CHALLANGES IN SUSTAINABLE DEVELOPMENT OF SMART CITIES: A REVIEW

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Abstract—Smart cities utilize information and communication technology (ICT) to collect urban data and improve quality, performance and management of urban services, thereby contributing to urban sustainability. The technological development is currently based on the market-led approach focusing on creating business-friendly environments and citizen centric service delivery but it should also be aimed at improving sustainability. Smart technology methods for gathering, connecting and utilising urban data should be developed aiming sustainable development and not just aiming cost efficiencies. Cities should initiate to be partners and enablers in ICT development, regulation, support and implementation which will also reduce the risk of private companies controlling the data of government and citizens. Bad planning and implementation of smart city can cause technological exclusion of people without ICT access, misuse of data, violation of citizens' privacy rights and prioritization of business interests neglecting social and environmental issues. Policies and strategies should be formulated to target smart cities with urban sustainability considering social, economic and environmental sectors.

Keywords— Smart city, Urban sustainability, Environmental sustainability, Urban planning and development, ICT, Smart technology

INTRODUCTION

A smart city can be defined as a city that utilizes the information and communication technologies (ICT) to provide decent quality of life to the citizens, to fulfil their demands. It focusses on enhancing the quality and performance of urban services to maintain a sustainable environment and to reduce resource consumption, wastage and overall costs. The development of urban eco-system can be classified into four sections i.e. institutional, physical, social and economic infrastructure. A smart city would include the provision of following elements:

➢ Water and electricity supply
➢ Health and sanitation
➢ Waste management and water treatment
➢ Transportation
➢ Affordable living cost, especially for the poor
➢ IT connectivity and digitalization
➢ Good governance, especially e-Governance and citizen participation
➢ Sustainable environment
➢ Safety and security of citizens, particularly women, children and the elderly
➢ Education, etc.

The development done based on area will retrofit and redevelop the existing areas including slums, into better planned ones, thereby improving the whole City. In order to accommodate the increasing population in urban areas, new areas can be developed around the cities. The infrastructure and services can be improved by smart application of technology, information and data. Such development will improve quality of life, employment opportunities and enhance incomes for all, especially the poor and the disadvantaged, leading to inclusive Cities. Smart solutions can be categorized as E-governance and citizen services, waste management, water management, energy management, urban mobility, etc.

Objectives of smart cities:
➢ To provide clean and sustainable environment by application of smart solutions.
➢ To meet the demands of the citizens
➢ To provide descent quality of life.
➢ To provide core infrastructure.
➢ To have vision for area based strategy, mobilization of resources and intended results in terms of infrastructure upgradation.
➢ To provide sustainable urban development considering social, economic and environmental issues.

According to United nations agenda for sustainable development (2015), smart city system is classified into different smart city components:

i.   Smart ecology
ii.   Smart economy and smart governance
iii.   Smart living
iv.   Smart environment

LITERATURE REVIEW

Adil Yosuf & Nishant Kumar (2019), discussed about the durability properties of concrete when it is subjected to chemical attack. Chemical attack (Sulphate, Chloride etc.) results in deterioration of strength of concrete with prolonged duration. The durability of a concrete structure is affected when it is prone to chemical actions (carbonation, chloride attack, sulphate attack etc). This chemical action may cause cracking of concrete, volume change and deterioration of structure. The repair of these structures is very costly and takes a lot of time and materials. Generally the material required for repair is chemicals (epoxy, resins, etc.) which are very harmful to the environment. The penetration of chemical ions and carbon dioxide into the concrete leads to dissolution of thin oxide protective layer surrounding the reinforcing steel, thus affecting the durability of structure and leading to premature failure. Different measures are used to prevent the steel bars from these chemical attacks. Coating steel bars with layers of organic and inorganic corrosion inhibitors is an effective way of reducing the corrosion in the bars, thereby leading to enhanced durability properties of concrete.

Bisakha Chalisey & Nishant Kumar (2019), discussed about the effect of sulphate attack on mechanical properties of engineered cementitious composite concrete. Conventional concrete is modified by random dispersion of short discrete fine fibers to improve its properties. Several fibres have been used so far to improve the properties of conventional concrete via: asbestos, steel, glass, carbon, nylon etc. A new advancement in the engineered cementitious composite concrete is the use of polypropylene fibre which has shown better results in improving the compressive & flexural strength of concrete composites. Polypropylene (PP), also known as polypropene, is a fiber that is used for strengthen concrete and for protection of concrete against micro cracks. The advantage of using fibres in concrete is the reduction of quantity of cement in concrete, thereby making it more environment friendly.

Ashraf Mir & Megha Gupta (2019), discussed about the benefits of rigid pavements utilizing bamboo fibre. The study investigated the feasibility of using bamboo as a fibre in pavement quality concrete with different water/powder ratios by adding bamboo fibre. Since the strength and stiffness of natural fibre concrete reduces with time, adequate precautions should be taken when using natural fibre. To prevent the decay of fibres, the partial replacement of cement with mineral admixture is being recommended. Also using mineral admixtures makes concrete less permeable and less the permeability more durable the concrete is. This proves an effect way to reduce the amount of cement in concrete and replacing it with bamboo fibre thereby reducing the overall consumption of cement in concrete manufacturing leading to a sustainable and environment friendly solution.

Götz, G., & Schäffler, A. (2015), focused on the conundrums in implementing a green economy in Gauteng city region. Gauteng city region(GCR) of South Africa has been facing problems of exploitative and resource intensive mining, industrial activities, sustainability challenge, high energy intensity, sprawling urban forms, increasing air and water pollution, growing water supply problem, acid-mine drainage, etc. which produce threat for future generation and the environment. Though a more sustainable future has been promised by a Developmental Green Economy Strategy (2010) and Green Strategic Programme (2011), there has been no significant progress on their implementation. This paper has discussed how government has emphasised on limited industrial policy style interventions rather than focusing on a fully regenerative economy, thereby creating difficulties for green economy strategies and sustainable economy.

Marsal-Llacuna, M. L., Colomer-Llinàs, J., & Meléndez- Frigola, J. (2015), proposed two ideas to monitor the smart cities initiative in a better way. The past and on-going initiatives in sustainable and livable cities were studied along with their respective monitoring indicators. It was demonstrated that a final synthetic or aggregative index is also needed to visualize the initiative's achievements along with the set of indicators required for efficient monitoring. The study proposed the construction of synthetic indices using principal component analysis (PCA). The second idea was to use the real time data instead of historical statistics to construct a set of indicators to asses a city's smartness accurately.

Joss, S. (2015), focused on the eco-city related concepts and the practices of sustainable urbanism since early 2000s. The implementation of sustainable urbanism is done by engaging various aspects i.e. environmental, economic and social. A sustainable development could be achieved by eco- city initiatives. During the process of eco-city initiative, government could face challenges such as effective coordination of innovation, planning and development of policies; engagement with the stakeholders and communities. The initiatives and international cooperation have increased as a result of need for sustainable city.

Bayulken, B., & Huisingh, D. (2015), conducted study to know if the lessons from existing eco-towns are guiding the planner in transforming cities into sustainable urban systems. The paper discussed whether or how the eco-towns have helped building sustainable systems through educational, experiential, societal diffusion and changes in governance processes. Eco-town based urban developments in the Northwestern Europe with particular emphasis on Neitherlands, Sweden and Germany were studied to summarize and systematize the obtained insights. The study focussed on the wide diversity of frameworks and processes used in the development of eco-towns that have caused relative success and /or failure. It was suggested that the ley elements to achieve the eco-towns' goals are political commitment, timing, financial aspects, physical qualities, stakeholder involvement and environmental planning.

Jong, M., Joss, S., Schraven, D., Zhan, C., & Weijnen, M. (2015), focused on multitude of concepts promoting sustainable urbanization. The developments in metropolitan areas can be reflected by different categories of cities: sustainable cities, green cities, digital cities, smart cities, intelligent cities, information cities, knowledge cities, resilient cities, eco-cities, low carbon cities, liveable cities and even combinations, such as low carbon eco-cities and ubiquitous eco-cities. This article investigates how these city categories are conceptualised individually and in relation to one another by bibliometric analysis. It was found that the "sustainable city" is the most frequently occurring category which is linked closely to "eco-city" and "green city" concepts. The concept of "low carbon city" and "smart city" has been rising as a dominant category.

Yigitcanlar, T., & Lee, S. H. (2014), have focused on ubiquitous-eco-city. The 21st century eco-city initiatives are branded as carbon neutral, low carbon, smart-eco, sustainable, ubiquitous eco and zero carbon aiming their sustainability. The main objective of u-eco-city is to provide high quality life to the people with almost no negative impacts on the environment utilizing state of art technologies to plan, develop and manage. The study is done to verify whether u-eco-city is a smart and sustainable urban form which can be an ideal model or not. The utilisation and implementation of ubiquitous technologies, infrastructures, services and management systems are studied. After the study of Korean u-eco-city initiatives, the possibilities to form an ideal model of smart and sustainable urban form are discussed.

Kramers, A., Höjer, M., Lövehagen, N., & Wangel, J. (2014), have studied the opportunities of using information and communication technology to reduce energy. For the study, an analytical framework is formulated combining a typology of ICT opportunities with a typology of household functions that require energy. A consumption-based lifecycle perspective is used to calculate the total energy consumption for household functions. This paper has discussed how proper investment of ICT could help reduce energy consumption on cities. The analytical framework studied in this paper can be used by researchers, city and regional authorities.

Lee, J. H., Hancock, M. G., & Hu, M. C. (2014), studied the two leading cases of US and Asia to develop an effective framework to build smart cities. This study aimed to examine and analyse the cases of San Francisco and Seoul to identify the heterogeneous characteristics in a process of planning and developing a smart city. After the study of implementation of smart cities in the chosen two cases, it was suggested that the dynamic processes involving the coordination of public and private sector contribute to build effective and sustainable smart cities. After qualitative and quantitative analysis, eight stylized facts and useful insights were developed to deliver improved implementation of smart city development projects.

Lazaroiu, G. C., & Roscia, M. (2012), proposed a model for computing smart city indices. The indicators chosen are not homogenous containing high amount of information. This study aims at computation of assigned weights for considered indicators using a fuzzy logic based procedure. The defined model to estimate "the smart city" can help access European funding. The model could contribute in policy making, adoption measures and best evaluated options.

CONCLUSIONS

Environmental problems caused due to population increase, rapid urbanization, high private motor vehicle dependency, deregulated industrialization, andmass livestock production have generated threat to the wellbeing of future generation. Eco-friendly practices are required to combat the environmental problems and stop the environmental degradation. The concept of smart city uses the information and communication technologies to meet the needs and demands of the citizen considering social, economic and environmental aspects of the city. The implementation of smart city initiation should be done to generate sustainable development. The planning, initiation and implementation of smart city should be done by investigating the existing cases to know about factors causing whether success or failure of smart city. Such initiatives should be aimed for sustainable development goals instead of cost efficient system. The implementation of smart cities is to be done keeping in mind to avoid misuse of sensitive data and violation of privacy right. An ethical framework should be developed for the collection and use of urban data will prevent misuse of data and maintain public trust. Instead of relying solely on digital technologies, non-digital services should also be maintained in parallel.Developing strategies and policies will help effective and efficient implementation of sustainable development of smart cities.

Rᴇғᴇʀᴇɴᴄᴇs

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