Developing a framework for self-isolation app: a case study of Jakarta’s COVID-19 mitigation

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Abstract. Self-isolation for COVID-19 suspects plays a crucial role due to a lack of medical personnel and hospital capacity in Jakarta. The ongoing COVID-19 pandemic has taken an unprecedented toll on health services because the number of infections continues to climb and is thought to be far higher because many people have not been tested. This phenomenon opens an opportunity to support innovative collaborations between government and city co-creators (e.g. start-up companies) to develop a digital application for monitoring the self-isolation activity of COVID-19 suspects. This paper proposes a conceptual framework for developing a self-isolation app by conducting in-depth interviews with 20 participants from the Jakarta Health Office and mobile health app start-up companies. The result of this paper figures out the key features of the app, such as suspects database, daily monitoring form, geotagging, chatroom, test scheduling, panic button, and daily notification. In this paper, Jakarta was selected as a case study since it is stated as a collaboration city which initiates the opportunity to business sectors for increasing access and public service quality. This paper uses design thinking methods as an evidence base to develop a self-isolation app. The conceptual framework provides the foundation for the input-process-output model and insights into what an appropriate approach for the requirements of the self-isolation app development. This paper provides a better understanding of common elements in building the app. Its conceptual framework fits in any government sector. Also, it can inspire other cities to consider the model in developing a similar application with structural and systematic phases in every development step. Further research should be carried out to build an extension model of the design thinking approach to get specific quantitative and qualitative results.

1. Introduction
Since Jakarta's first case of COVID-19 was reported in March 2020, the official data on corona.jakarta.go.id shows that the total number of COVID-19 cases has significantly increased to 18,230 infected patients on July 24, 2020 [1]. However, the Department of Health of Jakarta Provincial Government which hereinafter referred to Jakarta Health Office has limited services in terms of the capacity of medical personnel and the isolation rooms that only 657 places available [2]. As a result, the monitoring process of all the COVID-19 suspects (suspects) could not be accommodated. Such limitation causes the number of suspects referred for self-isolation to have significantly increased [1]. This issue led to the idea to execute self-isolation activities at the public facilities according to the health
protocol. Self-isolation at home cannot provide a guarantee of the optimal prevention of the spreading from the coronavirus due to the lack of supervision of the medical workers [3].

On the other hand, smartphone contact tracing technology can be limiting the spread of infection through supervised location due to a significant percentage of the population can be quickly and precisely monitored [4]. Moreover, the COVID-19 symptoms are similar to the flu virus, and there are recorded cases of COVID-19, which are asymptomatic [5]. Thus, it is complicated problems to be addressed by the government, especially in Jakarta, to obtain and to monitor information regarding the spreading of COVID-19 virus at early as possible.

Developing an appropriate self-isolation app is a continuing concern within mobile health app start-up companies in handling COVID-19, especially suspect who require supervision from time to time [4]. Lack of business process understanding has existed as a critical component for developing a suitable application (the app). Data from several studies suggest that the digital intervention for monitoring suspects has a significant impact on the quarantine of individuals, and cooperation between government and private sectors is needed [4] [5] [6]. Such approaches and models, however, failed to address the development of the self-isolation app because they did not focus on the method, but only explained the features of the app. Interestingly, no previous study has investigated the development of such an app, especially in the context of Jakarta and Indonesia [6]. This condition indicates a need to understand the various perceptions of the self-tracking app that exist among government as a problem owner and start-ups as problem solvers.

This paper provides an insight into the conceptual framework underlying the foundation of the input-process-output model in building a self-isolation app. It seeks to explain the development of such a framework in the form of a system diagram. A design thinking approach was used to follow a case study design, with in-depth interviews of 20 participants from Jakarta Health Office, Jakarta Smart City, and private sectors (start-up) to investigate key features of such an app. This paper is the first study to undertake qualitative research with design thinking models. We use Jakarta as a case study because Jakarta is introduced as a collaboration city to initiate the opportunity for business sectors in increasing access and public service quality [7]. The importance and originality of this study are that it proposes a conceptual framework in building a self-isolation app in which such a framework can inspire other cities to consider the implementation of the self-isolation app. Also, the reader should bear in mind that the study is based on qualitative analysis of real cases in Jakarta.

The remainder of this paper is structured as follows. Section 2 describes the methodology for investigating insights into the development of the conceptual framework. Section 3 presents the results and analysis of the study. Section 4 discusses how the finding compares with related work and the implication for government, private, and academic sectors. Finally, the last section presents the conclusion.

2. Methodology

2.1. Aim

This paper investigates the requirements to develop a framework for developing self-isolation platform monitoring by employing 20 participants, consisting of 4 participants from the Jakarta Health Office, 7 participants from Jakarta Smart City, and 9 participants from private sectors.

The process of developing a self-isolation monitoring system starts from observing the requisites of the medical personnel from the Jakarta Health Office as a problem owner in the interest of mitigating the monitoring process of suspects. This study was conducted through interviews with participants from the Jakarta Health Office, Jakarta Smart City, and private sectors (mobile health app start-up companies). The recruitment process for participants was carried out by using existing connections via verbal, Zoom invitation, or official invitation letter from Jakarta's Department of Communications, Informatics, and Statistics. Before the research began, a group discussion was held between the Jakarta Health Office and the private sectors, which finally engaged 20 of 38 invited participants whereas 18 participants from private sectors lacked the technological capability to accommodate the requirement of
Jakarta Health Office. Group discussions were conducted via the Zoom Meeting due to the COVID-19 pandemic issues. The selected participants consisted of health and technology professionals as well as medical doctors, systems, and IT development experts. Table 1 presents a summary of the participants involved in this study.

| Participant Identifier | Gender | Role          | Category            |
|------------------------|--------|---------------|---------------------|
| P1                     | Male   | Doctor        | Government sectors  |
| P2                     | Male   | Doctor        | Government sectors  |
| P3                     | Male   | Doctor        | Government sectors  |
| P4                     | Female | Doctor        | Government sectors  |
| P5                     | Male   | IT expert     | Government sectors  |
| P6                     | Male   | IT expert     | Government sectors  |
| P7                     | Male   | IT expert     | Government sectors  |
| P8                     | Male   | IT expert     | Government sectors  |
| P9                     | Female | IT expert     | Government sectors  |
| P10                    | Female | IT expert     | Government sectors  |
| P11                    | Female | IT expert     | Government sectors  |
| P12                    | Male   | Director/Doctor | Private sectors   |
| P13                    | Male   | IT expert     | Private sectors     |
| P14                    | Male   | IT expert     | Private sectors     |
| P15                    | Female | IT expert     | Private sectors     |
| P16                    | Male   | IT expert     | Private sectors     |
| P17                    | Male   | IT expert     | Private sectors     |
| P18                    | Female | IT expert     | Private sectors     |
| P19                    | Male   | IT expert     | Private sectors     |
| P20                    | Male   | IT expert     | Private sectors     |

2.2. Procedure

This study adopted a case study approach as an empirical inquiry method to understand a contemporary phenomenon and complicated situation faced by the Jakarta Health Office [8] [9], using focus group discussion (FGD) and in-depth interviews as the instrument for data collection of qualitative research [10]. It will give practical thoughts and opinions from participants. The activities of group discussion and interview took between 60 – 120 minutes per meeting.

There are six aspects of quality [11] and two elements of project management used to trigger the discussion and find the requirements of the Jakarta Health Office. For this purpose of this study, participants were asked to respond to the following aspects below:

- Performance refers to the functional product in operating characteristics to achieve its objectives.
- Reliability considers that the product will not fail within a specific period. It includes data security and integration.
- Serviceability appraises how convenient the product is to be repaired when it breaks down. It includes maintenance and cooperation agreement documents.
- Aesthetic indicates the impression of user response to the product. It includes ease of use.
- Perceived quality is based on the customer's experience of satisfaction with the product.
- Features are other functions that the product can perform besides the main functionality.
• A resource is the availability of human resources. It includes system maintenance, development, and users.

• Agreement cooperation: it includes cost, branding, period, test, and trial.

Finally, the participants had an opportunity to share any additional thoughts and opinions. Further, they were allowed to elaborate on their experiences beyond the aspects above, which were used for guidance to gain more information. This activity allowed for new elements to emerge, based on real experiences from participants in developing self-isolation app.

2.3. Data Collection and Analysis
This study used eight aspects to collect the requirements of system design and development. The design thinking approach of Stanford was used to create ideas and solve the problem [12]. It provides solutions for complex problems [13]. Moreover, it can help systems and strategies innovators to build a new concept because it will be the first step to develop others [14]. The design thinking process is an iterative process that has many detailed steps and intensive interaction with end-users. Each phase of the activities must achieve several results that can be delivered to the next stage [15]. The researchers must investigate and dig deeper to get the information needed from the problem owner to understand the context and problem [16]. Qualitative data was collected and analyzed through five-phases of design thinking. The result of focus group discussions and in-depth interviews will be mapped and analyzed in the design thinking method so that it can reduce the bias and obtain innovative works for the next study [16]. Figure 1 shows the five phases of the design thinking method were applied in this study.

| Empathize | To understand the situation and collect the information from the problem owner. |
|-----------|--------------------------------------------------------------------------------|
|           | This phase uses an in-depth interview.                                        |
|           | Applying the empathy map canvas as an instrument.                             |
| Define    | To identify the project objectives and understand the requirements of the problem owner. |
|           | This phase uses brainstorming with the stakeholders.                         |
|           | Applying the customer journey map and describing the requirements of the problem owner. |
| Ideate    | To explore ideas and solutions of the problem.                              |
|           | This phase uses brainstorming with the stakeholders.                         |
|           | Applying the sketches concept as an instrument.                             |
| Prototype | To build a prototype based on ideas, and to present the result to the problem owner. |
|           | This phase uses brainstorming with the stakeholders.                         |
|           | Applying the storyboards as an instrument.                                  |
| Test      | To test and fulfill the prototype, and to ensure the requirements of the problem owner. |

Figure 1. Five-phases of the design thinking method

3. Result
This paper introduces a conceptual framework in the form of a system diagram, as shown in Figure 2. It begins with the problem owner, Jakarta Health Office, which has a goal to conduct a collaboration
with private sectors that have competency in digital technology to develop a self-isolation monitoring app for Covid-19 suspects. Moreover, the stakeholders related to the problem are listed as Jakarta Health Office, Jakarta Smart City, and private sectors (start-up companies). Chosen stakeholders are the prominent policymakers and industrial actors that directly correlate with the problem owner goal. The strategies are derived from the crisis management of the Jakarta Health Office, in which such requirements will affect self-isolation monitoring app development. The government stakeholders such as Jakarta Health Office and Jakarta Smart City are then collaborating in framing the supportive policies to be considered in this model, such as:

- Jakarta Governor Regulation Number 306 of 2016. This policy governs Jakarta Smart City should develop coordination, partnership, and integration in information and technology dissemination with various parties [17].
- Jakarta Governor Regulation Number 159 of 2019. This policy states the obligation of the Jakarta Health Office in building a collaboration with private sectors to resolve health problems [18].

Further, the proposed framework consists of three main elements: Input-Process-Output model. First, the input variable is derived by the assumption that the number of COVID-19 suspects, the number of medical personnel, and the capacity of isolation rooms will be following the current trend that is independent of the process. The process, as the second aspect, is divided into five phases (which will be discussed deeper later). This study learned about the app users more deeply after going through the definition phase to make sure the needs and the requirements of the problem owner, and after going through the test phase, it obtained new ideas and revealed insight to redefine the needs of the problem owner. The last aspect, the output, is about suspects that can be isolated independently according to health protocols and well monitored using the developed application.

![Figure 2. The conceptual framework of self-isolation app development.](image-url)
the medical personnel is overwhelmed by the increasing number of suspects treated every day. Table 2 describes an empathy map of Jakarta Health Office.

Table 2. Jakarta health office empathy map.

| A. Say:                                                                 | B. Do:                                                                 | C. Think:                                                                 | D. Feel:                                                                 |
|------------------------------------------------------------------------|------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|
| "The total number of COVID-19 cases has significantly increased during the pandemic that makes the medical staff has to provide extra service to the suspects." | "Medical officers supervise not only one COVID-19 suspect but more than that." | "It's expected the workload of medical staff can be stabilized. So it can accommodate services during the increasing number of COVID-19." | "The medical staff was overwhelmed by the increasing number of suspects treated every day." |

3.2. Define

This phase begins with identifying the actual problem and trying to find the needs and requirements of the problem owner. Data were gathered from brainstorming activity, which is held among stakeholders to find the goals, and it was mapped into the customer journey map. Figure 3 provides the customer journey map based on group discussions with stakeholders. The customer journey map is used to illustrate the experience of the medical personnel from the Jakarta Health Office and the context of the problem.

In summary, the customer journey map confirms that the medical personnel feels overwhelmed due to the lack of medical staff and inpatient rooms capacity. This condition is supported by data of the level...
of COVID-19 inpatients increased day by day (March to June 2020), as can be seen in Figure 4 [19]. The Indonesian Ministry of Health also has given direction to conduct a self-isolation protocol by the Circular Letter of the Ministry of Health number 202 of 2020 [20].

After analyzing and understanding the problem, this phase formulates that the problem owner needs a self-isolation system based on technology to stabilize the workload of medical personnel, reduce the spread of COVID-19, and improve the medical services to the suspects. Table 3 explains the Jakarta Health Office requirements of the self-isolation monitoring of COVID-19 suspects.

### Table 3. The Jakarta Health Office requirements of self-isolation monitoring of COVID-19 suspects.

| Identifier | Needs | Description |
|------------|-------|-------------|
| N1         | Collecting self-isolation data | Collecting and identifying data on the number of suspects, based on data COVID-19 patients from Jakarta Health Office and the public who require self-isolation for 14 days. |
| N2         | Monitoring suspects’ condition | Monitoring the activities and conditions of suspects for 14 days. |
| N3         | Tracking the suspects | Tracking the movement of the self-isolation suspects for 14 days. |
| N4         | Communicating with suspects | Two-way communication. If the suspects have a COVID-19 symptom for 14 days, the medical staff can immediately provide treatment. |
| N5         | Scheduling suspects to come to the nearest public health centre | If the suspect doesn’t get better during 14 days, the public health centre officer will provide a schedule to get medical services in the nearest public health centre. |

3.3. Idea

From the various problems that have been outlined, then the Jakarta Health Office with Jakarta Smart City begin a focus group discussion activity between the private sectors and the Jakarta Health Office to brainstorm the new self-isolation process based on digital technology.

![Figure 5](image_url) The business process of self-isolation monitoring application.
The result is a new integrated system solution in monitoring and reporting the self-isolation COVID-19 suspects. This system is expected to accelerate the work process of the related parties. The system is expected to accelerate the work process of related parties to monitor all suspects. The conditions, the locations, and the treatments to every suspect in DKI Jakarta still can be maximally facilitated as well. Figure 5 shows the collaborative business process system.

This self-isolation monitoring and reporting system are integrated with the Jakarta Health Office, public health centres, application providers (private sectors), and users (self-isolation COVID-19 suspects). Users need to create an account with the ID number (resident number in identity card) to register on the application. The user data will be verified and directed to the Jakarta Health Office for the daily monitoring requirements of the suspect's condition by the public health centre in two weeks. Users have to fill out the form provided as a monitoring process. The daily data will be automatically recorded in the Jakarta Health Office system. The application also allows for two-way communication between suspects and public health centre officers for further treatment if needed. The system contains confidential information of COVID-19 suspects which is be guaranteed by segregation of duties between government and private sectors to reduce opportunities for unauthorized or unintentional modification or misuse of the organization’s assets. Jakarta Health Office as an authorized party has the responsibility to permit the data utilization based on Non-Disclosure Agreement (NDA).

Based on that business process, a solution requisite is formulated as the features that will be included in the application. Table 4 describes the result of features expected to resolve the problem.

### Table 4. Self-isolation monitoring application features.

| Needs | Feature                  | Description                                                                 |
|-------|--------------------------|-----------------------------------------------------------------------------|
| N1    | Suspect Database         | The table which contains self-isolation suspects’ data included their profile and status |
| N2    | Daily monitoring form    | It includes several questions based on the Jakarta Health Office standard for daily suspect condition checking |
| N3    | Geotagging               | The feature which can be tracked the location and the movement of the suspects during the self-isolation period |
| N4    | Chat room                | The feature which allows the suspects and the public health centre officer to have a two-way communication |
| N4    | Panic button             | The feature which enables the suspects to send an emergency to the public health centre officer to be rescued immediately |
| N4    | Daily Notification       | The daily notification feature which will be popped up on the suspects’ device as a reminder of the daily reporting |
| N5    | Test scheduling          | It contains the calendar and the digital clock which allow the suspects to choose the Swab test schedule |

### 3.4. Prototype

After the solutions are agreed upon by every participant concerned, the next pace is designing a prototype which includes a self-isolation monitoring and reporting system. In this phase, private sectors, Jakarta Smart City and Jakarta Health Office are collaborating to develop a prototype into two types of the app designed which are mutually integrated, the first one is a mobile application which will be used for suspects and public health centre officers, and the second one is a suspect monitoring dashboard used by public health centre officers. Figure 6 is the interaction system diagram of the self-isolation app.
**Figure 6.** Interaction System Diagram of Self-Isolation Apps.
3.5. Test
The next pace after completing the prototype is an implementation phase which will be started by pilot testing activity for the selected medical personnel at the public health centre and continued with the cooperation agreement signing among the participants concerned. The application then will be introduced to the medical personnel widely in technical guidance activities and disseminated to the public. This app is easy to use for medical personnel and the public. Surprisingly, testing phase revealed that people visited public health centre only checked up their health condition. On the other hand, this activity can be conducted by a self-assessment monitoring form.

In summary, these results show that supporting policy is needed to support a collaboration between the government and the private sector. This case study that focused on building an end-user app can be accommodated by the design thinking method, which has a human-centred design and iteration process. The iterating process should deepen the result of the defined phase from the empathize phase to learn the medical personnel needs accurately. Furthermore, the testing phase result revealed some insights and created new ideas for features app, which can be deepened by the iterating process from define and ideate phases.

4. Discussion
This paper has several contributions to the literature and potential guidelines for developing the COVID-19 self-isolation monitoring app, in which different sectors, who have diverse roles and responsibilities, as well as different perspectives, are collaborating.

4.1. Reflection on Related Works
Prior studies have noted the importance of the conceptual framework for developing a system or an app [21] [22]. Still, they only focused on technical issues and less on raising the holistic view of a management and governance perspective. It differs from the results presented here confirms the use of design thinking method that facilitates the holistic view of management perspective to make an understanding not only how to create an app but also support the policies, advocate the macro-level initiatives and micro-level strategies that commonly asked from the managerial level in the organization. The use of the design thinking method enables collaboration with different stakeholders for developing an app and can make it more convenient in analyzing processes, integrating technical and non-technical factors, and applying user-centred design [23]. It allows participants to empathize with different stakeholders with open up discussion, intuitive, and rational minds, leading to innovative solutions [24].

Several reports have shown that there are few studies on developing an app for COVID-19, such as the study of portable health screening devices of respiratory infections development [25], quarantine tracker, and COVID-19 info-self reporting application in Bangladesh [6]. However, such studies did not represent the app development method used, but it only spelt out the features with their development goals. Moreover, another research only discussed the model for analyzing the data obtained from the implementation of smartphone contact tracing applications [4]. Thus, this paper is present as a pioneer of the academic research of developing the COVID-19 self-isolation app and hopefully can help other cities to build a similar app to reduce the spreading of COVID-19.

4.2. Implications
Implications include:
- Implications for Private Sectors: Collaboration with the government sector gives more value-added to strengthen company branding due to gaining a collaboration license from the government to their portfolio. Contrary to expectations, there are some participants from private sectors who are not sufficient to address government’s standard operating procedures where an agreement shall be governed by the laws of the Republic of Indonesia to ensure that all sensitive government data are limited to authorized users. Some participants are not sufficient to address a standard daily monitoring form and chat room feature. This combination of findings provides...
some support for the premise that the private sectors should have a willingness to adjust their business process first while wanting to collaborate with government sectors.

- **Implications for Government Sectors:** The present research raises the possibility that smart collaboration improves the way of serving the public using technology, harness innovation to improve the outcomes, and engage young entrepreneurs who run start-ups in the technology sector to meet evolving needs. Thus, government sectors also can use this framework into many collaborations for developing an app in any public service sector such as education, public safety, public welfare, and other vital industries public sectors that can be implemented smart city initiatives. Unfortunately, this study needed extra time to complete government administration tasks such as a memorandum of understanding, meeting invitation letters, collaboration proposals from the private sector, and collaboration agreement.

- **Implications for Researchers:** this paper can provide the needs, features, and guidelines to develop the COVID-19 self-isolation monitoring app through the design thinking approach. However, the utility of design thinking research is not limited to develop technological aspects. It can, therefore, be assumed the design thinking approach can also be used to create user-centred business models or other systems. On the other hand, the most significant limitation lies in the fact that suspect diagnosis based on self-assessment potentially biases from the doctor’s so that the assessment result becomes less accurate.

5. Conclusion
This paper has developed a conceptual framework that illustrates a holistic picture of smart collaboration in developing the COVID-19 self-isolation monitoring app that can be used as the pioneer reference framework for the next researches in the future. The current conceptual framework highlights the importance of the design thinking approach. This paper has also shown that the smart collaboration of government sectors and private sectors is playing a significant role to use technologies as a solution to help the problem owner finding the key features of the COVID-19 self-isolation apps, such as suspect databases, daily monitoring form, geotagging, chat room, test scheduling, panic button, and daily notification. Overall, this paper strengthens the idea that the government sectors should increase the collaboration with private sectors using a design thinking approach that needs willingness from private sectors to be flexible aligning their business process to government sector requirements.

A useful conceptual framework can support the next step of modelling in any government service sector. Further research should be carried out to build an extension model of the design thinking approach to get specific quantitative and qualitative results. Further studies need to be carried out more validated and verified quantitative methods.

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