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Level of Regional Governments' Readiness to Deal with the Fourth Industrial Revolution Challenges: An E-Service Analysis

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ABSTRACT

The fourth industrial revolution (industry 4.0) has prompted major changes and challenges in all sectors, including governments. A recent theory explains that one of the challenges is changing needs for public services requiring appropriate response from the governments, both at national and regional levels. Departing from this situation, this study seeks to explore the readiness of regional governments in responding to the challenges. Through e-service assessment of applications developed by the Government of Malang Municipality, Malang Regency, and Batu Municipality (Greater Malang), document analysis, and focused group discussion, this study reveals several drawbacks of e-services, namely personnel's readiness, users' preparedness, flexibility, integration among applications, lack of socialization, weak support and commitment from leaders, low budget, and infrastructure constraints. These findings confirm previous studies on barriers to e-service delivery. This study also strengthens previous researches on the readiness of the governments to meet the challenges of the revolution regarding the importance of administrative innovation initiatives and the role and commitment of leaders. Grounded on the logic beyond the implementation of e-service, this study offers an academic framework concerning the categories of regional governments' preparedness to deal with the revolution's challenges, namely the level of readiness for initiation, development, and sustainability.

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INTRODUCTION

The fourth industrial revolution (industry 4.0) prompted significant changes in all sectors, including A revolution driven by new technological changes that have fundamentally changed how we live, work, and relate to one another (Schwab, 2016).

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The character of Industry 4.0, driven by various technological breakthroughs, leads to three main impacts. The first character is velocity. Many sectors and types of technology involved in the revolution cause changes to move exponentially rather than in a linear direction. The second characteristic is breadth and depth of change. The digital revolution contributes to broad changes in the paradigm of business, economy, individuals, and society. Finally, the revolution has a systemic impact (system impact). Simultaneous and rapid changes produce systemic impacts across countries, companies, industries, and society (Schwab, 2016).

Specifically, Schwab (2016) maps the challenges faced by the government concerning the revolution. There are two categories of challenges for the government due to technological breakthroughs: the character of change and the risk of inequality caused by Industry 4.0. The first is systemic effects, which consist of regulatory and security challenges.

Second is a detailed derivative of the systemic effect: giving rise to challenges in public authority, more empowered actors, spreading ideology, and the need for public services. This systemic challenge and its derivatives require an appropriate response from the governments at national and regional levels.

Specific to assessing regional government's response to these challenges, this study strongly relates to the construction of power relations between national and regional governments. Every country has a different legal construction of the relation. It depends on the degree of delegation of certain authorities from national to regional governments (decentralization).

Meanwhile, Indonesia applies a decentralized system through recognition of the existence of regional governments and the delegation of several authorities from national governments to regions. Law number 23 of 2014 concerning Regional Government recognizes "community initiative" in the administration of delegated authorities. Community initiatives encourage regional governments to consider the local context in their policies. Therefore, regional governments can respond to Industry 4.0 differently since it should fit the regional context.

This study covers the locus of regions in the Greater Malang area, namely Malang Regency, Malang City, and Batu City. The three regions claimed they have committed to applying the smart city concept. It is an innovative city applying information and communication technology (ICT) in governance, economy, public services, and environmental matters. Thus, these preferred sites have their academic ground to conduct the study related to Industry 4.0 readiness.

There have been few studies on the government's response to Industry 4.0, except studies conducted by the World Economic Forum (2018) and the IMD World Competitiveness Center (2019). A specific study conducted by Chung (2017) focuses on the future of electronic government (e-gov) in Industry 4.0. The study in South Korea shows the importance of administrative innovation through e-gov to face the challenges of Industry 4.0.

Meanwhile, Balkaran (2016) reveals that overprotective leaders against change and technology are a real challenge for the South African Government. Another challenge

concerns the widening gap among citizens due to the implementation of 4.0 revolutionary technology. The increasing use of 4.0 technology has resulted in the wealthiest citizens getting more benefits than the poorest.

Vahe and Tatevik (2019) reported that governments respond to Industry 4.0 by maintaining pace with technological developments and effective regulatory frameworks for modern enterprises. Australian government specifically created specific human resources improvement programs to respond to Industry 4.0. The government calibrated Ph.D. programs in universities through the program of employability skills training, the development of industry and end-user-engaged programs, and flexible pathways to the Ph.D. (Molla and Cuthbert, 2019).

Subsequent studies reveal similar findings regarding the government's policy response to encourage industrial competitiveness in facing Industry 4.0. These studies reveal the importance of government political support through providing a policy framework responding to industry 4.0, namely the government's role in making policies and ecosystems that support industry 4.0 (Hoyer et al., 2020); The government responds to industry 4.0 through education policies that encourage innovation (Pabbajah et al., 2020); The role of the Government and start-up company culture are the main factors in the transformation of industry 4.0 readiness in India (Tripathi and Gupta, 2021); The Kazakh government responded to industry 4.0 through macro policy schemes for industrial development and industrial digitalization (Dikhanbayeva et al., 2021); Government policy responses to encourage the use of technology 4.0 through regulations that force the use of more sustainable and mature technologies and encourage initiatives towards the adoption and advancement of less mature technologies (Mabkhot et al., 2021); The Chinese government established the "Made in China 2025" plan to implement several policies to exploit the potential of high-tech manufacturing capacity in Industry 4.0. (Li et al., 2021); The government provides a policy framework that supports technology transfer (Alkhazaleh et al., 2022); Exponentially increasing government assistance can help Industry 4.0 SMEs in collaboration schemes with technology start-ups (Tama et al., 2022); The government's response through providing subsidies to encourage technological innovation of Chinese energy companies (Li, et al., 2023); The government plays a major role in developing and determining a triple helix collaboration framework between industry, government, and universities to face industry 4.0 (Kiss et al., 2023).

Also, recent academic works show that several countries have begun to initiate post-Industry 4.0 policies or the transition to the Industry 5.0 series. The countries have started to design and develop the human-centric aspect of technologies, systems, and services (Mourtzis et al., 2022).

Another study group explored the response to the government administration of Industry 4.0. Kadarisman et al., (2022) tested the influence of bureaucratic strategic management and entrepreneurial government on readiness towards Industry 4.0 and Society 5.0 in Indonesia, both partially and simultaneously. Karabegović et al., (2023) developed an Industry 4.0 readiness assessment tool for developing countries, including readiness for the desired government role in Bosnia and Herzegovina.

This study has relatively the same idea as the study of Karabegović et al. (2023) regarding the readiness of local governments to face Industry 4.0. However, the indication of readiness in this study focused more on the capacity to provide e-services.

Next, this study maps the academic debate over implementing e-services in the public sector. The studies of Reschenthaler & Thompson (1996), Heeks (2003), Accenture (2001), Asgarkhani (2002, 2004), and Nath (2003) provide two views regarding the effectiveness of e-services. On the one hand, e-services can improve public services. On the other hand, e-service practice does not accommodate regional values and may reduce its benefits. However, both camps agree that technological factor is a driving force for e-services.

In its implementation, e-services must deal with technical and non-technical obstacles. The implementation of e-services, technically, does not work well due to limitations in internet infrastructure and difficulty accessing computers (Dien Novita, 2014; Musfikar, 2018; Napitupulu, 2016; Pole, 2013). Another obstacle lies in the complexity of the information technology (IT) process and technical requirements (Melin & Axelsson, 2009). Moreover, the scarcity of reliable human resources (HR) in managing technology and information is a severe obstacle for the government (Dien Novita, 2014; Melin & Axelsson, 2009; Napitupulu, 2016).

The non-technical problems are more diverse than the technical ones. E-services are not running well due to insufficient budget allocation and high investment costs (Musfikar, 2018; Pole, 2013). Furthermore, inadequate leadership and commitment discourage the development of e-services (Dien Novita, 2014; Napitupulu, 2016). Other inhibiting factors involve the lack of government regulatory support in e-service development (Dien Novita, 2014; Napitupulu, 2016) and inadequate literacy and digital culture among service users and providers (Dien Novita, 2014; Musfikar, 2018; Pole, 2013). This situation makes governments unprepared to face or manage the complex challenges and risks of implementing e-services (Andersen et al., 2007). Thus, in the case of Indonesia, the application of e-service is limited to developing a website, leading to the failure of e-service implementation (Junaidi, 2011; Supangkat, 2006)

Considering these studies, technical and non-technical impediments indicate that e-service delivery has not been appropriately implemented. If it is related to the readiness of the regional governments to meet the challenges of Industry 4.0, this situation can indicate readiness or unpreparedness. Thus, the results of the e-service assessment can be a portrait of the response to the challenges of the 4.0 industry, especially the service response. This logic has not been widely used in previous studies and could provide an entry point for further academic contributions. Therefore, this article focuses on its contribution to assessing the readiness of regional governments to deal with the challenges of the 4.0 industry through an assessment of e-service delivery provided by regional governments in three regions of Greater Malang.

METHOD

This study applied the e-service Model Based on the Reference Model for Service Oriented Architecture (Ostasius & Petraviciute, 2010) to assess the implementation of e-

services in Greater Malang. The model deploys eight assessment indicators, namely visibility (awareness, reach), e-service users (user identification, user roles), case handling (manual case processing, automated case processing, e-notification), document handling (application, e-authentication), electronic payments (internet banking, other electronic payment methods), service integration (shared information services, information or decisions, database access, transparency), post-service activities (manual or non-automatic processing, electronic delivery), and security (privacy data, payment security).

The assessment of each indicator in the survey or e-service assessment is based on the maturity value of the user-based web or mobile application, as written by Ostasius and Petraviciute (2010). A maturity value of 1 means that it has not been implemented. This value will arise if the assessment shows no features or modules from the e-services that match the indicator. Value 2 means it has been planned. This mark demonstrates no features or modules of the e-services that match the indicators, but they have been included in the planning document. However, this mark is not used because the survey applies a user-based perspective.

Value 3 means e-service application under construction. This mark indicates that the assessment finds features or modules of the e-service application matching the indicators but remains in the development process, or bugs are still found. Value 4 means the e-service application has been implemented. This value indicates that the assessment finds a feature or module of the application that matches the indicator and runs well. Value 5 means the application continues to be developed. This mark indicates that the assessment finds that the features or modules of the e-service application correspond to the indicators.

The e-service survey was conducted from September 29 to October 1, 2020. The assessment covered electronic services based on mobile and web applications developed and operated by the regional office (OPD). In addition, this study conducted interviews and document analysis to complement the assessment result. It also held three focused group discussions (FGD) with related OPDs representing each Regional Government in Greater Malang on 5, 7, and 8 October 2020. The object of assessment is service-based applications and electronic complaints developed by three regional governments, as shown in Table 1.

Table 1. Electronic services based on mobile and web applications in Greater Malang

Malang Regency	Malang Municipality	Batu Municipality
1. SIPEDULI (http://sipeduli.malang*Kabupaten*go.id)	1. Sambat (https://sambat.malangkota.go.id)	1. Disdukcapil (https://dispendukcapil.batukota.go.id)
2. MalangKab Tanggap (Mobile Android Apps)	2. Izol (https://izol.malangkota.go.id)	2. Among Kota (Mobile Android Apps)
3. MalangKab UMKM (Mobile Android Apps)	3. Pasar Mbois (https://pasarmbois.com)	3. Among Tani (Mobile Android Apps)
4. GOKIR (Mobile Android Apps)	4. Ker! (Mobile Android Apps)	

	5. Sampade (Mobile Android Apps) 6. Website Perpustakaan Kota Malang (https://dispussipda.malangkota.go.id) 7. D-Cillin (Mobile Android Apps) 8. Dinas Pendidikan (https://dikbud.malangkota.go.id) 9. Sembako Malang (http://sembakomalang.com)

Source: Author Proccesed, 2021

RESULTS AND DISCUSSION

E-Service Platform

This study analyzed official regional government documents to discover the response and commitment to facing the challenges of Industry 4.0, particularly in implementing e-services. The researcher analyzed two documents: the medium-term regional development plan (RPJMD) and the OPD strategic plan (*renstra*).

Malang Municipality shows its commitment to meeting the challenges of Industry 4.0 in the 2018-2023 RPJMD document. This official document explicitly states two policy options to respond to the challenge. First, Malang Municipality has prepared a 2019-2023 Smart City Roadmap to be aligned with the Malang Service concept.

To perform Malang service, Malang Municipality has developed more than 60 applications for government administration and public service functions. One of the key components in implementing the Malang service involves accelerating information technology integration. It includes the establishment of a quick response system, the utilization of big data and geospatial technology, the optimization of the command center, the formation of a regional coordination team for SPBE (Service Provider Business Entity), the strengthening of standard operating procedures for all IT-based applications, the collaboration of application sharing, and the establishment of partnerships with higher education institutions.

The municipality also determines the future of Malang, one of which is Malang 4.0 (Information Technology Literacy in All Fields). Malang is aware of its character as a city of education and the characteristics of Industry 4.0. It explicitly answers the challenge by being technologically literate and strengthening its residents' regional culture and wisdom (character).

Furthermore, OPDs translate these commitments into their strategic plans (*renstra*). The Communication and Information Office establishes a strategic plan for SPBE in public services. The Department of Manpower, Investment and One Stop Integrated Services (DPMPTSP) establishes a strategic plan to realize fast-paced,

accurate technology-based (IT) services. The Office of Cooperatives, Industry, and Trade adopted the "Making Indonesia 4.0" industrial roadmap established by the national government.

Meanwhile, Malang Regency does not explicitly state its response to the challenges of Industry 4.0 in the 2016-2021 RPJMD. The second mission of the RPJMD states, "Expanding innovation and bureaucratic reform for clean, effective, accountable and democratic governance based on information technology". One of the strategies to perform this mission is "improving ICT-based services".

Several OPDs explicitly translate these missions and strategies into their respective *renstra*. The Office of Communication and Information seeks to realize electronic data management and information systems based on information technology. DPMPTSP tries to provide an Electronic Investment Licensing Information Service System. The Office of Education and Culture deploys IT to implement information service functions and basic education data reporting (DAPODIK) connected to the Ministry of Education and Culture. The Office of Population and Civil Registry uses IT to implement population administration applications.

Batu Municipality has a platform explicitly writing a commitment to deal with the challenges of Industry 4.0. The 2017-2022 RPJMD establishes a commitment to accelerate the implementation of the smart city concept. As a smart city, Batu Municipal Government is targeted to be able to manage its various resources effectively and efficiently. The Mayor stipulates the Mayor Regulation Number 78 of 2017 concerning the Smart City Master Plan. The concept of a smart city is an innovative city applying information and communication technology (ICT).

To attain the objectives outlined in this plan, implementing a strategy involving effective and transparent governance, bolstered by utilizing information technology, has been undertaken. The Regional Medium-Term Development Plan (RPJMD) clearly articulates the necessity of incorporating technology and information in governance, particularly in light of the Industry 4.0 era. It is also consistent with endeavors to establish effective and ethical governance.

OPDs under Batu Municipality translate the RPJMD into their *renstra*. The Office of Population and Civil Registry applies IT to develop public service innovations. DPMPTSP and Manpower Office created an optimization program for information technology by compiling a licensing database, developing an online-based integrated licensing service information system, and an online-based integrated licensing service information system (Plan Strategis *of DPMPTSP Batu Municipality*, 2018).

In general, all regions have platforms to respond to the challenges of Industry 4.0. They set information technology-based services for the residents and businesses. Thus, written evidence shows that each region has responded to the challenges of Industry 4.0, primarily through implementing e-services. However, it should also be noted that apart from the challenges of Industry 4.0, the regional governments consider Presidential Regulation Number 95 of 2018 concerning Electronic-Based Government Systems (SPBE) as the legal basis for e-service development.

E-Service Assessment

The e-service survey assesses the implementation of several applications used by regional governments in providing services for businesses and communities. The assessment was based on eight e-Service Model indicators Based on the Reference Model for Service Oriented Architecture developed by Ostasius and Petraviciute (2010). The first assessment was conducted on September 29, 2020, to examine e-services developed by Malang Municipality.

The first assessment examined online licensing applications (IZOL). IZOL is an application developed by DPMPTSP to serve business licensing. IZOL manages 35 license types out of 129, such as trading business licenses (SIUP) and company registration certificates (TDP), doctor's practice licenses, research certificates, and new regular licenses.

IZOL assessment shows no explanation on the start page of the function, purpose, and method or terms of using the application. This application also does not provide contact information, does not use artificial intelligence (AI) to check documents, is not integrated with the existing population administration (Adminduk) module, and post-service activities are still quite complicated.

The survey results also found some problems with other e-service applications. Some applications glitched or could not be opened. The SAMPADE application is a regional tax application that did not work correctly in the register feature. This application failed to respond during the registration stage (it did not send an activation code); thus, the assessment could not be carried out further.

The Malang City Library application is still based on the website, and the service application cannot be opened. The library service application "DCillin" does not have information regarding the steps for registration; as a result, the assessment stopped at the login page and could not be done further. The Education and Culture Office application remains website-based and could not be accessed during the assessment. Also, two other applications, KER! and SEMBAKO, only provide one-way information.

There is an application considered to have almost exceeded the assessment standard, namely the marketplace application PASAR MBOIS. It results from collaboration with the Trade Office, Malang Creative Fusion, and the Indonesian State Bank Company (BNI).

Pasar Mbois is a marketing medium for superior products from Malang on the website and Android application. Pasar Mbois is equipped with a QR code feature. Users can directly make transactions by scanning the QR Code on product samples displayed in public facilities such as stations, terminals, airports, and hotels in the city. Malang Creative Cooperative Mbois (MKKM) operates the Mbois Market, formed by various creative communities and prominent producers from Malang. The Pasar Mbois application has generally met all aspects of e-service indicators.

The results of the e-service assessment in Malang Municipality reveal several problems. Most of the obstacles faced by OPDs managing applications are human resources (HR)-related problems. A participant of FGD (October 8, 2020) from the

Malang City Library and Archives Office stated that the staff is stuttering when facing the switch to digital-based services, "one of the problems is human resources. They are accustomed to manuals and suddenly forced to use digital".

Meanwhile, DPMPTSP also faced the problem of the availability of capable personnel when managing the IZOL application. One of the officials at DPMPTSP gave an example of this problem during the FGD (October 8, 2020), "If you find no number to be contacted (for service complaints), the classic reason is related to HR (availability)."

Another obstacle concerns service procedures, which are not entirely implemented online. In the FGD (October 8, 2020), one of the kelurahan's (village) staff said, "Not everything can be done electronically. This fact also causes the kelurahan to experience difficulties explaining to the community. The administrative process is hampered because several processes must be done manually".

Next is the presentation of e-service assessment results developed by Malang Regency. The survey was conducted on September 30, 2020. The first application assessed was SIPEDULI. It is an e-service system for population administration and civil registry. SIPEDULI allows residents to access services, such as registration, monitoring applications, family data, requirements, and other information regarding population administration.

The assessment results show that the SIPEDULI application has been running well. However, the assessment discovers several weaknesses. There is no explanation on the start page regarding the function, purpose, and how to use the application. The application has not used AI to check documents, has not used e-authentication/e-signature on every document uploaded or downloaded, post-service activities have not been developed, and has not applied standard application security rules.

The next application assessed is MalangKab UMKM. This official application is intended to allow business people in the regency to market and register their business. Business in regional areas can promote their commodities via this application (marketplace). Entrepreneurs can include the address or location of their businesses. Hence, it makes it easier for prospective buyers to find the location. The application is also linked to the platform used by an OPD issuing business license. It allows the OPD to verify business entities with official licenses registered in this application.

The following application is GOKIR. This application aims to help vehicle owners facilitate motorized vehicle testing inspection and administrative processes. However, the assessment indicates that this application provides information only. There are no service processes such as payment systems, delivery of test documents, or other service processes.

Another application, MalangKab Tanggap, is dedicated to managing service complaints. This mobile application is provided for OPDs in Malang Regency to respond to residents' complaints and problems around the regency. Nevertheless, during the evaluation, it was observed that this particular application exhibited a higher frequency of complaints and a complete absence of user feedback. This application consistently engages in unidirectional communication.

The FGD, with OPD officers and staff held on October 5, 2020, responded to the results of the e-service assessment. A participant from Poncokusumo Subdistrict, who frequently has direct contact with the community in doing his duties, explained that these applications were not working because "(the applications) intended for competition purpose, there was no follow-up."

A staff member who had served in the Agriculture Office revealed that the chief of the Agriculture Office has less commitment to support applications. He testified, "The application has won first place at the national level (an award from the national government). However, after those who had the idea of developing the application moved to another OPD, the application was no longer running". Another problem was revealed by staff from the health office. In the FGD, he said that his office had already developed several applications. However, this application is still hampered by a lack of socialization. Consequently, many residents have no clues on how to use it.

Another obstacle is the network infrastructure that is not evenly available throughout Malang Regency. In the FGD, a Tourism Office staff remarked that many tourist sites in Malang Regency experienced internet signal difficulties, especially in several locations in Southern Malang. In addition, several applications remain one-way traffic (providing information only), and the application development process is incomplete. He stated, "Pujon Kidul (tourist village) has an application, but it is only one-way, only informative. To anticipate this, we are in the process of going there to help those running businesses in tourism".

Furthermore, this study assessed e-service applications developed and implemented by the Batu Municipality Government on October 1, 2020. The assessment was conducted on three prominent applications: population administration and civil registry (Disdukcapil), City Living, and Among Tani.

The Disdukcapil application is a website-based application that delivers services for birth and death certificates. Through this application, residents can also access news, programs, activities, and services provided by the Population and Civil Registry Office.

The assessment results show that the application needs to improve the quality of e-services. The application has no user authentication or login and register pages, no feature to automatically check the progress or progress of documents requested by the user, has not used AI to check documents, and has not used e-authentication/e-signature on each document uploaded or downloaded.

The City Living application provides information about news, tourist attractions, and exciting locations in Batu. They are helpful information for the public and tourists visiting the region. The City Living application applies one-way communication. In other words, the application solely provides information, not an interactive service.

Among Tani is one of the three main applications in the smart city of Batu. Among Tani provides a service that simplifies the transaction process of horticultural products between farmers and buyers. The application also provides the latest city updates and agricultural guide information. In addition, users can also discuss each other. However, when the assessment was performed, the application was in advanced development (service take-down). Thus, no further assessment was conducted.

FGD (October 7, 2020) uncovered one of the crucial problems in e-service development: the lack of regional budget allocations. One of the staff from the DPMPTSP and Manpower office conveyed these obstacles. The office has developed the 'Si Cantik' application to serve about 130 license types, requiring high costs for its development. Each license type must be accompanied by a derivative program accommodating the realities of licensing service. Meanwhile, not all government officials have the capacity to develop applications. Of the 130 licensing types, only five types have been carried out.

Based on the results of assessments of e-services developed by the three regional governments in Greater Malang, e-service applications developed by Malang Municipality are more prominent than the two other regions. However, all regions have made efforts to utilize technology as a solution to improve public services. Also, this study finds several facts explicating the logic beyond achieving e-service implementation by the three regional governments.

Firstly, not all service processes can be converted into digital form. One of the main reasons is that special rules for processing certain documents oblige users to arrange them manually. For example, arranging a marriage permit requires prospective brides to verify themselves with service officers in the village. If manual verification is not conducted, it may cause administrative errors or abuse of the issued permit.

Secondly, the implementation of e-services deals with infrastructure and users' literacy. The geographical location of a large area constrained by topographical challenges significantly affects the provision of e-services. The regions have to deal with complex and expensive network infrastructure provision. Moreover, the level of digital literacy in certain demographic groups (senior citizens) is low, and it sparks issues in fitting with e-service applications.

Thirdly, a common obstacle in each region leading to the underdevelopment of e-services is the limited number of personnel mastering application development. Then, most applications are only made to fulfill obligations to comply with electronic-based government system (SPBE) regulation. The characteristics of these applications are usually unwell prepared when launched (premature), and there are many bugs and errors since they are developed within a short time and inadequate operational funds. If an application is built on this basis, it will usually dim after launch.

Level of Readiness

Assessing regional governments' platforms and applications for e-services strengthens previous studies on problems faced in providing e-services. Not all service processes can be transformed into digital form because the (national) regulations have not fully supported the implementation of e-services. These findings echoed previous research by Novita (2014) and Napitupulu (2016) regarding the lack of government regulatory support in e-service development. Next, the constraints in implementing e-services due to the lack of infrastructure availability and users' literacy support the studies by Asgarkhani (2004), Novita (2014), Napitupulu (2016), and Musfikar (2018) on the limitations of internet infrastructure and the findings of Axelsson et al. (2009) regarding the complexity of the process and IT technical prerequisites.

Moreover, the discoveries of limited expert personnel who maintain and develop e-service applications support previous studies by Axelsson et al. (2009), Novita (2014), and Napitupulu (2016) regarding the scarcity of reliable human resources in managing technology and information, which is a severe obstacle for the government in developing e-services. Other findings regarding budget shortages, early launching of e-service applications, and weak commitment of regional and OPD leaders match the findings of Asgarkhani (2005), Musfikar (2018), Novita (2014), and Napitupulu (2016). Finally, this study reveals that the haste in e-service application development causes the low quality of e-services. This finding strengthens the study of Supangkat (2006) and Junaidi (2011), implying that the application of e-services is limited to developing a website and makes the implementation unsuccessful.

When linked to the literature on the study of responses and governments's readiness and regions to face the challenges of Industry 4.0, this study strengthens the previous study by Chung (2017) regarding the importance of administrative innovation initiatives. This research finds regional governments' awareness of e-service development and innovation. Likewise, the importance of the role or commitment of leaders strengthens the findings of Balkaran's Study (2016). Based on relevant previous studies related to the implementation of e-services by governments and the readiness of governments to face the challenges of Industry 4.0 (Balkaran, 2016; C.-S. Chung, 2017), this study seeks to expand previous academic works by constructing ideas about the level of readiness for e-service implementation.

The case of e-service implementation by the three regional governments in Greater Malang shows different readiness levels. Nevertheless, the three regions show similar logic, demonstrating several factors that can contribute to achieving e-service policies and programs in their regions. Based on this logic, this study proposes an academic idea of the level of readiness to deal with the challenges of Industry 4.0, especially in e-service implementation.

As remarked by Schwab (2016), the demands of Industry 4.0 for the governments involve fulfilling regulatory capacity and services to the business community and society. Particularly in e-services, there are demands for the regional governments, namely the provision of friendly services (efficient, effective, and economical). Implementing e-services by the three regional governments in Greater Malang is one of the cases representing the public service response to the challenges of Industry 4.0.

Based on the results of e-service assessment, official document analysis, and FGDs, at least they show a portrait of the readiness of three regional governments in Greater Malang to deal with the challenges of Industry 4.0. This study constructs an academic framework concerning regional governments' readiness to face the challenges of Industry 4.0, especially in organizing e-services.

The first level of readiness is initiation. The three regional governments have been aware of the importance of using e-services in the Industry 4.0 Era. They have started to develop e-services in crucial sectors, such as education, health, and population administration. Moreover, the three regional governments have also developed e-service

applications in other sectors, such as facilitating the provision of marketplaces, information on tourism, and complaint handling.

The second level of readiness is development. This level is a critical point of regional governments' response. The capacity to implement e-services appears at the development stage as a follow-up to the previous level.

Based on the results of web-based and mobile-based application assessments and confirmed through FGD, this study reveals several problems impeding regional governments and users from implementing e-services. First is the preparedness of capable human resources (HR), namely the adequacy of the number of personnel with technical capacity to develop and maintain e-services.

Second is the readiness of users, which is related to users' literacy for e-services. Not all residents have the ability to access services through e-service mediation. For example, an e-service application aimed at facilitating an agricultural marketplace is not directly run by farmers but by brokers. It results in slow seller responses to buyers' requests. Not all farmers are familiar with or able to use marketplace applications provided by the regional governments. As a result, marketplace users are taken over by brokers who cannot immediately find out the stock of agricultural commodities offered in the marketplace.

Third is the flexibility of e-services, the ability to make compromises, or a combination of manual services and e-services. Not all services can be resolved through e-service mediation. Some service aspects require a combination of services, such as matching marriage certificate data and verifying compliance with investment and business licensing requirements. Flexibility is also related to e-service applications provided or directed by the central government, which ~~are~~ not entirely appropriate to the regional context. Thus, the regional governments made many modifications, such as using the 'Si Cantik' application in conjunction with the OSS application from the national government in licensing service.

Fourth is integration among similar e-service applications. The study uncovers several similar e-service applications for the same service. The government can merge many similar applications to provide optimal services for users. Fifth is socializing e-services to residents. It is urgent to increase the acceptability and utility of e-services. Lack of socialization causes e-service to be underutilized by the residents or users.

Sixth is the provision of e-service implementation infrastructure. In addition to providing software in the form of applications, providing internet network infrastructure is no less critical in developing e-services. Providers must pay attention to internet network coverage for all targeted areas of e-services implementation. Some areas in Malang Regency and Batu Municipality are recognized as having problems with internet network coverage. Thus, in these areas, e-services are not easily accessible. These six drawbacks impede the development of e-service in the regions that await solutions.

The third level of readiness is sustainability. The capacity for sustaining and creating e-service breakthroughs may guarantee the continuity of e-service implementation. This study discovers at least three main points that encourage or hinder the capacity to sustain e-services. Firstly, a leader must commit to transforming public

services into digitalized or electronic format. Leaders' commitment, primarily regional heads, is needed to encourage OPDs' chiefs and staff to keep e-services running.

The second is budget commitment. E-service development requires sufficient financial support. The development of e-service must adapt to changes in community needs and demands and technological transformation.

Third is the Regional House of Representatives (DPRD) 's support for implementing e-services. The legislature plays a vital role in voicing residents' demands and needs in realizing and sustaining the implementation of e-services. The House can support this by proposing sufficient budget provisions in the budgeting process. It can also evaluate the implementation of e-services to ensure accessible and efficient services to the residents and private sectors.

Fourth is a realistic design of e-service development. Regions are not only dealing with the needs and demands of the community in developing e-services. At the same time, regional governments must deal with national government regulations that are not always suitable for e-service provision. For example, the study obtained data related to the fact that the implementation of e-services has not yet been entirely appropriate with compliance practices based on audits by the State Audit Agency (BPK). The use of pure digital services is an irregularity of performance.

Fifth is consistent users' needs for e-service delivery. The sustainability of e-service implementation follows the dynamics of user needs. Not only does the orientation of the continuity of e-service implementation follow the demands of Industry 4.0, but it also seeks to meet user needs.

Furthermore, these findings become an essential basis for preparing measurements of regional readiness to deal with Industry 4.0, especially in implementing e-services. This study recommends the development of aspects, variables, and indicators of preparedness for implementing e-services by regional governments as one of the responses to rapid changes in the Era of the Fourth Industrial Revolution.

CONCLUSION

The limitation of this study is its claims. All claims about regional governments' readiness are grounded in specific cases of e-service analysis. However, it is worth discussing since research about regional governments' readiness to face Industry 4.0 has provided less academic evidence.

The e-service analysis can indicate at least the readiness of the three regional governments in Greater Malang to anticipate the challenges of Industry 4.0. In general, the regional governments already have a platform as a form of commitment to deal with the challenges of Industry 4.0. However, the governments have to face several challenges in its implementation, namely the readiness of managing human resources, users' readiness, e-service flexibility, integration between e-service applications, weaknesses in e-service socialization, weak support and commitment from leaders, budget shortages, and constraints in providing infrastructure for e-service implementation. These findings support previous studies on barriers to e-service delivery by government and regional governments. This study also echoes previous research on regional readiness to face the

challenges of Industry 4.0, as stated by Chung (2017) concerning the importance of administrative innovation initiatives and Balkaran (2016) about the importance of the role and commitment of leaders. Departing from the logic beyond the response of the regional governments to the challenges of Industry 4.0, this study offers an academic framework concerning the categories of regional governments' readiness level to deal with the challenges of Industry 4.0, especially in the implementation of e-services, namely the level of readiness for initiation, development, and sustainability.

This study recommends conducting similar research to assess provincial and national governments' readiness to deal with Industry 4.0 challenges since both levels of government have different divisions of decentralized authorities and services coverage. Findings and explanations of provincial and national governments' readiness will enrich the logic and explanation of the government's readiness. They can probably offer a new perspective on readiness based on the different characteristics of delegated authorities and service coverage. It may also provide ample academic evidence to test the implementation of e-government policies via e-services.

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