Some solutions of "Smart city" in response to urban climate change

Thi Bich Ngoc Nguyen and Thuy Linh Do

Department of Urban Planning, University of Architecture Ho Chi Minh City, 196 Pasteur Street, District 3, Ho Chi Minh City, Vietnam

E-mail: ngoc.nguyenthibich@uah.edu.vn, linh.dothuy@uah.edu.vn

Abstract. Responding to climate change is a great issue related to processes that help balance the natural environment [1]. In addition to changing people's awareness, the use of "environmentally friendly" technologies will also help bring about greater efficiency in response to climate change [7]. In order to address climate change adaptation objectives with "Smart City", scientific research is needed to provide rational solutions to each city [14]. Of these, it will include "smart" solutions associated with modern technologies (NewYork, United States) [18] and also "smart" solutions without technologies ("Amip city" in Japan) [5][19]. Within the scope of the article, we are also mention some typical criteria and solutions and notes when choosing solutions for cities in Vietnam.

1. Introduction

At the National Conference on "Development of sustainability on resilience for cities in Vietnam - Lessons from seven years of implementation of ACCCRN Program" held by the Institute for Social Environmental Transition (ISET), the National Coordinator of the Asian Cities Climate Change Resilience Network (ACCCRN) Program in Vietnam on November 24, 2016 in Hanoi, Ms. Tran Thi Lan Anh, Deputy Director of Urban Development Agency (Ministry of Construction) - said that Vietnam there were about 800 cities in Vietnam, of which about 300 coastal cities would be greatly impacted by climate change, including floods, salt intrusion, tides, etc.; about 140 to 150 mountainous cities would be affected by landslides, flash floods and droughts. Thus, it can be seen that climate change in cities is no longer a risk, but has actually been happening.

Meanwhile, at the conference on "Smart City: International Practices and Experiences, Prospects in Vietnam for the period of 2016-2030" held on August, 28, 2015 in Hanoi, Mr. Nguyen Thien Nhan noted that the urban development has been posing four major issues that need to be addressed: urbanization increase (increase in urban population, increase in number of cities) – Increased urban problems (environment, traffic, health services, safety, housing, etc.); Overloaded, outdated infrastructure (electricity, water, traffic); Economic competition increase among cities, regions; People's increased demand for quality of life (education, health, government). "With the roles of cities in the development of
the country, research and finding out the models of urban development and management is not only of immediate significance, but also of long-term strategic significance for the development of cities in particular, the sustainable development of the country in general, and smart city development is an inevitable choice, consistent with the development trend of the times” [9].

Therefore, it is can be seen that there are many issues for which our city needs to do, concern to find solutions. In many studies and assessments, Smart City, which is understood to be a city using modern technologies, is expected as a "final" solution to urban problems. However, in practice, there are many problems that cannot be solved by using the solutions of Smart City. For example, the increase in urban population, the number of cities, etc. must be solved by sociological solutions rather than by technologies.

In addition, the concept of Smart City is also a rather complex concept. First and foremost, Smart city are indispensable for the use of modern, advanced technologies in urban construction and management. However, the nature and objectives of Smart City are more profound and intensive; it includes the ability to "self-detection, self-response, self-repair, self-learning, self-re-creation" from errors, if any, in operation. To do this, does it always need smart machines? The answer is that it is completely true. Since the city is the place of people, owned and operated by the people not machines, the human can completely manipulate their intelligence to create a "Smart City" that is not completely dependent on modern machines or technologies. When it first appeared in 1990 in the Comarch Smart City project, the concept of "Smart City" was understood as: "The combination of human factors and innovative technologies in the development of new, comprehensive and unique solutions for city residents." Thus, it means that creative elements from the people and technologies both are required to be present in smart cities, as well as solutions that need to be typical ("unique") and suitable for each city.

Moreover, smart city solutions are tools for achieving certain objectives of the cities, such as response to climate change but not the vital purpose of the city. A city needs to be "smart" in some parts to solve a particular goal, not to be completely smart. Just like machines, technologies are man-made to better serve one's life, but not to and be unable to replace human beings. The abuse of technologies will also result in consequences which are as negative as the non-use of technologies, as in the movie "Robotics" by the director Alex Proyas, or his "IT" movie that has given the message "This world is too smart to be dangerous, it needs to be made more "foolish" to be safer.
2. Methods

The article chooses the goal of response to climate change to discuss the Architectural, Planning and Urban Infrastructure solutions needed for Smart City. Climate change is a result of the urban issues today and other non-urban issues. In order to resolve it, there needs other solutions in addition to the above fields, such as economic and social solutions, etc. In the scope of the article, we would like to mention the Architectural, Planning, Infrastructure solutions of Smart City to partly address some issues of urban climate change. Of these, it will include "smart" solutions associated with modern technologies and also "smart" solutions without technologies.

3. Results

3.1. Some Architectural, Planning and Infrastructure solutions of "Smart City" capable of responding to climate change in the world today [1] [8].

3.1.1. Architectural solutions

- Selecting shapes, blocks of energy-saving works
  If the shapes of high-rise buildings are circular cylinders, even polyhedra, square cylinders, rectangular cylinders, they will save more energy than the buildings with complex convex shapes.

- Making use of natural lighting
  High and narrow windows will make better use of the natural light than the low and wide windows (with the same area of the windows). The windows are easily open but also ensure sun protection.

- Using materials that absorb natural energy such as glass, thin film
  Glass surfaces in buildings not only save energy passively, i.e. they only prevent outside heat from entering and minimize heat transmission to outside, glass also has the ability to actively convert energy into energy serving the buildings. Using glass and other energy-absorbing materials such as thin film suitable for hot and humid climates in Vietnam.

- Using suitable and environmentally friendly building materials
  Environmentally-friendly building materials are those that can help reduce load, good sound insulation, energy saving. Brick has a great impact on the environment, causing heat pollution. Therefore, the use of gauged clay brick should be decreased, and it should use adobe brick with the rate of 50-70%.

- Using trees to improve micro-climate
  The green space around the works will create a cleaner, cooler environment that needs to use fewer air-conditioners and significantly saves energy consumption.

- Designing smart lighting system
  More energy-efficient lighting devices such as LEDs, compacts, etc. and smart control systems help reduce or cut lighting when it is unnecessary by sensors, automatically controlling brightness of the lights in the outdoor light or turning off the lights when there is no user.

- Designing smart water supply system
  New generation sanitation equipment can save 20% of water in use. Making use of rain water and gray wastewater - waste water from the showers, hand washers, washers and reuse to save energy. Use a solar water heater incorporating an electric heating system (operating when it is not sunny).

- Designing smart air conditioning system
  Inverter air-conditioning devices incorporating solar-energy air conditioning and central air conditioning system with induction system that self-adjusts temperature in the rooms to suit the outside temperature help save energy significantly.
3.2. Planning solutions

* “Amip city” solution of Japan

Cities are not dependent on the same patterns or rules, but they seem to be very free and "arbitrary" to be developed in nature. There is no need to spend too much area on the squares or the avenues, but there is regulation on empty space, yard and garden for each house. Therefore, the balance of urban environment is achieved by the balance between natural - artificial elements in each house and each town. Natural rivers are thoroughly researched on the location where should be kept natural and where embankments should be used. Public spaces are scattered rather than concentrated. In terms of landscape, they may not be as neatly organized as the cities in the Western countries, but urban living environmental issues are almost completely resolved from the smallest one. Cities like "Amip" have the ability to replicate themselves without the difficulties of "big head" disease causing environmental consequences and difficulties in urban management [5].

The cities that seem to disorder like Tokyo are forming through the convergence of heterogeneous and naturally spontaneous elements. They are not planned to be anything from the beginning but develop accidentally. Here, there is a “beauty of chaos,” a beauty that is appropriate for the 21st century. The beauty of the 21st century needs to be accompanied with the ability of adaptation, including the ability of response to climate change [17].
Inspired by the biblical character of Noah, the Serbian designers, Aleksandar Joksimovic and Jelena Nikolic, created the Noah Ark, a sustainable floating city capable of protecting lives on the earth in the event of a big disaster. The project will exist based on terrestrial lives, providing large space for food production models, food development, rainwater collection, and through sources of natural energies such as solar, wind and wave energies, etc. available on sea for human life.

In addition to helping protect against natural disasters, the project is designed as part of a network connected to underwater floating tunnel system, linking them to the mainland. As settlements, this place can be linked together to create a huge artificial continent. A 64m-high wall outside protects the city from strong sea waves and tsunamis. In an emergency, the people can come to the islands to be safe. The beneath part of the island, giant turbines convert ocean currents into energy while the artificial coral surface layers encourage the development of new ecosystems.

The project is able to create energy and everything needed for the comfort of the people, including residential areas, offices, parks, recreational areas, forests and beaches. Besides, there is also cultivating land and animal conservation area [2].

*“Floating city” solution of Noah Ark*

![Amip city, solution of Japan](http://www.smartcitiesasia.com/)

Figure 3. “Amip city”, solution of Japan
Source: http://www.smartcitiesasia.com/
3.3. Urban technical infrastructure solutions

* “Green city” solution of Vancouver - Canada

Vancouver Smart City focuses on smart people and smart living items. About 48% of Vancouver people were not born in Canada. Multiculturalism brings more creativity. The citizens in Vancouver city also have the highest life expectancy (around 84 years old) compared to the citizens of other smart cities. The Vancouver has been involved in many programs to develop a long-term strategy to become the greenest city in the world in 2020. This will help 97% of Vancouver's energy coming from recycled energy sources (mostly hydrogen). Vancouver is also the pioneering city that provides innovations for green buildings, helping to promote the entire green ecosystem, from architecture to engineering and other products of the building [3].
Figure 5. “Green city” solution of Vancouver - Canada

Source: Stephen Goldsmith – Susan Crawford, The Responsive City: Engaging Communities Through Data-Smart Governance, Jossey – Bass, 2014

* Smart city solution of Rio de Janero – Brazil

Rio de Janeiro is leading the trend in becoming a smart city. The city expects the smart city model will be the way to address pressures for developed cities and natural disaster prevention.

In 2010, Rio de Janeiro suffered from a major flood that killed more than 100 people. Shortly thereafter, Mr. Eduardo Payes, the city mayor, asked the IBM to set up a system for forecasting safety-related issues for the city. In 2010, the Rio City's Action Center was established. Data from more than 30 related agencies are aggregated and processed by algorithms that allow for establishing the link between the climate factors and the geographic location of Rio. They focus on monitoring activities in the city through 900 cameras and weather information to respond timely to traffic, environmental and flood risks. The city also set up an alarm system based on information gathered from rainfall analysis at position in the city to provide timely warning [4].
3.4. Notes when choosing solutions for cities in Vietnam

3.4.1. Determining prioritized group of solutions

By learning about the "Smart City" solution that is capable of responding to climate change in different cities around the world, it shows that each city will fit with some certain solutions. The choice of the solution depends on the natural, economic social features, etc., as well as urban development orientation and technology development level of that country. Japan adopts a "partial" approach which appreciates the balance of nature and is not technologically dependent, starting with a rational allocation of land. Meanwhile, Korea appreciates the "comprehensive" approach and put priority on construction of the smart infrastructure.

Vietnam is a developing Asian country. Compared with other developed cities in the world, we are still relatively backward in terms of technologies and limited funds to be able to purchase modern technologies from foreign countries. However, "smart" solutions that are less costly and do not require the use of modern technologies are still be applied, as in the case of Japanese cities. Japan is one of the leading countries in modern technologies, but it has chosen a technology-independent solution that is a rational land-use distribution to address the problem of urban environmental balances.
Cities in Vietnam, except for some large cities such as Hanoi and Ho Chi Minh City, which are partly affected by the overall planning of the Western countries, also follow a partial approach, although it is due to spontaneous development rather than due to clear targets like Japanese cities. As a result, our cities seem to be "disorderly" in Asian manner and are capable of self-replicating but cannot balance themselves like Japan's "Amip" cities. The unreasonable land use allocation in each area creates an imbalance among trees - architecture - people in cities. And so, we are facing a lot of urban issues as mentioned above, including climate change [1].

From the above analysis and examples, it is concluded that the determination of smart city construction method (using modern technologies or other means), followed by the determination of prioritized groups of solutions (land use, infrastructure or other solution groups) is very important at the outset. As Dr. Lee Yae Yong (South Korea) said "to build smart cities, Vietnam needs to determine the concept and target".

3.4.2. Choosing solutions that support other urban issues

As mentioned at the beginning of this article, our cities are experiencing four major issues that need to be addressed: Urbanization increase - Increased urban problems - Economic competition increase among cities, regions; People's increased demand for quality of life (according to former Deputy Prime Minister Nguyen Thien Nhan).

Thus, in the Architectural, Planning and Infrastructure Solutions, there are many solutions that are capable of responding to Climate change. However, it is important to consider the supportive impacts of these solutions with other urban issues in order to select the most effective solutions for the cities [20].

3.4.3. Choosing "friendly" technology solutions that provide early warning and prevention of the impact of environmental changes

Responding to climate change includes prevention - warning - stopping. If technologies are only "friendly" to the environment, they only have preventive effect. However, as far as we all know, climate change is caused by a number of causes and causes are not just from cities but also from other places that affect the cities, including deforestation, marine pollution, use of chemicals in agriculture, etc [7]. Therefore, "Smart city" solutions should be able to give early warnings and prevent the impact of environmental changes, such as the Rio de Janeiro's warning system or the floating city model of Noah Ark.

4. Conclusions

A city needs to be "smart" in some parts to solve a particular goal, not to be completely smart. Just like machines, technologies are man-made to better serve one's life, but not to and be unable to replace human beings. The abuse of technologies will also result in consequences which are as negative as the non-use of technologies. It can't help mentioning the presence of modern technologies when building "smart city". However, as discussed above, "Smart City" is not a target but a tool for achieving a certain developmental goal of a city. Given the current climate change situation in cities, environmentally-friendly technology solutions need to be prioritized. Responding to climate change is a great issue related to processes that help balance the natural environment. In addition to changing people's awareness, the use of "environmentally friendly" technologies will also help bring about greater efficiency in response to climate change.
References
[1] “How to respond to Climate Change Impacts in Urban Areas”, A Handbook for Community Action, Brandenburg University of Technology Cottbus, 2011.
[2] Khanh Phuong, “Floating city for future”, Construction newspaper, 2014.
[3] Stephen Goldsmith – Susan Crawford, The Responsive City: Engaging Communities Through Data-Smart Governance, Jossey – Bass, 2014.
[4] Anthony M. Townsend, Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia, W. W. Norton & Company, 2014.
[5] Yoshinobu Ashihara, Aesthetics of Tokyo: Chaos and Order, Ichigaya Publishers, Tokyo, 1998.
[6] Oliver Gassmann, Jonas Böhm, Maximilian Palmić, Smart Cities: Introducing Digital Innovation to Cities, Emerald Group Publishing, 2019.
[7] Raymond A. Young, Masood Akhtar, Environmentally Friendly Technologies for the Pulp and Paper Industry, John Wiley & Sons, 1997
[8] Chudnovsky, Daniel; Lopez, Andres, Diffusion of environmentally friendly technologies by multinational corporations in developing countries, International Journal of Technology Management & Sustainable Development, Volume 2, Number 1, Intellect Publisher, 1 March 2003.
[9] https://www.nhandan.com.vn/nation_news/item/27297602-do-thi-thong-minh-thuc-tien-va-kinh-nghiem-quoc-te-trien-vong-tai-viet-nam.html
[10] https://www.transportation.gov/smartcity
[11] http://labs.sogeti.com/smart-cities-dumb-people/
[12] http://aita.gov.vn/CMSPages/BaiViet/Default.aspx?IDBaiViet=1764
[13] http://europe-rl.com/makes-smart-city-smart/
[14] http://khoadothi.net/thong-bao/long-ghep-van-de-bien-doi-khi-hau-vao-ke-hoach-phat-trien-do-thi.html
[15] http://kienviet.net/2016/12/09/mat-toi-cua-thanh-pho-thong-minh/
[16] https://www.geospatialworld.net/blogs/six-technologies-crucial-for-smart-cities/
[17] http://www.smartcitiesasia.com/
[18] https://doimoisangtao.vn/news/2017/10/11/long-ghep-van-de-bien-doi-khi-hau-vao-ke-hoach-phat-trien-do-thi.html
[19] https://www.tapchikientruc.com.vn/chuyen-muc/thanh-pho-thong-minh-xu-huong-phat-trien-tren-the-gioi-va-viet-nam.html
[20] https://www.ireek.com/news/index.php/2017/01/17/urban-planning-definition-problems-and-solutions/
[21] https://link.springer.com/chapter/10.1007/978-3-319-56091-5_2, Impacts of Climate Change on Urban Areas and Nature-Based Solutions for Adaptation
[22] https://www.sciencedirect.com/science/article/pii/S1462901116305834, Climate change in the urban environment: Advancing, measuring and achieving resiliency