Sustainable Smart Cities and Associated Risks – A Review

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Abstract - Different nations strive to embrace new technologies in their towns or create towns utilizing technology. The new cities dubbed smart cities have unique features such as smart governance, smart economies, smart people, and digitized technology. Helsinki qualified for the case study due to the special features embraced by the city, such as a smart mobility program, digital inclusion, government-sponsored internet, investment in research and innovation, and a smart environmental climate. The city has faced risks similar to other smart cities worldwide, such as denial of distributed services and climate change alongside associated adverse factors such as floods. However, smart cities have embraced new technologies to manage risks, such as distributed data management, reduced heat emission, blue technology on slippery floors, and reduced carbon emission policies.

Keywords: Smart technology, Smart City, Climate change, Artificial technology, Digitalized market

I.   INTRODUCTION

Smart cities entail technologically modern urban centers that utilize various electronic and communication technologies to improve operational efficiency. Smart technology and communication technologies, alongside specific data collection, help create an efficient mode of sharing data with the public, improving government services and citizen welfare [1]. Various countries worldwide have revolutionized their strategies to facilitate the development of smart cities as the globe revolutionizes to adopt the smart city aspects alongside technological revolutions [2].

The revolution of urban planning as developed within smart cities has accelerated the improvement of the citizen quality of life. Smart cities feature various aspects, as exemplified by Helsinki, and have managed to solve the different societal challenges as outlined below.

1.2.   Features of Smart Cities

Smart cities feature various aspects which define their everyday activities. For instance, smart cities have embraced smart governance orienting on people-centered ambitions. Smart cities value their citizens and hence improvise the various technologies that connect the citizens within the region, such as through digitized communication strategies [3]. Smart cities also feature a smart economy, which drives economic activities within the particular center. The incorporation of digitized technology drives innovation among the residents as individuals adopt modern models of business and operations through which they secure city management and collect revenue.

Alongside the smart economies, smart cities have adopted the smart environment characterized by public and private buildings depicting efficient residential areas [3]. In addition, they adopted new environment management strategies, eliminating waste and poor disposal of waste and resources.

Smart people have also characterized smart cities. The government strategies initiate the residents to adopt modern management, such as empowering them to adopt smart technologies in their businesses. The government also supports the citizens in utilizing technology-based innovation as a source of livelihood [4]. The city habitants have a substantial role in influencing the city management hence the city shifting to the participatory mode, which ensures the habitant's query listening by the government.

The city also features modern living modalities such as efficient, safe, and smarter conditions. The cities also adopt quality health, education, and safety for the residents by adopting technology-based security systems [5]. Residents within the smart cities enjoy the revolutionized modes of management characterized by reduced pollution. For instance, smart cities have improvised shared electronic mobility blended with public and private interlinkages, promoting green mobility.
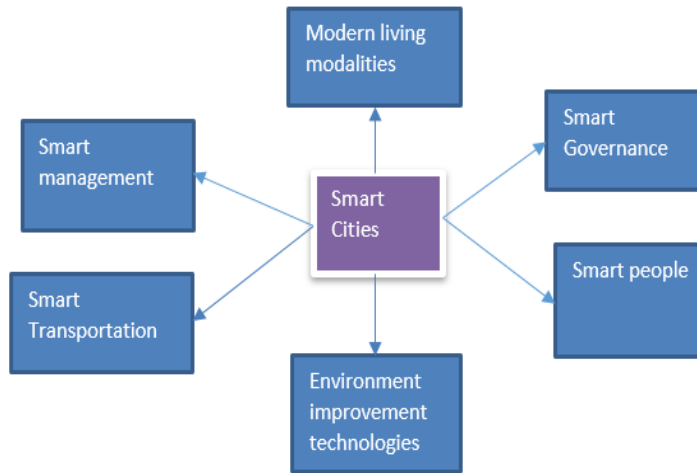
Fig 1. Smart cities' unique features

II. HELSINKI: CASE STUDY

Helsinki, the capital city of Finland, has various smart city features, which warrants the case study for smart cities. The city drew its origin in the 17th century when the city grew slowly after its foundation by Sweden's King Gustavus Vasa. The king founded the city to compete with Tallin for the Baltic Sea trade.

Helsinki's growth threatened Russia, prompting the construction of the Suomenlinna Maritime Fortress as protection, a project that attracted various influential individuals, such as merchants and healthy inhabitants [6]. Although Russia managed to capture Finland in 1809, it managed to regain independence in 1917. Since independence, the city has hosted various events, such as the summer Olympics in 182 and Conference for Security and Cooperation in Europe. The events led to the city's reputation, developing the smart city prospect among the city planners.
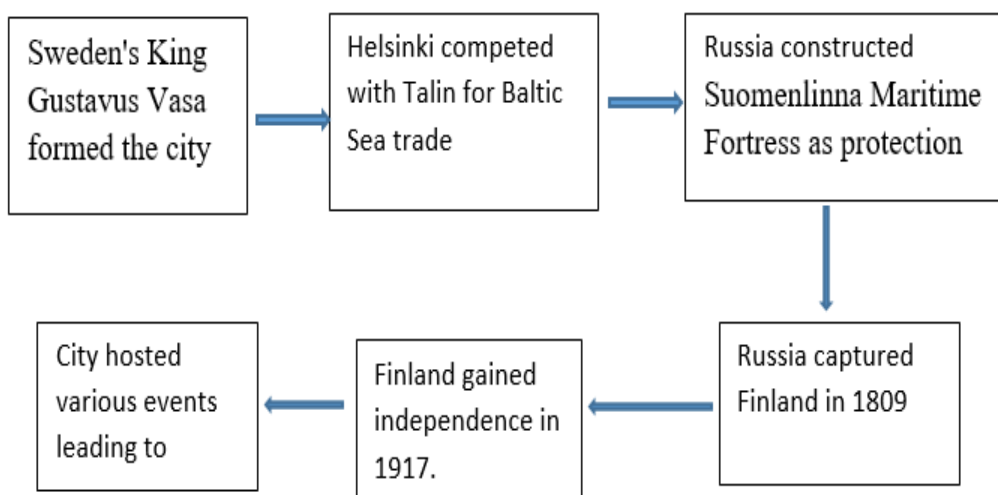

Fig 2. Helsinki development progress

Helsinki has an extensive population comprised of both local population and immigrants. Approximately 626,300 inhabitants reside within the city, while the more significant Helsinki population goes up to 1.4 million. About 14% of the population speak their ethnic language alongside the national language, Finnish and Swedish [7]. The

government spent about 42% of the research and development expenditure within the metropolitan planning and activities as it funds the various universities and research institutions within the area. The city has a mixed-up analysis of the labor force as the individuals aged 15-70 years constitute the labor while 7% comprise the unemployed individuals [7]. The population within Helsinki boasts high education level, with 40% of the citizens above 15 years possessing a degree certificate. Health and social protection comprise approximately 48% of the Helsinki expenditure.

2.1 Helsinki Unique Features

Helsinki exhibits some unique features that have driven the smart city's development. For instance, the city has improvised digital inclusion that has empowered the citizens to shape the city by providing accessibility to city data. As part of the city growth pattern to the smart city classification, it has empowered the citizens through data, improving their accessibility to data [8]. Government-sponsored data accessibility has prompt access to all types of data the client has, such as health statistics and 3D building models, through open data websites.

The provision of the services has facilitated the citizens to develop various applications, which drive citizen services [9]. Smart city management through the government has provided access to the benefits to all residents by incorporating the rural communities in the accessibility to internet services [9]. Technology and data accessibility have enabled the development of the GPS application, which helps blind and visually impaired residents navigate the city [8]. The city residents have also utilized the technology to develop carbon-neutral drone services that can help transportation resources to remote regions.

Helsinki has adopted the smart mobility program, which has fostered geared actions to improve the traffic flow and reduce vehicle emissions. The utilization of the traffic data and traffic flow enabled Helsinki to develop the digital Helsinki twin necessary for the traffic flow and helped the city in planning [5]. The Digital twin can also offer a solution to exploring traffic control within the construction sites, hence offering solutions to minimizing pedestrian disruptions. The technology that supports smart mobility solutions, including the Tromba Free, provides a solution to incorporating the modernized automated street sweeper with minimal energy consumption in society.

Helsinki has centered its operations on research and innovations. The high investment in the technologies has enabled the smart city to nurture Artificial Technology (AI) innovation and talent among residents, which seeks to empower the city to develop AI [24]. According to various studies, approximately three of four companies have developed or developed AI technology to help company operations [12].

Some of the AI technologies developed by the companies in Helsinki include the AI head analysis employed to help detect brain disorders, currently utilized in Helsinki University Hospital [26]. The Helsinki University Central Hospital, Intensive care unit utilizes a Helsinki-generated AI to see the patient release to standard hospital care hence facilitating critical patient care[11]. Besides, the AI helps monitor indoor air quality, thus warning of preventive measures for indoor individuals.

Helsinki has also invested in a clean climate, which aims at reducing carbon emissions as it aligns with the achievement of climate-carbon –neutrality by 2030. The change of the various nations to achieve a carbon-neutral community demands various modifications within the infrastructure, mobility, utility, and environment. 3D technology has enabled the smart city to visualize the urbanization effects on the trees, hence instituting the development of various sustainable practices within city planning [20].

The city planning has also incorporated projects seeking to address animal farming, which contributes the highest methane gas in the atmosphere hence, help in the management of climate change. The project focuses on producing an animal-free egg, which reduces the demand for animal farming [29]. The collaboration with the various sectors, such as universities and research institutions, helps drive this strategy as the research institutions invest in the research likely to develop solutions to the various problems that quantum computer technology exemplifies.

2.3 Associated Risk

Helsinki has experienced various risks during its development, which has incorporated different risk resolutions to help mitigate them. Helsinki experiences several risks associated with the smart city's exponential expansion. For instance, the smart city has identified risks to climate change, which leaves the city devastated as it seeks to improvise the various technologies to curb the effects. For instance, the city has high exposure to floods within the city [21]. The city's location within the coastal line exposes the city to the flooding risks owed to the increased

temperature changes, which has caused the increased ice melting and the consequent increase in the ocean sea levels. This phenomenon exposes the individuals within the lowlands to high risks of flooding.
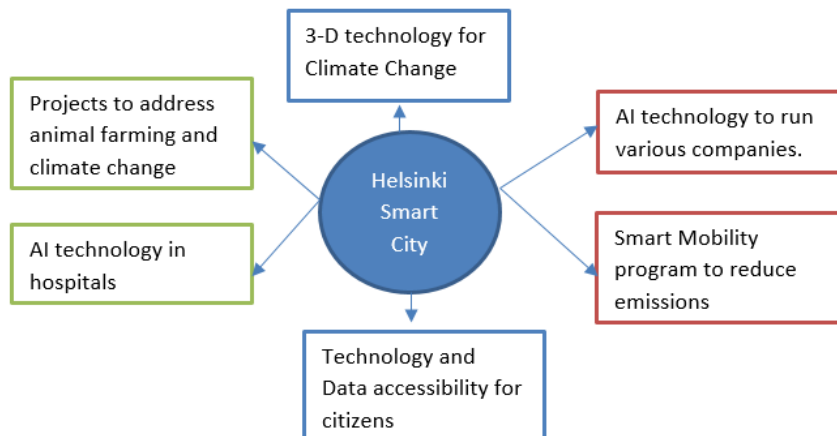

Fig 3. Helsinki smart city features

Alongside the devastating climate changes, Helsinki experiences various risks, such as temperature changes and slippery conditions. The smart city has witnessed extreme heat temperatures, which devastatingly affects industries as they cope with the frequent heating of machines and increase tear and wear [21]. The temperature changes brought along by climate change have resulted in the city's low temperatures. The city experiences more cold days, which increases the risk of slippery and accidents. Helsinki also witnesses various risks owed to the nation enjoying its expansive status in technological advancement and network accessibility. The automation of the transactions has led to the generation of a tremendous amount of data on which hackers can have an accessibility to personal information, which they can use in the undertaking of fraudulent and indemnity theft [17]. The systems' centralization contains personalized data by particular internet users, such as the data collected in the station charging facilities and the parking feeds [3]. Technological advancement also projects device-hijacking risk in which the attacker gains control of the device without recognition failure [2]. The attacker may exploit the hijacked meter before executing the ransom attack on the Energy Management Systems (EMS).

The smart city feature of Helsinki expresses the city to the various distributed denial of service (DDOS), a cyberattack criminal activity that prevents the user from accessibility to the machine by disrupting the services of the host connected to the internet. This cyberattack occurs by flooding the target with various superfluous requests, preventing the legitimate fulfillment of the various requests [16]. Since DDOS accrues from the incoming traffic flooding a target from multiple sources, it challenges halting the cyber offensive by blocking a single source. Smart cities such as Helsinki experience this risk, as denoted in the parking meters on which attackers breach security and demand joining botnet programming[18]. Botnet programming will simultaneously overwhelm the system by requesting the service [16]. In some cases, smart cities may experience permanent denials of services (PDOS), commonly described as plashing, culminating in damaging the device with a replacement solution, especially the parking meters with the highest vulnerability.

2.4 Associated Risks and Solutions

The smart city organization has facilitated various solutions to the associated risks, which may accrue to the specific smart city or the public innovative city organizations worldwide. For instance, Helsinki has developed and managed to offer various resolutions to the associated risks to the town. The city organization has adopted a climate change policy with strict guidelines to prevent the practices promoting climate change [19]. The task committee has developed the weather and climate risks assessment and published the report to avert the challenges of climate change. The proposed solutions, which Helsinki has already adopted, include flood risk management. Helsinki has built flood protection structures within the various flood risk amenities and replaced individuals from the flood risk areas [19]. The lowest building is approximately three-meter, a solution likely to avert flooding.

Helsinki has developed smart solutions to the various climatic conditions, such as adopting different infrastructures to cushion the public from disturbing heating. The measures already imposed include district cooling

through the guidance of the city planners and the building of considerate heat-resistant buildings [1]. The smart city has also adopted green and blue infrastructure alongside the planning, including road and pavement management practices, which seek to eliminate and prevent the public from the slippery conditions present during low temperatures.

Smart cities have also developed a new mode of data management, which seeks to improve the sensitivity and risk of the data accumulated in the city. The city has pioneered delivery services and accessibility by developing innovative blueprints for power data and analytics, improving residents' livelihoods [9]. Helsinki's development and implementation plan has incorporated storage, anonymization, and data processing for the citizens, upgrading their welfare [1]. In addition, it approves personalized, targeted services, reducing data inefficiencies and bureaucracy. For instance, data personalization has offered parents a solution to the prevailing challenges in access to daycare services for their children by recommending the various pre-primary educational facilities available through text messages.

Helsinki has developed new technologies to reduce carbon emissions and provide an economically friendly environment for business and residential services. For instance, Helsinki has adopted electric public transport blended with private transportation. The new modes have reduced carbon emissions, threatening global climatic changes [28]. The smart city has also geared its efforts on conservation measures through the institution of the smart collection system and extensive electric car capabilities[14]. Electric car investment has reduced carbon emissions as it depends on the renewable energy produced using innovative technology [7]. The transportation network utilizes modern forms of transport, which has expanded the Uber-style platform for electric on-demand boat rides [25]. The MaaS (Mobility as a Service) facilitates the citizens in buying the mobility services exemplified by the digital services discouraging private car ownership in towns.

Smart technologies adopted in Helsinki help in solving energy challenges. For instance, the city has developed various energy innovations to reduce heat emissions. For example, the city has initiated the prefabricated elements to renovate the various modular components, achieving smart solutions [30]. The city has also developed renewable energy use by replacing outdoor lights with more energy-efficient strategies such as thermal and wind energy, reducing carbon emissions. Utilizing the waste heat and heat pumps has offered a solution to the high heat emissions. Helsinki has developed a decentralization mode of data for the various companies operating in the city. This mode allows information transfer without unnecessary copies from one individual to another[10]. The decentralization of data prohibits data storage for more extended periods within a specific point, reducing the chances of data breaches [2]. The development of the decentralized data mode with the citizens having the consent right to share their data has reduced the high cyberattacks.

III. CONCLUSION

Ultimately, smart cities have started developing in various parts of the world as they offer smart solutions to different challenges. Smart feature such as smart governance, smart economy, and smart environment features the innovative city organizations in the world. Helsinki features a case study for smart cities as it has developed and utilizes various strategies, such as investment in innovative technology and developing various carbon-reduced measures. The city has developed a decentralized system to reduce the risk of security breaches and give the residents the ultimate right to control their data. Helsinki has also developed effective measures for reducing energy poised by the high energy consumed to run the smart city and adopted low energy emissions, as discussed above.

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