially used as the theoretical lens. (2) we also asked the respective interviewees to re-validate the resulting challenges identified in the analysis of the interviews.

Table 1: Composition of the Interviewees

No.	Department	Position	Number of Interviewees
1	Department of Education	Head of Department	1
		Middle Manager	1
2	Department of Trade and Micro Enterprise	Head of Department	1
		Middle Manager	1
3	Department of Industry and Labor	Head of Department	1
		Middle Manager	1
4	Department of Social Services	Head of Department	1
		Middle Manager	1
5	Department of Public Health	Head of Department	1
		Middle Manager	1
	Total		10

3.2. Case Description: Digital Government of the Regency of Bojonegoro

Policy making and decision process in Indonesia for each Regency is standardized through Law No. 12 of 2011, article 1 subsection 10. The formulation of Provincial Regulations or Regency/City Regional Regulations must be prepared in a planned, integrated and systematic manner. The policy-making and strategic decision processes are through the preparation, planning, design and discussion stage in the Regional People's Representative Assembly (Law no. 12 of 2011). Hence, the process is standardized across Regencies without any possible deviation, regardless of the differences in local culture. The differences in local culture only add to the nuances of implementing the said policy. However, the policy's implementation strategy depends on each Regency's creativity and progressiveness. Bojonegoro regency is one of the most progressive regencies in innovatively using ICTs to improve their regency's governance and government services. The effort started with adopting open government principles in March 2008, by initially promoting openness in government through a program called "Sobo Pendopo," a public hearing and interactive dialog program (Adarrma, 2017). This government-citizen participation program expanded by extending the interactive dialog through public radio called "Radio Malowati Madani." The effort to use ICTs to enhance the government-citizen participation program started in July 2014 when the regency developed two web-based applications called "Integrated Public Aspiration Systems (SIAP)" and "Public Aspiration Online Services (LAPOR!)." The public then could use the apps to express their opinions, ideas, critiques and input to local government agencies instead of calling through radio or physically visiting the regency office (Heriyanto, 2017). As an addition to the apps, the public could submit their grievances through SMS (Short Messaging) that will automatically be transmitted to SIAP and LAPOR! Each department receiving complaints has five working days to respond to and resolve the issue. Due to the success of the two apps (SIAP and LAPOR!) - on average, receiving 70 to 300 complaints monthly (Heriyanto, 2017), the regency extends the reach of the apps to every village within the regency jurisdictions. The regent has started to implement the "visiting village" program to expand the open government implementation further.

The Regency of Bojonegoro was not only the first Regency in Indonesia to join the Open Government Partnership movement in 2011 but also has been awarded a Smart City Award from 2017 until recently. Bojonegoro regency was selected as part of the 25 cities/regencies pioneer to adopt a smart city in response to the National government program of "100 smart city movement" in Indonesia in 2017. In addition, the Regency also received the Smart City Awards in 2019, 2020, 2021 and 2022 respectively. The Regency was awarded the Best of Smart Society in 2019, received the award for Smart People in 2020, was granted the Smart Governance award in 2021 and was conferred the Smart Economy award in 2022. The Regent Regulation no. 13 of 2020 supported the efforts to pursue Bojonegoro Smart City. In the Bojonegoro Smart City masterplan for the period of 2019 to 2023, Bojonegoro's smart city action plan consists of four development plans, namely: a) the smart city policies and governance, b) the smart city infrastructure, c) the software and applications supporting the smart city and d) the smart city literacy.

According to the master plan, the smart city effort is putting forward smart people as their first target (Bojonegoro, 2019). The objective is in realizing the socio-technical ecosystems for humanist

and dynamic society, both physically and virtually, to create a productive, communicative and interactive society with high digital literacy. For that, the regency aims to develop an ecosystem for efficient learning and community interactions. Some of the programs in smart city strategies are as follows: first, improving the system for management, restoration and preservation of the regional documents and archives. Second, strengthening the mechanism for public participation and consultation at the sub-districts and village level. Third, improving education services through, among others, e-library development and learning. Fourth, increasing the capacity of the digital literacy of the citizens. Finally, campaigning for the uses of social media that are smart, healthy and free of discriminations.

In conjunction with the effort to pursue smart people, the Bojonegoro regency also strives to improve the governance and management of agencies and offices to support an effective smart city. For that, each agency and office will develop standard operating procedures for ICTs usage to support smart city which includes: (a) policies for office computer use and internet access, (b) policies for using district/city official email, (c) policies for network and computer security, (d) policies for data-sharing across agencies and offices, (e) policies for management of the agencies websites, (f) policies for handling complaints and public services through ICTs, (g) policies for routine data backup, and (h) policies for change management. The master plan specified the plan to build a Data Center as a centralized supporting facility to provide the storage, computing and distribution of data needed to run the smart city applications in the Regency of Bojonegoro. However, there are minimum efforts in the current master plan of Smart City to support the use of data-driven decision-making aside from the policies for data sharing across agencies and offices. The plan proposes providing training and certifications to increase the capability, insight, knowledge, and skills to empower the Regency of Bojonegoro further. Of the twenty-two pieces of training planned, only one projected training about data management, analysis and visualization. Likewise, the masterplan envisioned the development of seventy-five new applications to support the smart city, but only three applications relate to the tools and dashboard needed for performance monitoring and to predict the need to make important decisions (Bojonegoro, 2019).

4. Main Results and Discussion

This study conducted a case study encompassing in-depth interviews with the executives of agencies and offices in the regency of Bojonegoro. This paper presents the preliminary efforts to critically analyse the executives' perceptions of the factors affecting the use of data and its analytic to support decision making in their respective agencies. Building from the identified factors, this study propositioned an initial attempt to portray the evaluative framework supporting effective data-driven decision-making at the local government level in the Developing country. The result section is organized into two sub-sections. The first sub-section discussed the factors affecting local government public managers' propensity to use data in decision-making. The second sub-sections detail the building blocks of effective, data-driven decision-making from the public managers' perspectives.

4.1. Factors Affecting the Propensity to Use Data for Decision-making

The interview results indicated that the institutional context is the significant aspect affecting the decision by the executives to use data to support their decision-making. There are predominantly two factors within the institutional context that instigate the use of data-driven decision-making: (1) the accountability pressures and (2) the hierarchical, bureaucratic structure.

The interviewees indicated that accountability pressures, primarily the financial accountability pressure, by and large, are one of the most critical factors affecting them to use data for decision making. There are two reasons for the substantial efforts to use data to fulfil the accountability requirement: (1) as a necessary survival strategy and (2) as means to satisfy the performance measurement.

The interviewee indicated that data is essential in countering the possible exposure and findings during an internal audit. Using data will minimize findings by the internal auditors during an inspection. As stated by the Department of Public Health interviewee, "if it does not conform to the data, there will be audit findings from the inspectorate [internal auditor] too. So, of course [to counter that], we attach all the possible data. We can't do whatever we want. Other parties monitor us, you know, there is supervision from the inspectorate". Hence, the executives concur on using data as a survival strategy to ensure they will not be exposed to a possible investigation. Data become the fortress to drive out potential incidents that threaten them and the survival of their unit.

Further, the executives also indicated that using data is necessary to conform to the performance evaluation, particularly related to their compliance with the financial accountability requirements. Using data, they could demonstrate that the budget was appropriated according to the plan authorized by their superior and approved by the legislator. As the Department of Trade and Micro Enterprise interviewee pointed out, "Yes, we need data showcasing we serve the people correctly. The data will indicate that we did not stray from the approved action plan. Hence, it is an indication that the budget is correctly appropriated".

Aside from the accountability pressure, the strict conformance to the hierarchical, bureaucratic structure is the other factor related to the institutional context, for affecting the use or not using, data for decision-making by the local government in Indonesia. As the interviewee from the Department of Education argued, there cannot be only data but should be a combination of data, regulations, and hierarchical structure. The interviewee further implied that not all local government decisions should be based on data. The rigid conformity to the hierarchical, bureaucratic structure further reinforced the authoritativeness of leadership and created a condition of a must-obeyed leader without question. As such, it is deemed that some of the decisions are the prerogative right of the superior in the hierarchical structure, which means that certain decisions are top-down without room for negotiation. The statement is further reinforced by the middle manager at the Department of Education, asserting the need for adaptation and flexibility in implementing the decisions made by their superiors without questions. The Department of Education interviewee stated, "We had to adapt. So, whatever decisions are made by the leader, we must do. We cannot simply choose to use data."

The need to conform to the top-down hierarchical structure is further strengthened by the obedient culture embedded as a social norm in Indonesia, particularly in Jawa. Thus, it is expected that the subordinate must consistently demonstrate their obedience to those superior in the hierarchy. As stated by one of the heads of the agencies, "The obedient to the superior must always be respected. So, once [I] made the decision, [the subordinate] must obey without questions. And I take that seriously".

The constantly expected obedience norm results in two conditions: (1) the disconnection of the head of agencies with the middle management about the importance of data and (2) the mindset of those in the middle and lower management regarding the required skills to support the decision-making. The middle-level manager interviewee asserted the need for a better understanding of the organizational structure and who is who, as necessary skills for decision-making by middle management. One interviewee stated, "skill in understanding the hierarchical structure and who is who is a must for me both inside and in other agencies or offices." Furthermore, the obedience norm also creates dissenting vision between the head of agencies and the middle management. The head of agency interviewees predominantly asserted the need to support decision-making with high-quality data. On the other hand, the head of the agency also expected the middle management to obey any top-down decisions made by the superior. This type of leadership augmented by a hierarchical structures, autocratic bureaucracy and obedient culture is detrimental to the propensity for data-driven decision-making, in contrast to the argument from extant literature (see Mandinach et al., 2006; Kennedy, 2009; Gil et al., 2014; van Oijen et al., 2019). It is proven by the leader's failure to function as the agent of change when applying data-driven decision-making to the organization as a whole. Thus, this leader's failure limits the vision of using data-driven decision-making to the upper level of the hierarchy only.

4.2. Components of Effective Data-driven Decision-making in Local Government

As highlighted in the results above, two institutional factors affect the propensity to use data to support decision-making. Notwithstanding, the interview results further demonstrated several components guiding a practical application of data-driven decision-making at the local government level. In brief, the results indicated that a practical application of data-driven decision-making depends on transforming quality data into knowledge, perceptive staff who know data and appropriate tools/apps. The three components are framed within the contexts of culture and institutions, as well as rules and regulations.

4.2.1. Ardent and Perceptive Staff

The interview results further pointed out the significance of public managers' three qualities for practical data-driven decision-making: a strong-willed personality, intuition and experiences and formal skills.

The results presented in sub-section one showcase total obedience as an important social norm, particularly in Jawa, Indonesia, which could dissuade public managers from using data for decision-

making. Thus, several interviewees emphasized the importance of having a strong-minded personality to defuse the possible adverse effect of the obedience norm. As one of the interviewees suggested, “we need a person who will not just succumb to obedience without question. We need people with backbone who know how to discuss it appropriately with the superior to avoid any hard feelings. A person like that should be ideal”.

As such, the interviewees contended the significance of having personnel who combine their experiences and intuition to apply data-driven decision-making effectively. As argued by the interviewees, such a person will be able to aptly pursue using data while deftly navigating the hurdle of obedience norm. The Department of Social Welfare interviewee stated, “Work experiences are, of course, critical. We rely on the senior staff for their experiences, understanding of structures and procedures and intuition. We must support data with regulations, intuition, and experiences for making decisions”.

Lastly, the interviewees agreed on the importance of formal skills learned from formal education or practices. Specifically, the interviewees are particular about three types of necessary skills. These skills are domain basic, statistical and ICTs-related skills. The Department of Public Health interviewees stated, “Basic skills are a must in each of their respective domains that fit their tasks and programs.” Basic domain skills are necessary, considering each unit has its main tasks and functions. Thus, basic domain knowledge is crucial in providing the context for analysing data. Aside from that, almost all interviewees signified the significance of having statistical analysis skills to assist in analysing the data. Yet, according to the interviewee from the Department of Industry and Labour, training in statistical analysis is never part of most of the department’s plans and programs. Skills in statistics are supposed to be learned in formal education when the staff is recommended for graduate studies or self-learning. As pointed out by the interviewee, “No, we don’t have technical things like that, never. We also ask the other agencies if they conduct [statistics] training so we can join them. But, no, they also do not have that.” Thus, while it is a long shot to hope for aspiring data workers, it is more plausible to hope for keen staff who know data.

4.2.2. Ensuring Quality and Transforming Data into Knowledge

4.2.2.1. Ensuring Data Quality

Ackoff (1989) argued that creating an understanding requires transforming data into information and knowledge. Public managers need to transform data into knowledge to use it as the basis of decision-making. For the knowledge to be useful for decision-making, public managers must ensure data quality at the collecting and organizing stage. The interview results signify both the effort of the public managers to obtain quality data, as well as the processes they took to transform data into knowledge.

All interviewees posited the importance of ensuring data quality, particularly in verifying and validating the data. However, the interviewees differ regarding the ways to verify and validate data to ensure quality. Some interviewees pointed to the significance of using regulations as a lens to verify and validate data. They argued that data is valid if it fits with existing regulations. Other

interviewees pointed out four elements needed for data quality assurance: (1) the need to ensure the trustworthiness and legitimacy of the data source, (2) the timeliness of data collection, (3) the correctness of the data collection method, and (4) the documentation of the processes. As the interviewee stated, "the source must be reliable, the data must be taken within the relevant period, and the data collection method must be correct. So documentation must be signed, dated, and stamped by the data source."

Although as argued by the interviewees, ensuring data validity continued to pose a challenge for them. Some agencies and offices often conduct more expensive plans by re-validating or re-verifying the data by directly comparing the data with the reality in the field. One of the interviewees acknowledged, "we validate the data directly, seeing the fact in the field, we identify whether the building is damaged or if there is something lacking or an excess of something. Suppose the data confirms the truth. Only then will we use the data." The requirement that the regional data match with the national data confounds the data validation process. The system will not accept the data if the data is not matched, as required by the central government, even if the data is actual. The Department of Industry and Labor interviewee stated, "So, the thing that slightly inhibits the process is that data at local government must match with data at central government. If it is not fit, then it will be rejected regardless if the data is real."

4.2.2.2. Transforming Data into Knowledge

The interview results indicate that public managers will transform data into knowledge for decision-making once the data quality is confirmed. The Department of Trade and Micro Enterprise interviewee pointed out, that the process started with data collection, initiated by identifying or selecting data. Subsequently, the data is organized by classifying data into different classification groups, to ensure the consolidation of the data. As stated by the interviewee, "we first identify the data based on the agency's required actions. Thus, we collected the data and then we classified the data, so that the implementation of the tasks is organized and the data is correctly compiled." Referring to the data transformation steps described by Mandinach & Honey (2008), the excerpt above indicates the first four processes of data transformation into information, which are collecting, organizing, summarizing, and analysing.

The interviewees also indicated the steps taken to summarize and analyse the data, suggesting the process of transforming data into information. The Department of Public Health interviewee described how summarizing the data began with determining the basis for summarizing. Notably, this process entails fitting the data with the existing rules, regulations and policies. Once the data is summarized, the interviewee mentioned that the team discussion conducted the analysis processes. As indicated by the interviewee, "we then recapitulate the data based on the rules and regulations. You know which of the existing policies fit with the data. The step was to ensure that the data is supported by law before we analyse it further and make the decision."

The interview results further indicated that the subsequent process of transforming information into knowledge for decision-making, was synthesizing and prioritizing the data. Corroborating different data sets did the synthesis and the extraction of conclusions based on limited statistical or simulation analysis from the data. As one of the interviewees highlighted, "We appraise each dataset

and then corroborate the data by comparing the different datasets to find the linkage. Afterward, we perform some statistics or simulations. We conclude or write an action plan that fits with the data.” While the interviewees acknowledged the none existence of statistical training to help them analyse the data, they mentioned the use of limited tools and apps that they could use to assist them.

4.2.3. Availability of Fitting Tools and Apps

As pointed out by the interviewees, the limited analytics skills suggest that public managers depend on the existing tools and applications to help them implement practical data-driven decision-making. According to the interviewees, different devices and apps assist with varying data transformation steps. There are various tools and apps for data collection or analysis, although, as argued by the interviewees with limited or unclear features and ability.

On the one hand, the interviewee admitted the availability of apps for data collection online really speeds up the data transformation and decision-making process. One of the interviewees cited the case of cash assistance distribution for Covid 19 relief. As pointed out by the interviewee, “the online system available for the village officials for inputting the data is beneficial. The data is available and changes every day or even minutes, speeding the collection and analysis process.” The availability of the tools and apps also assists the data analysis. The Department of Public Health interviewee stated, “yes, the information system fits with each program and is connected nationally. The information system also helps us categorize data, based on our needs, so that’s neat.”

On the other hand, many interviewees also cited several issues related to the existing tools and applications, from the existence of many tools and apps, the variety of reporting formats and the many, often confusing features. The availability of many tools and apps creates an additional burden on the field staff, who must use many different tools and apps. The Department of Public Health interviewee stated their need to manage almost sixty applications encumbered their activity and was counter-effective. As the interviewee said, “the community health centre in each county, for instance; they have to manage almost sixty types of applications. It is ineffective and creates a burden for the field staff.”

In addition, many apps and tools are created and provided by the national government. The local, government-level interviewees often found too many features and report formats that they need to learn. The Department of Trade and Micro Enterprise objected to the many features, stating, “apps should be easy to understand and used because we serve many populaces. Too many features create a burden. Why not focus only on the features that the populaces and staff easily understand.” The Department of Public Health interviewee further exclaimed that, “although the current apps are comprehensive, the many reporting formats are problematic and demanding. We hope for one app which will streamline the many applications into one.”

The results, as mentioned above, signify the functionalities depicting the usage of the tools and apps, as perceived by the government official in Bojonegoro. Specifically, three functionalities can be drawn from the interview results: (1) availability/accessibility, (2) flexibility, and (3) simplicity.

4.2.4. Culture, Institutional Contexts, Rules, and Regulations to Shape an Effective Data-Driven Decision Making

As the results imply, the application of the three components: (a) data transformation, (b) capable personnel, and (c) tools/apps to support effective data-driven decision-making is shaped by culture and norms, institutional contexts, rules, and regulations. The interview results indicate that data use also depends on the task level and function, whether administrative/operational or tactical/strategic. Most administrative or operational tasks are not data-driven; the officials will adhere strictly to standard operating procedures and regulations. The Department of Education interviewee stated, "If it conforms to the regulation and accord to the operating procedures, we carried it out as it is. As long as regulations, operating procedures and moreover, a referral from our superior are there, then we will follow through." The interviewees argue that conformance to the rules and regulations is the determining factor. As one of the interviewees denoted, "Data should accord to the regulations. If the regulations don't match, then no, we will not use them. All steps taken must be following the rules and regulations." The statement implies that rules and regulations govern the data and how the officials use tools and apps to manage the data.

The interview results demonstrate that culture, norm and institutional contexts significantly affect how public officials use the data and the tools/apps to manage the data. The obedient culture strongly affects not only the behaviour of the government officials but also, how the officials use the tools and apps to manage and administer the use of data for decision-making. In addition to the culture and norm, the adherence to the strict bureaucratic, hierarchical structure embedded in Indonesia influences how officials use or don't use data. The obedient culture reinforced commitment to the top-down bureaucratic, hierarchical structure that often constrains the public officials from using data, particularly for the middle management or below.

There is also the issue of politics affecting how public officials govern the use of data to support decision-making effectively. The Department of Trade and Micro Enterprises used the term X factor to describe cases where politicians often undermine the executives' decisions based on data to further the politicians' agenda. The interviewee denoted, "And then we have the X factor. For the [political] stage, legislator often freerides or undermines the decision made and agreed upon by executives. Often, they freeride without bothering to identify the issue at hand and the goal." Political intervention made the whole effort to use data to support decision-making, collapse.

5. Discussion and Conclusion

5.1. Discussion

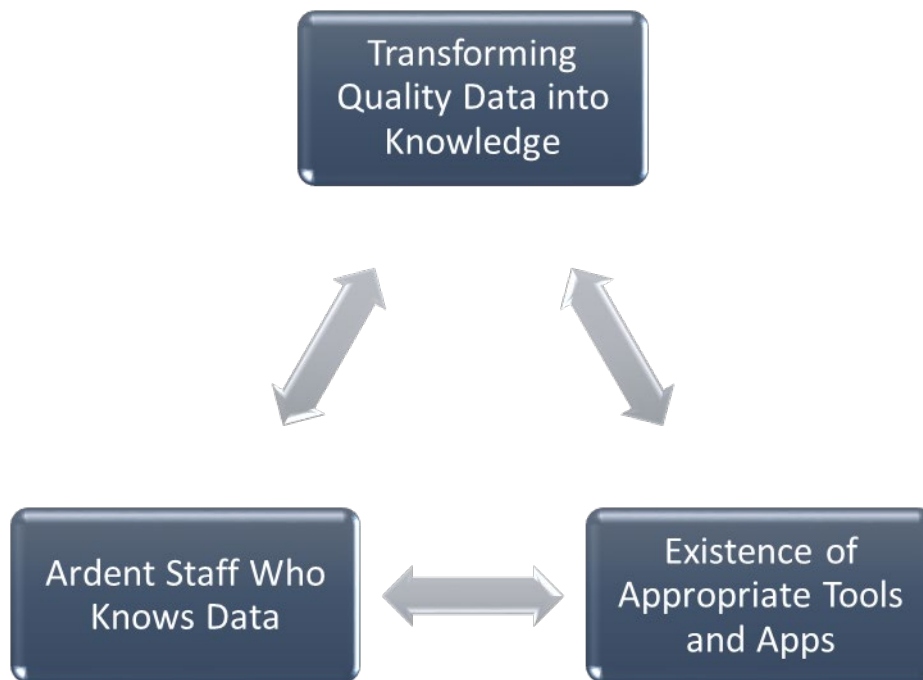
Janssen et al. (2012) called for a study to understand how the government deals with ICT-based initiatives, including using data for decision-making, particularly in developing countries. This paper outlines the components of a framework supporting effective data-driven decision-making at the local government level, using the Regency of Bojonegoro, Indonesia case. Extensive, in-depth, semi-structured interviews were given with public officials at the Regency, to better understand the factors and components affecting the use of data for decision-making.

Our analysis started with an enquiry into the factors affecting the propensity of government officials to use data for decision-making. The findings indicate two predominant institutional factors instigating the officials' inclination to use data in their decision-making. The first factor is the accountability pressures, primarily the financial accountability pressure. The insistence on compliance with the financial accountability requirement, emerges as the most critical factor affecting public officials' use of data for decision-making. The findings also signify that the initiative to use data is seen as a necessary strategy for survival and a means to satisfy the performance measurement in the effort to fulfil financial accountability obligations.

The second institutional factor is the rigid top-down bureaucratic, hierarchical structure employed in Indonesia's public sector. The findings indicate that certain decisions are the privilege of the superior in the hierarchy; thus, decisions are supposed to be top-down and dutifully followed. It is also probable to posit from the findings that the ingrained traditional value of compliance to the superior, reinforced the conformance to the hierarchy. As a result, this will, perchance, disrupt the likelihood of the government developing a culture of using data for decision-making. This obedient culture ostensibly propagated from Indonesia's long history of rigid bureaucratic and domineering administration during the autocratic regime. Leadership in Indonesia tends to be autocratic after decades of an authoritarian society (Efferin & Hopper, 2007; Van de Vliert, 2006). The embedded autocratic culture results in the staff's assumption that disagreeing with those with superior statuses leads to possible negative ramifications for their careers.

While the accountability pressure and bureaucratic hierarchy compel the officials to use data, our findings further signify the existence of three building blocks necessary for the practical application of data-driven decision-making. The components are: (1) transforming quality data into knowledge, (2) ardent and perceptive staff, and (3) appropriate tools/apps (figure 1). The three components are interrelated meanings that transform quality data into knowledge through the use of appropriate tools/apps performed by ardent and perceptive staff.

Figure 1: Components of Effective Data-Driven Decision-Making



Our findings align with and enrich Mandinach & Honey's (2008) argument signifying the need for the transformation of data to information to knowledge, in using data for decision-making. The findings further affirmed the stages required to transform data into knowledge conformance to Ackoff (1989). Our study confirms that data is transformed into information by collecting, organizing, summarizing and analysing the data. As our finding indicated, the crucial aspect of data collection efforts is ensuring data quality. In the case of Indonesia, ensuring data quality, entails the often lengthy and expensive processes of data validation and verification. Once the data quality is assured, our findings suggest that public officials synthesize and prioritize the information to transform it into knowledge for decision-making. The findings demonstrate that the process of synthesizing and prioritizing to extract conclusions was conducted through performing limited statistical or simulation analysis, followed by team discussion.

The findings indicate that government officials use the existing tools and apps along the data transformation processes into knowledge. Findings indicate that different devices and apps assist the officials with varying data transformation steps. The availability and accessibility of tools and apps speed up the data transformation and decision-making process. On the contrary, the existence of many tools and apps, the variety of reporting formats and the many, often confusing features, challenge government officials in effectively using the tools and apps. Our findings also identify three instead of six traits that help understand how the official use of apps and tools influences the data transformation process (see: light et al., 2004). The three characters: (1) availability/accessibility, (2) flexibility, and (3) simplicity signify the way the officials use tools and apps in the process of transforming data. The officials in Indonesia prefer accessible, flexible, and simple apps and tools to work with instead of complicated apps with many features and different reporting formats.

The extent to which the officials use tools and apps, depends primarily on their motivation and capability. Assessment of public official skills and motivation in terms of training, understanding of statistics, or information and communication of technology, is crucial. Our findings indicate several qualities necessary for public officials to apply data-driven decision-making effectively, namely: (1) strong-minded personality, (2) experiences and intuition, and (3) three necessary basic, statistical, and ICTs-related skills. The unyielding personality is necessary to defuse the possible adverse effect of the obedience culture that people in Jawa, Indonesia, firmly hold.

The functioning of the three components mentioned above is shaped by culture and norms, institutional contexts, rules, and regulations. The findings indicate that conformance to the rules and regulations is the determining factor. The public officials will firstly and strictly adhere to rules and regulations. From an institutional context, the selection of data, tools and apps and capable officials depend on the decision's objective, function and task level. For instance, most administrative or operational tasks are not data-driven. The adherence to the strict bureaucratic, hierarchical structure, embedded in Indonesia is another institutional context that influences how officials use or don't use, data. The institutional context is often confounded by the existing culture, norms and political nuances. In Indonesia's case, the obedient culture reinforced commitment to the top-down bureaucratic, hierarchical structure that often constrains the public officials from using data.

Notwithstanding, politicians often undermine the executives' decisions based on data to further the politician's agenda. Political interest and intuition are presumed to play more prominent roles in Indonesia's public officials' policy and administrative decisions (Bachtiar, 2011; Hwang et al., 2021) than in using data. On the other hand, political responsiveness to public demands and needs is a determining factor in decision-making in the public sector (Aucoin, 2005).

5.2. Conclusion

Given the increasing interest in extracting insight from data analysis, for better-informed decisions among governments worldwide, this study questions the effective application of data as a basis for decision-making in public sectors. We posit that effective data-driven decision-making in local government is a mechanism of three interrelated components. The three components of (1) transforming quality data into knowledge, (2) ardent and perceptive staff, and (3) appropriate use of tools/apps reinforced one another to generate effectual decision-making, based on data analysis. The working of the three components is promoted or demoted by the local government's culture, norms, institutional contexts, rules and regulations.

There are mainly two institutional contexts affecting the likelihood of using data in decision-making. Our findings thus, point to the novel contribution of identifying the influence of financial accountability pressures affecting the use of data, particularly in using data as a necessary survival strategy and as means to satisfy the performance measurement. Likewise, this study thus asserts that the need to change in attitudes and mindsets of public officials is invariably one of the critical determinants in shaping, or constraining, the adoption of the data-driven approach. Hence, our findings demonstrate the importance of the continuous training and education for public officials and increasing socialization for data awareness is crucial for the case of local government in Indonesia.

Consequently, further study is needed to identify effective tools and ways to create data awareness and its benefits.

A final point worth considering as a major limitation of this research, is that results may need more generalisability beyond Indonesia, due to our chosen research approach. This limitation further accentuates the necessity for researchers to test the proposed propositions further, by expanding the geographical objects to include other developing countries as another future avenue of research.

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