Exploring sustainable smart cities from the Middle East and North Africa perspective

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Exploring sustainable smart cities from the Middle East and North Africa Perspective

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Summary

It is anticipated that the growth pattern of the populace in urban regions will be greater in the first thirty years of the 21st century in comparison to the accumulative urban development patterns seen in previous data gathered from around the world. The Middle East and North Africa (MENA) is the region that constitutes developing countries. Most are rapidly urbanizing populations expected to get doubled by the end of 2030. Although many of the major countries in the Middle East like, Abu Dhabi, Dubai, Saudi Arabia, Qatar, etc., are becoming aware of their rapidly coupling populace, both natives and expatriates, and are shifting towards technology and competitiveness paving their way forward in streamlining their future potential to facilitate sustainability through digitalization. This will help in laying out a baseline development framework for other urban countries in MENA region for transformation into smart cities utilizing the successful models as guidelines for moving towards smartness. This study aimed to understand the key elements of successful smart city initiatives in the Middle East and North Africa (MENA) as a sample to explore various factors challenges and strategies in planning out smart cities in the MENA region. The study used two-fold methodology of Systematic Literature Review (SLR) and Case studies in achieve the research goals. The study outlined key elements of technological advancement, Infrastructure development, Education and Expertise, Internet of Things (IoT) and Smart Economy alternatives for transformation to Smart City. The study discussed strategies of Research, Innovation, Policy and Decision-making, Urban design, Technology and adeptness of the model according to the region as centric to the planning of smart cities.

Keywords: competitive advantage, cities, digitalization, IoT, MENA, smart, strategies.

Word count: 8244

Track: Organisational Transformation Change and Development

Introduction

Since the early 21st century there is an unprecedented increase in the number of populations in urban areas than that in rural areas, compared with the previous century (Cobbinah et al. 2015).

The rate of population growth is snowballing after the era of the Industrial Revolution (Kaba, 2020; United Nations Population Division, 2018). Such instantaneous urbanization is a global marvel. Based on an analysis of current estimations, United Nations has prophesied that by the end of 2030, the urban populace living in urban areas will be doubled to about 60% throughout the world, specifically in the developing nations of Asia, Africa, and Latin America. And the numbers are foretold to have climbed up to about 66% by the end of 2050 (United Nations, 2014). Glancing at the expected rate of such rapid jumps in the expansion of the rate with which development occurs worldwide highlights that the population living in developing countries and low-income will meet the higher numbers of urbanization much faster in comparison to the higher income countries in the developed world (Cobbinah et al. 2015). In the context of recently estimated trends, it is anticipated that the growth pattern of the populace in urban regions will be greater in the first thirty years of the 21st century in comparison to the accumulative urban development patterns seen in previous data gathered from around the world (WHO, 2016).

According to researchers, there is a direct connection between urban population growth and the environmental health of urban areas (Arfanuzzaman and Dhahia, 2017). Because 50% of the world's population lives in urban areas, cities are crucial in influencing climate change (Jennifer, 2019). The high percentage of people living in cities puts stress on the climate there and is a major contributor to greenhouse gas emissions due to artificial interferences in the natural environment for sustaining living costs (Hurlimann et al., 2021; Uniyal et al., 2020). About 60 to 80% of urban GDP requires energy consumption of some kind leading to strenuous environmental pressures in terms of pollutant emissions and carbon footprint altering the air quality (Taleghani, 2022). It is evident that population growth, industrialization, and technological advancements have overly exploited natural resources leading to irreparable environmental challenges by stimulating excessive pollutant emissions and aggravating climate change (Armeanu et al, 2021; Wang et al, 2018; Li and Lin, 2015). Through the direct impact of extreme weather, flooding, heat waves, and the rising of sea levels, the effects of climate change are increasingly being felt in cities (Hurlimann et al., 2021). Urban regions of countries subsidize approximately 70% of the total globalized use of energy and emissions of greenhouse gases (GHGs), but on the other hand, it subjugates to only 5% of the total plain area of the Earth (Sodiq et al, 2019). Such astounding patterns are supplemented by an exceptionally unparalleled rise in the various water needs, demands for land and construction materials, food security, controlling measures of pollution, and management of waste (Uniyal et al., 2020).

Humans are deemed as the poles of cities worldwide. The humanistic core of developmental structures identifies cities as determiners of personal satisfaction that impacts entities and establishments (Cocchia, 2014). Therefore, satisfying these human-centric needs requires empowering cities as such that they are not only permitting sustainability but also exceptional knowledge and progressive innovation to offer improvements and increase the value of living environments for civilians, companies, communities, and society along with the factor of preserving nature (Campbell, 2012). Consequently, cities can be viewed as organized connotations that show the multidimensional inter-connections achieved by implementing a strategic approach and vision of digitalization in the form of a *smart city*, a universal agenda for sustainably transforming the existing or newly formed civilizations altering the future of urban areas with technical advancements (Barlow and Levy-Bencheton, 2018; Angelidou, 2015). The aforementioned range of pressures is the primary cause of motivation for transforming the cities to shift towards smart solutions and experimenting with the several

application strategies of smart infrastructure. The research suggests that such transformation of urbanized cities into smart cities is essential for the provision of improved quality of services, promotion of the competitive nature of the local economic situation, improvement in the delivery of services, increases in the efficacy and minimization of costs, maximizing adeptness and productivity as well as addressing the issues of gridlocking and environmental sustainability (Sodiq et al., 2019; Barlow and Levy-Bencheton, 2018).

The conceptualization of smart and sustainable cities is an inclusive term for the development, support, and management of cities in a way that facilitates the protection of environmental, societal, and economic quotients with the help of digitalization through newer technology and innovative solutions (Doherty, 2014; Lazaroiu and Roscia, 2012). A smart city is a modernized concept that addresses the advancement of an urban area that utilizes the knowledge of digitalized techniques for the engineering and development of a city's framework in order to improve the economic and societal circumstances of its residents through the provision of accessible and manageable services (Rassia and Pardalos, 2014). Smart cities work on the principle of viewing human capital as an indicator of biological and social systems that utilize and undertake concepts of newer technologies of information and communication (ICTs) to incorporate them from various services and developmental infrastructures into individual entities as well as companies and organizations (Marsal-Llacuna and Segal, 2016). This is done by modifying the existing systems into advanced ones or building new ones from scratch, such as economic booms, cultural diversity, societal growth, and expansion of urban areas. Contrariwise, Caird and Hallett (2019) argued that the development of the smart city is primarily a multi-disciplinary venture rather than focusing on just a technological solution for urbanization challenges. Serbanica and Constantin (2017) argued that "countries and regions should identify and select a limited set of priority areas for knowledge-based investments, focusing on their strengths and competitive advantages". Nevertheless, the transformation of urban regions to smart cities by effective policy planning to adapt every aspect of digitization is necessary for the sustainable development of cities that could meet the goal of zero carbon footprint by 2030 (Pietrapertosa et al., 2019).

The goal of this research study is to understand the current frameworks of successful initiatives in the Middle East and North Africa (MENA) and around the world as a sample to explore various factors and elements employed in planning sustainable developmental strategies for transforming urbanized cities to smart cities in the MENA region. The study utilizes a systematic literature review to understand the key strategies and challenges in the successful planning and decision-making for digitized transformation into the smart city.

Rationale for the study

The Middle East and North Africa (MENA) is the region that constitutes developing countries (Ringel, 2021). Most are rapidly urbanizing populations expected to get doubled by the end of 2030 (United Nations, 2014; WHO, 2015). MENA (Middle East-North Africa) region has especial importance in global energy system in relation to comprising of the number of major oil-producing countries (Borghesi and Ticci, 2019) (Figure 1). Based on energy policy the countries in the MENA region can be widely categorized as: 1. Oil-exporting and labor-importing countries (Bahrain, Kuwait, Oman, Saudi Arabia, Qatar and United Arab Emirates) that rely on about 30% of expatriates as labors to meet domestic needs; 2. Countries that are oil-exporters and labor-abundant (Algeria, Libya, Syria, Iraq, Iran and Yemen); 3. Net oil-importers and labor-abundant (Morocco, Tunisia, Egypt, Jordan and Lebanon).

As nations' fiscal demands majorly depend on oil, there is a prevalent risk of economic volatility, which along with the political instability has been hindering the development of efficient energy policies in the region (Griffiths, 2017; Saxena et al. 2018). Although many of the major countries in the Middle East are becoming aware of their rapidly coupling populace, i.e., Abu Dhabi, Dubai, Qatar, etc., which not only consists of natives but also foreign expatriates, the evidences of shift towards technology and competitiveness of being a benchmark of standardized culture and science mix has been witnessed only in economic centers. Other MENA countries that are at the verge of political instabilities and struggling to sustain like Syria, Yemen, and Libya, have been prone to social or political unrest which has made them hesitant in strategizing their approach towards digitalizing and not relying on natural fuels to avoid unrest (Abumoghli and Goncalves, 2021). Therefore, the vulnerability of the region is coupled with the globally volatile energy prices, cost-competitiveness, relations with the neighbors and policies driven towards the west (Griffiths, 2017).

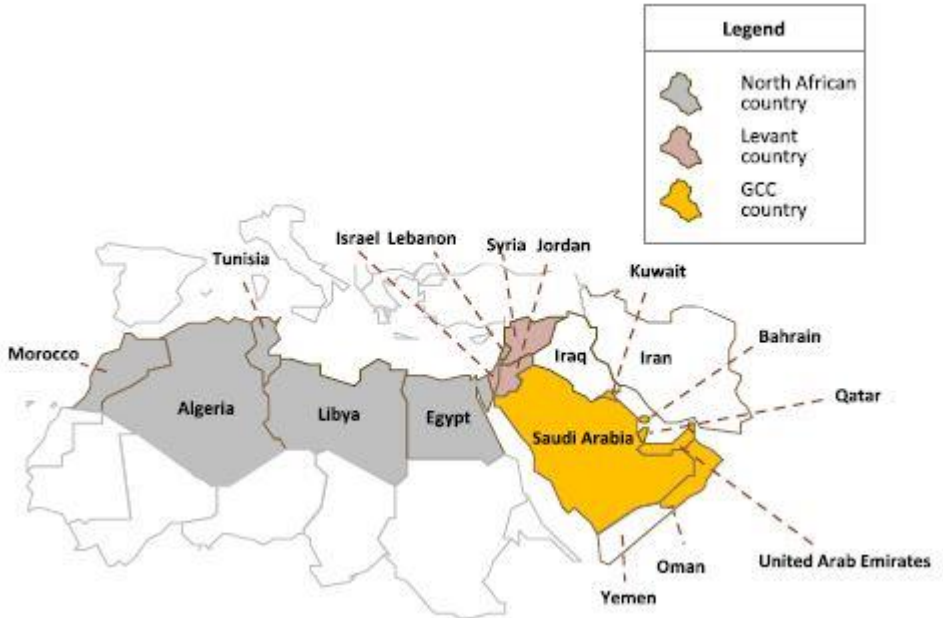

Figure 1- Countries included in MENA region (World Bank)

Smart cities are largely represented as the thoughtful urban development of infrastructure and services utilizing the digital and ICT tools in such a way that provides the optimization of technological, environmental, and living standards of nations meanwhile achieving the targets of sustainable development goals (Trindade et al. 2017; Jong et al., 2015). In order to envision the adoption of Smart cities in MENA region it is important to take into account their social, economic and political circumstances in addition to the energy policies of the countries that play the essential role in stabilizing or faltering the sustainability of urban developmental goals (Elamir, et al., 2020; Griffiths, 2017). Moreover, the data from the World Bank further presses the need of smart development to sustain the growth potential (World Bank, 2023). The major determiners for this shift include redirecting national economies from depending on fuel to alternative resources. The revaluation of this goal would result in elemental changes in employment and educational opportunities. Secondly, accommodating the expatriates in labor-importing countries would help in retaining their labor forces. Third, making the more secure countries of the MENA region the ideal for stability in war-inflicted zones. Fourth, the desire for change by the educated youth has paved the way for the national smart cities mission in the MENA region (Friesen and Ringel, 2022; Elamir et al., 2021; Doherty, 2014).

The successful initiatives by some MENA countries like Abu Dhabi, Dubai, Saudi Arabia, Qatar, etc., to pave their way forward in streamlining their future potential to facilitate sustainability through digitalization can help in laying out a baseline framework for the adoption of the guidelines for moving towards smartness. Although many parts of the regions have been dependent on hydrocarbon, the new dynamic towards smart cities has initiated a wave of diving into new clean energy technologies over many major epicenters in the Middle East like Abu Dhabi, Dubai, Jeddah, Doha, etc, by developing the system of smart grids (Al-Nasrawi, 2018; Ibrahim et al. 2015).

Many other smart initiatives in MENA region include SQP in Qatar through TASMU and an application of 'one-stop shop' in United Arab Emirates (UAE) for smart inclusion and governmental techniques (Doherty, 2014). In North Africa, Morocco has taken its initiative by hosting the first smart city summit internationally in order to bring the policy makers and research organizations from around the world on the same table to plan the accessible and manageable strategies and scenarios in Africa (Khabara, 2014). Other MENA countries are also planning and prioritizing for formulating new strategies for technological advancements in infrastructures as well as other core sectors (Saxena and Al-Tamimi, 2018). Therefore, this research focuses on utilizing the analysis of existing policies, developmental frameworks and research literature to answer the research questions of the proposed study.

Research Questions

- What are the key elements employed in planning out strategies for the adoption of smart city in MENA region for competitive advantage?
- What are the potential synergies for successful transformation of MENA urban areas into smart cities?
- What is the importance of urban planning in Smart city transformation?
- What is the role of policy and decision-making in planning Smart city?

Research Methodology

The aim of the present study is to find out the key elements that are employed in carrying out the successful transformation of urban cities in MENA region to the smart city by analysing the developmental strategies proposed by published literature and comprehending the case studies of successful smart city models from around the world and MENA region as well. The goal of the current study was to effectively analyse preliminary data using the exploratory research methodology (Bouchrika, 2020; Zhou, Liu, and Chen, 2021). The methodology was designed to incorporate Systematic Literature Review (SLR) to review relevant literature as well as analysis of the case studies of successful models of smart city. SLRs encompass a wide variety of material in connection to addressing a specific issue by generating a list of criteria for material to research, helping to avoid any type of bias (Xiao and Watson, 2019). This two-fold method will aid in identifying research gaps and areas of ambiguity within the chosen field and rule out any invalidity arising from a single method (Essa and Khalil, 2021). Despite the initial hypothesis, the methodology was conducted to find out the answers to the research questions that will help in prospective studies. The list of stages in conducting SLR include:
(1) the research questions were produced
(2) research criteria were produced with inclusion and exclusion data
(3) key terms were identified
(4) a qualitative analysis of literature and case studies with the specified criteria were produced
(5) the findings were outlined and related back to the research questions.

The process of gathering the necessary data from reliable sources and assembling it is known as data collection (Xu et al., 2020). The databases used for the literature search were ABI/INFORM EBSCOhost, Global, ICE Virtual Library, ProQuest, ScienceDirect and Scopus. Selecting research that are especially concerned with "adoption of smart cities strategies for competitive advantage " was crucial. The research projects that were of the highest calibre, had a robust study design, and produced valid findings or strategies were employed (Lefebvre et al., 2019). The outcomes of this systematic review will be of greater assurance as it focused on studies with credible methods and reliable findings. Materials are also of reasonable timeline, with a preference given to the most recent studies published since 2015 to elude any outdated knowledge. The research material was selected on the bases of inclusion and exclusion criteria in a systematic manner as shown in Figure 2. Initially the sample size of 30 research papers was collected. After the first round of exclusion, the sample size was reduced to 25, which was further reduced to 20 research papers based on the inclusion and exclusion criteria that were used for this system literature review as shown in Table 1.

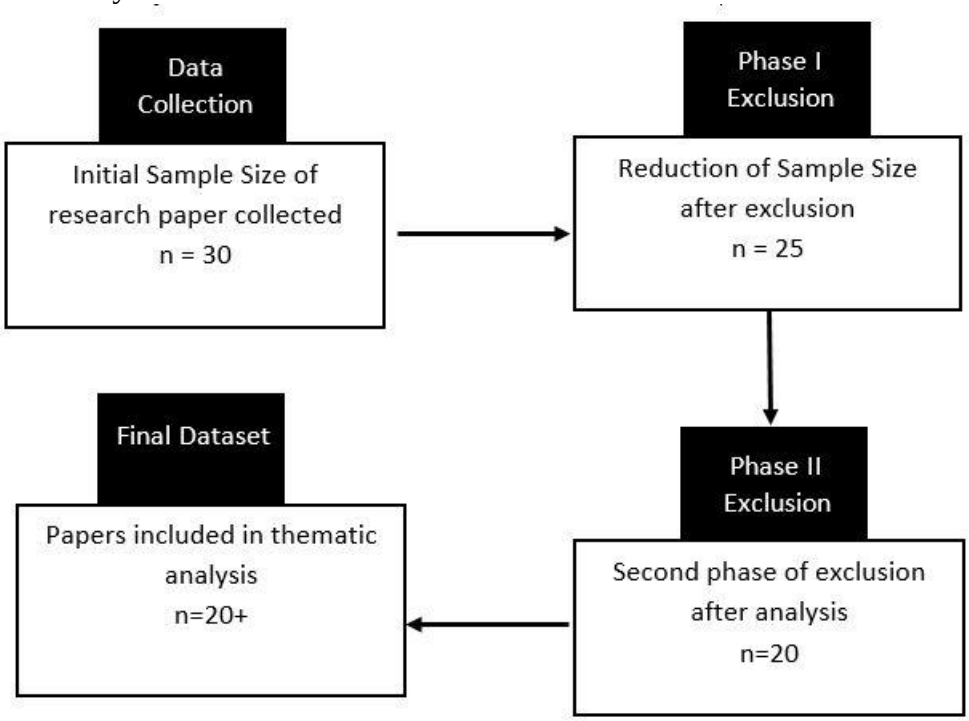

Figure 2- Schematic view of thematic analysis

Table 1: Inclusion and exclusion criteria

	Inclusion Criteria	**Exclusion Criteria**
Focus	Studies must be related to factors and elements that are employed in planning out strategies for adoption of smart city for competitive advantage	Studies not related to factors and elements that are employed in planning out strategies for adoption of smart city for competitive advantage
Language	Studies must have been published in English	Studies published in languages other than English.
Peer-Reviewed	Studies must be peer-reviewed articles from credible journals.	Studies that are not peer-reviewed.
Date	Studies must be Published in or later than 2015	Studies that are earlier than 2015.
Region	International	----

The following key terms were used in the search in order to narrow the search criteria: "Intelligent *" OR "smart cities*" OR "city*" OR "urban*" AND "investigating*" OR "investigation*" AND "adoption*" AND "strategies*" OR "strategy" AND "competitive*" AND "benefit*" OR "advantage*"AND/OR "MENA*" OR "middle east*". The timeframe for the search is shown in Table 2.

Table 2: Timeframe of searches

Time (weeks)	Stages
1	Planning and designing a research framework
2	Finding relevant studies
1	Evaluation of search criteria
2	Analysis of findings leading to a review of the literature
1	Conclusion

Table ***3*** outline the papers in review that were used to answer the research question.

Table 3: Extraction of Data

Author	Document type	Information	Region
Angelidou, 2014	Journal	This paper explains the efforts being made to use digital technologies to build "smart cities" globally. Case studies of smart city strategies from around the world are illustrated. It outlines various strategic decision's benefits and disadvantages.	Malta
Anthopoulos, and Vakali, 2012	Journal Article	This paper reviews the used smart city and urban planning interrelationship and finds the meeting points between them.	Germany
Boyle, and Staines, 2019	Report	A study on how African cities are beginning to explore smart city concept of management and coordination in governance of large cities as a way of tackling the rapid urbanisation	South Africa
Buhnova et al., 2022	Journal Article	This paper compares smart city domains such as smart mobility and/or smart urban planning in delivering smart city services. The results Identify the similarities and differences between each domain and potential smart service interfaces for each smart city domain across various smart city sectors.	Czech Republic
Ibrahim, Adams, and El-Zaart, 2015.	Journal Article	This a paper on study of existing Smart Sustainable Cities (SSC) transformation frameworks and examples of SSC initiatives to better explain the difficulties in implementing effective SSC projects throughout the Arab world.	Brazil
Jong et al., 2015	Journal Article	This paper used qualitative analysis to investigated policies of city in focus of twelve most developed city. The findings point on the implications for regeneration policy and practice.	International
Shokeir, and Yahia, 2020	Journal Article	This a qualitative study on aspect of smart cities initiatives in MENA region, with key focus on	UK

		digitalisation and internet of things. The results of the interview suggest three stages to putting a smart city into action: foundation, convergence, and transformation.	
Ringel, 2021	Journal Article		Germany
Kim, Sabri, and Kent, 2021	Book	A case studies on innovation and technology for smart city initiatives. The findings show the experience of large cities implementation of smart city concepts	International
Trindade, 2017	Journal Article	This study conducted a systematic review into concepts of smart city and environmental sustainability	International
Virtudes, 2017	Article	A study on how decision makers help implemented the concept of smart city such as the application of information and communication technologies (ICT)	Dubai
Woetzel et al., 2018	Journal Article	A paper on used of Big Data in smart cities management. The findings show how used of modern technologies can bring more liveable future	US
Zhou et al., 2015	Journal	A comparison study into low carbon smart cities	China
Yigitcanlar and Lee, 2014	Journal Article	A study on how u-eco-city can be smart and sustainable urban and bring high quality of life to its residents and visitors with minimum negative impacts on the natural environment	South Korea

Case studies in Europe

Amsterdam

Amsterdam Smart city has been regarded as one of the most successful initiatives of smart cities in Europe (Chief Digital Officer Club, 2014). The initiatives chief focus was testing out the results on smaller scale followed by adoption on the large scale. Two of the fundamental projects tested out on smaller scale were, first, converting a famous shopping street "Utrechtsestraat" to Climate Street (smart meters, energy displays and smart lightings) from 2009-2011 for observing commercial energy efficiency (Sauer, 2012); and the second, the West Orange Project to test out residential energy efficiency by providing alternative energy sources (digital gas and energy meters) to 400 households. The results showed approximately 18% of energy saving in commercial and at least 14% energy saving in residential project along with consecutive CO_2 emission reduction (Amsterdam Smart City, 2013).

Malta

Adoption of "Smart Island Strategy" (2008-2010) by the Governemnt of Malta to incorporate the ICT solutions to construct an economy base on knowledge and therefore, stirring new opportunities for employment. The five chief strategies inculcated in the policy includes a) aligning the country's research and innovation strategy with the EU Commissions' 2010 Action Plan b) Creation of technology parks (township of Smart city Malta) for hosting international ICT media c) willingness to adopt 360-degree approach in realizing a wider society of innovation d) integrating the system prone to learning and adopting global new best practices with time e) letting the country's own experience and results be the driver of Smart city approach (Ministry for Infrastructure Transport, 2008). The successive research and innovation strategies of smart specialization (RIS3) 2014-2020 and existing reinforcement of new policies for the programming period of 2021-2027 is focused to continue promoting the smart makeover of socio-economic and innovation policies among the European countries (Malta Council for Science and Technology, 2020).

Moscow

Moscow's shift towards Intelligent Transport System was the result of traffic congestion in 2011. The government actively devised a plan to implement traffic monitoring by utilizing the data insights of real-time disruptions along with incorporating traffic detectors, and modernizing bus services. The heavy investments in technical advancements of public transports have borne fruit in positively impacting the gridlocked transport system by the government of Moscow in order to recuperate the worst traffic disruptions to becoming global leader in mobility (Moscow Deputy Mayor of Transport, 2018).. For instance, installation of facial recognition to identify criminals, closed routs and real-time information about timings of arrivals have positively impacted in shifting driving trends in public to opting for public transits (1.9 Billion in 2010 to 2.8 billion in 2017). The government is now taking active implementations in sustaining the smart traffic model by continuous feedback mechanism from public and analytics from transportation data (McKinsey Global Report, 2018).

Successful Business Models in MENA region

Abu Dhabi – Masdar City

In the capital city of Emirates, Abu Dhabi, Masdar City is a master-planned intelligent initiative built to meet the nation's sustainability goals of 2050. The state of the art city is constructed from inception with the goal of obtaining carbon efficiency by minimizing energy and material usage. The city's innovation lies in the entire dependence of the project on renewable energy, smart buildings, utilizing Internet of Technology (IoT) in the functioning of entire city. Abu Dhabi's Urban Planning Council built the pearl rating system to assess the adherence of smart buildings and digitalized planning. The city provides a successful business model in the Middle East and North America (MENA) region by providing an investment zone that is based on absolute environmental-friendly policies to enable high-performance, low carbon buildings. The city is targeted to facilitate its 40,000 residents with provisions of renewable energy that is powered solely by the 10MW solar and wind power projects based on the speed dynamics of wind (Shankaran and Chopra, 2020).

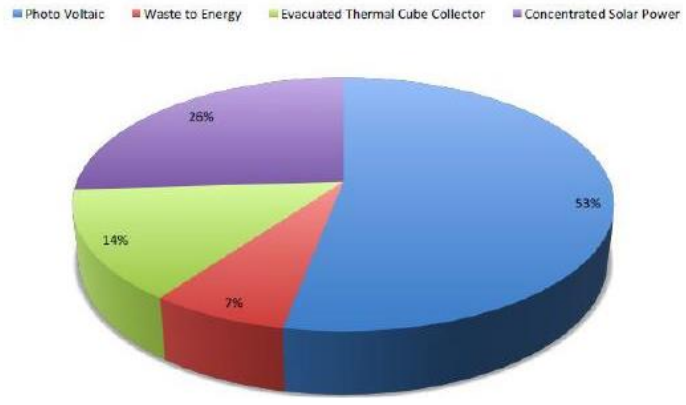

Figure 1 – Energy sources in Masdar city mainly utilizing Photo Voltaic energy sources.

Along with the utilization of Smart energy resources by minimizing the nation's dependence on oil resources as well as rehabilitating the already damaged image of negatively impacting country, the Masdar city venture has enabled other initiatives of installing parking systems, electric cars efficient use of water consumption facilities, minimizing the waste production by integrating smart recycling and utilizing waste to energy programs. The core element of the

city lies in the Internet of Things (IoT) approach that focuses on smart infrastructure, mobility, institutions, public participation and smart designing that promotes interaction of all key sectors through digitalized mediums (Shokeir and Yahia, 2020).

Dubai Silicone Oasis

Dubai Silicone Oasis is one of the pioneer projects initiated in 2004 which was a free zone initiative that allowed significant incentives to the companies operating within the region. The success of the project will be the key definitive factor for paving the pathway for Dubai's move towards the "Smart" global hub. The developmental elements of the project focus on the economic features, transit systems, government and policies, environment, population lifestyle and the dependence on ICT aspects. Towards the end of 2013, Dubai's governing leader Sheikh Mohammed bin Rashid Al Maktoum announced his plan of converting Dubai into the hub of Smart projects including urban rail system, a new airport, oasis project along with 100 more ventures (Doherty, 2018). DSOA initiated its first smart city project in 2014, the Silicon Park, worth $299 million, that is comprised of large area destined for office space, retail and economic area and over 2 million square feet for the residential area. The Smart City is planned to have Electric-powered vehicles and smart rechargeable bikes will be the primary means of transportation and advanced parking areas all over Silicon Park. The IoT technology is planned to be widely available such as stations for charging smart vehicles, along with free broadband Wi-Fi and charging stations for personal devices (Virtudes et al. 2017). These developmental milestones embedded in the initiatives like Silicon Park are raising the level of competitiveness for what it means to shape an intelligent environment that enables maximization of comfort and well-being of its citizens, tourists, labor and expatriates. Therefore, Silicon Park provides the best example of Smart City strategies and mechanisms that makes it the model for future Smart Cities throughout the Middle East North Africa (MENA) region and a bench-mark worldwide.

Kingdom City and Kingdom Tower

In the north of Jeddah, the construction of the iconic Kingdom Tower is under process. The towers are regarded as one of its kind entities that will incorporate fundamentals of Smart City into a Smart Building form. The tower will have 200 floors and require about 5.7 million square feet of concrete and 80,000 tons of steel. It will host mixed-use commercial, residential and resort facilities, including offices, residential units, a school, hotels and retail facilities. Both Kingdom City and Kingdom Tower can be viewed as two cities in one location; one is vertical, and the other is horizontal, but both are designed to be Smart Cities. These ventures are destined to serve the functions of smart cities incorporating all aspects of ICT that will ensure Communications, insights into data, coping with life safety and security by enabling crime identification and mitigation, providing as the hub of ecommerce, and utilizing the power of IoT by utilizing social media and a various other Kingdom Tower apps that will enable the functionality of tower more like a computational masterpiece that provides holistic lifestyle points, as the towers are meant for its residents to carry out their routine lifestyle activities within the vertical smart city (Doherty, 2018).

Lusail city

In Qatar, many private real estate developers have been working on the most notable projects such as Lusail City, Msheireb, Barwa City, Energy City Qatar, and Pearl Qatar. Lusail City is located on over 35 km2 and hosts approximately up to 450,000 people. One of the efficient and sustainable experiences that the city will provide is the fibre-optic network infrastructure which connects the residents with many smart services, such as intelligent transport systems,

deployment of the internet in public areas, video surveillance, and more. One project of an intelligent transportation system will provide solutions for traffic management, logistics management, road safety, and public services.

Other MENA Initiatives

Morocco is taking a stance for some key improvements in the deployment of strategies to achieve cleaner energy, advanced urban layout, enhancing its agricultural resource planning, coping with water security and modernizing transportation dynamics. The Moroccan government has decided to initiate smart cities agenda by conducting its first international summit on relatively smaller cities in North Africa, held in Ifrane, the government has been pushing policies to help in decentralization of energy and policy systems as well as facilitate the digitalization of governance to incorporate the aspects of public inclusion.

The city of Casablanca has decided in investing about 94 million dirhams (which accounts for more than €8 million) in its digitalization of services by 2022 (El-Hefnawi, 2016). This budget will fund 70 projects, including four currently under process. These include the formulation of a system that provides information about taxation, the development of a comprehensive pattern of geographical information system (GIS), digitalizing of the certification system and the acquisition of Customer Relationship Management (CRM) in terms of citizenship. To improve access to information in the city, the municipality established a platform called 'Casa Urban Data', which allows the unified distribution of data about transit services between local government and citizens aiming for inclusion at governmental level (Shokeir and yahia, 2020). In Tunisia, the National Strategic Plan 'Digital Tunisia 2020' was initiated in order to position Tunisia as an international reference for nation's digital transformation and to promote the concept of technical/Smart infrastructure aligned with the modernization of economy. In 2018, Tunisia became a pioneer among the MENA region by launching the first national caravan that was dedicated to the smart city. The travelling event was co-ordinated in between twenty four Tunisian cities, with the main objective of breaking down the wide hesitation and myths relating to the approach of smart cities and raise awareness campaign of this little-known concept and issues related to it. Furthermore, the Tunisia city of Bizerte sits in list of the top four smart and sustainable cities in the world. The city of Bizerte launched an innovative project called 'Punic Counter to Digital Port' that aimed to connect Europe and Africa by using the submarine fiber-optic cable and contribute to the emergence of smart and sustainable cities in Africa.

Results and Discussion

In this age of rapid urbanization, cities are continuously antagonized with the pressures overarching the challenges of socio-economic, technological as well as political evolution. Significant environmental as well as socio-economic factors have significantly affected societies on a global scale since last two decades. Several metropolitan areas have been focusing on improving their urbanization patterns and services by administering various initiatives that could improve the cities' aesthetic layout along with meeting the requirements of sustainable infrastructure and economies (Jong et al. 2015). Consequently, the former concept of intelligent cities (Komninos, 2002) has evolved to smart cities (Trindade et al. 2017). Nevertheless, the achievement of such targets can be attained by multi-dimensional articulation of sustainable policies reiterating the works of urban planning relating to infrastructure, waste management, technological and energy distribution, and utilization (Stratigea et al., 2017). The growing social concerns have pressed the need of advanced research and rather aggressive implementation of smart city adoption in the existing or newly

built infrastructures. The new ventures take into account an array of analytical approaches to comprehend the previous literature considering the backdrop of geographical limitations.

Smart cities are majorly focused on managing civic engagement by incorporating the tools of digitalization in order to optimize the value chain from transport to health facilities. Thus, the major goal is catered to the requirements, desires and needs of the citizens in a more efficient and dynamic manner (Stratigea et al. 2017, Townsend, 2013, and Deakin and Al Waer, 2012). Many researchers have reported their results regarding investigations of different frameworks in adopting smart cities. Yigitcanlar and Dizdaroglu, (2015) have focused on inculcating the factors of use of natural resources and awareness of environment in the urban developmental layout called as "ecological cities". Yigitcanlar and Lee, (2014) reported on the Korean smart city model that focuses on utilizing digital tools of Information, Communication and Technology (ICT) and eco-technology to introduce less environmental impacting methods for urban planning and architecture. Lazaroiu and Roscia (2012) gave the model of formulating logically driven indices to evaluate discuss best feasible option for adopting smart city policy at decision- maker as well as citizen level. Among all of the previous literature skimmed, prominent conclusions have recommended on proposing models and frameworks for the formulation of policies, governance methods and optimizing urban infrastructure in response to the natural environment as pivotal to the realization of a smart city (Marsal-Llacua and Segal, 2016; Zhou et al. 2015; Cohen and Amoros, 2014).

Key Elements of Smart City

Since the goal of the smart cities is to incorporate the digitalization tools for sustainable monitoring and application of resources in order to conserve the environmental characteristics, the key drivers that influence the nations' adoption towards the goals of smart city are significantly determined by its social, economic, political and energy policies. Elamir et al. 2020 conducted his study spanning on six years for 2012 to 2018 based on 13 MENA countries in order to report the key drivers of smart cities in MENA region as based on technology, infrastructure, health and education, economic reasons and innovation (Elamir et al. 2020).

Technological Advancement

The readiness of a region to embrace technological progressions embarks the foremost driver of the global shift towards smart cities. Caragliu et al. (2011) reported while scrutinizing previous literature that only "soft-infrastructure" and dependence on knowledge- driven and skilled workers cannot boost urban growth trends but the smart cities require high-technology and creative industrial framework to realize. Virtudes et al. (2017) argued that "smart infrastructures" are the backbone of an urbanized city. He defined the digital framework of such infrastructure to be primarily based on Wifi, ICT devices (wireless hotspots, computers, sensory technology, smartphones, and networking) and other data basics. Angelidou et al. (2014) scrutinized the literature in reporting "hard Infrastructure" as utilization of technology in instrumentation of city's infrastructure can help to present the technical solutions in managing smart cities. In an international report on intertwined role of technology and urban development led by Woetzel et al., (2018), the resultant ideas suggested that smart technologies handle the smart cities using data. The insights of such data can enable individuals and companies to make better decisions in city's performance as well as planning for the future (Woetzel et al. 2018). Buhnova et al. (2022) recounted the common goal of technological readiness after their qualitative study as the provision of services facilitating the interaction and participation of citizens meanwhile reducing environmental impacts.

Infrastructure development

The infrastructure development is the main enabler of the smart city ideology. Angelidou et al. (2014) reported that a smart city adoption greatly depends on the capability of an existing city or the one planned at inception to integrate the physical design and development of infrastructure building incorporating the technical edge. The infrastructure can be determined by either the soft infrastructure or hard infrastructure (Elamir et al. 2020 and Angelidou et al. 2014). Hard infrastructure involves the physical structures, tangible resources and sectors that influence substantial economy and societal aspects, while soft infrastructure deals with more of the non-tangible and knowledge based accounts of society. Managing the smartness of infrastructure and adequacy of services can enable smart living standards leading to sustainability (Abtar, 2014 and Kirwan and Dobrey, 2022).

Education and Internet of Things

Education and awareness of the digitalization of cities is a major factor in increasing the quality of people's lives by the IoT and ICT incorporation (Angelidou et al. 2014). The utilization of public participation is central to the success of a smart venture and therefore the incorporation of inclusion of citizen interaction with government in policymaking calls for the increase in the efficient skills of individuals as well as their level of realization for smart approach (Elamir et al. 2019). In fact, education can play an essential role in achieving people's economic prosperity. It creates a positive impact on people's lives and provides them with employment opportunities and higher income. Therefore, its presence in the smart cities is crucial (Aditya, 2016). As well, smart cities seek to provide high quality health services by facilitation of technical advancement, a clean environment and green spaces. Conventz et al. (2015) suggests that the major driver playing the central idea in developing smart urban units is the knowledge pyramid which reinforces the hand in hand utilization of both implicit and explicit information as a successful business strategy by propping the case study of knowledge-based companies in Doha.

Smart Economy

The Smart Economy aims at providing the commonwealth for the equal distribution of resources across city. Major smart economy trends call for a shift to digital currency for monetary alternatives as well as transactional alternatives (e.g., Cryptocurrency, Tokenization, Blockchain, and Holochain) and convergence of many decentralized networks that result in the factors of inclusivity, sustainability, corporate social responsibility as well as societal wellbeing (Kirwan and Dobrey, 2022). The goal of achieving Smart Health and Economy lies with the inter-dimensional resource management by utilizing strategies of clean energy, facilitating sustainability quotients, and green structures. The main idea of Angelidou et al, (2014) suggests that for the nations to become smart it is important to focus on cultivating their economies. Abtar et al. (2014) focuses that creating new markets and expansion of competitiveness can open new doors to overcome the economic challenges faced by a nation. Angelidou et al., (2014) suggests that innovation is the core of planning a smart city. However, they point out that managing the innovation at local levels can be more effective in integration rather than that on the national level.

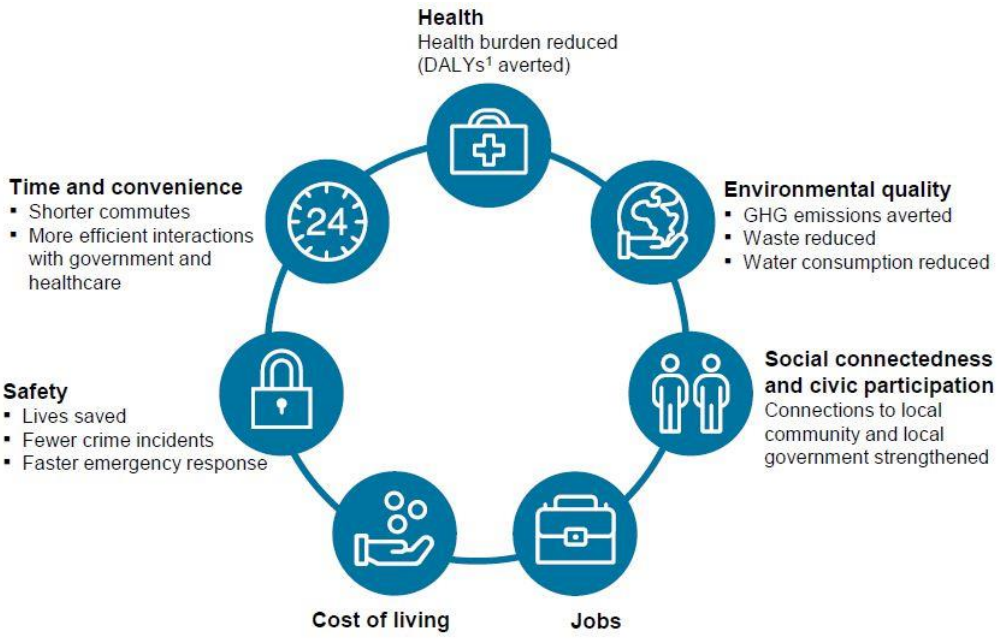

*Figure 2 – Positive indicators of various quality of life measures improved by Smart City application *Source: McKinsey Global Report, 2018, [1]Disability-Adjusted Life Years.*

Challenges and barriers

Urban administration has been central to the transformational approaches utilized for urban planning. Gibbs, Krueger, and MacLeod (2013) visualized the construction of smart city from the standpoint of urban administration. They emphasized that planning an urban layout for construction of smart city is strongly influenced by the existing policies of economic growth and political stability along with societal influences and readiness for adopting environmental sustainability. Some researchers have visualized regionalism at the core of the success of adoption of smart city (Herrschel, 2013). The policy-making and decision making are vital to the process of making the cities smarter, which can be seen in the cases of Vancouver and Seattle. Angelidou et al. 2014 realized that the major barrier in the cities' urban layout planning might be posed because of the misconception of ignoring cities' personalized needs and generalizing the challenges and barrier proffered for smart planning.

Transit system

Transit system can serve as key element in making a smart city successful venture. For example, Moscow has paved its way to the top of mobility hubs by utilizing the fundamentals of smart cities via incorporation of policies tailored specifically to deal with transportation disruptions and enabling smart strategies by it "Intelligent Transit Strategy" (Moscow deputy Mayor of Transport, 2018). Intelligent syncing of traffic signals, in order to prevent backups at intersections; Real-time navigation alerts drivers against accident warnings, disruptions and congestion alerts and helps them choose the fastest route. Many sustainable apps like Uber and Airbnb are working up the routes on a fast track. Smart parking apps can point the drivers directly to available spots ehich will help to eliminate spare time spent circling around the city blocks (McKinsey Global Report, 2018). Moreover, utilizing face detection system, digitalized arrival of transport, moderninzing the public transit system to alternate personal cars can help in easing out worst gridlocks. However, Angelidou et al, (2014) focuses on the barrier professed by integrating a city's existing transportation and infrastructure layout with the new smart city layout is difficult to realize, unless a new city is being made from conception phase.

Waste Collection

Digitalizing waste collection, sorting and end use is the prominent element of many municipality trends in the successful smart cities. Digital tracking and payment for waste disposal can serve as key enabler cities to charge households for the exact weight and type of trash they throw away. (McKinsey Report, 2018). For instance, in Songdo the circulation of garbage trucks is eliminated by sucking waste from households through a mesh of tunnels (Angelidou et al., 2014). Although these successful instances can be seen in the sustainably development societies, the major barrier to the smart cities adoption in terms of waste management is improper handling of municipality. Waste is serving as the prominent background problem for many countries worldwide. There is a comparatively a very low local landfill space, due to which many big cities such as New York pay to ship their garbage elsewhere called as trading in wastes. Nevertheless, after the implementation of reduction techniques have come to its limit the digitalization can come to play.

Sustainable Energy Distribution

Abtar et al. (2014) reviewed that by increasing the potential of energy generation its conservation and refurbishing technologies that can redeem energy expenses more efficiently can serve as the key element in making the smart city initiative successful. Collaco et al., (2016) observed while analyzing the focus of Sao Paulo's energy conservation strategies in Latin American region that energy distribution needs to be an integral part of policies relating to urban planning along with the energy policies and requires close surveillance by the smart governance in order to actualize the sustainable energy goals. Shankaran and Chopra, (2020) analyzed the successful model of Masdar city in Abu Dhabi to be entirely powered by renewable energy in order to achieve the absolute goal of cleaner energy generation, utilization, and distribution. However, Angelidou et al. (2014) regarded the disparity among opportunities as a factor of building entirely new city from scratch and refurbishing old systems to integrate smart mechanisms and dynamics.

Disparity of Expertise

Angelidou et al. (2014) reported the challenges presented by utilizing technically-oriented infrastructure to include the spatial disparity among cities depending on the availability of resources in consumption, distribution, housing, lifestyles, leisure, etc. Furthermore, the lack of trained staff, unequal access and usage of ICT solution and technology not encompassing the people's smartness or knowledge are the alternating barriers frequently discussed in their paper.

Key strategies of successful smart cities

Research and Innovation

Shokeir and Yahia, (2020) reviewed that the designing of smart strategies is most integral part of devising a smart city venture from its inception to success. The adoption of smart strategies to deploy in the new frameworks can be realized by the comprehensive research and innovation teams for scrutinizing the pitfalls in the existing frameworks; however Angelidou et al. (2014) suggested that the biggest recipe for failure of systems lies with the fact of ignoring special disparities and geographical barriers.

Policy-making

The policy-making and decision making are vital to the process of making the cities smarter, which can be seen in the cases of Vancouver and Seattle. Contrarily, Tretter (2013) utilizes the case study of Austin, Texas for citing that the mere digitalization of systems cannot provide

the solution for many of the problems posed by urbanization or to the residents in urban regions but see into the environmental aspects of it.

Technology and Urban Design

Meanwhile, Townsend (2013) presents a unique standpoint in allowing for wide scope in application of strategic approach in the perception of urban civilization while planning for urban design and incorporating ICT technologies. He identified that the global role of rapid urbanization and prevailing support from Ubiquiti technology and discusses its potential to impact future of smart cities.

Knowledge and Skill

By reviewing the case studies of specific cities from different regions like Amman, Barcelona, and Portland and Seattle from the US, he documented the analysis of the functioning and mechanism of utilizing learning and knowledge for the innovation. However, Deakin (2014) gives priority to the concept of innovation in smart cities systems and utilization of competitiveness in the inclusion and governance models to transform the cities into intelligent framework. The study also presses the need for inculcating the knowledge and skill in the process of adoption for smart cities. Similarly, Campbell (2012) also gauges the inception of smart city from the standpoint of incorporating learning in the urban strategies, and ruminate the importance of interdisciplinary relation between the knowledge of theme, innovation as a base, and competitive nature of policies in the success of smart city venture.

Regional Adeptness

Thus, an apt strategy needs to follow socio-economic frameworks of region, citizen requirements, measuring non-tangible determiners of the society. Many successful cases of smart city adoption differ in their strategies, for instance, European and Japanese nations have focused more on transforming into smart energy networks by initiating renewable energy grids. For Japan the technology would be life savior being prone to power shutdown as a result of natural disasters (Tokoro, 2016). Some of the other strategies from successful nations are as follows.

Relationship between urban planning and smart city

Kirwan and Dobrey, (2022) suggested a new theory of Convergent Autopoiesis of Smart cities by collaborating two different theories proposed in the twentieth century, i.e., Convergence (Human, Environment and Digitalization) and Autopoiesis (process of self-production mainly coined for the the behaviors of living systems) (Geyer 1995). Their theory described the relationship between the organizations of urban systems in adopting the smart city as biological systems where success of the smart city can be analogous to the natural environment by mimicking its regulation by digitalization tools to make the integration of such digitalized ventures in a self-regulatory manner. They suggested that utilizing such systems can strengthen the smart models to face the volatile challenges presented by nature, such as climate change, unguided resource depletion, rapid urbanization, and prevalence of diseases as well as social disparities, in a more efficient way (Kirwan and Dobrey, 2022).

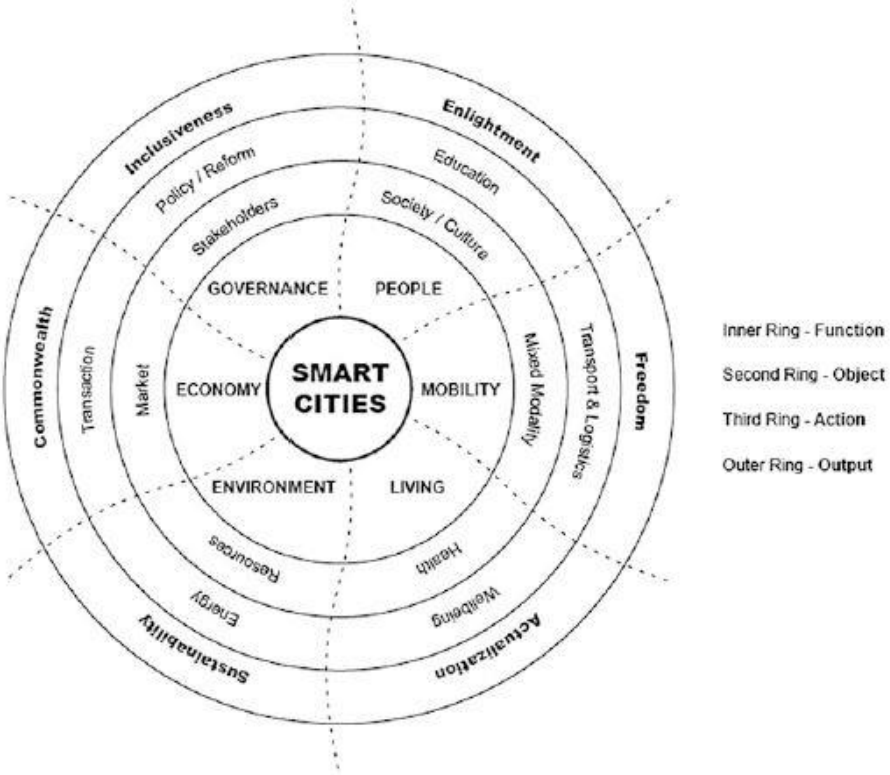

*Figure 3 – Smart city elements, functions and respective outcomes of a self-regulatory plan *Source: Kirwan and Dobrey, 2022*

Role of Policy and Decision-Making

Anthopoulos et al. (2011) suggested that the smart city has to be taken into account in the frameworks planning of regional and urban infrastructures, and the Information and Communication Technology (ICT) should be resourced for information insights, retrieval of data and analyzing it for policy and decision making; while the sustainable and carbon efficient drivers of a smart city should be assessed and evaluated alongside the city planning phase. Many researchers have reported on their models which focus more on devising frameworks that can instill policies; however, less emphasis is seen on strategizing clear choices in mapping out smart cities (Marsal-Llacua and Segal, 2016; Zhou et al. 2015; Cohen and Amoros, 2014; Yigitcanlar and Lee, 2014 and Lazaroiu and Roscia, 2012).

Conclusions and Recommendations

A "smart city" is a modern concept that focuses on the development of urban areas and makes use of digitalized engineering and development techniques to build a city's framework and improve the economic and societal conditions of its citizens by offering manageable and accessible services. In order to incorporate newer technologies of information and communication (ICTs) from various services and developmental infrastructures into individual entities as well as businesses and organisations, smart cities operate on the principle that human capital is a biological and social system indicator. By managing numerous efforts that might enhance the cities' aesthetically pleasing layout in addition to fulfilling the requirements of sustainable infrastructure and economics, several metropolitan regions have been concentrating on improving their urbanisation patterns and services. MENA Region has significant importance due to its socio-economic affluence in the world. Although many economically stable cities in the UAE have transformed into smarter cities like Dubai, Abu Dhabi etc, many MENA cities still lack on urban design and sustainable development due to

various socio-political issues and cause an effect on the overall sustainability as well as global sustenance of the whole region. Therefore, the current study utilized Systematic literature Review and Case study analysis of the successful model from Europe as well as MENA cities to answer the research questions and find out the key elements and strategies required for smart city planning in the MENA region. Research suggested that planning the urban layout of the city is the most common approach undertaken to employ smart engineering strategies of digitalized architecture in building smart infrastructure (Rassia, 2014).

In addition to urban layout, the sustainable development approach is considered to devise technology and renewable energy to transform the existing energy expenditure into a smart utilization of natural resources integrated by digitalized systems is making its headway into the adoption of smart cites. Additionally, literature review focuses on the interdisciplinary investigation of technological and social issues hindering the adoption of smart cities and suggestions for the use of eco-technologies as promising solutions for future urban growth. Moreover, the relationship between all these strategies would result in the cohesive developmental model that would lead to a successful smart city. Meanwhile, the binding of strong policies and comprehensive decision-making along with specialized learning and skill would help in adept urban planning that would be pertinent for the regional competitive advantage.

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