Building Integrity & Collaboration in the Balkot-Farm Pilot Project through IoT (Internet-of-Things)

Totok Amin Soefijanto[1], Atika Nur Rahmania[2], and R. Fauzy[2]

[1]Universitas Paramadina
[2]Communications & Informatics Agency, Jakarta City Government, Jakarta, Indonesia

Abstract: Internet of Things (IoT) becomes the household phrase recently. On the other hand, urban farming activities attract public attention in spite of food supply sustainability. Hence, combining both into a project should be remarkable. "Balkot-Farm" is a Jakarta City Government's initiative to apply IoT in urban farming that exploits vacant lands and spaces within the city hall area. It started in August 2019 after several meetings that involve four city government offices, such as Communication & Information (CI), Maritime, Fishery & Food Security (FS), Health (HO), and General Bureau (GB). The Governor of Jakarta supervises the "Balkot-Farm" through TGUPP or the Governor's Delivery Unit. Using IoT, the five Jakarta government offices have developed collaboration capacity. CI sets up the technology, FS supplies the plants, fertilizers, and related farming needs, HO provides family-medicinal plants. Meanwhile, the GB assembles the land, water, and electricity. Furthermore, the IoT contributes to project integrity and governance. Through the website (http://balkotfarm.jakarta.go.id), all parties can manage farming and monitor data remotely. The McKinsey Model stated that IoT must pay attention to three important aspects: (1) asset coordination & collaboration; (2) production system; & (3) human factors. This study employs a descriptive qualitative procedure to gain lessons from the Balkot-Farm pilot project. The findings show that IOT played a significant role at the beginning due to its novelty effects. In addition, the government offices were able to build trust among them because the IoT offered a real-time monitoring system. "Balkot-Farm" can run properly because IOT helps to solve daily problems in farming management. Eventually, each government office can deliver routine reports with credibility and integrity.

1 INTRODUCTION

Green open space is very important for an urban area. Major cities of the world must have extensive parks, like New York with Central Park or San Francisco with Golden Gate Park. Jakarta has a National Monument park, which is enough to make this metropolitan city center green. Unfortunately, this kind of land, which is often called green open space, is in a very limited amount. According to World Vision, the amount of green open space (RTH - Ruang Terbuka Hijau) is decreasing every year. In 1965, Jakarta still had RTH up to 35 percent, but in 2011 the number had decreased to 10 percent. Therefore, all initiatives that make Jakarta greener will be highly valued by its residents.

At present, Jakarta has 10 percent RTH of Jakarta's area around 661.5 square kilometers.

Jakarta Governor Anies Baswedan has plotted additional RTH of around 6 percent in the Regional Regulation on Spatial Planning Details. As for this year, Jakarta city government plans to build 53 green open spaces (RTH) in the form of Progress Together Parks (Taman Maju Bersama). Besides being used for public activities, this park complements the flood control program. "So, the rainwater is not immediately discharged into the city channel," said Jakarta Forestry Department's Forestry Planning Section Head, Hendrianto (Tempo, 2019).

In addition to Taman Maju Bersama, the Jakarta City Government seeks to develop urban farming in the capital city through the Urban Farming 4.0 program with a flagship program called the "Balkot-Farm." The farm is a pilot project in the City Hall complex, located on Jalan Medan Merdeka Selatan, Central Jakarta. This program involves four offices

(Regional Government Work Units) and one local bank, such as (1) Communication and Informatics Department; (2) Food Security, Maritime and Agriculture Farming and Fishery Department, (3) Department of Health (Dinkes), (4) City Hall General Affair Bureau, and (5) Bank DKI. This initiative is regularly monitored by the Governor's Delivery Unit Team for the Acceleration of Development (TGUPP).

Implementing the concept of urban farming and using lOT (Internet of Things), "Balkot-Farm" was formed to assist Jakarta Governor's program regarding the 2018-2030 Urban Agricultural Design and Jakarta Governor's Instruction No 14 of 2018 on Urban Agriculture Implementation. The "Balkot-Farm" program began with a dream of exploiting vacant land in the City Hall of DKI Jakarta Province since 2018. This dream came true with the disposition of the Head of the Department of Communication and Information on 8 January 2019 on the Implementation of Urban Agriculture and the Agriculture Website. It was supported by Dinas KPKP (Food Security Office).

Figure 1: The atmosphere of urban farming in the Block E DKI Jakarta City Hall complex (Source: Balkot-Farm).

On 22 February, 2019, the Urban Farming 4.0 program proposed by the Head of the Jakarta Provincial Communication and Information Agency was selected as one of the participants in the Jakarta Provincial Government's Innovation Exhibition at the BPSDM (Human Resources Development Body) event located in Balai Agung, City Hall. The Urban Farming 4.0 program, which became known as "Balkot-Farm," received support from the Jakarta Governor, Anies Baswedan, to be implemented immediately. The location is also immediately determined: a lot in Block E.

At the meeting on 14 March, 2019, the design of the "Balkot-Farm" was approved. Every government agency in the program has a dedicated major task (Table 1).

Table 1: This caption has more than one line, so it has to be set to justify.

Agency	Major task(s)
Communication and Informatics Department (Diskominfotik)	Building (APP farming), utilization of IoT (Internet of Things), and Gathered Group Discussion (FGD)
Food Security, Maritime, and Agriculture Farming and Fishery Department (Dinas KPKP)	Prepared a set of Urban Farming agriculture, plants, fertilizers, agricultural murals, and management (through the Central Jakarta and South Jakarta KPKP Sub-departments)
City Hall General Affair Bureau (Biro Umum)	Provides land, water, and electricity
Department of Health (Dinas Kesehatan)	Provides family medicinal plants
Bank DKI	Supporting funding for the urban farmers' activities and future e-commerce platform (market place)

There is also another party involved: the Governor's Delivery Unit Team for the Acceleration of Development (TGUPP). This team monitors the progress of the program as a pilot project for the implementation of the Governor's Instruction on the Implementation of Urban Agriculture. On 3 April 2019, the construction of "Balkot-Farm" was started, with necessary features from both the Hydroponic, Mural, and IOT farming systems and other infrastructures. The governor has formally opened and inaugurated the farm on 2 August 2019. Recently, the 68 square-meter farm holds around 400 types of plants, including 23 vegetables and 40 family medicinal plants. Figure 2 shows the first page of the plants' list. In this case, the family medicinal plants or Tanaman Obat Keluarga (Toga). The lists of both Toga and vegetables are available on the Balkot Farm website.

The Toga list is available on https://balkotfarm.jakarta.go.id/id/list/tanaman-toga/n-0-529-1

The vegetable list is available on https://balkotfarm.jakarta.go.id/id/list/sayuran/n-0-29-1.

Balkot Farm's plant's collection includes spinach, water crest, green bean, galanga (kencur), vinca (tapak dara), gardenia augusta (kaca piring), and the list goes on and on.
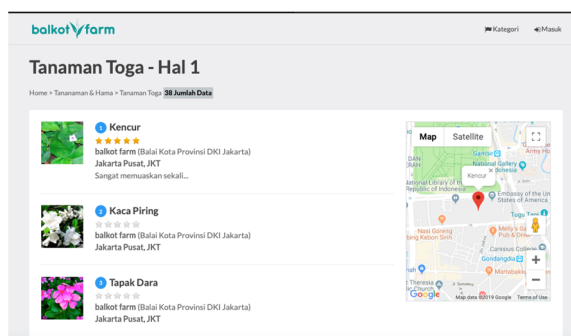
Figure 2. The list of family medicinal plants on the Balkot Farm website (source: Balkot Farm).

The research question is, how does the application of the Internet of Things in "Balkot-Farm" have a positive impact on efforts to improve collaboration and to instill integrity practices in urban farming? This research uses a descriptive qualitative methodology with informants from urban farmers and government officials involved in the "Balkot-Farm" program. This research also captures the satisfaction of stakeholders who feel the benefits of information technology that facilitates the farming process and simultaneously creates a working system that is more accountable and with integrity.

2 LITERATURE REVIEW

By combining physical and digital realms, the Internet of Things (IoT) broadens the reach of information technology. IoT is defined as "sensors and actuators connected by networks to computing systems. These systems can monitor or manage the health and actions of connected objects and machines. Connected sensors can also monitor the natural world, people, and animals" (Manyika, Chui, Bisson, Woetzel, Dobbs, Bughin, & Aharon, 2015: p.1). According to the Manyika, et al. (2015) study, many possibilities arise from the ability to monitor and control things in the physical world electronically. This has inspired a surge in innovation and enthusiasm in the community. Major changes that IoT can cause include how companies manage physical assets, how consumers pay attention to their health and fitness, and how a city operates. McKinsey, that has observed the implementation of the Internet of Things for years, found how difficult it was to get the greatest benefits from the implementation of IoT, which requires a very complex production system and coordination technology. The people behind IoT must also change

because their application in the field requires different competencies from previous periods.

IoT in the agricultural sector is indeed very timely. The new era development makes the agricultural sector seem outdated, but with the application of IoT in this sector, many young people are interested in the agricultural sector, especially in urban areas. According to Rikolto International (2019), young people do not want to enter the agricultural sector in Indonesia for the following reasons:

1. Young people see agriculture as a less prestigious profession with high risk, lack of security, and intense dirty work.
2. Because most farmers are poor, young people think agriculture is not a profitable job compared to the industrial sector.
3. Young people do not have the support to become farmers from parents. Most parents do not want their children to become farmers, and they encourage their children to become professional "white collar" workers.
4. Young people do not have the capacity/skills to farm, both in cultivation and in agribusiness management. There is a lack of curriculum about production, processing, and business in agriculture in schools.
5. Young people have limited access and control over productive resources (land, capital) and markets.
6. There are very few groups of young farmers organized for solidarity and exchanging information and ideas.
7. Industrialization influenced young people's work preferences. Young and educated workers choose to leave their villages and migrate to find better jobs in the city.

Balkot Farm intensively invites young people in Jakarta to do agricultural activities in their neighborhood. The myth that farming requires large tracts of land can no longer be used because farming in the information age can be done in a narrow area. Urban agriculture can also supply residents with nutritional needs, such as fresh vegetables. One recent survey found that 51 countries did not have enough urban areas to meet the recommended nutritional target of 300 grams per person per day of fresh vegetables (Altieri, 2019). In addition, it is estimated, urban agriculture will require 30 percent of the total urban areas of these countries to meet global demand for vegetables. The issue of land tenure and urban expansion can make it difficult to free up this much land for food production.

According to Aziz (2018), urban work activities that take a considerable amount of time can result in plants that have been planted cannot be properly taken care of, resulting in the death of these plants. There are three alternatives for managing urban farming; first, by building a reminder system for watering plants. Second, create an automatic soil watering system based on soil moisture and plant conditions. Third, create a watering system that can be controlled using the internet with web-based media. According to Aziz (2018), the most optimal choice is an automatic watering system by considering the condition of the soil, nutrients, and plants to be a solution in the development of the Urban Farming system. Figure 2 shows the web-based automatic watering system scheme.
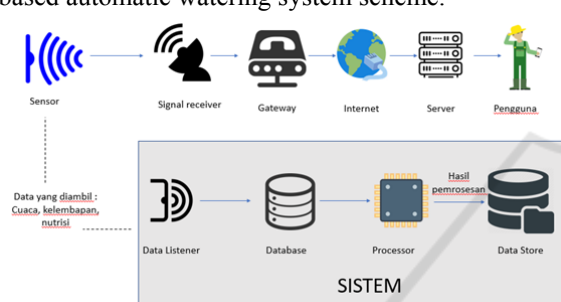

Figure 2. Urban Farming system development diagram (Aziz, 2018).

As the term "Internet" indicates, the networking capability is one of the core features of the IoT devices. The internet, as we know it today, is mostly the internet of human end-users. Meanwhile, the IoT is an internet of non-human entities. Therefore a lot of machineto-machine (M2M) communication will occur (Tzounis, Katsoulas, Bartzanas, & Kittas, 2017).

According to Lee & Lee (2015), infrastructure in logistics for the food and agricultural sector aims to facilitate the exchange of information and the transportation of goods, optimizing the production process and the supply chain networks globally. IoT is gradually transforming business processes by providing more accurate and real-time visibility to the flow of materials and products. Crucial parts of collaboration become easier to handle because of the IoT features.

In fact, the urban farming activities in the Balkot Farm must ready to deal with some obstacles. Previous studies on the real-world deployments have shown that the performance of popular transceivers is affected by temperature (Bannister, Giorgetti, & Gupta, 2008; Boano, Tsiftes, Voigt, Brown, & Roedig, 2010), humidity (Thelen, 2004), human

presence and other obstacles within the space in which a wireless node attempts to communicate. Therefore, Balkot Farm must employ a reliable data transfer system, with robust technology, corresponding to the requirements and challenges of the urban environment.

In a real IoT scenario, according to Tzounis, Katsoulas, Bartzanas, & Kittas (2017), many parties involved will use different equipment, with different technical specifications and/or sensor characteristics. Obviously, the interoperability, the filtering, and the semantic annotation of the data, coming from each party, have to be made to some extent. This is the only way in which the data, coming from vastly heterogeneous sources, can be used to optimize shared decision support or expert system.

According to Eggers, Datar, Parent, & Gustetic (2019), government leaders and organizations should seek to advance the change both vertically and horizontally to harness the enormous potential provided by the future of work. Furthermore, Eggers et al. (2019) describe "Vertically" means proactively architecting work units or specific jobs and "horizontally" means encouraging organization-wide practices for redesigning work, including encouraging mindset shifts and embracing design thinking.

Finally, the issue of assets such as land and other equipment is crucial for urban farming. According to Indraprahasta (2013), one must solve the land issue first before proceeding with urban farming activities. This is especially important for Jakarta, a megapolitan city, that has limited land availability due to commercial use. The urban farmers must compete with developers that have been dominating the land business in the town for a very long time since Indonesia's independence in 1945.

3 METHODOLOGY

This research on "Balkot-Farm" uses a descriptive qualitative approach. Information was obtained from informants, including the head of the Office of Communication and Information (Diskominfotik), the Office of Food Security, Maritime Affairs and Fisheries (Dinas KPKP), the Health Services Office (Dinkes), and the General Bureau (Biro Umum). The role of Diskominfotik is very important in this pilot project because this office is the focal point or "coordinator" to building the collaboration.

Two types of data were collected: primary and secondary. The primary ones acquired through interviews and focus group discussions. The

secondary data received from documents and formal letters circulated within the pilot project.

The research was conducted from April to August 2019 and mostly done in the Jakarta area. The main location of the study is the Jakarta City Hall, located in the heart of the metropolitan city. The lot for the Balkot Farm pilot project is in Block E that is just next to the health clinics and Governor's office.

4   DISCUSSION

"Balkot-Farm" pilot project involved 15 people from the general public (city farmers in central and south Jakarta: 11 dedicated farmers and 4 "leisure" farmers for a hobby). One of them is Ms. Latifah, who will leave for Japan in November 2019 to attend the Urban Farming Summit 4.0, representing the city of Jakarta.   There are also 5 public officers from the Food Security, Maritime, and Fishery Office (*Dinas KPKP*), 5 officers from Communications and Information Office (*Diskominfotik*), 2 officers from General Bureau Office (*Biro Umum*), and 1 officer from Health Office (*Dinas Kesehatan*).

According to McDougall, Kristiansen, & Rader (2019), people flock into urban farming for many reasons; three of them are fresh food, sustainable food, and environmental reasons. Indeed, the majority of gardeners were not highly motivated by the desire to produce large quantities of food. Figure 3 shows the other motivations to do urban farming or urban agriculture. "reduced food costs" and "cultural reasons" are at the lowest number.   This is similar to finding from Urban Farming farmers who do the farming because of fresh and sustainable food, but the cost is almost free; The government has paid for the farming costs through the public budget.
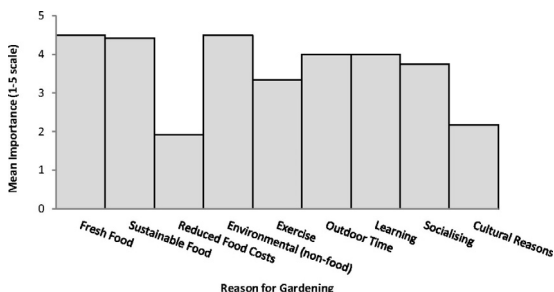

Figure 3: Mean motivations for engagement in Urban Agriculture listed by volunteers in surveys (McDougall et al., 2019).

The city farmers manage vegetables and seedlings. They are assisted by the Dinas KPKP public officers as counselors. The officers of the Communication and Information Office deploy the IoT, monitor and develop the application and management of the whole system of "Balkot-Farm" project. Health Agency officers manage the family medicinal plants. Last but not least, the officers from the General Bureau conduct monitoring and maintaining the water supply, electricity, and ground housekeeping.

The majority of city farmers are in their 30s, so the "Balkot-Farm" project potentially will attract the youth to do farming as their main occupation. As Rikolto International (2019) found, the IoT application could possibly the reason for the youth to work in urban farming activities. Most of the young people who were participating in this study said that the IoT and new technology applications have raised the job attractiveness because it has diminished the negative images of farming works, such as dirty, not profitable, capital-intensive (land and supplies), boring, much idle time, limited exchange of ideas, and less technology use.

This study employs the McKinsey concept of IoT implementation, in particular for urban farming, which shows three essential aspects, such as asset coordination and collaboration, production system, and human factors (Manyika, Chui, Bisson, Woetzel, Dobbs, Bughin, & Aharon, 2015). These essential aspects complement the findings in integrity and collaboration issues in the Balkot Farm, a Jakarta government urban farming pilot project. Manyika, et al. (2015) describe IoT as "sensors and actuators connected by networks to computing systems. These systems can monitor or manage the health and actions of connected objects and machines. Connected sensors can also monitor the natural world, people, and animals". The elaboration of research findings are as the following:

4.1   Asset coordination & Collaboration

Coordination and collaboration in the government bureaucracy is always an issue. Balkot Farm can be a new place for the State Civil Apparatus (ASN) and the community in the DKI Jakarta Provincial Government and guests who come to interact with each other. The Balkot Farm area is also an interesting spot to take pictures at City Hall, in addition to urban farming, which is supported by the use of information technology.

The study found that several collaboration problems can be solved, such as the following:

i. The Office of Communication & Informatics (Kominfotik) activates Balkot Farm through the initiation of the urban farming 4.0 program through IoT,

ii. All offices and bureaus conduct monitoring and evaluation of artificial intelligence applications,

iii. All departments involve in public communication, public information, and they work together as an integrated "bridge of collaboration" between the government and the Jakarta community.

4.2 Production System

The production system in Urban Farming looks very similar to other urban farming projects. "Balkot-Farm" has several findings, such as:

i. Users can access integrated services through balkotfarm.jakarta.go.id as public information material through digital mapping of urban agriculture as well as a database of types of plants and vegetables, including maintenance.

ii. Data share users are urban farming activists in DKI Jakarta

"Balkot-Farm" is a miniature of an integrated and collaborative urban farming program, between the government and the community, according to the Instruction of the Governor of DKI Jakarta Province Number 14 of 2018 concerning Implementation of Urban Agriculture. This project also further implements the Great Design of Urban Agriculture in 2018-2030.

The plan, Dinas KPKP (Food Security Office), will launch SiPetaniDKI application. One of the objectives is to take stock of the urban agricultural activities that have been carried out and explore the existing potential. Later, SiPetaniDKI -- the web-based Internet of Things (IOT) -- will be integrated with the "Balkot-Farm," so that the State Civil Apparatus (ASN) and urban farming practitioners can inform the activities and its potentials in their respected areas. Henceforth, the Urban Farming 4.0 Digitalization Program becomes widespread, and reality in DKI Jakarta province.

4.3 Human Factors

It is important to consider humans as the most important factor in urban farming. The findings from Balkot Farm is as the following:

i. DKI Jakarta residents who do urban farming were dedicated farmers; just a handful of them was doing urban farming for leisure.

ii. Guidance for narrow land use through the balkotfarm website

iii. Guidance for good planting procedures

iv. Guidance for how to sell the results of urban farming by urban farmers to improve the economy of the citizens according to the vision and mission of the governor: "move the city forward, prosper the citizens."

4.4 Integrity

Balkot Farm project has encouraged the Jakarta government conducting activities openly and collaboratively. This is due to the transparency of the IoT system. The system enables routine checks and reports swiftly and almost instantly. The farmers can work in the field as they wish, and the IoT system will take care of the routine jobs, such as injecting water or nutrition as needed. Consequently, Balkot Farm brings integrity values into the actors: farmers, government staff, and participating NGOs. Pusat Edukasi Anti-korupsi (2019) defined integrity as "to act consistently between what is said and its behavior according to the values adopted" (values can originate from the value of the code of ethics in the place where it works, the value of social or personal moral values).

4.5 Public Involvement & Governance

As Tzounis, Katsoulas, Bartzanas, & Kittas (2017) found, public involvement elevates the public project significance due to its impacts on the community. Urban farming is popular in urban life because it satisfies the public's longing for open green space in the city areas. Yet, this communal approach brings several issues, namely the coordination, collaboration, governance, and integrity. Balkot Farm has brought changes to the government projects that were usually oriented to serve the government staff and their relatives. Balkot Farm took further steps in involving many parties in the community and simultaneously bring new values and professionalism in the farming jobs. Balkot Farm is supported by a variety of IoT devices and facilities such as LEDs and monitor panels. Those gadgets are expensive; therefore high integrity is required from residents of the Jakarta City Hall to maintain and preserve the shared facilities. The task of monitoring and supervising is carried out voluntarily by urban farming activists. Also, the monitoring mechanism via CCTV will be installed to ensure all functions are running well.

5 CONCLUSIONS AND RECOMMENDATION

The research question is, how does the application of the Internet of Things in Balkot Farm have a positive impact on efforts to improve collaboration and to instill integrity practices in urban farming? Balkot Farm has been initiating a collaboration setting for all parties to work together with IoT helps. The study also captures the satisfaction of stakeholders who feel the benefits of information technology that facilitates the farming process and at the same time, creates a working system that is more accountable and with integrity.

The study recommended several points as the following: (1) implement integrity system to maintain the honesty and professional ethics among the parties; (2) expand the involvement of government departments and community groups, so the urban farming skills can be developed and improved among the wider areas; (3) manage the assets and financial activities openly, employ IoT for monitoring and evaluation processes, so the whole system can be checked by the public through a transparent system.

Further study needed for urban farming, especially the economy and technology of staple food farming in the city. This study has started a new observation of government-initiated projects, especially in urban farming or urban agriculture. The quantitative study is also needed to measure the impact of urban farming in a certain society or country. Urban farming is part of our efforts to secure food and energy globally. Cities are growing globally, and we need to utilize the potentials of urban farming worldwide.

ACKNOWLEDGMENTS

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APPENDIX

Layout

Balkot Farm pilot project lay out:

Figure 4. Artist rendering of Balkot Farm setting.

Figure 5. Top view of the Balkot Farm site.

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