A systematic literature review of environmental concerns in smart-cities

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A systematic literature review of environmental concerns in smart-cities

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Abstract. The concept of smart-city is to use information and communication technology to efficiently manage assets and resources in order to support sustainable urban environment. Examples of smart-city implementation are the use of ICTs in government systems, energy management, buildings, infrastructure, health services, population, and others. The purpose of this study is to identify and analyze existing study of environmental concerns in smart-cities. Search terms with relevant keywords were used to identify appropriate studies. Filtering and scoring techniques were used to obtain relevant studies. 345 papers were obtained from abstract search results, 248 were successfully downloaded. 14 manuscripts pass abstract filtering and quality assessment, it included into analysis phases. Environmental concern is an integral part of smart city management. Some smart-city frameworks have identified environmental factors that must be considered. The majority of studies focus on areas of resource, governance, and urban infrastructure. In general, the application of smart-cities that focus on resource and urban infrastructure will have a positive impact on the environment. This can be maximized by smart-cities governance that supports environmental policy.

1. Introduction

The concept of smart-city is to use information and communication technology to efficiently manage assets and resources in order to support sustainable urban environment [1][2]. Examples of smart-city implementation are the use of ICTs in government systems, energy management, buildings, infrastructure, health services, population, and others.

The application of ICT to environmental issues has been widely practiced [3][4]. The question that arises is how many environmental issues are considered in the application of smart-cities. If it exists, what aspects of the smart-cities implementation consider environmental aspects? Understanding of environmental concerns in smart-cities is important, in order to initiate sustainable development of green smart-cities.

Currently, the focus of smart-cities development is on technology and infrastructure factors [5][6]. Need a new point of view concerning environmental concerns in smart-cities. The purpose of this research has focused on two things, namely: areas are environmental issues considered in implementing smart-cities and how are environmental issues considered in smart-cities implementation.

2. Research Methods

2.1. Search Strategy

To understand the research that has been studied related to environmental concerns in smart-cities, the authors conducted a systematic literature based on the [7] [8].

2.2. Review questions

This work is based on two research questions that are

RQ 1 : In what areas are environmental issues considered in implementing smart-cities?
RQ 2 : How are environmental issues considered in smart-cities implementation?

2.3. Identification of Source

The review was limited to articles and conference proceedings that were published in Sciencedirect database as main database. The timeframe of the search are limit from the year 2016-2018, this is to get the latest trend of research related environmental concerns in smart-cities.

We choose keywords according to research objectives. We identify the synonym of the keyword. Then we connect the keywords with the boolean operator to be used as a search string as follows:

(environment OR atmosphere OR ecosystem) AND (intelligent OR smart) AND (cities OR city)

345 papers were obtained from abstract search results, 248 were successfully downloaded. 14 manuscripts pass abstract filtering and quality assessment.

2.4. Inclusion and exclusion criteria

When conducting this review, we have to set some criteria on which studies to be included and also those that need to be excluded. Our main inclusion criteria aim to only include all articles describing environmental concerns in smart-cities implementation.

Articles that fulfilled any of the criteria listed below were excluded: Short papers, proposals, lecture notes, summary of conference keynotes, work in progress reports, doctoral symposium papers, and Review papers

Quality assessment is done by answering the following questions for each paper that passes abstract filtering: Was there a clear statement of the aims of the research? Does the study present a personal opinion piece or viewpoint? Is the proposal validated? Does the study present a detailed description of the approach? If the majority of the answers are positive, then the paper will be included.

3. Result and Discussion

We included in our work 14 identified relevant studies. As follow [9][10][11] [12] [13] [14] [15] [16][17] [18] [19] [20] [21] [22].

3.1. Summary of studies

from 14 studies identified, 71% were from the journal, while the remaining 29% came from the conference (Figure 1). The scope of journals and conferences is diverse, none of which dominate.

Distribution of research methods can be seen in Figure 2. The majority use case study as a method of research (72%), followed by literature & document review (14%), Brainstorming and Design Science respectively 7%.

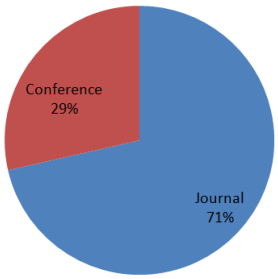

Figure 1. Distribution of research, based on publication source

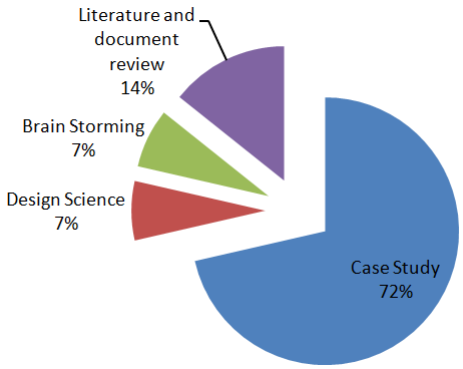

Figure 2. Research methodologies distribution.

3.2. (RQ1) Areas are environmental issues considered in smart-cities implementations

Eco-service, smart-grids, and waste management are services in smart-cities that have been done by smart-cities in some countries [23]. In his research, [24] declared smart-cities domain can be grouped into Resource, Transportation, Urban infrastructure, Living, Government, Economy, and Coherency. Resource deals with energy, natural resources, and water. Transportation has a focus on the use of ICT for transportation management. Urban infrastructure includes building management. Living includes education, health, safety, and quality of life. Government includes public services provided by the government as well as smart cities governance. Economy covers areas that reflect both city and e-business products. Coherency deals with the social connectivity of city residents.

Table 1. Areas are environmental issues considered in smart-cities implementations.

Areas	Number of papers discusses this area
Resource	8
Transportation	0
Urban infrastructure	3
Living	0
Government	6
Economy	0
Coherency	0

What needs to be noted is that some papers discuss more than 1 area in the paper. The majority of papers discuss resource management (8 papers). The material discussed starting from the efficiency of energy consumption, water, carbon/air, and electricity. The next area that is widely studied is the

government (5 papers). all the papers discussed from the point of view of smart city governance. Such as the smart-cities development strategy and the index to measure the success of smart-cities. Three papers discuss urban infrastructure, related to smart city spatial planning. the environmental issues considered will be divided according to the area in RQ1.

3.2.1. Resource. Modeling the consumption of resources so can be more effective and efficient. The model is used for decision support for resource management. The model maps the patterns of energy consumption [9][12] [13], water [10][12], carbon / air [18] [21], and electricity [22].

*3.2.2. Government.*More studies in smart-cities governance. There is a lesson learn from the application of smart cities, especially how to deal with ecosystem risk [11]. There are also studies related to green index measurements using satellite imagery [15]. Strategy preparation for smart-cities development becomes a smart energy-efficient district [17]. Policy discussions related to the environmental point of view in smart cities are also discussed [16] [19] [20] .

3.2.3. Urban infrastructure. This topic is closely correlated with smart city governance [11] [15]. The main focus is to determine effective spatial planning in smart-cities by promoting environmental issues [14].

4. Conclusion

In general, the implementation of ICT in the management of cities (smart-cities) needs to consider the environmental aspects. Some recent papers have this point of view, especially in the aspects of resource, government, and urban infrastructure. There is still a wide opportunity to focus on the area of Transportation, Living, Economy, and Coherency. The development and implementation of Smart-Cities is not a simple task and must take into account the outlook. Implementation of smart-cities, in general, can keep the environment, especially smart-cities that have a focus on resource management and urban infrastructure. The governance aspect is also important to ensure that the system is running as planned.

5. Acknoledgement

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