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Risk Management for Analytic Closed Circuit Television based on Internet of Things in Semarang City

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A b s t r a c t

Successful implementation of a program is the goal of program design. However, currently, many programs fail to be implemented due to the failure of efforts to prevent the occurrence of failure factors. Especially in the era of digital governance such as today, the planning of various smart city programs has a large potential risk of implementation failure. The Semarang City of IoT CCTV program, for example, the implementation of the use of analytics-based CCTV requires long and careful preparation. Not only management preparation but risk management is also needed for the program. This research aims to analyze the map of potential risks in the Semarang City CCTV of IoT program along with analyzing how the risk management of the program. This research is based on qualitative research with primary and secondary data collection techniques. Primary data collection by interviewing related informants purposively, then the data is analyzed based on qualitative analysis. The findings of this research are that the highest level of risk occurs in the shortage of human resources and CCTV operators because there are no human resources who are data analytic experts and Artificial Intelligence experts. Other high risks are database errors / down; CCTV devices using old technology; long loading dashboards; and no Fiber Optic connection in internet management.

Keywords: Smart City; Internet of Things s; CCTV analytics; Risk Management

Introduction

All government programs are risky with different levels of complexity (Project Management Institute, 2017). These risks are why government programs may fail to be implemented. At the same time, government programs respond to stakeholder expectations that can be conflicting and changing. Organizations must choose to bear program risks in a managed and deliberate way to deliver value while balancing risks and rewards (Project Management Institute, 2017).

The definition of risk involves both uncertain events that can negatively impact the program (threats), and those that can positively impact the program objectives (opportunities) (Project Management Institute, 2017). In the Semarang City CCTV Internet of Things (IoT) program, for example, the presence of high uncertainty due to the novelty involved in this type of program

carries high risk, resulting in many failures (Simonofski, et al., 2019). In this type of program, it is possible to identify several potential risks, such as the level of stakeholder involvement in the program; disruption of information flow and communication between stakeholders; strategic misalignment; lack of program socialization, and many others (Fernandes et al., 2021). An in-depth study is needed in analyzing the risk management of CCTV's Internet of Things(IoT) program.

According to the literature, the practice of risk management in the public sector is increasingly needed because it can offer a systematic process for identifying and managing risks; help achieve different program objectives improve program monitoring improve communication between stakeholders in the program; facilitate decision making, process and prioritize action;, and ultimately increase the chances of program success (Cedergren et al., 2022; Cienfuegos Spikin, 2013). Putri's research (2021) on risk analysis of toll road development mentions financing risks, poverty risks, and environmental, social, and political risks are all risks associated with toll road construction.

Risk Management is an ongoing process that is directly dependent on changes in the inner and outer environment, which demands continuous attention to the identification and control of program risks (Oduoza, 2020). If unmanaged, risks can potentially cause the program to deviate from the plan and fail to achieve the set goals. As a result, the efficiency of program risk management is linked to project success (Alam & Ray-Bennett, 2021; Rivera et al., 2020).

In short, the focus of risk management is to develop strategies to reduce the negative impact of risks and increase the positive impact of risks on program objectives. It addresses risks according to program exposures, adds activities and resources to the budget, and adjusts the program schedule (Project Management Institute, 2017). So conducting a risk analysis of the CCTV Internet of Things (IoT) program can reduce the negative impact that will occur later.

The importance of risk management in the CCTV Internet of Things (IoT) program is that the Semarang city communication and informatics service program is a public program owned by most local governments. The CCTV Internet of Things (IoT) program is needed by the entire community. In today's digital era, the ease of service and convenience of the community is absolute. On the other hand, the development of the smart city is getting faster (Bellini et al., 2022). We can see the trend of the Smart City-based city or regional development movement in various parts of the world such as Barcelona, Tokyo, London, Berlin, Amsterdam, Melbourne, Seoul, Shanghai, Mumbai, Singapore, and others. Every city in various parts of the world has a different Smart City development success story according to the problems faced by each city (Fernandes et al., 2021). In Korea, a 600-hectare reclamation area was built from scratch as a Smart City; Masdar in Dubai is a city that builds energy independence programs with solar and renewable energy and is determined to become a carbon emission-free city; Amsterdam focuses on building Smart People, Smart Energy, and Smart Waste Management; while in Singapore, Smart City development is directly controlled by the Prime Minister's Office as a program for citizens, businesses, and government to support the improvement of quality of life by utilizing technology, ideas, applications, and big data. The use of technology can help optimize the creation, management, and use of enterprises (Zainal et al., 2021).

Semarang City has an Internet of Things (IoT) CCTV program as a smart city quick win in the area of Smart Society. This program is the flagship program of Semarang City because it prioritizes technology in the implementation of monitoring community activities through analytic-based CCTV. However, no risk analysis has been conducted by this program. So the author conducts research aimed at assessing the risks posed by this program and conducting risk mitigation analysis so that the implementation of the program can run successfully.

Smart City

The era of digital governance has entered the public sector since 2000 (Alcaide-Muñoz et al., 2017) as can be seen from research in the field of digital governance. The development of digital governance research is in line with the rapid development of smart city implementation in various cities in the world (Wawer et al., 2022). Even today, the development of smart cities has used Artificial Intelligence in making public policy decisions (Bokhari & Myeong, 2022).

There are two approaches to the smart city concept that are often mentioned in the literature, namely smart cities that focus on ICT development and smart cities which focus more on the participation of local communities in building sustainable cities (Cortés-Cediel et al., 2021; Simonofski, et al., 2019). However, the smart city literature focuses on how technology solves societal problems more than any other focus (Thomas et al., 2016).

Caragliu et al. (2011) identified key characteristics proper to a smart city: 1) The utilization of networked infrastructure to improve economic and political efficiency and enable social, cultural, and

urban development; 2) An underlying emphasis on business-led urban development; 3) A strong focus on the aim of achieving the social inclusion of various urban residents in public services; 4) A stress on the crucial role of high-tech and creative industries in long-run urban growth; 5) Profound attention to the role of social and relational capital in urban development; 6) Finally, social and environmental sustainability as a major strategic component of smart cities.

Most smart city indexes are based on six dimensions: smart economy (competitiveness), smart mobility (transport and ICT), smart environment (natural resources), smart people (social and human capital), smart living (quality of life), and smart governance (participation of societies in cities) (Caragliu et al., 2011). This is in line with Purnomo, the characteristics of Smart City are divided into six criteria, namely smart economy, smart environment, smart government, smart living, smart mobility, and smart people (Purnomo, 2016).

Table 1
The three generations of smart cities

Smart City 1.0	Smart City 2.0	Smart City 3.0
The creators of technological advancements encourage cities to implement their solutions, with the aim of improving the efficiency of urban management. Technology is the key element of the smart city-1.0 concept. Technological innovations are often implemented in cities that are not fully prepared for this process.	Local authorities play the key role in the development of smart city 2.0. They focus on new technologies, to explore various options for improving the quality of life in cities. Cities introduce programs and projects that support the implementation of modern technologies in various areas of life. In a smart city 2.0, the significance of the quality of life and local governance is equated with that of modern technology.	This is the latest and the most advanced generation of smart cities. Citizens play the key role in urban development. Local residents consciously choose to participate in the process of building modern cities; they rely on modern social participation tools, and are creative. In the smart city 3.0, urban space is created for users with their involvement.

Source: (Szarek-Iwaniuk & Senetra, 2020)

In Indonesia, smart city studies are mostly on ICT development. The Ministry of Communication and Informatics promotes the 100 smart city cities/regencies program by focusing on exploring ICT programs that can help solve community problems both in public services and local government management. Semarang City Government, for example, created an innovative Internet of Things (IoT) CCTV program to solve the problem of monitoring community activities by utilizing ICT in the form of analytics-based CCTV. The existence of this program provides a safe and comfortable sense of community in carrying out daily activities because they feel protected with 24-hour monitoring.

Risk Management in Smart City Program

Risk management is a structured effort to understand and handle risk, reduce uncertainty and make it easier to achieve goals and objectives (Ministry of Finance, 2019). Risk is the effect of uncertainty on goals. Risk management in the government or public sector refers to the international standard CSA ISO 31000. By applying this standard, public sector risk management includes identifying risks; implementing risk mitigation strategies; determine priorities; facilitate discussion about the types and levels of risk that the government is ready to accept (tolerance); and make long-term plans for the future.

The risk management process must be integrated with business processes in the public sector. This means that risk information can influence policy making. The risk management process in the public sector is as follows.

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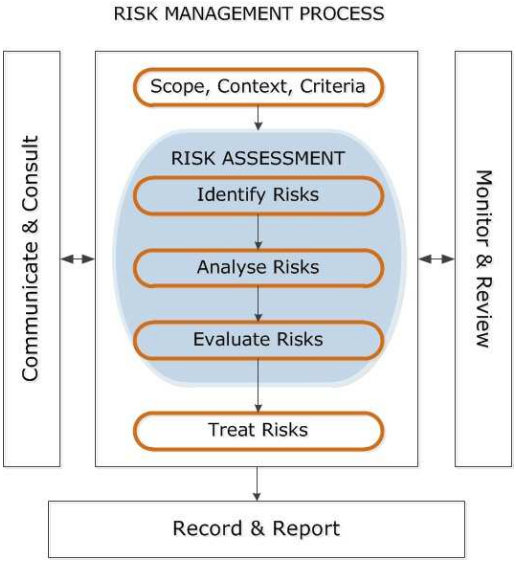

Figure 1. Risk Management Process
Source: (Ministry of Finance, 2019)

The first step is to know the scope, context, and risk criteria in a public sector. In this study, to find out the scope of the IoT CCTV, such as service profiles. The context of the risks that may occur and the limitation of risk criteria that will occur.

The next step is to identify what risks might occur. Then analyze the risk by providing a risk rating. Risk analysis is the process of calculating the likelihood of an event and the consequences if it occurs. The product of these two variables is the Risk Rating (see Figure 2).

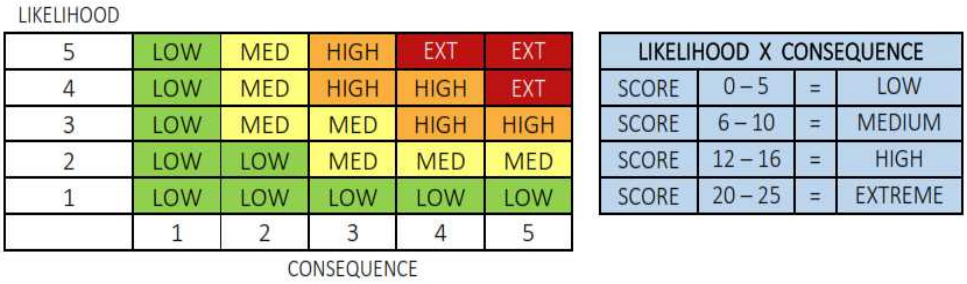

Figure 2. Risk Rating Matrix

Likelihood is the chance that the risk event identified will actually occur. When available, statistical data can support estimates of likelihood and severity. In practice, however, often we do not have historical data. Instead, we often rely on the experience of those around the table; therefore, likelihood rarely implies mathematical certainty; rather it is a subjective estimate.

Table 2
Risk Criteria

Likelihood = Probability of the risk event actually occuring		
Score	Criteria	Probability (%)
5	Almost certain	80%-99% or once a day or more frequently
4	Likely	61%-79% or once a week
3	Possible	40%-60% or once a month
2	Unlikely	11%-39% or once six months
1	Almost certain not to happen	0%-10% or once a year

Source: (Cienfuegos Spikin, 2013)

Table 3
Consequence

Consequence = Degree of severity, with respect to goals/values, should the risk event occur		
5	Catastrophic	Major problem from which there is no recovery Significant damage to ministry credibility or integrity Complete loss of ability to deliver a critical program
4	Major	Event that requires a major realignment of how service is delivered Significant event which has a long recovery period Failure to deliver a major political commitment
3	Moderate	Recovery from the event requires cooperation across departments May generate media attention
2	Minor	Can be dealt with at a department level but requires executive notification Delay in funding or change in funding criteria Stakeholder or client would take note
1	Insignificant	Can be dealt with internally at the branch level No escalation of the issue required No media attention No or manageable stakeholder or client interest

Source: (Cienfuegos Spikin, 2013)

After reporting the risk rating, the next step is to evaluate the risk and then provide risk mitigation.

Research Method

The main purpose of this research is to analyze and make the right risk management program for Internet of Things (IoT) CCTV program. For this reason, this research is a qualitative research type. The researcher used interview guides to conduct in-depth interviews with four informants consisting of staff from the communication and information technology office, staff from transportation office, and staff from the Semarang regional development planning agency. The selection of informants with purposive techniques is due to the selected staff who have the main duties, knowledge, and skills in the IoT CCTV Program (Creswell & Poth, 2018). After conducting in-depth interviews, researchers sort and select the results of the interviews which are then processed and analyzed using qualitative analysis techniques (Sugiyono, 2016).

The stages of this research are first collecting both primary and secondary risk data, then classifying the data based on the elements of nature, structure, infrastructure, superstructure, and culture. Elements of nature include the environment. Structure elements include community HR, HR Bureaucracy, and regional finance. Infrastructure elements include Physique, digital, and technology. The superstructure elements include Law, politics, and institutional. Elements of culture include social and economic. The second analyzes the risk based on the Risk Rating Matrix. Third, determine the possible value and score value, then multiply the two scores. Furthermore, after knowing the total risk value score, the researcher classifies the risk into risk levels. Researchers make red color indicates extreme risk, orange color indicates high risk, yellow color indicates medium risk, and green color indicates low risk. Fourth, determine the appropriate risk treatment and risk mitigation for the IoT CCTV program.

Results and Discussion

IoT CCTV Analytics is an analytics menu that displays CCTV monitoring results that are automatically analyzed based on 5 data elements, namely crowds of people, traffic crowds, puddles, illegal parking, and garbage. In the first stage, CCTV will be built in Pandanaran, Simpanglima, and Tugumuda.

The uniqueness of this program is the utilization of CCTV for the Internet of Things s. The benefits of the CCTV analytics program are to facilitate stakeholders in managing garbage, water discharge/flooding, wearing masks, and crowd detection; knowing the right decision-making for stakeholders related to the above problems; and ensuring public comfort and safety. In addition to the benefits, there are also challenges, namely, if there is a system failure, the consequences will be very high. The development and sustainability strategy in this CCTV analytics program is that the local government has poured the regional innovation program into the RKPD and has been

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implemented in the last 1 year. The implementation has been determined by the Regional Head Regulation / Regional Regulation. While resource needs have been provided with sufficient human resources.

The Risk Management component consists of Risk Identification, Risk Analysis, and Risk Mitigation information. The following is a risk management analysis of IoT CCTV from the Semarang City Communication and Information Agency.

Table 3
Risk Management of IoT CCTV in Semarang City

	RISK IDENTIFICATION				RISK ANALYSIS			RISK TREATMENT			RISK MITIGATION	
	Category	Sub category	Risk	Consequence	Possible Value	Score impact	Risk Value	PIC	Target Time / Frequency	Resource Needs	Structural	Non Structural
1	2	3	4	5	6	7	8	9	10	11	12	13
1	**Nature**	Environment	Flood	CCTV connection lines are disrupted	2	4	8	Public works office	As soon as possible	Funds for IoT implementation Human resources with IoT capabilities Operator	Cleaning of waterways and monitoring of water discharge both locally in Semarang and other areas	Water channel check, river check, DAM check, water pump check
			landslide	interrupted CCTV connection line	2	4	8	Communication and informatics office	1 year	Budget for construction of soil barriers and greening	Construction of cast barriers, tree planting	
2	**Structure**	Bureaucratic HR	Admin and Operator human resources are lacking	Operators are not concentrating well enough so they are not careful in monitoring	5	4	20	Communication and informatics office; Personnel education and training agency	6-12 months	Budget for HR, quantity of HR	Opening a new CCTV operator formation	socialization and selection, and operator training
			No human resources for data analytics and AI experts	Lack of maximum data analysis and utilization	3	4	12	Communication and informatics office; Personnel education and training agency	6-12 months	Budget to recruit and pay human resources, increase the quality and quantity of human resources	Open Data Analytics formation	Socialization, selection, training
3	**Infrastructure/ Application**	Technology	Database eror / down	analytic process disrupted	3	5	15	Communication and informatics office	As soon as possible	IT Human Resources	Open Data Analytics formation	Socialization, selection, training
			CCTV equipment using old technology	Unable to analyze data (for monitoring only)	3	4	12	Communication and informatics office	1 year	Budget for CCTV Analytic procurement	Procurement of goods in the form of CCTV with analytic technology	
			Dashboard takes a long time to load	Disruption of the analytic process	3	4	12	Communication and informatics office	1 month	IT and CCTV analytics experts	Open Data Analytics formation	Socialization, selection, training
		Digital infrastructure	No FO connection yet	CCTV at several strategic points	3	4	12	Communication and informatics office, OPD	1 year	budget allocation for	Integrate points that are still	check, inventory unconnected locations
4	**Superstructure**	Law	Stakeholder leaders are not yet committed to CCTV integration	Some blank spots are not monitored by CCTV analytics	3	3	9	Communication and informatics office, OPD and other external stakeholders	1 year		Socialization and negotiation of CCTV integration from OPDs and external stakeholders	Acceleration of integration with the signing of the MoU agreement
5	**Culture**	Social	Device broken/lost	Disruption of CCTV services	1	3	3	Communication and informatics office	1month		Conducting padlocking / more security efforts	

Source: Primary data, 2022

The formula for calculating the Risk Level measurement is the Risk Level equal to the Probability Level multiplied by the Impact Level. Table 4 shows the risk analysis of the Semarang City CCTV IoT program has a very high risk in the limited number of operators who monitor analytical CCTV. While the low risk is the risk of damaged/lost devices. Then, the value of high to low risk can be seen in the following matrix.

Table 4
Risk Level Matrix of CCTV IoT Program

Consequence \ Likehood	1	2	3	4	5
1	Low	Low	Low	Low	Low
2	Low	Low	Medium	Medium	Medium
3	Low Device broken/lost	Medium	Medium Stakeholder leaders not yet committed to CCTV intergation	High	High
4	Low	Medium Banjir Longsor	High - CCTV equipment using old technology - Dashboard takes a long time to load - No FO connection yet	High	Extreme Admin and Operator human resources are lacking
5	Low	Medium	High Database eror/ down	Extreme No human resources for data analytics and AI experts	Extreme

Source: Primary data, 2022

Thus, after knowing the Smart Society risk level matrix above, risk mitigation is needed. Risk mitigation is a planned and sustainable action taken by the risk owner to reduce the impact of an event that has the potential or has harmed or endangered the risk owner. In smart city programs, especially the Quick Win IoT CCTV program for Semarang City, there are several risk mitigations as follows.

Table 5
Risk Mitigation Matrix of IoT CCTV Program

ID	Risiko	Mitigasi Struktural	Mitigasi Non Struktural
1	2	3	4
R-1	Admin and Operator human resources are lacking	New formation for CCTV operator	socialization and selection, and operator training
	No human resources for data analytics and AI experts	Open Data Analytics formation	Socialization, selection, training
R-2	CCTV equipment using old technology	Open Data Analytics formation	Socialization, selection, training
	No FO connection yet	CCTV procurement with analytic technology	
	Dasboard takes a long time to load	Open Data Analytics formation	Socialization, selection, training
	Database eror/ down		
R-3	Flood	Cleaning of waterways and monitoring of water discharge both locally in Semarang and other areas	Water channel check, river check, DAM check, water pump check
	Landslides	Construction of barriers with castings, tree planting	
	Stakeholder leaders not yet committed to CCTV intergation	Socialization and negotiation of CCTV integration from OPDs and external stakeholders	Acceleration of integration with the signing of the MoU agreement
R-4	Device broken/lost	Conducting padlocking / more security efforts	

Source: Primary data, 2022

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The most extreme risk in the IoT CCTV program is the risk of lack of human resources in the field of CCTV admin and operators. Analytical CCTV is needed by the community. Analytical CCTV is useful in creating community peace and discipline. The existence of analytical CCTV provides a sense of security to the community. This is because analytical CCTV is equipped with 300 software. With this analytical capability, CCTV in Semarang City can automatically detect and determine temporal and spatial events, which can then directly infer the number of people, the number of vehicles, the presence of illegal parking, garbage, puddles, and various other things needed. However, the problem of the high number of software is not matched by the number of operators who are competent in the field of CCTV analytics. So that no matter how sophisticated the technology is, if there are no competent human resources, it cannot operate as it functions. So it is necessary to recruit the formation of human resources who are experts in the field of CCTV analytics.

Conclusions

Risk management in IoT CCTV Semarang City is necessary to anticipate the most extreme risks that may occur to disrupt the implementation or even become a factor in the failure of the program implementation. Based on the findings, the most extreme risk is the lack of human resources for admins and operators. On the other hand, Semarang City also does not yet have human resources for data analytics experts and AI experts so it will be difficult to operate CCTV analytics. Risk mitigation that is currently needed is to conduct socialization and selection of analytic human resources. The other high risks are related to technical matters, namely database errors / down; CCTV devices using old technology; old loading dashboards; and the absence of Fiber Optic connections in internet management. These technical matters can hinder the IoT CCTV program, so strengthen the anticipation of technical matters by building FO networks and recruiting analytic / IT experts. When viewed based on the most extreme risk, smart city development in Semarang City is still at the smart city 2.0 stage.

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