A REVIEW OF SECURITY AND PRIVACY IN ISLAND CITIES: KEY ISSUES, CHALLENGES, AND SOLUTIONS

Assaf Arief*[1], Miftah Muhammad[2]

[1, 2] Faculty of Engineering, Universitas Khairun,
Ternate, INDONESIA.
(E-mail: assaf.arief@unkhair.ac.id)

A smart city can be defined as an urban or regional area where information technology and communication are the keys to its infrastructure, providing innovative and advanced services for its residents to improve the quality of facilities. On the other hand, a smart city can be defined as any city that uses technology to upgrade and develop its functions, starting with gathering information from various sources and formats, and then analyzing that information based on the city's needs to improve services in that city.

Key words: Island Cities, Key Security, Privacy, Challenges, Solutions.

INTRODUCTION

Nowadays, there is no exact definition for a smart city because various aspect need to be present for a city, region, or area, including islands, to be considered "smart"[1], [2]. A smart city can be defined as an urban or region area where Information Technology and communication are the keys to its infrastructure, providing innovative and advanced services for its residents to improve the quality of facilities. On the other hand, a smart city can be defined as any city that uses technology to upgrade and develop its functions, starting with gathering information from various sources and formats, and then analyzing that information based on the city's needs to improve services in that city[3], [4]. It can be concluded that both describe a smart city as one that uses technology to support services for the sustainability of the city, including island cities[5].

In recent times, many cities in the world are racing to implement technology in their services through smart energy, smart building, smart mobility, smart utility management, smart communication, smart technology, smart health care, smart government, dan smart security[6], [7]. Furthermore, humans living in cities will be connected with the many smart devices linked by various networks and systems. These connections will result in an exchange of data and information between users through interlinked devices. The security and privacy issue arising from this event is the user data tracking due to an exchange of data and information[8], [9]. Security and privacy challenges in smart cities are multifaceted, prompting extensive research efforts to identify issues and propose solutions. Through a systematic literature review encompassing studies conducted from 2018 to

2022, this theoretical analysis delves into the current state of security and privacy in smart cities. It aims to comprehend the evolving landscape, examining the impact of smart city development on these crucial aspects. The study endeavors to pinpoint key considerations, laying the groundwork for future research endeavors in this dynamic field.

MATERIAL AND METHOD

This study was conducted with a systematic literature review (SLR) approach from Kitchenham [10] with the following phases: (1) formulating a research question; (2) developing research protocols; (3) selecting source papers; (4) data extracting and analyzing.

Formulating Research Question

The formulation of the research question begins with the identification process using the PICOC (Population, Intervention, Comparison, Outcomes, Context) approach by Kitchenham [10].

Table 1. Example of table for the extended abstract

Approach	Descriptions
Population	Security and Privacy
Intervention	Challenges, Issues, Risks
Comparison	N/A
Outcomes	Key Issues, Challenges and Solutions of security and privacy in island city
Context	Smart City or Island City

The formulate the research question as follows: RQ1. What are the key issues, challenges and solutions of security and privacy in a island city?

Review Process

To identify and select the primary studies that are relevant to the research objectives, we developed the review process as follows:

1. The search was performed on the Scopus database, as it included a catalog of more than 80 million records from approximately 24,100 titles and 6,000 publishers.
2. Search string: "Smart Cit*" OR "Island* Cit*" AND ("Security" OR "Privacy") AND ("Issue*" OR "Challenge*" OR "Risk*")
3. Inclusion criteria: Period from 2018 to 2022; studies in English; peer-reviewed paper (journal); title/abstract and study content are relevant to the research question.
4. Exclusion criteria: publication year below 2018; studies not in English; types of publications; title/abstract and content of the study are not relevant to the research question.

Selection Strategy

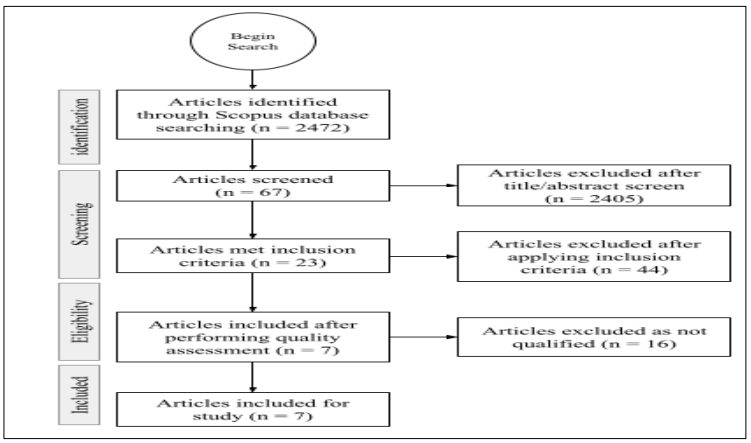

Figure 1. The Selection Strategy.

Based on Fig.1, the first step of study selection is to search to identify existing studies in the Scopus database. From this search process, we have 2472 articles identified. In the second stage, 2405 articles were filtered based on the article's title and abstract, then obtained 23 articles. According to the based inclusion criteria, 33 articles were obtained. In the last step, 23 articles were read and analyzed to evaluate whether the contents of the full-text paper were relevant. Finally, the seven most relevant articles were selected.

RESULTS AND DISCUSSION

Primary Study

Based on the review process, seven papers were relevant to the context of our research and can be used as the primary study to answer the research question. The information on the six primary studies can be seen in Table 2.

Table 2. Result of Primary Study

No.	Authors	Years	Title
1.	Cui, L., Xie, G., Qu, Y., Gao, L., Yang, Y.	2018	Security and privacy in smart cities: Challenges and opportunities[11]
2.	Braun, T., Fung, B.C.M., Iqbal, F., Shah, B.	2018	Security and privacy challenges in smart cities[9]
3.	Kitchin, R., Dodge, M.	2019	The (In)Security of Smart Cities: Vulnerabilities, Risks, Mitigation, and Prevention[12]
4.	Ismagilova, E., Hughes, L., Rana, N.P., Dwivedi, Y.K.	2020	Security, Privacy and Risks Within Smart Cities: Literature Review and Development of a Smart City Interaction Framework[13]
5.	Allahar, H.	2020	What Are the Challenges of Building a Smart City[14]
6.	Chen J. Ramanathan L, Alazab M.	2021	[15][15]
7.	Al-Turjman F, Zahmatkesh H, Shahroze R	2022	An Overview of Security and Privacy in Smart Cities' IoT Communications[16]

Key Issues and Challenges of Security and Privacy in Smart/Island Cities

A study by Cui, 2018[11], explains cyber-attacks against smart city infrastructures such as Botnet activities in IoT-based smart cities (Mirai Botnet, infection, DDoS), Threat of driverless cars in smart cities, security bugs to conduct remote attacks, and attackers understand ML-Based protection mechanisms. Braun [9], states that the technology applied to smart cities, such as cloud services, Artificial Intelligence, M2M Communication, and Radio Frequency Identification (RFID), is vulnerable to cyber-

attacks. Kitchin, 2019[12], a study to reviews the forms of security vulnerabilities in cyber-attacks on infrastructure and smart city services, such as weak software security and encryption. The use of legacy systems that are not secure and not continuously updated; the existence of interdependence between large and complex systems so that cyber-attacks can cause a cascade effect; and vulnerabilities due to human error or the willful misconduct of former employees. Ismagilova[13], identifies challenges related to security and privacy in smart cities, namely, how to strategically build and manage the transition process and smart city capabilities while minimizing disruption to stakeholders and mitigating threats to system integrity and data security. Allahar, define Smart cities enhance citizens' quality of life through real-time control of physical objects for intelligent information dissemination in areas like transport, healthcare, and public safety. Despite their benefits, security and privacy issues in the architecture of the smart cities' applications.

Recommendations and Solutions

Ismagilova[6] emphasizes the crucial role of government in fostering citizens' trust in smart city initiatives through robust privacy and security measures, effective data management, and communication. The success of smart city implementation hinges on a well-designed approach, operational efficiency, and a human-centered perspective. Kitchin[13] suggests technical and organizational steps, advocating a security-by-design approach in procurement, comprehensive assessments of infrastructure and information systems, and security enhancements. Cui[14] underscores the application of technical mechanisms, including encryption-based technologies, two-factor authentication, abnormal detection, and intelligence intrusion prediction systems for ensuring Authentication, Confidentiality, Availability, and Integrity. Braun[15] recommends layered system security, privacy-enhancing technology, and intelligent data aggregation techniques. [16] addresses key applications of smart cities, highlighting privacy and security concerns, reviewing current solutions, and proposing research challenges for performance improvement.

CONCLUSION

Smart Cities Issues and challenges relating to security and privacy in smart cities, found in the preliminary study, can be categorized into four key aspects that are viewed from a multidimensional perspective, namely: legal dimension, technical dimension, organizational dimension, dan social dimension. The result of this study has identified key issues and challenges related to security and privacy in smart cities but still has limitations in obtaining comprehensive solutions to overcome these various issues and challenges. Hence, we suggest conducting further research that mainly focuses on comprehensive solutions and recommendations based on the key issues and challenges formulated in this research. Moreover, the results of this study could also be further validated by conducting an empirical case study in one or several cities that have fully implemented smart cities.

Acknowledgment:

REFERENCES

[1] B. N. Silva, M. Khan, and K. Han, “Towards sustainable smart cities: A review of trends, architectures, components, and open challenges in smart cities,” *Sustain Cities Soc*, vol. 38, no.

January, pp. 697–713, 2018, doi: 10.1016/j.scs.2018.01.053.
[2] E. Ismagilova, L. Hughes, Y. K. Dwivedi, and K. R. Raman, “Smart cities: Advances in research—An information systems perspective,” *Int J Inf Manage*, vol. 47, no. January, pp. 88–100, 2019, doi: 10.1016/j.ijinfomgt.2019.01.004.
[3] U. Kulkarni and J. Robles-Flores, “Data Analytics to Improve Citizen-Centric Smart City Services,” *25th Americas Conference on Information Systems (AMCIS 2019)*. Association for Information Systems, Cancún, Mexico, p. [1-10], 2019. [Online]. Available: https://aisel.aisnet.org/amcis2019/org_transformation_is/org_transformation_is/10
[4] K. Sunassee, T. Vythilingum, and R. K. Sungkur, “Providing improved services to citizens, a critical review of E-government facilities,” *2017 1st International Conference on Next Generation Computing Applications, NextComp 2017*, pp. 129–134, 2017, doi: 10.1109/NEXTCOMP.2017.8016187.
[5] D. N. Pantazis *et al.*, “Smart Sustainable Islands Vs Smart Sustainable Cities,” *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, vol. 4, no. 4W3, pp. 45–53, 2017, doi: 10.5194/isprs-annals-IV-4-W3-45-2017.
[6] T. Raaijen and M. Daneva, “Depicting the smarter cities of the future: A systematic literature review & field study,” in *2017 Smart City Symposium Prague (SCSP)*, 2017, pp. 1–10. doi: 10.1109/SCSP.2017.7973352.
[7] M. A. Ur Rehman Tariq, A. Faumatu, M. Hussein, M. L. Ur Rahman Shahid, and N. Muttil, “Smart city-ranking of major australian cities to achieve a smarter future,” *Sustainability (Switzerland)*, vol. 12, no. 7, pp. 1–19, 2020, doi: 10.3390/su12072797.
[8] E. Ismagilova, L. Hughes, N. P. Rana, and Y. K. Dwivedi, “Security, Privacy and Risks Within Smart Cities: Literature Review and Development of a Smart City Interaction Framework,” *Information Systems Frontiers*, vol. 24, no. 2, pp. 393–414, Apr. 2022, doi: 10.1007/s10796-020-10044-1.
[9] T. Braun, B. C. M. Fung, F. Iqbal, and B. Shah, “Security and privacy challenges in smart cities,” *Sustain Cities Soc*, vol. 39, pp. 499–507, May 2018, doi: 10.1016/j.scs.2018.02.039.
[10] B. Kitchenham, O. Pearl Brereton, D. Budgen, M. Turner, J. Bailey, and S. Linkman, “Systematic literature reviews in software engineering - A systematic literature review,” *Inf Softw Technol*, vol. 51, no. 1, pp. 7–15, 2009, doi: 10.1016/j.infsof.2008.09.009.
[11] L. Cui, G. Xie, Y. Qu, L. Gao, and Y. Yang, “Security and privacy in smart cities: Challenges and opportunities,” *IEEE Access*, vol. 6, pp. 46134–46145, Jul. 2018, doi: 10.1109/ACCESS.2018.2853985.
[12] R. Kitchin and M. Dodge, “The (In)Security of Smart Cities: Vulnerabilities, Risks, Mitigation, and Prevention,” *Journal of Urban Technology*, vol. 26, no. 2, pp. 47–65, Apr. 2019, doi: 10.1080/10630732.2017.1408002.
[13] E. Ismagilova, L. Hughes, N. P. Rana, and Y. K. Dwivedi, “Security, Privacy and Risks Within Smart Cities: Literature Review and Development of a Smart City Interaction Framework,” *Information Systems Frontiers*, 2020, doi: 10.1007/s10796-020-10044-1.
[14] H. Allahar, “What Are the Challenges of Building a Smart City,” *Technology Innovation Management Review*, vol. 10, no. 9, pp. 38–48, 2020.
[15] J. Chen, L. Ramanathan, and M. Alazab, “Holistic big data integrated artificial intelligent modeling to improve privacy and security in data management of smart cities,” *Microprocess Microsyst*, vol. 81, Mar. 2021, doi: 10.1016/j.micpro.2020.103722.
[16] F. Al-Turjman, H. Zahmatkesh, and R. Shahroze, “An overview of security and privacy in smart cities’ IoT communications,” *Transactions on Emerging Telecommunications Technologies*, vol. 33, no. 3, Mar. 2022, doi: 10.1002/ett.3677.