Sri Lanka Journal of Marketing
University of Kelaniya- Sri Lanka

Smart City Concept and Review on Strategic Readiness of Sri Lanka

Sampath Liyanage
Deputy Inspector General of Police, Sri Lanka Police, Ministry of Defense, Sri Lanka
chan_sampatha@yahoo.com

D.M.R.Dissanayake
Senior Lecturer, University of Kelaniya, Sri Lanka
ravi@kln.ac.lk

ABSTRACT

Smart city concept is one of the sought after strategies in many countries whereas the role of information communication technology (ICT) is broadly highlighted within. Recent studies extendedly discuss the contents and the integrated nature of the smart city concept. Sri Lanka is also attempting to initiate some massive projects in which smart cities become resulted. However, it requires comprehensive policy framework and the execution strategies to activate smart cities. This has found challenges even though it makes huge potential for different industries and lifestyles of the related communities. Alongside, explaining the essentials for smart city concept in Sri Lanka was the main focus of this paper. Authors followed a comprehensive literature review as the main research tool to investigate the empirical thoughts and findings related to smart city concept to explain the integrated contents of it. Alongside, paper attempted to discuss the key components and integrated concepts towards smart city concept providing policy makers to frame smart city strategy with supportive inclusions. It has made a special attention to Sri Lankan context by reviewing the policies and strategies made on related projects and programs on information communication technology (ICT) to reveal the readiness of the nation towards smart city development perspectives. Specific attention was made to link the discussion on how smart city model and the role of ICT should act connectively for economic sustainability. Paper presented a conclusion by proposing the future research and policy development directions to examine the effective strategies to plan and execute smart cities in Sri Lanka.

Keywords: *ICT, Smart City, Sri Lanka, Sustainability.*

1. BACKGROUND OF THE STUDY

Having better living standards is a key focus of every human being in the world and the governments need to focus on providing better and enhanced living standards for the people in the respective countries. Urbanisation has become a key factor with the developments of countries whereas world is experiencing a fast growth in urbanisation, and it is estimated that around 50% of the world population is living in cities whilst it will reach 70% by 2050 (Naphade, Banavar, Harrison, Paraszczak, & Morris, 2011). Though urbanisation is considered as a key factor in evaluating the development of a country, the governments also face issues to provide facilities for the people in the cities with increased urbanisation. This has resulted to introduce the concept of smart cities in order to identify and find better as well as smart solutions for urban population in particular (Cohen, 2014). The smart city concept came to the arena and discuss openly in 1990's since the concept was identified as a solution to reduce the human traffic in urban areas and the high-power consumption due to increased population whereas the concepts of globalisation, technology and innovations attributed in urban development (Harrison & Donnelly, 2011). The focus of the concept at this stage was on innovations, creating opportunities as well as enhance employment (Harrison & Donnelly, 2011). As a result, governments and the policy makers proposed to use information communication technology (ICT) as the main service platform that increases the living standards, prosperity and quality of life of the people who live in urban areas or cities.

ICT is an essential and important component in smart city concept that can be used in enhancing the productivity of the services and the infrastructure of the smart cities (Harrison & Donnelly, 2011). Technology is having a higher usefulness in reducing the usage of energy as well as reducing the carbon emission that will create a higher positive contribution for the global climate changes which is identified as a critical environmental issue (Hodgkinson, 2011). The innovation in the technology is used to minimise the consumption of natural resources and reduce the pollution in the cities that resulting to increase the quality of life of the people who live in cities (Jong, Joss, Schraven, Zhan, & Weijnen, 2015). The empirical insights are found claiming digitally enabled cities of a country or a region as intelligent cities whilst such ICT connected societies are highlighted in modern ICT driven e-societies (Dissanayake, 2011; Komninos 2002). The modern terms of smart cities are attributed with digital information availability for the areas such as health, education, governance and knowledge transferring activities (Yigitcanlar 2015; Townsend, 2013). We also highlight that countries like Sri Lanka can be benefitted via smart city concept since its economy is thriving towards urbanization and service sector driven.

1.1. Smart City Initiation of Sri Lanka

The government of Sri Lanka initiated a new concept for the country called "Megapolis Plan" which focused on developing the western province of the country which includes Colombo district and Colombo city as the main commercial regions in 2015. It had extended plan for the rest of areas too. This development plan was introduced in three phases as namely Urbanisation to consider as a better policy for the economic development of the country, have better organised urbanisation policy and a plan to reduce the pressures in current developments of infrastructure, services and environment, and Minimise the cost of capital in developing urban cities in the country (The Western Region Megapolis Planning Project, 2016. There is no difference in the foundation of Megapolis Plan and smart city concept whereas Megapolis plan has planned to introduce the smart city concept to the country. As to indicate the positive focus of the government on the concept, it introduced a fresh and new cabinet minister as well as a ministry for the efficient introduction of the smart city concept to the country (The Western Region Megapolis Planning Project, 2016). With the approvals of the cabinet, Kandy, which is one of the most attracted cities in the country attributed with cultural, historical and economic values to convert as a smart. Then it had a plan to move to Galle which is the capital of the southern region (The Official Government News Portal of Sri Lanka, 2015).

The smart city plan of Sri Lanka had many economic and social inputs. "Advance ticketing or booking systems, automated settlements, big data, e-government services in real time, electronic and smart card ticketing, environment sensors, government news and alerts, GPS navigation and digital location identification, providing government services through apps, smart digital meters in utility management, street lights and automation, management of traffic and predictions by phones, delivery efficiencies through digital addresses and other related efficiencies of the digital addresses were some of the services that the government planned to offer through the Megapolis Plan or the proposed smart city concept (The Western Region Megapolis Planning Project, 2016). Technology, data, information and the information communication technology (ICT) are considered as the key factors that create an impact for sustaining the concept of smart cities (Cisco, 2014). Almost all the developed countries that adopted smart city concept used many developed technologies such as Global Positioning System (GPS), Global System for Mobile Communication (GSM) and Wi-Fi etc. For the implementation, conduction and success of the smart city operation. The need of very effective and efficient technologies has become highly important to the success of the smart cities and the future requirement of the technologies will be high when cities becoming smarter (Cisco, 2014). The technology infrastructure, data and the security of data are considered as critical success factors to sustain of smart cities in the world and smart cities will be a failure and a waste of money if technology is not being properly managed within (Pan, et al., and 2013).

The above arguments on sustaining of the smart city concept indicated that the countries need to have a strong, consistent and well-established technology infrastructure. It includes ICT and data even more than any other factors that required for the implementation, operation and sustain of the smart cities whereas Sri Lanka is also alert on those (The Western Region Megapolis Planning Project, 2016). Sri Lanka is also having a sound ICT infrastructure whereas Sri Lanka is the first to introduce 3G and 4G technology which involve with fast internet and data transfer in the South Asian region and it was first to consider on the 5G technology and conducting trial implementation of the new technology (Official Government News Portal of Sri Lanka, 2016). However, ICT adaptation into the lives and industry practises seem still arguable in Sri Lanka even though massive initiations have been implementing over the years (Dissanayake, 2011: Official Government News Portal of Sri Lanka, 2016). The smart city concept is a critical concept for Sri Lanka as per its future potential, but execution of the concept is a challenging task.

2. EMPIRICAL AND CONCEPTUAL REVIEW ON SMART CITY CONCEPT

Smart city has been defined as a unit that considers to increase the performances of economy, governance, people, environment, mobility and living through enhancing the activities of aware and independent people who are self-decisive through identification of intelligence solutions that ensure and focus on the enhanced service providence and its quality (Giffinger, Fertner, Krama, & Meijers, 2007). Smart cities are the processes which make the urban cities with green environment that helps to minimise the damage to the environment through reduced carbon emission through the help of intelligence of economy. Smart city life demands higher value through actual current data which are collected from the sensors and activators and knowledge that is innovative in helping the standards of living of the people and the economy (Zygiaris, 2013). Additionally, smart city has also been defined as a city that uses advanced technology to connect elements of the city, information and people in order to create a sustainable environment, innovative and competitive environment to enhance the quality of life (Cisco, 2014).

By considering those arguments, smart city can be reflected as a concept focuses in a process of creating environmentally focus economic development and quality life of the people through technology. The ICT infrastructure creates a higher impact in achieving the objectives of a smart city (Giffinger et al., 2007). A country requires a comprehensive e-society and e-government policies to establish ICT enabled business models and community services (Dissanayake, 2011). Thus, availability of quality data and information made via effective and efficient ICT platforms could be the key factor in a smart city to gain higher effectiveness in creating a green environment. In addition, smart cities support for economic development assisting to increase the standards of the quality of life of the people alongside the business sector growth.

3. DISCUSSION ON THE CHARACTERISTICS OF A SMART CITY

Smart city is having its own characteristics whereas society, economy, environment and life styles are prominent within. Smart city is identified with the people, infrastructure and the environment where such evaluations help to monitor the performances of any smart city (Giffinger et al., 2007). As per Giffinger (et al., 2007), smart city exhibits some key characteristics as reviewed in the undermentioned contents with supportive empirical insights.

3.1. Smart Economy:

Gaining a higher economic competitiveness through entrepreneurship and innovation is the main focus of smart economy (Giffinger et al., 2007). Thus, the people who live in smart cities need to produce new innovative ideas that could convert into better business creating an opportunity for such ideas to go international and even to attract customers from cross borders. Further, these smart business ideas and the business will produce a higher productivity for the development of the city (Giffinger et al., 2007; Kondepudi, 2014). Thus, smart city should be attributed by smart economy with competitive features of innovative technical applications providing business community to apply entrepreneurial business ideas. In addition, smart city concept highlights the smart economy with the integrated components of sustainability, quality of life, urban aspects and intelligence (Dhingra & Chattopadhyay, 2016). Moreover, economic factors have been claimed with social, environmental and intelligence related components when it comes to analyse the attributes of smart city concept (Kondepudi, 2014). Thus, smart economy is an integrated component found within the framework of smart city.

3.2. Smart People:

The focus of the people on the education and the qualifications is not making them smart people, thus, people need to have a quality public life as well as interaction with others as referred in cosmopolitanism perception indicating they belong to one single community with no other demographic differences (Balakrishna, 2012). Such a perception of smart people will further support the development of the city whereas this required people to be more informed and educated where such could be achieved through the support of the digital technology (Balakrishna, 2012). Digitally abled systems can enhance communication efficiencies through technology whereas the smart people are the people who live under the conditions of innovation enhancements, information sharing, enhanced learning and knowledge while having and enhanced inter relationships and interactions supported by the technology and communication efficiencies (Hollands, 2008). Thus, smart cities require informed and exposed communities supported by information links via digitalized systems. Sri Lankan city community is also a diversified community compared to the South Asian region and attributed with advanced literacy

compared to neighbouring countries. Thus, converting the city community towards smart people seems not that challenged.

3.3. Smart Governance

Governance is considered as the collaboration of information, structures, norms, rules and procedures that create or focus to create a certain behaviour among the people (Johnston & Hansen, 2011). Smart governance focusses on reforming the governance infrastructure to become more smart, efficient and responsive to motivate the people to strive with lower level of resources and encourage to focus on new sources (Johnston & Hansen, 2011). The support of communication and computer-based technologies are highly important in creating smart governance since such support will help to increase the ability of the people to organise, govern, interact and supports to ensure a higher accountability (Chen, 2010). Further, the smart governance leads to increase the data exchange, collaboration, communication and service integration whereas information communication technology plays a major role in smart governance (Chen, 2010). Additionally, having a higher transparency in decision making, political strategies and governance and superior public services are key components of smart governance which informational availability as well as an infrastructure to make information available are must in smart governance supported by ICT infrastructure (Lin, Zhang, & Geertman, 2015). Sri Lanka is also striving with many ICT initiatives with e-governance and e-society projects and the country's ICT policy has been transforming with timely required matters to create strategic foundation for smart governance (Dissanayake, 2011). However, sector integration and public awareness with attitudinal transformation should be further considered to create extended smart governance in Sri Lanka even though there are many positive events found.

3.4. Smart Mobility

The focus of smart mobility is creating efficiencies in fuel consumption of all the transportations where such strategies could reduce the energy consumption and environment pollution (Lombardi, Giordano, Farouh, & Yousef, 2012). Samrt mobility can further reduce the carbon emission while offering a safer transportation (Giffinger et al., 2007). New logistic and transport technologies and new transport systems are considered to increase the urban traffic and mobility to achieve smart mobility (Lombardi, et.al. 2012). The sensors that developed for transportation system and the GPS technology could consider in providing safety of transportation and the development in the communication technology could be used to do information sharing helping to increase the smartness of the mobility that reduce energy consumption and pollution (Maheshwari, Kachroo, Paz, & Khaddar, 2015). On the other hand, the focus of smart mobility could be linked with non-motor vehicles such as bikes which reduce both the energy waste and environment pollution due to higher carbon emission. Such projects should be implemented for communities attributed with higher level of education so that information sharing

through ICT is quite efficient (Yazid, et al., 2011). Thus, smart mobility is always supported by smart people attributed with responsible commitments and exposure for smart city life style.

3.5. Smart Environment

The smart environment is one of the main mechanisms found within a smart (Liu, Wang, Xie, Mol, & Chen, 2011). Smart environment focuses on reducing the environment pollution mainly through carbon output (Giffinger et al., 2007). Further, it has become very important to have a higher focus on renewable energy and having a low focus on the non-renewable energy in achieving a smart environment (Giffinger et.al. 2007). Thus, it has to consider more in technology developments that reduce the consumption of energy and reduce environment pollution while reducing the waste of natural resources which leads to have a better quality in life as well as sustain the resources for future consumption (Jong et al., 2015). Sri Lanka is focusing more on green friendly energy sources including sola power projects, and this trend is much important to encourage a society for smart environment. Accordingly, smart environment could be achieved with policy driven decision of a country since energy sourcing and consummation should be governed by government policies and authorized bodies.

3.6. Smart Living

Smart living focuses on increasing the living standards or increasing the quality of lives of the people in the smart cities where it links with housing, health, safety and culture of people live in a city society (Zygiaris, 2013). The technologies for smart living should play a vital role to facilitate human life style. Thus, ICT could be used in most of the aspects of the human life such as assessing for daily necessities of the people like food, transportation, medication, education entertainment and housing etc. This requires a system to provide accurate and fresh information with a higher efficiency of information flow to the people (Lee, et al., 2011). This mechanism could result people to consume essentials for their daily requirements with affordability of the people (Lee, et al., 2011). Further, smart living is an emerging application of sensor technology, networks and information collaboration where information collaboration offers a higher efficiency for the people in researching for information required. The sensor technology offers a higher service to the end users which mostly be effective in health care services (Lyu, et al., 2015). Likewise, ICT could directly support to establish smart living required for a smart city for different consummation requirements.

In brief, aforesaid six characteristics of a smart city prove that ICT plays a major role in smart city concept whereas the efficiencies and the effectiveness of ICT could be crucial in this regard. Planning and execution phases of smart city projects need a serious focus on ICT as an enabler of many integral components within. Thus, countries require a strong policy and strategy on ICT to establish smart city concept with sustainable focus.

4. EXPLANATION ON SUSTAINABLE CITIES

A city that has been planned with a higher consideration on the impact to the environment focusing people to reduce the inputs such as food, water and energy as well as a focus on reducing the waste outputs like water pollution, air pollution and heat is considered as a sustainable city (Kolte, et al., 2013). Sustainable cities are defined as the places that focus on enhanced living quality in the means of policies connected on reducing the resources demanded for energy and materials (Jong et al., 2015). Smart cities are explained as the cities that occupy arrangements in measuring energy and water consumption, energy mix, green-space ratios, pollution and carbon emissions, primary forests and agricultural land loss, waste volumes and recycling rates and water quality aiming sustainable atmosphere (Brugmann, 1997). Smart cities focus on reducing the impact of its behaviour to the climate changes and aiming on achieving climate chargers with the use of ICT. ICT can be used to develop innovative methods to reduce usage of energy and greenhouse gas emission, for instance, companies in the telecommunication industry focus to reduce the consumption of energy (Kramers, Hojer, Lovehagen, & Wangel, 2014).

Smart cities are focusing on reducing the traffic jam that increases the safety of the people in the roads, increase efficiencies in life and reduce the energy and fuel waste which again reduce the carbon emission with the use of new technology to use smart traffic lights and increased information flow of traffic alerts in real time (Barba, Mateos, Soto, Mezher, & Igartua, 2012). This indicates that the smart cities are focusing to be sustainable cities in terms of reducing the waste of input as well as output that create a negative impact to the environment. Such measures could reduce the usage of resources that could save for future and focusing more on green environment where the ICT is used in achieving the sustainability through information sharing and integrations (Kramers, et.al.2014). The environmental protection strategies implemented in smart cities and the lives could assist sustainability via energy savings and reducing the harmful activities to environment (Fischer, 2008). Additionally, demobilisation is another measure where digitalisation reduces the physical transportation since the digital products can mobile through telecommunication networks (Kramers, et al., 2014). Thus, the ability of the ICT to demobilise or reduce physical transportation can reduce the costs and the energy consumption as well as reduce the waste and save environment via automated methods resulted by digitalisation (Kramers, et al., 2014). Alongside, mass customisation is another opportunity that ICT has to support for the sustainability in smart cities since this reduces the resource requirements for customisation (Kramers, et al., 2014). In brief, ICT brings sustainability in smart cities since ICT could be used to increase the efficiencies in operations which required higher resources such as transport, energy and water systems (Kramers, et al., 2014). In overall, sustainability has been a widely concerned matter in Sri Lankan firms whilst some environment sensitive industries in manufacturing sector have been converting their value chains with greener processes and systems. Green value creations via

sustainability-driven value chains heavily depend on green supply chains. Thus, even smart city concept has to be alert and linked with green supply chain strategies for sustainability. Having said, it can postulate sustainability and smart city are much interrelated concepts and most of the components required for a smart city directly connect to sustainability.

5. CONCLUSION

As it reviewed in the foresaid contents, smart city concept is integrated and holistic in terms of its model and the practical use. Thus, executing a smart city concept needs to focus on smart urbanism, smart economy, smart environment for sustainability, smart energy, smart mobility and smart life style for a strong propel **(**Cocchia 2014; Lara, Costa, Furla & Yigitcanlar, 2016). This provides a comprehensive mind mapping for a county to plan and execute a smart city project. Smart city is not technology or digitalization, but a strategy that connects life style of people with related services, systems and processes through digital knowledge and information. Sri Lanka is also a county that desperately drives to implement smart city concept. Sri Lanka needs to focus on smart city concept since it does add values to overall value chain of many industries found in urbanized communities. Sri Lankan is a huge potential for tourism sector and it has to focus on many strategies to enhance the tourism sector revenue models. Thus, smart city concept should be executed with a strategic plan enabling city life of both locals and foreigners connected to many consumption opportunities. Thus, government has to play a strategic role to encourage industries and firms to be a part of the smart city concept. It will generate positive results for the firm and subsequently generates revenue to the nation. The most challenging matter is to maintain one specific policy for ICT and town planning aiming at commercialization benefits. According to the matters discussed, smart city concept should not be implemented as a single project but in the face of an integrated model. The country's policies, people motivation for smart life, ICT and environment planning should be integrated for a sustainable plan to implement smart city concept. Future studies have to investigate the effectiveness of smart city concept with reference to policy frameworks, institutional coordination, stakeholder participation and public perceptions. In overall, smart city concept should be studied and properly planned as a holistic model that connects with social, economic, environmental and technical components within.

6. REFERNCES

[1] Balakrishna, C. (2012). Enabling Technologies for Smart City Services and Applications. *2012 Sixth International Conference on Next Generation Mobile Applications, Services and Technologies,* 224.

[2] Barba, C. T., Mateos, M. A., Soto, P. R., Mezher, A. M., & Igartua, M. A. (2012). Smart city for VANETs using warning messages, traffic statistics and intelligent traffic lights. *2012 IEEE Intelligent Vehicles Symposium*. doi: 10.1109/ivs.2012.6232229

[3] Brugmann, J. (1997). Is there a method in our measurement? The use of indicators in local sustainable development planning. *Local Environment*, 2(1), 59-72.

[4] Cocchia, A. (2014). *Smart and digital city: A systematic literature review. In Smart city* pp. 13–43. Berlin: Springer

[5] Cohen, B. (2014). *The 10 Smartest Cities In Europe*. http://www.fastcoexist.com/3024721/the-10-smartestcities

[6] Chen, T. M. (2010). Smart Grids, Smart Cities Need Better Networks. *IEEE Network*, 24(2), 2-3.

[7] Cisco. (2014). Smart City Readiness: Understand the Issues to Accelerate the Journey. White Paper. Smart City Council.

[8] Dhingra, M., & Chattopadhyay, S. (2016). Advancing smartness of traditional settlements-case analysis of Indian and Arab old cities. *International Journal of Sustainable Built Environment*, 5(2), 549–563.

[9] Dissanayake, R. (2011). Information Communication Technology (ICT) Policy of Sri Lanka and its Impacts to Socioeconomic Development, Journal *of Education and Vocational Research*, 53-59.

[10] Fischer, C. (2008). Feedback on household electricity consumption: a tool for saving energy?. *Energy Efficiency*, 1(1), 79-104.

[11] Giffinger, R., Fertner, C., Krama, H., & Meijers, E. (2007). *Smart Cities: Ranking of European mediumsized cities.* Vienna: Centre of Regional Science.

[12] Harrison, C. & Donnelly, I. A. (2011). *A Theory of Smart Cities. Proceedings of the 55th Annual Meeting of the ISSS-2011.* http://journals.isss.org/index.php/proceedings55th/article/viewFile/1703/572

[13] Hodgkinson, H. (2011). *Is Your City Smart Enough?: Digitally enabled cities and societies will enhance economic, social, and environmental sustainability in the urban century.* http://www.kovacevic.be/web/strategy/docs/Is_your_city_smart_enough Ovum_Analyst_Insights.pdf

[14] Hollands, R. G. (2008). Will the Real Smart City Please Stand Up. *City: Analysis of Urban Trends, Culture, Theory, Policy, Action*, 12(3), 303-320.

[15] Johnston, E. W. & Hansen, D.(2011). Design Lessons for Smart Governance Infrastructures. *American Governance*,3,192-212.

[16] Jong, M. D., Joss, S., Schraven, D., Zhan, C., & Weijnen, M. (2015). Sustainable–smart–resilient–low carbon–eco–knowledge cities; making sense of a multitude of concepts promoting sustainable urbanization. *Journal of Cleaner Production*, 109, 25–38. doi: 10.1016/j.jclepro.2015.02.004

[17] Kolte, S., Kandya, A., Lakhtaria, K., Patel, V., Ghosh, P., Singh, P., & Morabia, H. (2013). Evolving Sustainable Cities through the Fabric of Technological Transformation. *Procedia Engineering*, 51, 480–486. doi: 10.1016/j.proeng.2013.01.068.

[18] Komninos, N. (2002). *Intelligent cities: Innovation, knowledge systems, and digital spaces*. New York: Taylor & Francis.

[19] Kondepudi, S. N. (2014). *Smart sustainable cities analysis of definitions*. *The ITU-T focus Group for Smart Sustainable Cities*, United Nations, Washington

[20] Kramers, A., Hojer, M., Lovehagen, N., & Wangel, J. (2014). Smart sustainable cities – Exploring ICT solutions for reduced energy use in cities. *Environmental Modelling & Software*, 56, 52–62. doi: 10.1016/j.envsoft.2013.12.019.

[21] Lara, A., Costa, E., Furlani, T., & Yigitcanlar, T. (2016). Smartness that matters: Comprehensive and human-centred characterisation of smart cities. *Journal of Open Innovation*, 2(8), 1–13.

[22] Lee, C.-K., Lee, J., Lo, P.-W., Tang, H.-L., Hsiao, W.-H., Liu, J.-Y., & Lin, T.-L. (2011). Taiwan Perspective: Developing Smart Living Technology. *International Journal of Automation and Smart Technology*, 1(1), 93–106. doi: 10.5875/ausmt.v1i1.74

[23] Lin, Y., Zhang, X., & Geertman, S. (2015). Toward smart governance and social sustainability for Chinese migrant communities. *Journal of Cleaner Production*, 107, 389–399. doi: 10.1016/j.jclepro.2014.12.074

[24] Liu, W., Wang, C., Xie, X., Mol, A. P. J., & Chen, J. (2011). Transition to a low-carbon city: lessons learned from Suzhou in China. Frontiers of Environmental Science & Engineering, 6(3), 373–386. doi: 10.1007/s11783-011-0338

[25] Lombardi, P., Giordano, S., Farouh, H., & Yousef, W. (2012). Modelling the smart city performance. Innovation: *The European Journal of Social Science Research*, 25(2), 137–149. doi: 10.1080/13511610.2012.660325

[26] Lyu, Y., Yan, F., Chen, Y., Wang, D., Shi, Y., & Agoulmine, N. (2015). High-performance scheduling model for multisensor gateway of cloud sensor system-based smart-living. *Information Fusion*, 21, 42–56. doi: 10.1016/j.inffus.2013.04.004

[27] Maheshwari, P., Kachroo, P., Paz, A., & Khaddar, R. (2015). Development of control models for the planning of sustainable transportation systems. *Transportation Research Part C: Emerging Technologies*, 55, 474–485. doi: 10.1016/j.trc.2015.03.024

[28] Naphade, M., Banavar, G., Harrison, C., Paraszczak, J., & Morris, R. (2011). Smarter Cities and Their Innovation Challenges. *Computer*, 44(6), 32–39. doi: 10.1109/mc.2011.187

[29] Pan, G., Qi, G., Zhang, W., Li, S., Wu, Z., & Yang, L. (2013). Trace analysis and mining for smart cities: issues, methods, and applications. *IEEE Communications Magazine*, 51(6), 120–126. doi: 10.1109/mcom.2013.6525604

[30] The Official Government News Portal of Sri Lanka.(2016). *Kandy to be developed as Sri Lanka's first smart city.* http://www.news.lk/news/business/item/9599-kandy-to-be-developed-as-sri-lanka-s-first-smart-city

[31] The Western Region Megapolis Planning Project, (2016). *The vision, goals, strategies, and initiatives of the Megapolis Masterplan.* http://www.megapolis.gov.lk/downloads.php

[32] Townsend, A. M. (2013). *Smart cities: Big data, civic hackers, and the quest for a new utopia*. New York: WW Norton & Company.

[33] Yazid, M. R. M., Ismail, R. & Atiq, R. (2011). The Use of Non- Motorized For Sustainable Transportation in Malaysia. *Procedia Engineering*, 20,125-134.

[34] Yigitcanlar, T. (2015). Smart cities: an effective urban development and management model? *Australian Planner*, 52(1), 27–34.

[35] Zygiaris, S. (2013). Smart City Reference Model: Assisting Planners to Conceptualize the Building of Smart City Innovation Ecosystems. *Journal of the Knowledge Economy*, 4(2), 217-231.