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Analysis Of Possibilities And Problems Of Smart City: Global Perspective

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Abstract
There is a need for the cities to get smarter through the application of innovative solutions with advanced and smart technology to address large-scale urbanization challenges and find new ways for creating live-able, competitive and self-reliant cities around the globe. Today the use of advanced and smart technology presents many distinct hopes along with significant challenges. Those prospects included transforming industries, agricultural and service sectors by improving daily life with sustainability. These technologies develop smart homes, smart cities by improving healthcare, transportation, connectivity, finance, business etc. with comfort, safety and security. On the other hand, it creates challenges in technological, economical, legal and ethical facet along with data privacy, security, and accountability. Today's top-notch and cutting-edge technologies such as mobile phone, digital/quantum computers, camera surveillance, robotics, Internet of Things (IoT), artificial intelligence (AI), machine learning (ML), Big Data, Digital Twin, etc. make radical changes on human culture, law, religion, work, etc., and that have greatly up-sated the normal order of things in the society. The use of these smart technologies in smart cities and business enterprises has been met with certain technological, economical, legal and ethical consequences. Today smart cities utilize IoT, AI, ML, Big Data, Digital Twin, and data analytics to enhance sustainability, efficiency, and quality of life, with greater urbanization and climate challenges toward peaceful and smart living. Important prospects like intelligent traffic, smart grids, and citizen-centric services, though high implementation costs and cybersecurity risks remain significant challenges. This study will appraise the prospect and challenges along with ethical aspect of extensive and wide use of smart technology to develop smart cities. Beside many prospects there are some major challenges need to handle to a balance between technological innovation and the protection of individual rights and societal values. This is an investigate study to evaluate the potential, prospects and challenges of smart city in the high-tech era.

Keywords: *Smart City, ICT, IoT, AI, surveillance, healthcare, ecosystem*

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I. Introduction

Technology has woven itself into our lives, transforming everything from the way we communicate to how we handle legal matters. With innovations like Internet of Things (IoT), artificial intelligence (AI), machine learning (ML), quantum computing, and the legal field isn't untouched by these advancements. However, with technological progress comes the need to address ethics in technology. Legal ethics now involves understanding how these innovations impact confidentiality, accuracy, and privacy [1]. Our lives are made more convenient and easier by technology. We use technology, such as video calls and messaging, to swiftly communicate with others. Additionally, it facilitates fast access to information through search engines like Google. We can complete jobs more quickly and effectively thanks to technology. Today's society relies heavily on technology, which affects how you communicate, work, and make decisions. In the legal field, technology plays a significant role in ensuring confidentiality, managing factual discrepancies, and enhancing data security [2]. Let's delve into these aspects and see how they influence ethics and technology. Again, Generative AI is increasingly being used in legal systems to automate tasks like creating documents or assisting with research. This integration raises questions about legal responsibility, especially when AI makes autonomous decisions. For instance, if an AI system drafts a contract, who is accountable for any errors? As you work with AI, it's important to regulate its use to prevent inaccuracies. Consider a scenario where a law firm in Dhaka uses AI to draft contracts. They must ensure that the AI's outputs meet legal standards and that there's a system in place to review these documents [3]. These days, smart cities leverage data from cutting-edge technologies like IoT, AI, and ML to give residents better environmental cleanliness and safety. In order to meet the requirements of their residents and increase the effectiveness of service delivery, some cities also make use of IoT or AI devices [4]. Cybersecurity threats are one of the many threats that smart cities face, despite their high degree of connectedness and security. However, possible threats and attacks can be avoided with appropriate safety precautions [6, 18]. Smart cities, are the result of the growing importance of orienting our life toward sustainability. These cities use infrastructures, innovation and technology to reduce energy consumption and reduce CO_2 emissions. There are different parameters by which

a city ranks more highly than another. To achieve these there are few key dimensions are considered. Such as: Governance, urban planning, public management, technology, environment, international projection, social cohesion, mobility and transportation, human capital and economy [62]. The main goal of a smart city is to optimize city functions and promote economic growth while also improving the quality of life for citizens through smart technologies and great data analysis. The value lies in how this technology is used [63].

The impact of globalization and industrialization has been a subject for research around the globe due to the huge paradigm shift caused by them. Such phenomena are also a cause of concern as cities consume close to three-quarters of the world's natural resources and generate three-quarters of its pollution and waste. Eighty percent of the world's population is predicted to live in cities by 2050, when there will be nearly nine billion people on the planet. Just over half of the seven billion people on the planet now live in cities. City dwellers consume 80 percent of the planet's resources, although making up only 2 percent of the planet's land area. The conventional structures that cities rely on to supply resources are unsustainable, as are the cities' disproportionate use of social and physical resources and their rapid growth [7]. Local action is essential to attaining a low carbon future, even though urbanization continues to contribute to rising carbon emissions worldwide. Cities are now taking the initiative and creating plans to deal with the effects of climate change due to the lack of legally enforceable international climate action and the lack of leadership in many state governments. Cities are, in many ways, our best chance to combat climate change (World Urbanization Problem, United Nations, 2014) [8, 105]. By 2030, 70% of the world's population will reside in our global cities, which currently account for 80% of the world's GDP and are centers of innovation and commerce (World Bank). It is vital that we proactively determine what we want for our future cities and put in place mechanisms now that serve those future demands in a sustainable and integrated fashion because the appearance of these cities will have an impact on our environment globally [9]. Future consequences include optimized energy usage and improved mobility, but also present serious challenges regarding data privacy, security risks like cyber security, digital divide and many uncertainties [136]. The concept of smart cities, also known as a city 4.0, should not be confused with sustainable cities, which seek to reduce the carbon footprint of its activities and promote efficient consumption and production patterns, depending on its geographic, social, economic, and cultural characteristics. Smart cities, or advanced cities, thrive off technology-based tools and methodologies in order to advance toward a fairer, safer, more efficient and nature friendly future. To do this, effective solutions are presented that respond to typical challenges found in a large city such as mobility, the economy, public services, employability, and citizen engagement, among others [16].

Over the past century, there has been a notable improvement in the quality of life, mostly in terms of service access. However, administrators, architects, and urban planners have faced significant challenges due to the strong industry and population growth in urban regions. In 21st century a major focus is transitioning to Net Zero through smart energy, waste management, and climate adaptation strategies [10]. The use of digital twins, artificial intelligence, and robotics is accelerating to create responsive urban environments. Real-time data collection enhances public services, such as, for instance, in traffic management and public transport. Future development emphasizes engaging citizens to ensure solutions meet actual needs, rather than just technology-driven initiatives. On the other hand, huge dependance on connected infrastructure introduces vulnerabilities, making cybersecurity a top concern [12]. Many of these cities have difficulties due to the enormous amount of capital needed for growth and upkeep. In addition, there are numerous ethical and legal difficulties. Regulatory and compliance issues, privacy concerns, and questions about intellectual property rights protection are just a few of these legal nightmares. [13]. Meanwhile, the ethical dilemma fluctuates between dignity, conscience, right and wrong, addictions, etc. The main legal challenges revolve around applying existing law to new, complex technologies and ensuring compliance with evolving regulations. Evaluating smart city initiatives becomes difficult without agreement on parameters [14]. Additionally, it makes it more difficult to compare projects and find best practices. The transformation of smart cities into "smart regions"—for example, by fostering greater cooperation between the public and private sectors—is the way forward [15]. So, a smart city uses a framework of information and communication technologies to create, deploy and promote development practices to address urban challenges and create a joined-up technologically-enabled and sustainable infrastructure [63]. In order to evaluate the potential, opportunities and challenges of smart cities in this high-tech era, this paper will discuss the contemporary issues of smart city and related smart technology. The complexity and process of striking a balance between the employment of smart technology and the defense of individual and collective rights as well as societal values in the complicated global context will also be depict. In this high-tech era, this research will emphasize the importance of advanced technical skills and that will be boosting employability and competence for future citizen to develop smart city with more comfort, safety and security.

II. Literature Review And Methodology

The goal of smart cities is to improve the quality of life for its citizens through technological means, ultimately creating more sustainable cities. It is a team effort that requires many sectors of a society to safely and strategically integrate technology, information, and data solutions [5]. Digitization is a key driver of recent

economic, cultural, political, and societal transformations in a smart city, but as with any consequential reform, these changes entail both positive and negative impacts. While the ease of processes has reformed urban lives, we are posed with the substantial risk of cyber threats. As a result, there has been a growing impetus to rethink the concept of security in the digital age. The emerging need for operating and maintaining digital infrastructure with 24/7 diligent coverage is critical for the secured vision of a smart city. The vision of a smart city with secure digital infrastructure can only be attained with a people-first approach. After a decade of trial and error, leaders have realized that the shift towards the vision of digital society is to use technology and data purposefully to make better decisions and deliver a better quality of life. Let us delve deeper into what exactly is a smart city and how digital solutions can help in creating a secure digital society in smart cities [6]. Because IoT devices are interconnected and use AI, smart cities are vulnerable to cyberattacks. It is crucial to safeguard the infrastructure from possible threats and secure the data that is sent between devices. To prevent unwanted access and preserve the integrity of the data gathered, smart cities must have strong cybersecurity measures in place, such as encryption methods, frequent software updates, and intrusion detection systems [25]. The Internet of Things (IoT) and artificial intelligence (AI) are major forces behind efficiency and creativity in the age of linked technology and smart cities. However, the crucial relevance of cybersecurity cannot be understated given the growth of smart cities and the proliferation of connected devices.

The importance of cybersecurity in the context of IoT and smart cities is examined in this blog post, which also outlines best practices for protecting infrastructure and data. Mobile phones can determine where and when we cast our ballots by tracking us as we shop. Drones monitor our neighbors and provide drinks to fishermen in the middle of a frozen lake, and algorithms based on commercial data enable businesses to sell us goods they believe we can afford and refrain from displaying those they believe we cannot. One day, autonomous cars will talk to each other to reduce traffic jams and, consequently, energy usage. Technology has repercussions, challenges conventions, alters our abilities and actions, acts on our behalf, and renders biased judgments [64]. There are drawbacks to using this technology, particularly with regard to human privacy and emotional and financial stability. Technology use can lead to moral dilemmas, political challenges, and a host of other legal issues. The combination of these technologies and their negative impacts is what gives rise to ethical issues surrounding the usage of smart and contemporary technology. The report of "World Smart Cities Outlook 2024' highlights best practices, successful case studies, and key drivers for future developments and that offering recommendations and procedures to policymakers, governments, intergovernmental organizations as well as relevant stakeholders. This report accentuates the need to create a collaborative ecosystem to substitute innovation and sustainable urbanization. It includes capacity building, knowledge sharing, adequate strategies, policies frameworks, leadership support, resource allocation, oversight and monitoring mechanisms to ensure sustainability, inclusivity and compliance with human rights thoughts in the digital space. This report is very useful to get necessary idea to study smart city meticulously [143].

Smart cities are vulnerable to cyber threats due to the interconnectedness of IoT devices that use AI. It is crucial to secure data being sent between devices and to defend the infrastructure against possible threats. To prevent unwanted access and preserve the integrity of the data gathered, smart cities need to have strong cybersecurity measures in place, such as encryption methods, frequent software updates, and intrusion detection systems [25]. The Internet of Things (IoT) and artificial intelligence (AI) are major forces behind efficiency and creativity in the age of connected technology and smart cities. However, the crucial significance of cybersecurity cannot be emphasized given the growth of smart cities and the proliferation of connected devices. This blog post examines the critical need for cybersecurity in the context of smart cities and the Internet of Things, exploring potential threats and describing recommended practices to protect infrastructure and data. Mobile phones can determine where and when we vote by tracking us while we buy. Drones observe our neighbors and provide drinks to fishermen in the middle of a frozen lake due to algorithms based on commercial data that allow businesses to offer us things they believe we can afford and avoid displaying us things they believe we cannot. By communicating with one another, autonomous cars will eventually reduce traffic jams and, consequently, energy usage. Technology affects our behavior, challenges conventions, alters our capabilities, acts on our behalf, and produces biased results [64]. There are drawbacks to using this technology, particularly with regard to human privacy and emotional and financial security. Technology use has the potential to influence and elevate political issues, moral concerns, and several legal challenges. Modern technology use raises ethical questions because of the confluence of various technologies and their negative impacts.

With over 95% of the world's population now connected to mobile networks in the twenty-first century, closing the digital divide both within and between nations was essential, and we must never forget that information and communications technologies (ICTs) are always beneficial for development. In the modern era, ICT is a useful instrument for reducing environmental deterioration. Large volumes of sensitive personal, behavioral, and environmental data are now collected by smart devices, making adherence to strict data protection regulations necessary. The stories about how technology will eventually interact with people and the myth of digitalization have finally come to pass. Nature has been profoundly altered by technology in previously unimaginable ways.

The world is in awe of the entrance of mind-blowing technologies like robotics, the Internet of Things, artificial intelligence, machine learning, and smart devices like computers, phones, watches, and cameras. Nearly every aspect of human life, including society, has seen significant change as a result of this contemporary technology. Politics, election trends and analysis, financial analysis, economic growth, social life, medical, education, energy, religious beliefs, and other areas are all significantly impacted by modern technology. Thanks to artificial intelligence (AI) and automation, humans may now effectively engage with technology in the twenty-first century. There are numerous facets to important regional and global frameworks. A strict EU framework that requires user consent, data minimization, transparency, and the right to be forgotten is the General Data Protection Regulation (GDPR). Alternatively, California customers have the right to know what data is collected and to request that it be deleted under the California Consumer Privacy Act (CCPA). Another is the Health Insurance Portability and Accountability Act (HIPAA), a federal law in the United States that regulates the security and privacy of personal health data gathered by smart health devices. However, while both Singapore's PDPA and Australia's Privacy Act are national laws that protect personal data, they differ in their enforcement and scope. The Australian Privacy Act, which is based on 13 APPs, regulates handling across sectors with a strong emphasis on individual access and transparency [95].

Again, the Singapore PDPA, which is overseen by PDPC, establishes baseline guidelines for the gathering, use, and disclosure of data. It was recently improved with stricter penalties and guidelines for reporting data breaches. Both seek to strike a balance between organizational requirements and data protection [96]. Productivity and efficiency are the keys to success in the fast-paced world of business. The same holds true for personal achievement in contemporary life. Because technology can automate monotonous work, minimize manual errors, and speed up procedures, organizations, businesses, and even astute citizens who embrace it are discovering that they have a clear advantage. In addition to saving money, this increased efficiency helps companies become more productive and profitable [115]. Complex jobs, simulations, calculations, and other tasks can be completed 100 times faster by computers, IoT devices, and artificial intelligence (AI) systems than by the human brain. Smart technology, including artificial intelligence (AI), the Internet of Things (IoT), machine learning (ML), data science, big data, and ICT in general, is made up of various computer components and technological fusions that can readily adapt to human nature and carry out tasks more quickly and independently. An intelligent bottle, for instance, can cock bottles in minutes, but it will require 100 workers working long hours to complete the same activity. Given that time is the most valuable resource in the business world, this efficiency is a welcome boon. Digitalization and the application of smart technologies make production and distribution, as well as the manufacturing of goods and services, comparatively simple, precise, and quick. Contemporary technology is designed to be flexible. It can adjust to changes in the business environment, pricing, quality, quantity, and kind of goods or services because of its independent and effective character [79]. The new pricing labeling in a supermarket can be easily reprogrammed and mastered by modern computer or AI systems. Therefore, modern technology is a strength because it keeps the organization, firm, business, or even the everyday work of a smart citizen current and present regardless of changes that take place in the course of business or odd events. Numerous disputes and public discussions have been sparked by the new environmental challenges. Degradation of the environment is becoming a worldwide problem. An estimated trillion tons of carbon dioxide would be added by 2050 if current emission rates continue, according to the literature, which could have a negative impact on human existence [117].

In recent years, there has been research on the function and significance of ICT for various economic outcomes. Increased use of information communication technology (ICT) has been shown to have positive economic effects [118]. Nonetheless, the literature has paid the least attention to ICT's ecological aspects. ICT has actually had an impact on human life from a variety of angles, including ecological ones. However, ICT is seen as a way to strengthen environmental protection, lessen the negative effects that human activity has on the environment, and tackle important environmental issues like sustainability and climate change. By raising knowledge of environmental issues and encouraging the use of ecologically friendly technology, ICT can also aid in reducing environmental damage [119]. Environmental dangers can be anticipated and managed with the aid of ICT technologies. Computerized simulation tools, for instance, can make "learning by simulation" easier in order to speed up decision-making processes and avoid the negative effects of trial and error. The "internet network" is another component of ICT that enhances environmental awareness. Due to their ability to lower greenhouse gas emissions, ICT-based solutions are regarded as beneficial for environmental sustainability [120]. The legal and ethical implications of these developments cannot be disregarded in the age of smart cities, when the integration of IoT, AI, and other smart technologies promises previously unheard-of levels of efficiency and innovation. Questions around data privacy, surveillance, cyber security, and the ethical use of technology become more pressing as urban areas become more globally connected and accessible through the internet or web. The gathering and use of personal data as well as open connectivity to the outside world are among the main issues in the context of smart cities [81]. IoT devices and AI technology collect data from a variety of sources, including sensors, cellphones, and security cameras. Therefore, establishing strong data privacy legislation becomes essential. To

guarantee that people's or personal information is handled responsibly, openly, and with the highest level of security, smart cities must abide by strict data protection rules. Concerns regarding citizen privacy are brought up by the use of surveillance technology, such as voice and facial recognition and video analytics. Finding the ideal balance between protecting individual rights and maintaining public safety is a difficult task.

Clear rules and guidelines controlling the use of surveillance technology are necessary in smart cities to guard against misuse and shield residents from unjustified intrusions into their personal life. It is essential to make sure that people are aware of how data is collected in smart cities. People are empowered to make educated decisions about their involvement in smart city efforts when there is open communication and explicit agreement is obtained for the gathering and use of personal data. This openness promotes a cooperative and moral approach to urban development by increasing trust between citizens and city officials. There is increasing demand to make cities more environmentally friendly while also increasing their efficiency as urbanization rates rise and governments throughout the world set aggressive goals to cut carbon dioxide emissions. Over two-thirds of the world's CO2 emissions come from cities. Some have taken up the task and are managing the difficulties of urban sustainability with the aid of technology [121]. Cities that are managed more effectively can increase economic growth, lower expenses, and increase productivity. Government assistance, technology innovation, and necessity are driving this movement toward smart, sustainable cities. Secular growth should benefit businesses that offer answers [15]. Despite being widely discussed, the term "business model" is relatively new and lacks a standard definition [106]. A business model explains the logic behind how a company generates, provides, and acquires value (economic, social, cultural, or other forms of value). A business model is defined as "an architecture of the products, services, and information flows," which is one of the most commonly used definitions. Actors, roles, potential economic value, and the revenue source are all acknowledged in this definition. Four components make up a business model framework, often known as a "canvas," which centers the value proposition. [101, 107]. According to Roy (2005) [108], business models can be categorized into five categories, despite the possibility of different value propositions. Unbundling business models are useful for companies that operate in the three essentially distinct business categories of infrastructure, product innovation, and customer relationships (i.e., private banking).

A company that uses the long tail business model aims to sell more for less. Offering a wide variety of specialty products, each of which sells comparatively infrequently, can help address this problem (i.e., LEGO). Multi-sided platform models, which combine two or more separate yet connected client groups (i.e., game console production vendors). Free business model: consistently provide a free offer to at least one significant consumer category (i.e., cell phone operators). Unbundling business models are useful for companies that operate in the three essentially distinct business categories of infrastructure, product innovation, and customer relationships (i.e., private banking). More sophisticated threats are always emerging, and the environment of cyber security is constantly changing nowadays. Since the pandemic, businesses and individuals have become increasingly dependent on technology, which has given hackers a special chance to take advantage of their weaknesses. Actually, there has been a 600% surge in cybercrime since the pandemic started. Sadly, most small and medium-sized business owners (SMEs) are not sufficiently equipped to protect themselves from a cyberattack, even though they are the most vulnerable. There are several reasons for this, including as inadequate cybersecurity plans, undertrained staff, and antiquated IT hardware and software. You must address this technological issue head-on because the majority of SMEs fail within six months of a cyberattack. Effective protection can be established by collaborating with the appropriate outsourced IT support company [80, 81]. Automation has the potential to increase productivity, but it also puts certain jobs at risk of being replaced. Employee morale and corporate culture may suffer if there is less demand for some job positions as a result of increased reliance on technology [76]. There are many advantages to using AI, ML, robotics, or information and communication technology (ICT) in business, but there are also risks and complicated legal issues involved. There are some of the main risks associated with ICT use in businesses. Such as: old or malfunctioning hardware, software, or network components that can cause system crashes, data loss, and service interruptions. inadequate redundancy or backup solutions to guarantee the uninterrupted availability of vital IT resources in the event of emergencies or failures [77]. Once more, the widespread usage of smart gazettes, devices, and systems will raise significant ethical and legal concerns in the future.

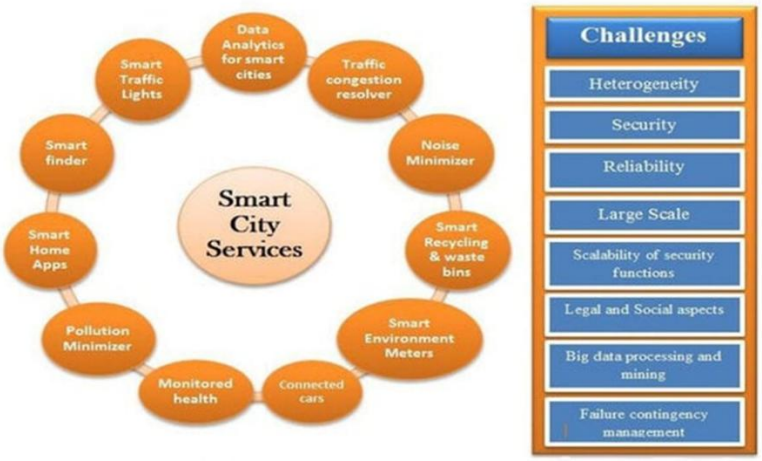

Figure 1: Smart services and challenges [141].

A smart city is a technologically advanced urban area. Generally, it is a digitalized version of a physical city. It is one of the newest forms of IoT technology as it uses different kinds of electronic methods to collect data. It integrates all the different layers of a city's infrastructure. This includes sensors to detect people walking by the street, sensors to detect when it is dark outside our other sensors that might be necessary for effective technological performance around the city. For example, a light-detecting sensor enables a city to turn on the street lights automatically when necessary [62]. Smart city solutions are an important component of a smart life, which soon be the only one way to live. The IoT solutions for smart cities are used by governments to make decisions regarding transportation and climate. The concept of a smart city involves bringing together a number of fields of knowledge. It includes public administration and e-government. The latest developments in this field have made it possible for cities to create and deploy their own intelligent systems [38]. Developing a sustainable smart city is an important part of a city's development, so the new concept of a sustainable smart city must be incorporated [63]. Actually, there is a distinct gap to study, analysis and to evaluate the prospect of smart city, its potential, challenges, and what to do to solve those issues in global contest to develop successful smart city in this high-tech era. This study will be explored the definition, function and concept of smart city along with various attributes. Advance and smart technology span required for smart city development and that need to be analyzed and presented. Smart city potential, prospect, economy, business, problem, challenges, and other aspect need to discussed. Some of the global initiatives also need to be discussed. So, there are few specific questions need to solve as follows:

a. What is smart city and what are the function of it?
b. What are the potential and prospects of smart city?
c. What to handle smart city business problem?
d. How smart city economy can be managed?
e. What are the probable challenges of smart city?
f. What are the legal and ethical challenges of digital and smart technology to develop smart city?
g. Why and how top smart cities uses IoT and AI to solve future challenges?
h. How to develop successful smart city?

III. Definition And Function Of Smart City

A smart city is a city that integrates digital technologies into its networks, services, and infrastructure in order to become more efficient and livable, thereby benefiting residents and businesses. According to the European Commission, a smart city requires: Smart urban transport networks; Improved water supply and waste disposal facilities; More efficient ways to light and heat buildings; More interactive and proactive city administration; Safer public spaces. In other words, a smart and sustainable city uses information and communication technologies (ICT) to improve quality of life, efficiency, and competitiveness, while ensuring that the needs of present and future generations are met. According to the United Nations Economic Commission for Europe (UNECE), the definition of a smart city includes elements such as widespread home connectivity and Wi-Fi in public areas, smart infrastructure, smart meters, the use of open data, and e-government solutions [17]. The Smart City concept has become a key factor in sustainable urban development. It is a compilation of urban planning strategies with lots of far-reaching benefits, including efficient distribution of resources, speed of policy implementations, seamless communication, and a range of environmental benefits. A city's "smartness" is determined using a set of characteristics, includes infrastructure based around technology, environmental initiatives, effective and highly functional public transportation, progressive city plans, people able to live and

work within the city using its resources, etc. The success key of a smart city relies on the relationship between the public and private sectors as much of the work to create and maintain a data-driven environment. Additionally, there is also the need for data analysts to assess the information provided by the smart city systems so that any problems can be addressed and improvements found [63]. Today, smart cities are blooming in every corner of the globe, with Singapore, Copenhagen, Amsterdam, and Oslo as indisputable frontrunners for this new trend. Here are four major smart city technologies that are gaining considerable traction and are universally adopted in the modern evolution of smart cities [46].

A smart city is a technologically advanced metropolitan region that combines explicit information from sensors and numerous electrical strategies. The information gathered from that data is used to effectively manage resources, assets, and administrations; as a result, that data is used to advance duties throughout the city [17]. This includes data collected from inhabitants, devices, buildings, and resources that is processed and examined in order to track and control AI, web technologies, smart mobile platforms, telecommunications, e-commerce, e-business, and other technologies are all integrated in smart cities and smart businesses [18]. As seen in Figure 2, the fields of utilization pertain to services for citizens and users, such as utilities, e-health, transportation, and structures. Information and communication technologies (ICTs) are used in smart cities to scale services like transportation and utilities for a growing population. Growing urbanization and population growth are igniting a fresh interest in incorporating technology into the planning of municipal services, which is what "smart cities" are all about [19]. In order to detect variables like temperature, moisture, allergens, contaminants, traffic, and power matrix status, smart cities heavily rely on sensors. These parameters' values offer a context that aids a system in comprehending a citizen's condition at any given time [16]. The common features of modern smart city are smart energy, smart mobility, smart healthcare, smart economy, smart homes, smart information communication and technology (ICT), smart Infrastructure, smart citizen and smart governance. The central motivation for the building of smart cities is to raise the quality of living, safety, security, comfort of its citizens. In simplest terms, the smart city can be described as a city planning approach that banks significantly on ICT to monitor and then integrate and enhance the conditions and usage of city's lifelines like roads, bridges, tunnels, railway lines, seaports, airports, electricity, water, communication, etc. and a style that efficiently plans their management [148, 149].

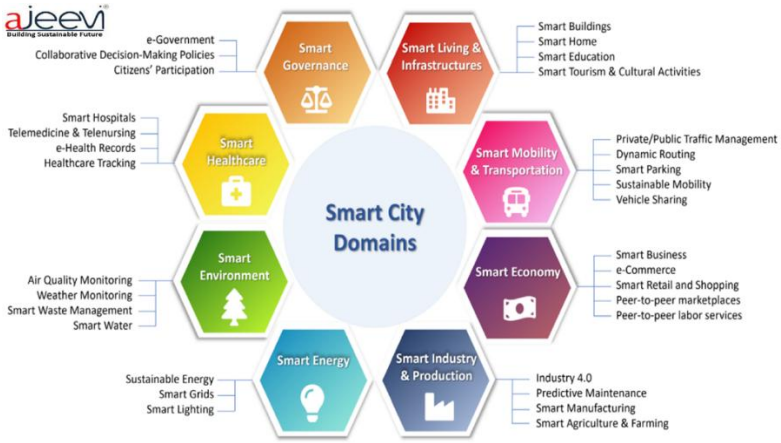

Figure 2. The utilities and comfort in a smart city [115]

The multi-tier design is used in nearly all large, well-managed smart cities in an effort to combine the physical and ICT environments. Smart cities, however, seem to be adopting another intriguing strategy that involves the Internet of Things, artificial intelligence, robots, and automation. This means that many smart cities could use data from sensors, buildings, and users as sensors with their applications without having to install networks or other large-scale infrastructure from scratch. Any or all of the elements of smart cities could be mentioned in potential business models. For example, vendors in smart cities create and implement infrastructure; operators profit from the use of these facilities or the supply of services; service providers profit from the provision of their services, etc. To do this, a smart city might make use of a variety of modern business models [150]. A city can be viewed from a number of perspectives, some of which are already present while others require design. The dimensions are:

- The environment includes parks, buildings, lakes, rivers, and landscapes.
- Public transportation is an example of infrastructure.
- Open Data, innovation, synergy, cooperation, and creativity make up the Collaboration System.
- E-government, e-learning, and e-traffic are solutions.
- Living: working, recuperating, and having fun.

The interactions between the different disciplines in a smart city offer the greatest potential for value creation. Additionally, services made possible by technology should be mentioned while discussing smart cities. People and their needs are frequently disregarded in this situation. Figure 3 provides a visual representation of the importance of the value of people in a smart city. It is important to keep in mind that a smart city is built for the people, not for its own purpose. It is now necessary to connect disciplines and sectors that did not previously interact closely in a way that adds value. Smart city initiatives are frequently approached solely from a technological standpoint. Nonetheless, it is crucial to address a number of other non-technological factors, including organizational settings, societal culture, and the culture of city management departments (viz. municipalities, corporations, district councils etc.). As cities grow, smart solutions are essential to handle population density, moving from conceptual ideas to, in some regions, highly connected urban environments. While Western cities often focus on retrofitting existing infrastructure with smart solutions, other regions may focus on new, purpose-built smart developments [120, 134].

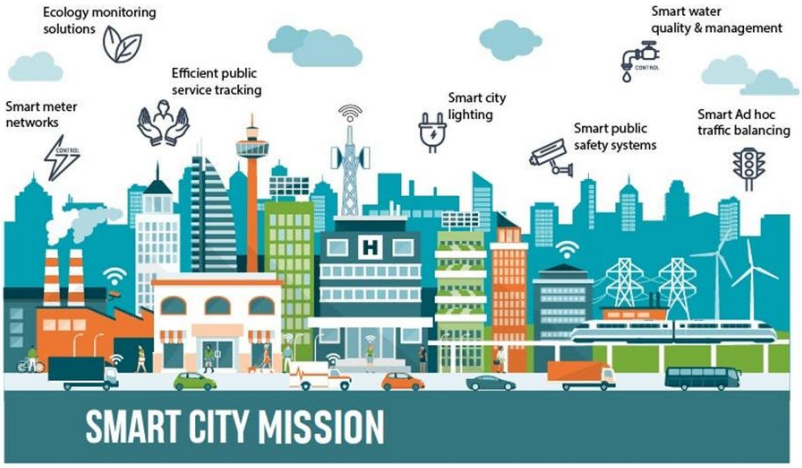

Figure 3: Facilities of a Smart City [98]

Smart Cities make life easier and better for those who live and work there by utilizing technology to enhance urban administration. They reduce their environmental impact by making the best use of natural resources. More precisely, sensors gather information from various urban locations, including hospitals, law enforcement, waste management, traffic, transit systems, and air quality. The information is kept, examined, and applied to real-time problem solving. "Barcelona has been in the forefront of testing the internet of things with a municipal network of 500 km of optical fiber, free WiFi piped via street lighting, and sensors to monitor air quality, parking places, and even rubbish bins," the Financial Times boasts. One of the Smart Cities of Europe is Barcelona. There are many different applications and services for smart city solutions. They can provide safer public areas, more efficient transportation networks, just-in-time waste management, better-balanced and less wasteful water supplies, and efficient building heating and lighting. All of this may sound futuristic, but many of the cities where we live have already adopted some clever solutions, like telemedicine, intelligent traffic signals, ride-hailing, emergency response optimization, and municipal water leak monitoring [151].

Smart systems are being adopted by city planners and authorities at an increasing rate due to the numerous issues posed by rising urbanization rates. Over 60% of the world's energy is consumed in cities, which also produce 70% of its CO2 emissions. Reducing the footprint of big cities is crucial, as most governments have promised to cut national emissions. Another contributing cause is declining air quality, which results in health issues and restricted access to clean water. Perennial traffic and overwhelming trash management have long been serious problems that are getting worse. According to the World Economic Forum, the pace of urbanization worldwide is predicted to increase from 56.2 percent in 2021 to 70 percent by 2050. By that time, an additional 300 million people are predicted to live in cities in China and 400 million in India alone. North America's current high rate of urbanization (83.6%) is expected to rise even further.

Smart City transformation

A smart city is built on the foundation of 5G technology. In contrast to 4G, 5G is ten times faster, has low latency (i.e., there is only a slight delay of 1 to 1,000 milliseconds before a data transfer begins following an instruction), and allows for the connection of millions of devices and sensors within a one-kilometer square area, whereas 4G only allows for a limited number of connections. Various 5G-related technologies are necessary for the development of a sophisticated Smart City. A city, for example, implements several Internet of Things sensors

to supervise traffic. Once the data has been collected, it is transmitted across the 5G network. During this process, blockchain technology can facilitate secure data flow. Traffic authorities employ edge computing analytics to assess data in real-time in order to forecast traffic flows and devise feasible congestion management strategies, such as rerouting traffic or altering traffic signal sequences. Massive quantities of Big Data can be efficiently processed by AI. After that, the dataset is securely stored on a cloud server for future study and utilization. There are a number of players and aspects involved in bringing Smart Cities into reality:

- **Manufacturers of 4G, 5G, and WIFI** equipment and service providers meet the growing need for dependable high-speed connectivity by sending sensor data over their networks.
- **High-capacity** telecom towers and data centers that support edge computing are examples of communications infrastructure.
- Manufacturers of semiconductors that provide sensors for data collection Software firms that control devices and sensors and offer intelligent solutions
- Businesses that use cloud storage to store the encrypted data
- Cybersecurity firms that defend systems against hackers and attacks during the data collection, transport, analysis, and storage process Businesses that offer building management solutions to maximize facility operations, such as waste management, energy, water, and energy consumption
- Businesses that facilitate the transition to electric cars and smart grids

The character of cities has always been multifaceted. Cities must incorporate the use of big data and information and communication technology (ICT) into everyday operations and in the achievement of their urgent objectives if they are to become smart and sustainable—more ecologically sound, commercially successful, and socially just. As we swiftly move into the twenty-first century, it becomes clear that in order to keep up with the expanding population and limited resources, a city's total livability will need to take on a new dimension and horizon. The city will become a more livable place if technological innovation is combined with smart connectivity that makes use of the expanding Internet of Things to address the real problems of traffic congestion, waste/pollution control, and energy efficiency. Although smart city efforts are always a "work in progress," communities worldwide stand a better chance of receiving the most livable award when they are carried out with actual business results and the specific demands of end users in mind. Therefore, through multilateral trading systems like those provided by the WTO, smart cities as they are now defined and understood have immense potential to open up in the worldwide business arena. Though descriptions and visions of the future city will still reflect the competitive dynamics between cities and the businesses and organizations that want to service them, the conversation about future cities is becoming more multidisciplinary, evidence-led, and conceptually rigorous. Most people's lives, whether or not they reside in a city, will be directly impacted by the shape, functionality, look, and atmosphere of cities in the future. In addition to its effects on people, the future city will have an impact on economies and broader global environments. Economically speaking, the biggest metropolitan marketplaces have already surpassed those of several countries. This article examines the importance and new prospects of smart cities for global enterprises to meet the problems of the twenty-first century, keeping in mind the aforementioned vision of smart cities.

IV. Potential And Prospects In Smart Cities

Smart cities are poised to revolutionize urban living by making our environments safer, faster, and more efficient, creating a fertile landscape for long-term growth in the sectors providing these solutions. The Internet of Things (IoT) serves as the backbone of this innovation, driving systemic efficiency through constant connectivity. However, as the digital footprint of our infrastructure expands, the role of cybersecurity becomes non-negotiable; integrating AI-driven defense mechanisms and rigorous best practices is essential to safeguarding data and protecting the vital systems that keep a modern city running. A smart city is an urban model that makes use of technology, human resources, and governance to enhance social inclusion, efficiency, and sustainability—all of which are regarded as objectives for cities of the future [23, 27]. Digital technology is used by smart cities to provide services and gather data. IoT and smart technology integration offers previously unheard-of possibilities for increased productivity, sustainability, and quality of life as smart cities develop. The advantages are numerous, ranging from smart grids improving energy management to connected gadgets optimizing traffic flow. However, new and complex cybersecurity concerns are also made possible by this interconnectedness. The transition to smart cities calls for a thorough reorganization of municipal operations and management, focusing on citizen involvement and public service delivery strategies. Planning, management, and operational procedures must change in order to become a smart city. In order to optimize urban services and identify areas for development, this data can be analyzed [54]. "Smart cities" were conceptualized as a result of the fast use of information and communication technology in global cities [55].

The four elements that Deakin and Al Waer identify as contributing to the definition of a smart city are the territorializing of practices that bring ICT and people together to enhance innovation and knowledge, the integration of ICT into living and working environments, the use of ICT in government systems, and the use of a

wide range of electronic and digital technologies [56]. The very aspects that make smart cities intelligent and responsive—such as real-time data interchange and remote-control capabilities—can be misused if they are not appropriately protected [28]. Smart cities operate through a three-layered framework—a foundation of sensors and high-speed connectivity, an application layer that converts raw data into intelligence, and a social layer for public adoption—all accelerated by the convergence of 5G, IoT, and mobile technology. This digital evolution has shifted healthcare from an individual-focused model to a community-centric "smart health" (s-health) approach, which differs from standard e-health or m-health by utilizing localized, distributed sensors to enhance inhabitant well-being. By analyzing real-time data, such as air quality or allergen levels, s-health systems can proactively guide residents away from environmental hazards and toward personalized care, effectively reducing the strain on traditional medical infrastructure through preventative, data-driven insights. Every city's infrastructure serves as its foundation, and development can improve current connections in a variety of ways, such as by implementing green buildings, waste management programs, and traffic regulations. For instance, the goal of Singapore's Green Mark certification scheme is currently to make 80 percent of the city's buildings green.

According to Gartner by 2028, there will be several billion connected IoT devices in business-savvy buildings, driven by broadcast communications systems, 5G, and high-efficiency Wi-Fi in addition to smart utilities like water, garbage, and electricity. Platform assessment frameworks, IoT sensors for wastewater and obstruction detection, stopping sensor applications, lighting sensors, and fire detection frameworks are examples of moving innovations. Future metropolitan areas may become more conservative and close-knit as a result of this [126, 127]. Therefore, every resident of a smart city greatly benefits from smart infrastructure. Mart cities, thus, elevate their tenants' voices. While local area network platforms allow users to collaborate and share resources, applications allow inhabitants to temporarily report local problems. With increased investment and transparency, metropolitan areas are developing into cooperative settings. Metropolitan cities are getting ready to be more human-focused and multidirectional for the government, associations, and inhabitants alike thanks to open information and new advancements [130]. In addition to investing in sustainable energy, cities can employ development to monitor and improve energy use in real time. This involves the use of ethical and sustainable materials, carbon-friendly and resource-efficient strategies, frameworks powered by renewable energy sources, and cutting-edge innovations that adapt to their needs. According to Deloitte Insights, the energy transformation contributes to the construction of a circular economy by decentralizing the production of energy from limitless sources. This is getting ready for urban areas to become energy self-sufficient [114].

Living in a smart city with smart energy is always pleasant and environmentally friendly. With increased use by law enforcement, biometrics, facial recognition, smart cameras, video, and other forms of smart surveillance have all been gaining some traction. These developments help cities look into crime prediction, reduce reaction times, and identify examples and patterns in crime data. However, inhabitants' security, opportunity, and shared freedoms remain of utmost importance, even when new advancements provide enticing options. Urban areas need to exercise caution. in order to investigate the ethical and practical implications of using such technologies, and to avoid repressing specific regions or dividing groups [54]. Therefore, a well-maintained smart safety system may help keep an eye on crime, manage it, and promote peaceful life in smart cities. Urban planning faces a significant challenge in creating intelligent, cost-effective, and resilient urban communities due to environmental change and climatic circumstances. A green urban plan, motivated by decarbonization goals, combines 15-minute city models with reasonable area methods where the majority of daily needs are accessible by bicycle or foot. Additionally, biodiversity is increased by vertical tiny forests and smart farms for plant development. New and sustainable alternatives, such as floating cities, islands, ranches, schools, and riverbanks, are gaining attention worldwide as ocean levels rise [114]. In order to enable people and other forms of transportation to function in more effective, robust, and maintainable ways, smart mobility uses innovation. Developments in metropolitan portability revolve around improved infrastructure, adaptability as an administration, micro mobility, operational arrangements, and zero-emission transportation. Eco-friendly urban mobility is being made possible by autonomous vehicles, high-level driving, and intelligent traffic management. Innovative vehicle options, including as water taxis, robot axes, and the hyperloop, also find uses in incredibly adaptable cities [113].

In a smart city, smart transportation efficiently empowers all residents. Smart city players are compelled by the e-governance pattern to make their decisions and administrations more transparent, palatable, collaborative, and uncomplicated. Blockchain and IoT-based agreements are used by startups to do this, keeping track of all partners for the dynamic exchange. Advanced visas, web-based voting, and robust information security tools are examples of computerized administrations that encourage resident collaboration and contribute to the growth of e-majority rule government. Additionally, local e-profession centers, online retraining programs, and digitalization of corporate functions like burden filing and permitting contribute to financial growth and an innovative business environment [111, 112]. In a smart city, e-governance guarantees citizens' satisfaction, accountability, and openness. Waste production rises in tandem with the continuous development of metropolitan populations and purchasing culture. IoT sensors are used by sophisticated and intelligent waste management

systems to accurately track waste pickup, provide residents with usage advice, and incentivize them with financial benefits. Reusing e-waste also allows people to exchange equipment for cash. Smart containers manage the quantity of waste and sort uncategorized rubbish [115]. By avoiding human interaction, artificial intelligence recycling robots precisely identify the types of materials during waste sorting, increasing total productivity and large efficiency. When combined, emerging waste management strategies lessen the impact of economic activity on the environment [113]. Effective trash management keeps the city clean and healthy for its residents.

V. Divergent Aspect Of Smart City Development

With its early adoption of a sustainable, environmentally friendly agenda and emphasis on public transportation and urban infrastructure, Europe has long led the way in Smart City projects, despite having many old cities with legacy infrastructure systems. Intramodality, which combines several public transportation options into a seamless travel experience, has been a priority of European transport policy, according to 2018 McKinsey research. Rapid technical advancement has also fueled electronic services like ticketing systems. One characteristic of Smart Cities in the West is that development is primarily bottom-up, with individuals and the private sector actively involved in creating projects to enhance quality of life, promote economic growth, and protect the environment. In 2018, for example, the federal government of Canada invited about 200 communities nationwide to enter a competition wherein technological advancements may be used to improve people's quality of life. In order to identify demands and give city officials a plan for creating future traffic and public transportation infrastructure, the Intelligent Cities program held resident workshops. There must be a cultural change in the way cities are run and controlled in addition to the participation and input of local residents [15]. Additionally, municipal technology platforms must be more accessible and not kept in disconnected "silos" that are unable to work together. More than 40 local departments were operating on disparate, disjointed technology platforms when Los Angeles Mayor Eric Garcetti investigated the implementation of Smart City solutions.

In order to compile approximately 500 datasets from the city's departments as well as those from the county, state, and federal governments, Geo Hub was established in 2016. Los Angeles was able to manage resources and make better decisions thanks to the information that GeoHub uncovered about the city's infrastructure and public safety needs. A number of silo-type models were dismantled in Barcelona, including those in which networks lacked communication, users were bound by rigid contracts, or service delivery was contracted out to big operators with no government control over the collection or use of resident data. Since then, the government has taken over accountability for such data in order to protect privacy. With an emphasis on small, local businesses, the procurement of services was also made transparent. In the meantime, Asia has seen a boom in Smart City initiatives in recent years. The creation of smart cities is typically top-down in nations with powerful central governments, like China or Singapore, where the government creates rules and allocates funds. Usually, the emphasis is on enhancing urban governing capabilities and expanding infrastructure. Smart Cities are highly developed areas where many services are owned by the public sector. These areas include waste management, water, power, transportation, and telecommunications. A fully functional Smart City must have this smooth data and technology flow [130]. Large heritage Western cities might need a few years to get to this level of Smart City development. However, there is a need for improvement, and both in the East and the West, more clever ideas are probably in store.

In Chicago, infrastructure investment, economic development, and community involvement are the three primary application areas for open data and smart city initiatives. To achieve gigabit speed over an open network, the city is investing in a new open fiber-optic ring. The city intends to support a more vibrant and competitive marketplace by making investments in open infrastructure. The city expects that reasonable pricing and high-speed broadband would entice digital technology enterprises to establish or relocate in Chicago. The unlicensed radio spectrum in Chicago City is exhausted. It is currently collaborating with the Federal Communications Commission on spectrum to dynamically share spectrum allotted for public safety so that it can be utilized for cell phones, tiny cells, etc. when not in use. The goal of the Smart Chicago Sustainable Broadband Adoption program is to promote economic growth in five underprivileged Chicago areas. More than 11,000 residents, 500 small enterprises, and non-profit organizations can get computers and training opportunities through the broadband awareness and adoption program. Since companies and applications are developed on their open data platforms, Chicago sees an economic growth justification for data accessibility [123]. One of Chicago's top priorities is facilitating a market of interested parties and coordinating the demands of the public, business, and community sectors. In order to boost the diversity of the Chicago technology industry workforce, the mayor gathered a group of specialists known as the Technology Diversity Council to create policy suggestions. It could be necessary to work with other departments on some recommendations. The Smart Chicago Collaborative is responsible for a large portion of Chicago's community engagement efforts [128].

Chicago's investment in smart cities has been measured using a mixed-method approach. Cost savings are a major indicator for the city. For instance, by switching to cloud-based productivity tools, the city was able to save $400,000. In a similar vein, the Windy-Grid application aims to reduce costs by providing information

about how the city runs in order to facilitate more effective city operations and guide long-term policy decisions. However, measuring this is a major problem for Chicago. Singapore has evolved into a global benchmark for urban innovation by transforming developmental challenges—such as water scarcity and land constraints—into lucrative business opportunities through progressive leadership and a commitment to "life-ability." By integrating sustainable policies with advanced ICT, the city-state maintains a highly productive, innovation-driven economy that mirrors the R&D intensity of nations like the Netherlands. Central to this strategy is the Economic Development Board (EDB), which actively attracts foreign direct investment through targeted incentives, ensuring a steady influx of global expertise to bolster its skilled workforce. This holistic approach ensures that Singapore remains a "smart" city that prioritized not just technological efficiency, but a high quality of life that serves as a replicable model for urban centers worldwide. Businesses with significant R&D expenditures, advanced technology, and high productivity are of primary interest to the EDB. Foreign design and architecture also pique Singapore's curiosity. Singapore is constantly searching for talent [129, 132]. To draw gifted students and academics from the area and beyond, it offers unique programs.

Today, smart cities are revolutionizing urban development by leveraging advanced data analytics and technology to enhance citizen quality of life, infrastructure efficiency, and sustainable economic growth. According to the Sustainability Magazine ranking, Helsinki leads globally for its citizen-centric digital twin project, Helsinki 3D+, followed closely by Dubai, which showcases high technological ambition through autonomous taxis and AI integration despite significant non-resident property ownership. Other global leaders include Seoul, which excels in connectivity and smart transit via Samsung SDS; London, which prioritizes open data and social participation through its partnership with Arup; and Tokyo, recognized for its Hitachi-powered disaster response capabilities. This competitive landscape is rounded out by New York's wireless management, Copenhagen's Siemens-integrated public transport, Amsterdam's Philips-driven energy efficiency, Singapore's urban mobility, and Barcelona's commitment to digital democracy, illustrating how diverse public-private partnerships are tackling unique local challenges like traffic congestion, housing constraints, and environmental risks.

VI. Smart City Business And It's Models

A smart city is neither a neutral, self-sufficient benefit nor an objective in and of itself. While a smart city is a place that supports innovation and businesses, reducing environmental impact will also improve the quality of life for inhabitants and employees. This support comes in the form of a number of services, including: e-Government, which facilitates communication between businesses and the appropriate authorities; efficient transportation, which enables employees to get to work quickly and safely; competitive pricing and performance of telecommunications media for businesses operating abroad; local cloud services, which can foster confidence regarding data security; and a dependable power supply, which is a crucial component of business continuity. At the very least, cheap energy is a competitive factor. Today, software development is a common area where innovation is realized. Information is the starting point for new applications. The software developer will have the chance to incorporate the data into new applications if the city makes it available for free in a machine-readable format. Open Data is the term for this accessibility in urban areas. Other "Open" movements, including open source, open hardware, open content, and open access, share the same objectives as the Open Data movement. Compared to product or process innovation, business model innovation yields higher profits. More than half of executives think that new business models are more advantageous than new products and services, which smart cities use to reach their full potential and take advantage of strategic economic prospects in their future undertakings (University of Sankt Gallen, Competence Centre for Business Models). Nowadays, the majority of sectors acknowledge—sometimes unwittingly—that digitalization creates new business models. We should be persuaded that discussing business models is at least as crucial as discussing projects and business cases, which are the most crucial aspects of developing smart cities. Like an Innovative Triangle, a smart city business model flips the conventional municipal business model on its head.

Despite its recent popularity as an urban planning model in both the theoretical and policy arenas, there is a startling lack of consensus over the definition of the term "smart city." The broad utilization of internet and communications technology (ICT) infrastructure to foster urban growth through improved service delivery, environmentally friendly development, and the building of social capital is frequently referred to as a smart city. Nevertheless, a significant percentage of the literature on smart cities is framed from a single perspective, with a primary emphasis on the technological, environmental, or social components. The governance aspect is neglected, and more comprehensive definitions have just recently emerged. The six attributes Hin and Subramaniam (2012) highlighted were developed by Giffinger et al. (2007) to evaluate the "smartness" of medium-sized cities throughout Europe: people, living, economy, mobility, environment, and governance [100, 101]. Townsend's "smart city" paradigm, which is similarly comprehensive, illustrates the convergence of urbanization with pervasive digital technology. This paradigm is characterized by four key "intelligent" drivers: markets, design and planning, governance, and the commons (Institute for the Future, 2010). This smart city perspective

acknowledges the extent to which ICT can impact urban human relationships, as opposed to segmenting the city (the model of six characteristics recalls the heritage of department-led municipal governance). The smart city distinguishes itself from its predecessors by emphasizing the specific tools that will facilitate the resolution of urban issues, such as embedded systems—sensor technologies, cell phones, and smart meters—and big data—vast and complex databases that are employed to analyze urban life [98, 99]. The physical smart city is supported by the following essential ICTs: public interfaces, cloud computing, open data infrastructures, smart personal gadgets, and widespread internet access [102, 107].

Local and national governments, utility companies, ICT firms, non-governmental organizations (NGOs), international organizations, chambers and industry associations, universities, businesses, and citizens are just a few of the many stakeholders in smart cities. Value offers for local clients could therefore be created by each stakeholder (or in groups). Therefore, it is possible to worry that every smart city service or product adheres to or ought to adhere to a modern or creative business strategy. Even in web-based scenarios, modern business models exist, and the city functions as a direct supplier of content and services to its residents and businesses [108]. However, different smart city business models have been described. The Municipality uses smart cities to draw tourists, residents, and investments, even if business models are not meant to be seen in public organization cases (such as Masdar, Gdansk, etc.). Additionally, some of the cases under investigation involve new business models, like the South Korean "city-in-a-box," which is copied in other Asian cases; the Dubai/Malta/Kochi Smart City, which capitalizes on the private investments of the businesses situated in the business parks; and Taipei Eco-city, which refers to a business model for sustainable growth. Representatives from two kinds of modern business models were assigned to these studies: 1. E-service business model [109] and 2. ICT network ownership and commercial enterprise transparency [110]. Every service group was regarded as being provided by a separate provider under the e-service business model (or groups of stakeholders). The network was regarded as the primary resource for the value proposition when a pattern was assigned. In doing so, the network owner provides value to both individuals and businesses. The application of business model patterns in situations where network-related business models were inapplicable is a significant result of this assignment procedure. Broadband, smart, digital, ubiquitous, and eco-cities are the circumstances where the unbundling pattern is most prevalent, and more precisely, in all cases where the smart city has access to and uses essential resources. This is a logical result given that each of these city shapes needs a distinct kind of infrastructure to provide services, such as networks, grids, sensors, etc. The unbundling pattern persists even if these facilities are rented for the provision of services. When the Internet of Things is used as the primary resource, things change, leading to the development of related IoT business models. However, current smart cities across many nations have not yet capitalized on the Internet of Things, leaving room for start-ups and other suppliers to increase the value of their clients [111, 112].

VII. Smart City Economy

In 21st century, smart cities drive economic growth and development by integrating IoT, AI, ML, big data, robotic, automation and data analytics to improve efficiency and comfort, fostering innovation, and enhancing competitiveness. Which will also create jobs in tech sectors, attract investment, and optimize urban infrastructure like transport, energy, health, finance, industry as well as boosting productivity distinctly and reducing operational costs for businesses. According to the smart city's economic dimension, the concept can be used to boost the urban economy. Specifically, it is anticipated that the smart city will "keep employment and fight against poverty through employment generation, support the innovative economy and wealth of cities" [99]. There is a wealth of research on regional competitive advantage and the traits that, in addition to technological prowess, make places like Silicon Valley more resilient to failure. These traits include a culture of openness between businesses and the institutions in a region and collective innovation [103]. The "presence of a creative class, the quality of and dedicated attention to the urban environment, the level of education, multimodal accessibility, and the use of ICTs for public administration" [104, 105] are all positively correlated with urban wealth. These components, which correspond with the six-part conception of the smart city—smart people, living (lifestyle), economy, mobility, environment, and governance—are viewed as the cornerstone of a new strategic agenda for European cities.

Smart city projects generate employment in IT, engineering, and data management, and attract a skilled workforce. Data-driven, connected environments are highly attractive to corporations, fostering innovation hubs and enhancing local GDP growth. Intelligence agencies and businesses will continue to want services from organizations like "Recorded Future" as the Internet of Things grows in scale and reach and generates even more data. According to Techopedia, the Internet of Things is a "computing concept that describes a future where every day physical items will be connected to the Internet and be able to identify themselves to other devices." In a 2011 report, Cisco describes the explosive growth in the number of internet-connected gadgets in recent years: There were 500 million Internet-connected devices and about 6.3 billion people on the earth in 2003. In 2010, there were 12.5 billion devices linked to the Internet due to the explosive expansion of smartphones and tablet PCs. According to Cisco IBSG, there will be 25 billion Internet-connected devices by 2015 and 50 billion by 2020.

Since over half of the world's population currently resides in cities, this trend is expected to continue, meaning that the smart city concept will have an impact on billions of people worldwide. Singapore is expected to become the first smart nation in the world, and India is leading the charge with plans to construct 100 smart cities over the next several years. However, smart cities are not limited to Asia; among the cities participating in IBM's "smarter cities challenge" are Glasgow, Rio de Janeiro, New Orleans, and Cape Town.

VIII. Smart City Challenges

AI creates prospects for more intelligent healthcare through the development of smart cities. Concurrently, the collection and exchange of information is necessary for these developments. Information sharing is often hampered by security concerns. However, the topics that come up most frequently when discussing the limits of incorporating progress into medical services are security and protection. There are three types of privacy-ensuring information withdrawal mechanisms being investigated that could provide residents of smart cities with confirmation. First, by making the information difficult to understand, it can be "camouflaged" while being collected. Second, ensuring the information's obscurity is a goal of protection-saving information mining in cases where the initially collected data will be sent to external parties [86]. This is a validation that certain arbitrary customers' identifiable attributes are identical to those of essentially k-1 different clients. Strategies such as removing mild attributes, increasing the range of touchy traits, or introducing fake information to confuse the honest qualities are some ways to achieve K-anonymity [122]. allowing sensitive information to be "concealed in the group." Due to multifunctional information, changing identifiers periodically is an alternative to downgrading a single, consistent identification for each client. Long-term and spatial client tracking becomes challenging as a result of this shift. When a client enters a space with k-1 other clients, it's the perfect time to alter the identification. Thus, it won't be possible to rapidly connect old and new IDs. Third, the outcome of information mining computations can be modified to prevent sensitive data from leaking. Once more, a gathering calculation's reasonability can be sufficiently reduced to fulfill execution constraints while limiting the risk of being used to identify individuals. Regardless of the combination of approaches used, it is crucial that all parties involved—city planners, strategy developers, and tech providers—agree on security measures and illustrate to city residents the potentially sensitive information sharing that could occur with smart city developments [115].

Both usability and accessibility A common theme in smart city initiatives is healthcare. However, the cost currently stands in the way of the inevitable adoption of advancements that can be used at the municipal and individual level. Long-term cost savings for the city and its residents can be achieved by incorporating technology into large medical care. In any case, the cost of the real development may prevent networks from adopting the innovation for a while [87]. There are several ways that smart cities make use of information and communications technologies. The goal of smart city platforms is to develop appropriate and play smart objects that can be delivered anywhere and blend in with their surroundings. Along with design observation, climate observation, security, and intelligent transportation, the things should aid in assessing well-being [20]. A Smart City needs "shrewd" citizens who actively participate in and effectively navigate new developments if it is to actually exist and thrive. Redetection of the smart city paradigm should be a part of the execution cycle of any new, comprehensive technology project. ember highlighting the advantages of the local area. This should be possible through a series of in-person civil focus-style gatherings, email campaigns to recruit voters, and an online preparation phase that stays up to date with the latest election results. Local communities are more willing to take advantage of developments and encourage others to do the same when they wish to influence the alternatives that affect daily life and are being passed on in a clever and pragmatic way. This is essential to the success of a Smart City [21]. Notwithstanding the wealthy and technologically advanced, it is crucial that Smart City orchestration incorporates the prospect, all else being equal. Development should always aim to bring people together rather than further dividing them based on factors like income or educational attainment [22]. Examining these networks in relation to the various topics covered in this article will improve the overall result of a solution outside the domain of knowledgeable clients [24, 25].

Smart cities integrate multiple domains, including transportation, energy, health, education, agriculture, business, social, banking, economy and governance, to create an interconnected and intelligent urban environment. The integration of smart technology and data-driven solutions in smart cities has all potential to revolutionize urban living by providing citizens with personalized and accessible services. However, the implementation also presents challenges, including data privacy concerns, unequal access to technology, and the need for collaboration across private, public, and government sectors [132]. Even though technology has a lot of appeal, becoming a Smart City will not be easy. Because it's simpler to start from a relatively fresh slate than to upgrade outdated infrastructures, legacy cities face considerable challenges. In this sense, newer cities in Asia and the Middle East have a clear advantage. Another encumbrance that can make the adoption of some clever solutions more difficult is very big populations. New technologies can be adopted more quickly in smaller cities like Zurich (400,000) or Helsinki (1.3 million). In the 2020 IMD Smart City Index, they came in second and third place worldwide, respectively. The following are examples of typical points of vulnerability:

- **Data breaches and privacy issues:** Cybercriminals are drawn to the enormous volumes of data produced by IoT devices or AI systems. Individual privacy is seriously threatened by unauthorized access to sensitive data, which can result in identity theft or other nefarious actions [29].
- **Infrastructure Vulnerabilities:** Public services, electricity grids, and transportation networks are all susceptible to cyberattacks. The functioning of cities and public safety may be significantly impacted by disruptions in these vital services [50].
- **Device Manipulation:** Malicious acts, such interfering with communication networks or changing data, can be carried out by compromised IoT devices or AI systems. The dependability and integrity of smart city operations are at stake as a result [51].
- **Denial of Service (DoS) Attacks:** Critical services can be interrupted by flooding systems with so much traffic that they fail. This may result in grid outages, traffic jams, or compromised emergency response systems in the context of smart cities [52].
- **Risks of Surveillance Systems:** Smart cities and security technologies coexist. However, having inexperienced staff and ineffective processes can be risky and lead to cyberattacks even with the strongest technology defenses. In the event of a cyberattack, security and emergency alarm systems are the most vulnerable and might have the most effects [154]**.**
- **Device Hijack:** Because a smart city's infrastructure is made up of millions of devices, attackers often try to take over a device in order to obtain control. Because the item has continued to function as intended, users might not be aware that someone has taken control of it. Once in control, a hacker can take advantage of other networked devices. For example, they might utilize smart meters to steal electricity from a municipality or employ ransomware to threaten a city's energy management system [97].

Deakin defines a smart city as one that utilizes ICT to meet the needs of the market (i.e., city people) through community participation [57]. As an alternative to broad notions that are difficult to define, investigations of smart city projects could be employed to elucidate the concept of smart cities [58]. Data is collected from individuals, devices, structures, or cameras. Smart cities are employed in a variety of applications, including traffic and transportation systems, power plants, utilities, urban forestry, water supply networks, trash disposal, criminal investigations, information systems, schools, libraries, hospitals, and other community services [30]. The cornerstone of a smart city is the integration of people, technology, and processes, which connect and interact across industries such as infrastructure, healthcare, transportation, and education [31]. The monitoring, analysis, planning, and governing procedures of their local governments are the defining characteristics of smart cities. In a smart city, the interchange of data involves businesses, people, and other parties who stand to benefit from its utilization [32]. Outdoor lighting, public transportation, and visual surveillance were the three primary sources of expenditures associated with smart cities as of 2022 [34]. In order to optimize city services and foster a relationship with their residents, smart cities integrate ICT (information and communication technologies) and IOT-connected devices [35]. ICT has the potential to enhance the quality, performance, and interactivity of urban services, as well as to reduce resource consumption and costs, and to enhance communication between the public and the government. Smart city applications regulate urban flows and facilitate real-time responses [36].

Figure 4. Smart city surveillance system [125] and ensure cyber security in smart city [126].

A geographic information system (GIS) enables government staffs to easily tap into existing data and citizen feedback, and use that information to answer the most important questions about what is best for the community. However, a GIS is more than a map, it's a communication channel that reveals underlying relationships and informs decision-making by placing you and what's important to you within the context of geography. Location intelligence must be at the core of smart city planning and design. The role of GIS is to provide a trusted framework for decision-making and communication that everyone can use [153]. Compared to a city that has a traditional "transactional" relationship with its residents, a smart city might be more equipped to handle difficulties. However, there are numerous ways to interpret the phrase [35]. Smart city technology has already been used in a number of cities. Initiatives for smart cities have drawn criticism for being corporate-driven [37], poorly tailored to the requirements of locals [39], generally unsuccessful, and a step toward totalitarian

surveillance [40]. Cybersecurity must be a key factor in the transition to smarter and more connected urban environments [26]. Although there are many advantages to IoT and smart cities, there is also a duty to protect inhabitants' safety, privacy, and general well-being [41]. Smart cities can create a secure foundation for the future and one where innovation and resilience go hand in hand by implementing preventive measures, adopting strong cybersecurity practices, and cultivating a culture of awareness. This will guarantee a connected urban landscape that is not only intelligent but also safe and reliable [46]. IoT, AI, and smart city cybersecurity best practices:

- **Encryption and Secure Communication:** Use strong encryption techniques to protect information sent between networks and devices. This guarantees that the information is kept private even in the event that it is intercepted [42].
- **Regular Software Updates and Patch Management:** Update IoT systems and devices with the most recent security fixes. Frequent software updates aid in patching security holes that hackers might exploit [43].
- **Network Segmentation:** To reduce the possible consequences of a security breach, isolate important systems and network parts. By doing this, vital portions of smart city infrastructure are shielded from unwanted access [44].
- **Authentication and Access Control:** Put in place robust authentication procedures to confirm users' and devices' identities. Strict access restrictions should be implemented to guarantee that only authorized users can communicate with IoT systems. [45].
- **Security by Design:** From the beginning of IoT devices and smart city initiatives, integrate cybersecurity measures. Instead of being an add-on, security should be a crucial component of the design and development process [47].
- **Incident Response and Recovery Plans:** Create thorough incident response plans to quickly handle cybersecurity issues. A clear plan in place speeds up recovery efforts and lessens the impact of a security incident [48,59].
- **Public Awareness and Education;** Inform stakeholders and the general public on the significance of cybersecurity in smart cities. To enable people to defend themselves and support citywide security, cultivate a culture of cyber awareness [49, 53].

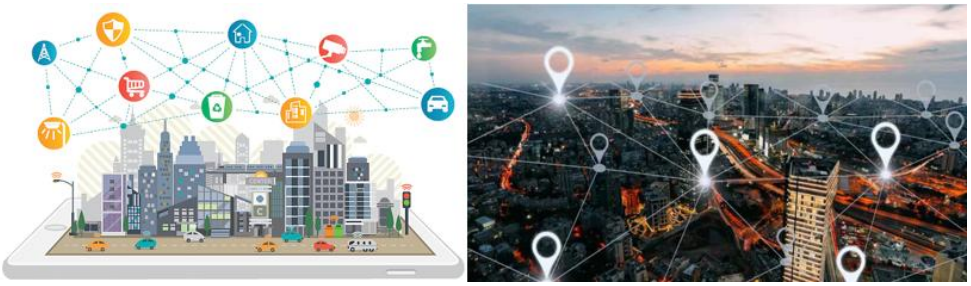

Figure 5. Use of few smart technologies and solve the challenges in smart city in high-tech era [60, 61].

IX. Legal And Ethical Aspect Of Digital And Smart Technology

One of the major problems caused by the fragmentation of regulations on a regional level is the global Internet of Things ecosystem. Lack of global data policy uniformity makes it difficult to deploy IoT solutions efficiently in every jurisdiction. For example, GDPR outlines strict cross-border data transfer laws that are not covered by CCPA. Regional regulations, such as India's DPDP, place additional limits on global scalability due to their focus on data localization; frameworks, such as the Privacy Act of Australia and the PDPA of Singapore, need to be flexible enough to accommodate the rapid evolution of the Internet of Things (IoT) sector. Data protection policies around the world need to be standardized to address these issues. Unified standards that strike a balance between privacy, security, and innovation can facilitate international cooperation, lower costs, and simplify compliance. By conforming to these new standards, internet of things (IoT) developers can build AI and IoT systems that are user-friendly, secure, and scalable on a global scale [82]. Unauthorized access to tracking devices is a major security concern in the Internet of Things ecosystem because hackers can take control of equipment that are specifically designed to monitor and acquire sensitive data. Several techniques exist for executing such attacks, such as evading security measures, using stolen or compromised credentials, or exploiting firmware vulnerabilities. Most users' privacy may be violated if attackers gained unauthorized access and changed the data being received, disabled the tracking device, or listened in on users' actions. Because hackers can get knowledge about users' habits, health data stream, preferences, and behavioral patterns with just one infiltration, this is a worrying situation for home digital twins. Improper handling of such data could lead to fraud, identity theft, or even worse, physical invasion, including the theft of a user's house or vehicle. Cyberattacks on AI and IoT are on the rise, and the more sophisticated these attacks are, the more they target specific aspects of human lifestyle, such as homes, wearable technology (home space), or vehicle type [83, 152].

Although Bluetooth beacons improve data anonymization, they are not always secure and can be abused. Additionally, wireless connection tracking offers relatively little protection against cybercriminal activity and is highly vulnerable to privacy invasion and misuse. Biometric sensors have better data anonymization than other technologies, but they can raise privacy concerns despite being useful for identification. These monitoring techniques demonstrate that the performance and level of dangers in IoT systems vary, therefore it is necessary to consider tracking in light of privacy and security concerns. Once more, the widespread presence of IoT devices—the majority of which lack robust security measures—contributes to the ongoing issue of illegal access. It is also more difficult to guarantee consistent protection because of the differences in security methods between manufacturers and devices. Furthermore, consumers usually neglect to change the default security settings or update the software on their devices, leaving them vulnerable to attack. Attackers may occasionally utilize password-protected or password-free devices to listen in on data as it is being transmitted, and if the encryption technique is inadequate or nonexistent, they may be able to retrieve important data [84]. The Home Digital Twin system's trust and privacy are also jeopardized by tracking devices' illegal access. Smart thermostats, security cameras, alarms, and other devices that monitor and regulate vital operations could be tampered with to cause havoc in a home. This would occur if hackers took over security systems, altered environmental controls, or sent malicious commands to other devices that were connected, causing the system to malfunction and possibly turn malevolent. This emphasizes how crucial it is to have thorough privacy and security measures in place to stop unwanted access, which will only increase as IoT devices become more integrated into daily life [85].

False data injection attacks over tracking devices in IoT systems could compromise the entire Home Digital Twin ecosystem's integrity and reliability [86]. Attackers intentionally inject false or misleading information into the system to taint the tracked and sent data of IoT devices. Instead of powering down the devices, we can alter the data they receive or share in order to influence the system's decision-making or behavior in hostile environments. The impact of fake data injection attacks can range from minor disturbances to complete system crashes, depending on the data's intended use and the significance of the decisions dependent on it. One common method for injecting misleading data is intercepting and modifying the communications between the Internet of Things (IoT) devices and the control system or cloud platform. One example could be an Internet of Things (IoT) gadget for smart homes that records data on environmental monitoring, such as energy use, humidity, and temperature. It is possible for an attacker to inject the system with bogus data, leading it to incorrectly define normal ranges for environmental circumstances [87]. For example, if no one is home, it's possible to fool a thermostat into thinking the house is hotter than it actually is by directing the heat to different areas or floors. At their worst, these might create catastrophic failures, like home systems breaking down, or even more dangerous safety risks, such a data breach that triggers false fire alarms. Redundancy and cross-checking by many devices are also critical safeguards against bogus data injection [88]. In addition to finding discrepancies between different sensors or devices tracking the same data, this system has the ability to identify outliers as potentially fabricated data [89]. When multiple smart thermostats in a building detect an anomalous temperature difference, for instance, they can coordinate an inspection to confirm the data's accuracy. Particularly in fields like security and health monitoring systems, where data manipulation is possible, having similar data from many sensors can help detect these incorrect attempts to enter false data [90]. Last but not least, machine learning algorithms can be used to identify these suspicious patterns of fake data injection. These models are able to learn normal behavior by rapidly identifying unusual (irregular) data values that deviate from the expected pattern. Historical device data might further improve the models by illuminating patterns that can indicate data manipulation and offering a broad comprehension of typical device usage.

Data protection, accountability, and the secure implementation of autonomous systems are the main concerns of legal frameworks. Future legislation is influenced by ethical considerations, which frequently come before formal regulation. Concerns of widespread surveillance and the degradation of individual privacy in areas that are customarily regarded as private are raised by the continuous monitoring capabilities of smart devices such as wearable health monitors, smart home sensors, and security cameras. As is well known, AI systems and Internet of Things devices learn from data and networks, which can carry ingrained societal prejudices. This can result in biased outcomes in fields like law enforcement, recruiting, and finance. To guarantee justice and equal treatment for all demographic groups, it is morally necessary to recognize and address these biases. However, a loss of human control and a decline in critical thinking abilities might result from an over-reliance on automation, IoT devices, and AI or ML-driven decision-making. According to ethical design principles, systems should encourage digital literacy, prioritize user interaction, and permit manual overrides. Furthermore, there is an ethical worry that some groups of people may not be able to profit from smart technology because of their location, socioeconomic level, or lack of digital proficiency, which could exacerbate already-existing social disparities. Once more, the opaque nature of many AI algorithms makes it challenging to comprehend the decision-making process, undermining openness and confidence. Clear disclosure on data collection and use is essential for ethical practice in order to foster user trust and accountability.

The responsible adoption of IoT and AI-powered smart homes is greatly influenced by the legal and

regulatory environment, especially in developing countries like Bangladesh and any burgeoning digital economy. We require some kind of digital or smart economy policy and strategy, which should offer a thorough framework that guarantees and strikes a balance between innovation and the defense of individual rights. This calls for vigorous and appropriate regulation, regulatory sandpiles, and robust institutional cooperation. Ethical IoT, AI, data governance, and cybersecurity must be given top priority in the policy in order to guarantee that smart home technologies function in a setting that respects human rights and is people-centered [4]. by giving regulatory organizations like the national cybersecurity authority and the national data protection commission/authority more jurisdiction. They should be in charge of the seamless digital transformation of pertinent smart technology use sectors and must promote public awareness and stakeholder participation. In addition to supporting equitable growth, digital literacy, personal safety, data/digital security, and the development of a strong, meaningful, and sustainable digital or smart economy, such a holistic strategy is in line with worldwide best practices [7]. IoT, AI, data protection, and cybersecurity laws must be sensible and well-balanced in order to address the intricate relationship between innovation and each person's right to use the internet. Transparency, equity, and accountability are among the values outlined in the UNESCO guideline on the ethics of IoT and AI [5]. Once more, because of the speed at which technology is developing, there will be challenges in the future in regulating and using IoT and AI-powered smart appliances. Therefore, it is necessary to make adjustments and ongoing revisions to the regulations, as well as strike a balance between the risk of strangling innovation and aggressive regulations.

The quick development of smart technology raises a number of ethical and legal issues. Data protection and privacy are two of the main issues. Lawyers must manage the ethical responsibilities of protecting client confidentiality and preserving the privacy of sensitive information when technology gathers and analyzes enormous volumes of personal data. The possibility of bias and discrimination in technology-driven decision-making processes, such as algorithms used in legal research or IoT, AI, and ML employed in predictive analysis, is another matter of concern. Legal practitioners need to make sure that these technologies don't reinforce unfair prejudices or provide unfair results. Additionally, concerns including cybersecurity, the unlicensed practice of law via internet platforms, and the moral use of social media by attorneys are also relevant. Legal professionals need to keep up with technological developments, create ethical standards, and strike a balance between using technology for its advantages and adhering to ethical and professional requirements [91]. Legal practitioners need to increase awareness and educate themselves on a constant basis. It is essential to keep up with technology developments and comprehend their ramifications. In a technologically advanced society, maintaining competency and ethical standards requires active participation in continuing education and training. It is crucial to create and adopt best practices and ethical standards tailored to smart technologies. In order to create thorough ethical frameworks, professional associations and governing bodies are essential. These frameworks ought to address issues like cybersecurity, privacy, data protection, bias reduction, and ethical social media use that are brought on by smart technology [92]. In order to resolve complex legal or ethical crises or challenges in the near future, technology specialists and legal professionals must collaborate in the twenty-first century.

Artificial intelligence, machine learning, data science, robotics, and other cutting-edge technologies are continuously changing and influencing our lives. Our lives are improved by the new breakthroughs and developments brought about by new technology. We can now accomplish tasks more quickly, more effectively, and in ways we never could have previously thanks to new technology that keeps pushing the envelope. Whether it is in transit or at rest, we must make sure that all sensitive data is encrypted. To make sure AI systems and IoT devices are operating accurately and morally, we must schedule routine audits. Our staff needs to receive frequent training on ethical AI use and the most recent cybersecurity best practices. Interdisciplinary communication and teamwork are essential. Experts in technology, artificial intelligence, data science, and cybersecurity should interact with legal professionals. This cooperative strategy guarantees a thorough grasp of the ethical ramifications associated with evolving technology, encourages creativity, and encourages accountability. It is now a constant process for regulatory frameworks to change in tandem with technology improvements [92]. Legal professionals and technology stakeholders should be actively involved in the creation and revision of laws and regulations by governments and policymakers. These policies successfully handle ethical issues like data governance, privacy protection, and algorithmic decision-making responsibility. Future legal issues and the environment will be more technologically advanced and complex.

Today, it is essential for policy maker of developing nations considering critically to develop policies that promote lifelong learning and continuous smart skill development, ensuring that the workforce remains agile and adaptable to the rapidly changing demands of smart cities. These could include offering incentives for businesses to invest in the ongoing education of their employees or implementing urban development plans that seamlessly integrate technology and learning spaces into the city landscape [138]. So, effective strategies like investing in employee training programs, promoting cross-departmental projects, facilitating mentorship and knowledge-sharing sessions to develop smart skill for citizen is very important. For all stakeholders including citizen of smart city, relevant study emphasizes the importance of digital engagement and smart technology

friendly approach as a key driver of skill development. Therefore, it is imperative to ensure digital and smart technology inclusivity and literacy, guaranteeing that all citizens, regardless of age or background, have access to the digital and smart resources and training necessary to flourish in a smart city environment [139]. Additionally, developing and accessing specific policy and educational involvements need to be inform stakeholders in creating effective programs for lifelong learning of smart skill development across diverse demographics and career stages in smart city environments in 21st century [140].

X. The Best Smart Cities Around The Globe

Smart cities go far beyond the mere installation of sensors; they require a sophisticated understanding of how to integrate IoT and AI to foster sustainability, resilience, and economic growth. By moving past the "buzzword" phase of technology, cities like Singapore, Zurich, and Oslo have demonstrated that real-time data analysis can revolutionize infrastructure—ranging from coordinating rescue robots through smart fire sensors to optimizing renewable energy grids and waste management. These innovations do more than just lower energy costs; they introduce sustainable commerce models and mitigate urban challenges like traffic congestion and air pollution. Ultimately, the success of a modern smart city depends on its ability to transform raw sensor data into immediate, actionable responses that directly improve the safety and daily quality of life for its residents.

Singapore

Since 2014, Singapore has evolved from a smart city into a comprehensive "Smart Island," anchored by a groundbreaking national digital twin that serves as a virtual replica for real-time urban optimization. This sophisticated infrastructure allows the city to move beyond reactive management to a predictive model that significantly enhances "life-ability" for its residents—from professionals enjoying streamlined commutes to an elderly population benefiting from proactive emergency services and safer, widened walkways. By integrating a vast IoT ecosystem and advanced 5G connectivity, the government has successfully deployed autonomous vehicle pilots, smart surveillance, and real-time monitoring of water levels and traffic congestion to create a truly citizen-centric environment. Ultimately, Singapore's journey offers a roadmap for the future [145], proving that the synergy of digital twin technology, data-driven policy, and a commitment to public well-being can transform a high-density nation into a resilient, globally leading smart ecosystem where every street and building is part of an intelligent, constantly learning network. Singapore has become the top smart city in the world in 2022 and that has been shown in figure 6 below [91].

Figure 6. Singapore is the top smart city in the world [91].

Additionally, Singapore's government remains deeply committed to environmental sustainability, implementing IoT-driven initiatives like smart waste bins that notify services when full to optimize collection, improve air quality, and align with United Nations environmental regulations. Beyond sanitation, the city-state has integrated innovative digital services into daily civic life, such as the Singapore Police Force's web-based electronic center for seamless report filing and the Singapore Power mobile app, which empowers citizens to audit home energy usage and manage smart meters directly from their mobile devices. By leveraging a vast network of access points and allocating significant resources to these projects, Singapore is cementing its position as a global leader in utilizing the Internet of Things to create a more responsive, efficient, and ecologically conscious urban ecosystem.

Zurich

Topping the IMD Smart City Index for five consecutive years, Zurich sets the global standard for urban living by seamlessly blending technological innovation with exceptional livability and natural beauty. The city's digital transformation is driven by a lean, transparent collaboration between the municipal government, Swiss Federal Railways (SBB), and local utilities, focusing on high-impact initiatives like 3D city mapping, smart grids, and the integration of IoT sensors to optimize energy consumption and digital security. Beyond its technical prowess, Zurich maintains its status as one of the world's most beautiful and sustainable cities, balancing modern smart infrastructure with its historic Altstadt, over 70 green spaces, and a circular waste management system. By prioritizing greenhouse gas reduction and public safety through data-driven planning [146], Zurich proves that a smart city's success lies in its ability to enhance both its economic efficiency and its rich cultural and geographic landscape. Zurich has once again taken the top spot as the world's smartest city in 2025, based on the latest IMD Smart City Index from the International Institute for Management Development (IMD) and that shown in figure 7 below [94].

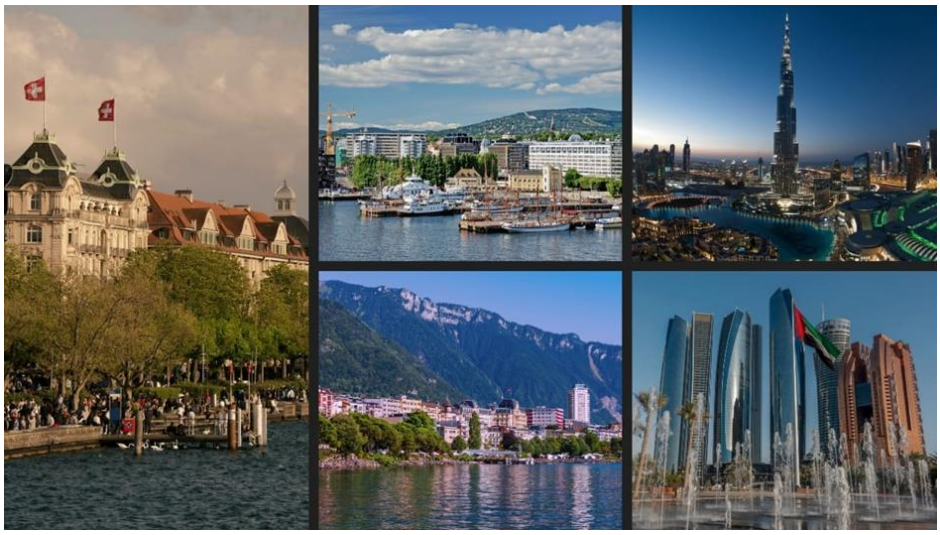

Figure 7. Zurich own the crown of the smartest cities in the world in 2025 [94]

Zurich has emerged as a premier role model for the Swiss smart city concept by prioritizing a deep understanding of social needs alongside its "climate-neutral" mobility and sustainability goals. While not an early pioneer like New York or Tokyo, the city has rapidly scaled its digital landscape through massive investments in fiber-optic networks and a unique "smart community" model that integrates outlying metropolitan areas into a unified service grid. A standout success of this strategy is the deployment of smart streetlights and a collaborative framework where transportation, energy, and water suppliers co-develop integrated IoT solutions, such as smart grids and advanced metering. Under the leadership of the municipal government, Zurich is currently developing a comprehensive mobility platform to streamline public transit in a resource-saving manner, ensuring that every technological layer—from smart traffic signals to the overarching digital infrastructure—serves to reduce costs while fundamentally elevating the inhabitant's quality of life [141].

Oslo

Oslo, recognized as the European Green Capital 2019, has solidified its status as a global smart city leader by prioritizing deep decarbonization and inclusive innovation. Central to its strategy is the E-Street project, an intelligent lighting initiative that has achieved over 70% energy savings while utilizing multi-purpose sensors to monitor environmental data like humidity and rain, which in turn optimizes waste collection operations. As the world leader in electric vehicle (EV) adoption, Oslo plans to phase out internal combustion engine sales by 2025, supporting this transition through aggressive incentives and a "Climate Dashboard" that allows citizens to track environmental progress in real-time. Beyond mobility and energy, the city addresses the social dimensions of urban aging through the "Alma's House" project, a demonstration flat equipped with assistive technology for dementia patients, ensuring that technological advancement remains human-centric. By integrating autonomous parking guides, solar-powered infrastructure, and smart public transit, Oslo is actively pursuing its goal of carbon neutrality by 2050 while ensuring no citizen is left behind in the digital transition [147].

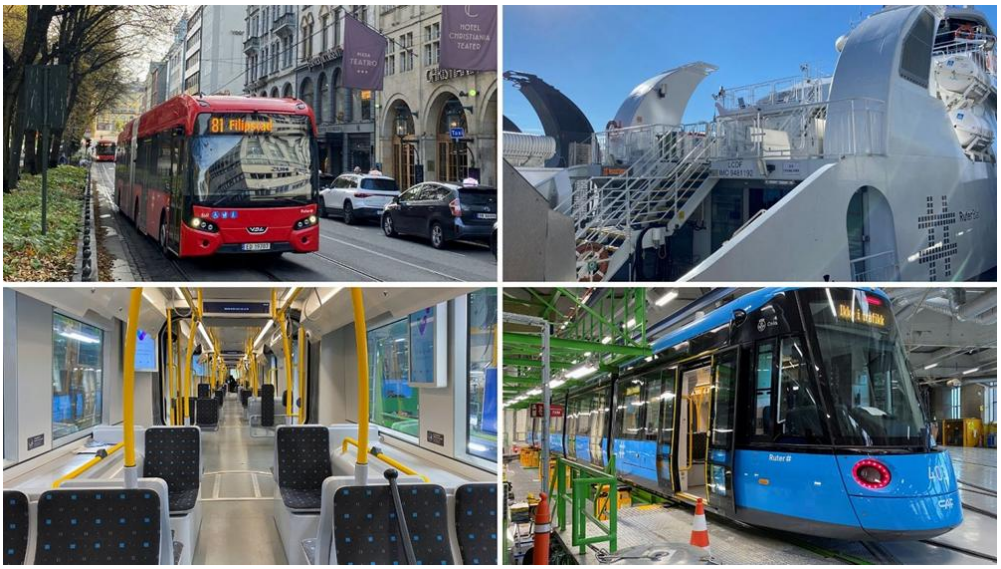

Figure 8. Oslo is one of the top sustainable smart cities in the world [142].

Oslo further strengthens its smart city profile through extensive public-private partnerships and the "Smart Oslo Pitch," a competition designed to harness entrepreneurial innovation for improving urban quality of life. The city's multi-phase development strategy includes six core smart projects focused on enhancing accessibility for both businesses and the local population, effectively mapping neighborhoods to identify and resolve resource constraints. By scaling initiatives such as automated streetlights, smart parking systems, and expanded bicycle rental networks, Oslo is streamlining the daily commute while fostering a more inclusive urban environment. These collaborative efforts, highlighted in recent development reports [141], underscore the city's commitment to making sustainable infrastructure not just a technological achievement, but a practical tool for universal accessibility and green growth.

XI. Developing Successful Smart City

Today, the advent of smart cities could be a much larger wave of transformation and that is about to stumble the entire world. The detailed content, feature and nature of smart cities in this high-tech era vary from country to country, and that depending upon geographical condition, ecosystems, resource availabilities, safety pattern, comfort aspect, and major challenges being faced. Many pilot projects have been taken up around the globe to emulate such cities. Many countries have rolled out grand plans for the development of both greenfield and brownfield smart cities. However, as the United Nations projects that 60% of the global population will reside in urban areas by 2030, cities are increasingly adopting smart technologies to address the complex challenges of rapid urbanization, including crime, congestion, and inefficient waste management. With global investment in smart initiatives rising toward an estimated $135 billion annually [41], the success of the city of the future hinges on a well-organized, multi-level strategy that prioritizes the "human" element of urban life. To prevent the loss of talent to competing regions, municipal leaders must deploy a suite of integrated services that reduce infrastructure costs while simultaneously boosting economic growth and sustainability. By utilizing data-driven applications to optimize public transportation, emergency response, and essential utilities, cities can create the efficient, high-quality environments necessary to satisfy and retain their growing populations [62, 63]. Using geospatial technologies can help city leaders bring their smart city visions fully to life by turning location-based data into location intelligence to empower quality-of-life and safety-related city developments. For example, smart monitoring of power and water systems can lead to earlier identification of disruptions and get services back online quickly for public utilities, driving more efficient infrastructure operations and management [38]. A smart city develops an advantage by delivering relevant geospatial data, workflows and analytics to any device in the hands of local government, services providers and residents interested in making the city a better place to live. By implementing this technology in different services, it is possible for city leaders to monitor changing environments and be better prepared for what's to come. Smart city surveillance system showcases a modern surveillance system integrated with advanced technology, introducing multiple high-definition cameras with a large digital display panel and that should be ideal for urban security, smart city initiatives, and technology-focused content. The system is designed to enhance public safety and monitor urban environments competently [154].

Identifying the community responsible for smart city development is a vital component of a smart city creation process. This will allow smart sustainable cities to secure the power of new information and technologies.

It is important to identify the community's attributes to create a smart city [46]. What is more, it is incredibly important to study the social environment for effective smart systems management and integration. Investment management is another essential component of smart infrastructure success. The challenges are numerous, and overcoming these obstacles will require a systematic approach. In some cases, budget constraints may prevent cities from developing smart city initiatives. The city needs to invest in a variety of smart technologies, including AI, smart city applications, IoT, and smart tools as well as other smart city devices. From travelers and commuters becoming accustomed to having ubiquitous access to real-time transportation data on their smartphones to the rise of green fleets, smart city transportation is all about digitally driven solutions that fully optimize the movement of people. Smart parking is gaining traction. It not only allows for tracking and monitoring of parking spots in garages and on streets, but also helps reduce traffic and pollution and provide a better citizen experience. Making cities smarter, safer and more sustainable is a key vision for many city leaders. In addition to tracking air quality, it is also possible to monitor energy use, electricity, water and waste tracking, which can provide critical insights for developing sustainability policies. Keeping citizens safe and secure is foundational for today's cities. From sensors and video intelligence to citizen reporting to enabling cross-department collaboration for responding to incidents, there are many facets and solutions related to smart city safety and security [41]. City officials need to implement clear policies and which will improve the quality of life for their residents. To do this, smart cities should implement equitable policies that benefit all people. Small cities, particularly those in developing countries, must also have a public policy that protects the environment since more than half of them are facing problems with them [38]. Future smart cities will open up a host of new possibilities and hope, by improving the quality of urban spheres along with safe and comfortable life of citizen and making them more connected with advanced technology to provide a holistic living experience by reducing jammed spaces, pollution and taking the basic architecture of urban planning models to a new course. Smart cities are certainly the future of urban habitation and various governments around the globe have started preparing the roadmap for developing existing, safest, and comfortable cities. For example, China smart cities as digital evolution at scale has been shown in figure 9 below [153].

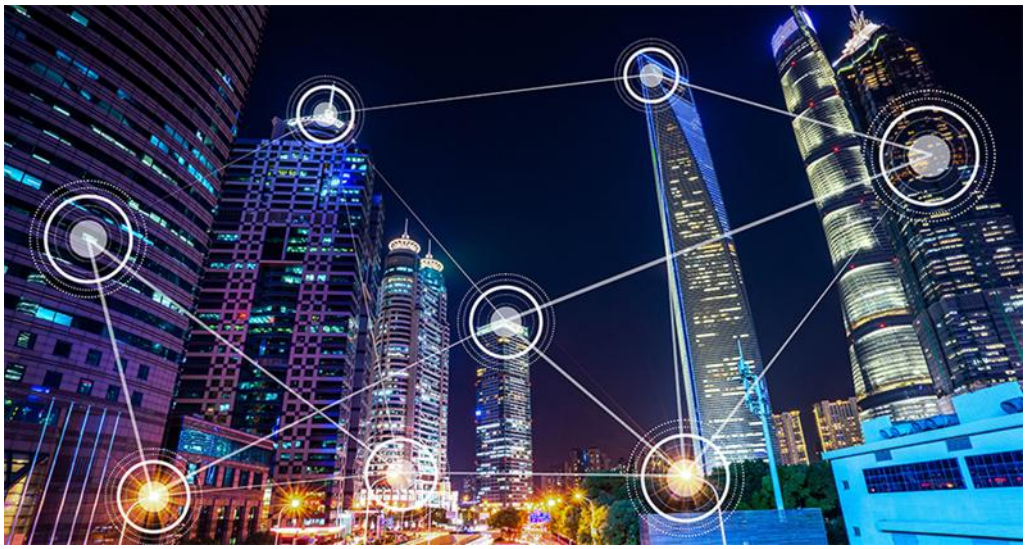

Figure 9: China smart cities as digital evolution at scale [153]

By implementing innovative city services that allow effective real-time data analysis, governments will be able to better serve their citizens and use collected data for the improvement of entire city life. By developing a sustainable strategy, smart cities will create new revenue streams and cut costs. Enhancing the air quality in any city through smart city technology can play a major role in improving life for all citizens. Thankfully, there has been a tremendous leap forward in air quality sensing for smart cities [41]. With water and electricity systems being a core part of a city's critical infrastructure, today's smart water and power innovations allow for rapid responses and cross-department coordination in real time, when a burst water pipe or power outage impacts an area of a city. There should have smart home infrastructure solution. There need to solution for tracking different changes in a house, including humidity levels, temperature changes, light, movement, and many other things that occur in the home, office and community environment. There should be devices to measures CO2 and dust particle levels for the constant improvement of air quality in different indoor environments [141]. The solution which can simplify the management of room occupation, meetings scheduling, and planning of work conferences, using big data collected previously and generated statistics. There should be quality and capable organization in the field of advance technology which can find solution to provide support by delivering devices and IoT or AI platform

solutions. They need to be specialized in a range of IoT and AI application fields, including smart cities, agriculture, transportation, banking, business, healthcare and many more. The devices which can helps to track, monitor and manage working assets in difficult RF environments, such as medical institutions and departments at global and local levels [46]. There should be enough cloud solutions for a range of vertical applications. They should have gateways, sensors, and wireless network management platforms which can be deployed in multiple frequency bands. The smart products of the organization should be highly reliable and scalable, ensuring the lowest cost of ownership possible. Additionally, they need to create a customized smart cities solution for our clients [63]. Today, many societies have decided to go ahead because of the greater advantages and requirement of smarter systems for ensuring a quality, comfort, and safe life for citizens. The revolution of upcoming smart cities in future will be the most holistic movements, and that may require wide participation and contribution from almost all fronts of the society, and that only can ensure substantive and sustainable development [144].

XII. Conclusion

Today, we are living a era of smart and advance technology. By 2030, AI is expected to require the transformation of about 75 million to 375 million jobs globally, according to forecasts by MGI Research. In addition, the MGI study emphasizes the establishment of new roles and duties. The American Economic Association's researchers agree with the MGI's predictions, stating that only a few jobs can be fully mechanized, even though some tasks can be automated. The world is now more interconnected and operates as part of a global financial and economic ecosystem. The 2008 financial crisis severely damaged the economies of developing and least developed countries, causing economic contraction, social and political unrest, and a general decline in the standard of living for the general populace. It is clear that any setback on one side of the globe would have an impact on the entire global economy. The world is waiting for the same financial crisis. Along with digital and smart technologies like IoT, AI, ML, DL, big data, blockchain, etc., organizations that have emerged in 21st have grown increasingly complex in the areas of information and communication. People's interpersonal relationships, communication styles, professional lives, and skill sets have all changed as a result of this circumstance. According to Warren Buffett, artificial intelligence is profound, but it also poses serious threats and ethical dilemmas that are comparable to the development of nuclear weapons. He emphasizes that the development and application of technology must have a purpose and that moral principles like accountability and integrity cannot be compromised. One of the most basic factors that improved openness and transparency, according to Mark Zuckerberg, is the growing emphasis and that lead to deeper social interactions, better connections, and trustworthiness. Rapid urbanization in this high-tech era has presented benefits as well as challenges. The complicated demands of urban life have led to the emergence of smart cities as creative solutions. The foundation of this change is ICT, which integrates public services, infrastructure, and environmental sustainability. While AI, ML, robots, IoT, and big data improve urban planning, optimize resource usage, and fortify governance. Natural resources and energy, transportation and mobility, infrastructures, governance, economics, and humans are the six core areas and associated sub-domains of smart city sending. To understand the relationship between various geological, urban, demographic, human resources, ecological, and innovation-related aspects, a dataset of logical factors has been compiled, and deterioration analyses have been guided. In reality, there isn't a single, globally recognized definition of smart cities, and the most recent developments and examples of smart city development typically depend on neighborhood setting variables. In the era of rapid urbanization and technological advancement, the concept of smart cities has emerged as a revolutionary approach to urban development. Today smart cities influence cutting-edge technologies to create more efficient, sustainable, comfortable, and livable urban environments with optimum safety and security of the citizens.

The concept of smart cities has recently gained attention and will likely continue to do so in the future. Smart innovations can help metropolitan communities manage traffic streams, reduce the use of fossil fuels in products, and set aside money. There are many different stakeholders involved, such as local experts, citizens, innovation groups, academics, etc. with different idea of what a smart city should be. For all of the benefits offered by smart cities, there are also challenges to overcome. These include government officials allowing widespread participation from citizens. There is also a need for the private and public sectors to align with residents so that everyone can positively contribute to the community. Smart city projects need to be transparent and available to citizens via an open data portal or mobile app. This allows residents to engage with the data and complete personal tasks like paying bills, finding efficient transportation options and assessing energy consumption in the home. These all require a solid and secure system of data collection and storage to prevent hacking or system misused. Smart city data also needs to be anonymized to prevent privacy issues from arising. The largest challenge is quite probably that of connectivity, with millions of IoT devices needing to connect and work in harmony. Though far less glamorous, the future of waste and energy management is another way that Blue IoT can improve our cities of tomorrow. However, a city can use IoT to monitor the temperature of its citizens, which is crucial for a healthy and sustainable environment. These services are the most beneficial solution to the city environment and the residents. Right now, waste collection and disposal, overconsumption, and carbon footprint are three of the

biggest obstacles that cities have. The IoT, computing continuum, big data, AI, ML, etc. are converging in the 21st century, making smart cities a reality. Data localization, scalability, and responsiveness are handled via the computing continuum (edge-fog-cloud-HPC). These days, smart cities are touted as the way to handle city issues like pollution, trash, and overcrowding. When discussing the company strategy, nevertheless, these ideals do not emerge as obvious. Particularly, whether it's through increased internal efficiency (web-based models), financial gain (network providers), enhanced city appeal (e-commerce models), or uniformity, all of the studied business models seem to benefit smart city owners. There is debate on the vendor-imposed technological push, even as smart city development is on the rise. Sustainable, citizen-centric, and real-time urban services are made possible by the incorporation of new paradigms into smart cities.

To tackle issues of digital inequality, ethics, and privacy, policies and e-governance will need to change in tandem with technology. However, holistic integration of advanced technology and data-driven methodologies, are not merely altering the architectural landscape but fundamentally reshaping the societal fabric, economic operations, and life's quotidian beats, mainly within the ambit of growing markets. Today, this rapidly transforming urban environment, the pivotal role of human capital, especially the acquisition and application of smart and advanced skills, is increasingly pronounced. These competencies, summarizing a diverse spectrum of skills including and that not limited to critical thinking, creativity, collaborative prowess, and digital literacy, are deemed essential for individuals to navigate and excel amidst the ongoing flux of urban transformation and technological progression. The acquisition and refinement of these smart skills are instrumental in fostering a workforce to drive innovation and productivity within the smart city ecosystem. As rapid changes to technology are coupled with accelerated citizen demand, today's smart city solutions must be capable of adapting swiftly and reasonably. This means enhancing the efficiency of all urban operation and services, while also meeting the needs of future generations. As such, all smart city technologies should have an eye towards the future and should be easily replicated as a city evolves. A recent report by the United Nations showed that five out of 10 people living in the world will sooner or later live in urban areas. It requires a new concept of managing sensitive information with various ways to automate processes in the city. Using these smart technologies, many cities can improve energy consumption, energy distribution, and overall sustainability. Moreover, cloud-based IoT applications and AI can help manage big data in real-time and make quicker decisions. IoT and AI can help cities automate many processes and provide better public safety. That is why the decision to integrate IoT device network and AI into the city infrastructure is the decision that has to be made for a better quality of life and comfort. Now it's time to take a step toward the future of smart life. The future smart cities will serve the purpose of socio-economic development and citizen-centric governance, instead of procedural governance, without posing a threat to security, stability and integrity of the citizens and the society as a whole to ensure safety, comfort, sustainability and balanced ecosystem.

References

[1] Hossain K A, (2015), Leadership Qualities For 21st Century Leaders, Journal Of Management, Social Science And Humanities, Published On 19 May 2015, Available At: Http://Pearlresearchjournals.Org/Journals/Pjmssh/Archive.Html, Accessed On 31 Jul 2025

[2] Hossain K. A., (2015), "Essential Tips And Tactics Of Motivation, Journal Of Management", Social Science And Humanistic, Volume 1, Issue 1, April 2015, Accessed On 29 Jul 2025

[3] Hossain, K. A. (2025a). Digital Transformation And Entrepreneurial Visibility. Journal Of Digital Entrepreneurship, 8(1), 45-67, Accessed On 17 Dec 2025

[4] Saaman Nadeem, Noor Ismail, Paridah Daud And Tahir Mehmood, 'Emerging Technologies And Ethical Challenges In AI And Cybersecurity' (2025) 15 International Journal Of Academic Research In Business And Social Sciences, Available From: Https://Doi.Org/10.6007/IJARBSS/V15-I2/24636, Accessed On 31 Jul 2025

[5] Ron Chiong, (2016), What Exactly Is A Smart City? Available From: Https://Www.Linkedin.Com/Pulse/What-Exactly-Smart-City-Ron-Chiong, Accessed On 17 Jan 2026

[6] Emudhra Blog, (2023), A Vision Of Smart City: Digital Solutions For A Better Quality Of Life, Available From: Https://Emudhra.Com/En/Blog/Vision-Of-Smart-City-Digital-Solutions-For-A-Better-Quality-Of-Life, Accessed On 17 Jan 2026

[7] Nam, T., & Pardo, T. A. (2011a). Conceptualizing Smart City With Dimensions Of Technology, People, And Institutions. DG.O. Pp. 282-291, Accessed On 11 Jul 2025

[8] X Li Et Al, 'Internet Of Things To Network Smart Devices For Ecosystem Monitoring' (2019) 64 Science Bulletin (17) 1234 Https://Www.Sciencedirect.Com/Science/Article/Abs/Pii/S2095927319304013, Accessed On 11 Jul 2025

[9] Lombardi, P., Giordano, S., Caragliu, A., Del Bo, C., Deakin, M., Nijkamp, & P., Kourtit, K. (2011). An Advanced Triple-Helix Network Model For Smart Cities Performance. Accessed Jan 23 2026

[10] Lee, Hoe S., Hoon Han, J., Taik Leem, Y., & Yigitcanlar, T. (2008). Towards Ubiquitous City: Concept, Planning, And Experiences In The Republic Of Korea. In Yigitcanlar, T., Velibeyoglu, K., & Baum, S., (Eds.), Knowledge-Based Urban Development: Planning And Applications In The Information Era (Pp. 148-169). Hershey, PA: Information Science Reference (PDF) Significance Of Smart Cities In 21st Century: An International Business Perspective. Accessed Jan 23 2026

[11] Komninos, N. (2011). What Makes Cities Smart? SC Conference, Edinburgh, 30 June, 2011, Accessed Jan 23 2026

[12] Hall R. E. (2000). The Vision Of A Smart City. In Proceedings Of The 2nd International Life Extension Technology Workshop (Paris, France, Sep. 28), 2000, Accessed Jan 23 2026

[13] Anthopoulos, L. & P., Fitsilis. (2014a). Exploring Architectural And Organizational Features In Smart Cities. 16th International Conference On Advanced Communications Technology (ICACT2014), IEEE, 2014, Accessed On 11 Jul 2025

[14] Anthopoulos, L. & P., Fitsilis. (2014b). Smart Cities And Their Roles In City Competition: A Classification. International Journal Of Electronic Government Research (IJEGR), 10(1): 67-81, Accessed Jan 21 2026

[15] Https://Www.Rbcwealthmanagement.Com/En-Us/Insights/How-Are-Smart-Cities-Meeting-The-Challenges-Of-Urbanization-In-The-21st-Century, Accessed On 11 Jan 2026

[16] City 4.0, (2025), What Are Smart Cities? Available From: Https://Www.Repsol.Com/En/Energy-Move-Forward/Innovation/Smart-Cities/Index.Cshtml, Accessed Jan 29, 2026

[17] ENEL, (2024), What Is A Smart City? Available From: Https://Www.Enel.Com/Learning-Hub/Smart-City, Available From: Https://Www.Enel.Com/Learning-Hub/Smart-City, Accessed On 11 Jan 2026

[18] Al Nuaimi E, Al Neyadi H, Mohamed N, Al-Jaroodi Applications Of Big Data To Smart Cities. Journal Of Internet Services And Applications. 2015 Aug;6(1):1-5, Accessed Jan 23 2026

[19] Harrison C, Donnelly IA. A Theory Of Smart Cities. In Proceedings Of The 55th Annual Meeting Of The ISSS-2011, Hull, UK 2011 Sep 23, Accessed Jan 23 2026

[20] Baba SM, Banday MT. Application Development For Wearable Internet Of Things Using Hexi Wear. In2020 7thinternational Conference On Signal Processing And Integrated Networks (SPIN) 2020 Feb 27 (Pp. 542-548). IEEE (PDF) Recent Trends And Challenges In Smart Cities, Accessed On 01 Jan 2026

[21] Baba SM, Banday MT. Application Development For Wearable Internet Of Things Using Hexi Wear. In2020 7thinternational Conference On Signal Processing And Integrated Networks (SPIN) 2020 Feb 27 (Pp. 542-548). IEEE, Accessed On 01 Jan 2026

[22] Hossain, K. A. (2025b). Assessment Of Global Great Entrepreneurs, Life: Lesson For New Entrepreneurs For Success In 21st Century, Norwegian Journal Of Development Of The International Science, 167/2025, ISSN 3453-9875, Accessed On 17 Dec 2025

[23] Hossain, K. A. (2025c). Problem Of Toxic Leadership Instead Of Modern Leadership At New Age In 21st Century, Open Journal Of Leadership, 2025, 14(3), ISSN Online: 2167-7751, Accessed On 17 Dec 2025

[24] Hossain, K. A. (2025d). Transformation Of Contemporary Leadership In 21st Century, International Journal Of Advanced Research (IJAR), Int. J. Adv. Res. 13(09), September-2025, 352-390, DOI:10.21474/IJAR01/53711, ISSN:(O) 2320-5407, ISSN(P) 3107-4928, Accessed On 17 Dec 2025

[25] Murthy BS, Peddoju SK. Iot-Based Patient Health Monitoring: A Comprehensive Survey. ICT Analysis And Applications. 2021:349-56, Accessed On 01 Jul 2025

[26] Trigyn, (2024), Smart City Surveillance Technologies For Urban Safety, Available From: Https://Www.Trigyn.Com/Insights/Cybersecurity-Smart-City-Surveillance-System, Accessed On 01 Jul 2025

[27] Marchesani, F. (2023). The Global Smart City: Challenges And Opportunities In The Digital Age. Emerald Publishing Limited., Accessed On 01 Jul 2025

[28] James, Peggy; Astoria, Ross; Castor, Theresa; Hudspeth, Christopher; Olstinske, Denise; Ward, John (2021). "Smart Cities: Fundamental Concepts". Handbook Of Smart Cities. Springer International Publishing. Pp. 3–33. Doi:10.1007/978-3-030-69698-6_2. ISBN 978-3-030-69698-6, Accessed On 11 Jul 2025

[29] Goldsmith, Stephen (16 September 2021). "As The Chorus Of Dumb City Advocates Increases, How Do We Define The Truly Smart City?". Datasmart.Ash.Harvard.Edu, Accessed On 11 Jul 2025

[30] Fourtané, Susan (16 November 2018). "Connected Vehicles In Smart Cities: The Future Of Transportation". Interesting Engineering.Com, Accessed On 11 Jul 2025

[31] Mclaren, Duncan; Agyeman, Julian (2015). Sharing Cities: A Case For Truly Smart And Sustainable Cities. MIT Press. ISBN 978-0-262-02972-8, Accessed On 11 Jul 2025

[32] Musa, Sam (March 2018). "Smart Cities-A Road Map For Development". IEEE Potentials. 37 (2): 19–23. Bibcode: 2018 ipot...37b..19M. Doi:10.1109/MPOT.2016.2566099. ISSN 1558-1772, Accessed On 11 Jul 2025

[33] Paiho, Satu; Tuominen, Pekka; Rökman, Jyri; Ylikerälä, Markus; Pajula, Juha; Siikavirta, Hanne (2022), Opportunities Of Collected City Data For Smart Cities, IET Smart Cities. 4 (4): 275–291. Doi:10.1049/Smc2.12044. S2CID 253467923, Accessed On 11 Jul 2025

[34] IDC, (2022), "IDC Forecasts Smart Cities Spending To Reach $158 Billion In 2022, With Singapore, Tokyo, And New York City Among Top Spenders", Available From: Www.Businesswire.Com. 23 July 2018, Accessed On 11 Jul 2025

[35] Zhitao Li, (2026), Construction Of Training Course System—The Synergistic Efforts Of Traditional Chinese Culture And Artificial Intelligence, Available From: Https://Www.Scirp.Org/Journal/Paperinformation?Paperid=149777, Accessed On 22 Feb 2026

[36] "Building A Smart City, Equitable City – NYC Forward". Archived From The Original On 4 December 2017, Accessed On 11 Jul 2025

[37] Hossain K A, (2023), Analysis Of Present And Future Use Of Artificial Intelligence (AI) In Line Of 4th Industrial Revolution (4IR), Scientific Research Journal 11 (8), ISSN: 2201-2796, Aug 2023, Accessed On 30 J1n 2026

[38] Vicky Meek, (2022), Thinking Smart: The Rise Of The Smart City, Available From: Https://Www.Infrastructureinvestor.Com/Thinking-Smart-The-Rise-Of-The-Smart-City/, Accessed On 30 J1n 2026

[39] Watson, Vanessa (6 December 2013). "African Urban Fantasies: Dreams Or Nightmares?". Environment And Urbanization. 26 (1): 215–231. Doi:10.1177/0956247813513705. ISSN 0956-2478,

[40] Hossain, K. A., (2023), Evaluation Of Influence Of Artificial Intelligence (AI) On Technologies In 21st Century, Journal Of Eiectronics And Communication Engineering Research, Quest Journal, Accessed On 30 Dec 2025

[41] Nele Coghe, (2021), What Is A Smart City? Available From: Https://Sigblog.Hexagon.Com/What-Is-A-Smart-City/, Accessed On 30 Dec 2025

[42] Hollands, R. G (2008). "Will The Real Smart City Please Stand Up?". City. 12 (3): 303–320. Bibcode:2008City...12.303H. Doi:10.1080/13604810802479126, Accessed On 11 Jul 2025

[43] Chan, Karin (3 April 2017). "What Is A 'Smart City'?". Expatriate Lifestyle. Archived From The Original On 24 January 2018, Accessed On 11 Jul 2025

[44] Komninos, Nicos (22 August 2013). "What Makes Cities Intelligent?". In Deakin, Mark (Ed.). Smart Cities: Governing, Modelling And Analysing The Transition. Taylor And Francis. P. 77. ISBN 978-1-135-12414-4, Accessed On 05 Feb 2026

[45] Lipman-Blumen, J. (2005). The Allure Of Toxic Leaders: Why We Follow Destructive Bosses And Corrupt Politicians – And How We Can Survive Them. Oxford: Oxford University Press

[46] Liao Er Dong, (2023), 4 Commonly-Used Smart City Technologies, Available From: Https://Earth.Org/Smart-City-Technologies/, Accessed On 05 Feb 2026

[47] Peris-Ortiz, Marta; Bennett, Dag R.; Yábar, Diana Pérez-Bustamante (2016). Sustainable Smart Cities: Creating Spaces For Technological, Social And Business Development. Springer. ISBN 978-3-319-40895-8. Archived From The Original On 30 October 2020, Accessed On 11 Jul 2025

[48] Talari, Saber; Shafie-Khah, Miadreza; Siano, Pierluigi; Loia, Vincenzo; Tommasetti, Aurelio; Catalão, João (2017). "A Review Of Smart Cities Based On The Internet Of Things Concept". Energies. 10 (4): 421. Doi:10.3390/En10040421, Accessed On 11 Jul 2025

[49] Albino, V., Berardi, U., & Dangelico, R. M. (2015). Smart Cities: Definitions, Dimensions, Performance, And Initiatives. Journal Of

Urban Technology. Doi:10.1080/10630732.2014.942092, Accessed On 13 Jul 2025
[50] Vanolo, A. (2014). Smart Mentality: The Smart City As Disciplinary Strategy. Urban Studies, 51(5), 883–898. Doi:10.1177/0042098013494427, Accessed On 11 Jul 2025
[51] Marsal-Llacuna, Maria-Lluïsa; Colomer-Llinàs, Joan; Meléndez-Frigola, Joaquim (2015). "Lessons In Urban Monitoring Taken From Sustainable And Livable Cities To Better Address The Smart Cities Initiative". Technological Forecasting And Social Change. 90: 611–622. Doi:10.1016/J.Techfore.2014.01.012, Accessed On 11 Jul 2025
[52] Marchesani, Filippo (2023). The Global Smart City. Emerald. Doi:10.1108/9781837975754. ISBN 978-1-83797-576-1, Accessed On 13 Jul 2025
[53] Lim, Yirang; Edelenbos, Jurian; Gianoli, Alberto (2019). "Identifying The Results Of Smart City Development: Findings From Systematic Literature Review". Cities. 95 102397. Doi:10.1016/J.Cities.2019.102397, Accessed On 11 Jul 2025
[54] Hossain MS, Muhammad G, Alamri A. Smart Healthcare Monitoring: A Voice Pathology Multimedia Systems. 2019Oct;25(5):565-75, Accessed On 11 Jan 2026
[55] Batty, M.; Axhausen, K. W.; Giannotti, F.; Pozdnoukhov, A.; Bazzani, A.; Wachowicz, M.; Ouzounis, G.; Portugali, Y. (2012). "Smart Cities Of The Future". The European Physical Journal Special Topics. 214 (1): 481–518. Bibcode:2012EPJST. 214..481B. Doi:10.1140/Epjst/E2012-01703-3, Accessed On 11 Jul 2025
[56] Deakin, Mark; Al Waer, Husam, Eds. (2011). "From Intelligent To Smart Cities". Journal Of Intelligent Buildings International: From Intelligent Cities To Smart Cities. 3 (3): 140–152. Doi:10.1080/17508975.2011.586671, Accessed On 13 Jul 2025
[57] Deakin, Mark (22 August 2013). "From Intelligent To Smart Cities". In Deakin, Mark (Ed.). Smart Cities: Governing, Modelling And Analysing The Transition. Taylor And Francis. P. 15. ISBN 978-1-135-12414-4, Accessed On 13 Jul 2025
[58] Albino, V., Berardi, U., & Dangelico, R. M. (2015). Smart Cities: Definitions, Dimensions, Performance, And Initiatives. Journal Of Urban Technology. Doi:10.1080/10630732.2014.942092, Accessed On 13 Jul 2025
[59] Camboim, Guilherme Freitas; Zawislak, Paulo Antônio; Pufal, Nathália Amarante (May 2019). "Driving Elements To Make Cities Smarter: Evidences From European Projects". Technological Forecasting And Social Change. 142: 154–167. Doi:10.1016/J.Techfore.2018.09.014, Accessed On 13 Jul 2025
[60] Aditya Chaturvedi, (2018), Convergence Of Technologies Undergird The Smart City Revolution And Paves Way For A Smarter Future, Available From: Https://Geospatialworld.Net/Blogs/Technologies-Undergird-Smart-City-Revolution/, Accessed On 19 Jan 2026
[61] Matthew Marson And Mohamed Moselhy, (2025), Solving The Challenges Of Smart Cities, Available From: Https://Www.Jll.Com/En-Ae/Insights/Solving-The-Challenges-Of-Smart-Cities Accessed On 19 Jan 2026
[62] Activesustainability, (2024), What Is A Smartcity? Top 5 Smart Cities, Available From: Https://Www.Activesustainability.Com/Construction-And-Urban-Development/What-Is-A-Smartcity-Top-5-Smart-Cities, Accessed On 19 Jan 2026
[63] Blueiot, (2024), Smart City Definition And Why Do We Need Them, Available From: Https://Www.Blueiot.Com.Au/Smart-City-Definition-And-Why-Do-We-Need-Them/, Accessed On 19 Jan 2026
[64] Nagar, P. (2024) The Power Of Technology: Driving Efficiency And Productivity In Business. Https://Www.Linkedin.Com/Pulse/Power-Technology-Driving-Efficiency-Productivity-Business-Nagar, Accessed On 13 Jul 20259
[65] Soni, A. (2023) Technology In Business Communication: Examples, Advantages & Types, Available From: Https://Clearinfo.In/Blog/Technology-In-Business-Communication/, Accessed On 13 Jul 2025
[66] Adel A., (2023), Unlocking The Future: Fostering Human–Machine Collaboration And Driving Intelligent Automation Through Industry 5.0 In Smart Cities, Smart Cities. (2023) 6, No. 5, 2742–2782, Https://Doi.Org/10.3390/Smartcities6050124, Accessed On 31 Dec 2025
[67] Zerfass, A., (2007), Innovation, Communication, And Leadership: New Developments In Strategic Communication. International Journal Of Strategic Communication, 1(2), 107–122, Accessed On 13 Jul 2025
[68] Rost, J. C., (1993), Leadership For The Twenty-First Century, Greenwood Publishing Group, Accessed On 13 Jul 2025
[69] Di Stefano, G., Scrima, F., And Parry, E., (2019), The Effect Of Organizational Culture On Deviant Behaviors In The Workplace. The International Journal Of Human Resource Management, 30(17), 2482-2503, Accessed On 11 Jul 2025
[70] Yukl, G. (2006). Leadership In Organizations (6th Ed.). Upper Saddle River: Pearson, Accessed On 11 Jul 2025
[71] Nauman, S., Khan, A. M., And Ehsan, N. (2009), Patterns Of Empowerment And Leadership Style In Project Environment. International Journal Of Project Management, 28, 638-649, Accessed On 11 Jul 2025
[72] Goulet, L. R., And Frank, M. L., (2002), Organizational Commitment Across Three Sectors: Public, Non-Profit, And Forprofit. Public Personnel Management 31(2), 201-210, Accessed On 11 Jul 2025
[73] Einarsen, S., Aasland, M. S., And Skogstad, A., (2007), Destructive Leadership Behaviour: A Definition And Conceptual Model. The Leadership Quarterly, 18(3), 207-216, Accessed On 21 Dec 2025
[74] Kellerman, B. (2004). Bad Leadership: What It Is, How It Happens, Why It Matters. Harvard Business Press, Accessed On 21 Dec 2025
[75] Madzar, S., (2001), Subordinates' Informationinquiry: Exploring The Effect Of Perceived Leadership Style And Individual Differences. Journal Of Occupational And Organizational Psychology, 74,221-232, Accessed On 13 Jul 2025
[76] Patterson, N. (2023) What Is Cybersecurity And Why Is It Important? Available From: Https://Www.Snhu.Edu/About-Us/Newsroom/Stem/What-Is-Cyber-Security, Accessed On 21 Dec 2025
[77] FM Contributors (2023) Compliance Challenges In A Digital World: Regtech's Role In Evolving Regulations, Finance Magnates, Available From: Https://Www.Financemagnates.Com/Institutional-Forex/Regulation/Compliance-Challenges-In-A-Digital-World-Regtechs-Role-In-Evolving-Regulations/, Accessed On 21 Dec 2025
[78] Faster Capital (2024) What Are The Challenges Of Using Technology In Business, Available From: Https://Fastercapital.Com/Questions/What-Are-The-Challenges-Of-Using-Technology-In-Business.Html, Accessed On 21 Dec 2025
[79] Klein, A.Z. (2022) Ethical Issues Of Digital Transformation. Organizacoes & Sociedade Journal, 29, 443-448, Accessed On 21 Dec 2025
[80] Trevino, L.K. (1986) Ethical Decision Making In Organizations: A Person-Situation Interactionist Model. Academy O Management Review, 11, 601-617, Accessed On 21 Dec 2025
[81] Hossain, K. A., (2023c), The Potential And Challenges Of Quantum Technology In Modern Era, Scientific Research Journal 11 (6), Jun 2023, Accessed On 11 Jul 2025
[82] Navigating The Digital Maze: Privacy And Security Challenges In The Era Of Cloud Computing - Harsh Pandey, Chinmay Lunia, Er. Nisha Rathore - IJFMR Volume 6, Issue 3, May-June 2024. DOI 10.36948/Ijfmr. 2024.V06i03.23105, Accessed On 13 Dec 2025
[83] Greser J. Proceedings Of The ETHICOMP 2020. Paradigm Shifts In ICT Ethics, Logroño, Spain. 2020. Legal And Ethical Challenges For Cybersecurity Of Medical Iot Devices; Pp. 144–146. June, Accessed On 13 Dec 2025

[84] Anwar S., Panda U., Mohapatra H. Legal And Ethical Issues In Iot Based Smart City: Data Privacy, Surveillance, And Citizen Rights. J. Comput. Sci. Eng. Softw. Test. 2024;10(2):17–26. Doi: 10.46610/JOCSES. 2024.V10i02.003, Accessed On 17 Dec 2025

[85] Abobakr, Azer M.A. Proceedings Of The 2017 12th International Conference On Computer Engineering And Systems (ICCES), Cairo. 2017. Iot Ethics Challenges And Legal Issues; Pp. 233–237, Accessed On 17 Dec 2025

[86] Zeng Q., Pan Z., Zhang Q., Han T., Zheng W., Li J., Zhang Z., Feng W., Zhen Li, Ma L., Liu K., Yuan X., Xing S. CSR Evolution: New Opportunities And Challenges For Iot In Advancing ESG Practices. Int. J. Front. Eng. Technol. 2024;6(3):1–8. Doi: 10.25236/IJFET.2024.060301, Accessed On 17 Dec 2025

[87] Wachter S. Proceedings Of The Living In The Internet Of Things: Cybersecurity Of The Iot - 2018, London. 2018. Ethical And Normative Challenges Of Identification In The Internet Of Things; Pp. 1–10, Accessed On 17 Dec 2025

[88] Zakerabasali S., Ayyoubzadeh S.M. Internet Of Things And Healthcare System: A Systematic Review Of Ethical Issues. Health Sci. Rep. 2022;5(6): E863. Doi: 10.1002/Hsr2.863, Accessed On 31 Dec 2025

[89] Falkowski P., Osiak T., Wilk J., Prokopiuk N., Leczkowski B., Pilat Z., Rzymkowski C. Study On The Applicability Of Digital Twins For Home Remote Motor Rehabilitation. Sensors. 2023;23(2):911. Doi: 10.3390/S23020911, Accessed On 30 Dec 2025

[90] Dhinakaran D., Srinivasan L., Gopalakrishnan S., Anish T.P. An Efficient Data Mining Technique And Privacy Preservation Model For Healthcare Data Using Improved Darts Game Optimizer-Based Weighted Deep Neural Network And Hybrid Encryption, Accessed On 31 Dec 2025 Biomed. Signal. Process. Control. 2025;100 Doi: 10.1016/J.Bspc.2024.107168, Accessed On 31 Dec 2025

[91] Rankingroyals, (2022), Top 13 Smart Cities In The World 2022, Available From: Https://Rankingroyals.Com/Tech/Top-13-Smart-Cities-In-The-World-2021/, Accessed Jan 29, 2026

[92] Timespro, (2025), Digital Transformation Trends: Top 6 Emerging Trends And Technologies, Available From: Https://Timespro.Com/Blog/Digital-Transformation-Trends-Top-6-Emerging-Trends-And-Technologies, Accessed On 31 Dec 2025

[93] Classcentral, (20250, AI In Education Courses And Certifications, Available From: Https://Www.Classcentral.Com/Subject/Ai-In-Education, Accessed On 31 Dec 2025

[94] Priyanka Roshan, (2025), Smart City Index 2025: Zurich Crowned Smartest City In The World, Available From: Https://Www.Travelandleisure.Com/Zurich-Switzerland-Named-Worlds-Smartest-8649035, Accessed Jan 29, 2026

[95] PDPC, (2025), Memorandum Of Understanding Between OAIC And PDPC, Available From: Https://Www.Pdpc.Gov.Sg/News-And-Events/Announcements/2020/03/Memorandum-Of-Understanding-Between-Oaic-And-Pdpc, Accessed On 31 Dec 2025

[96] PDPC, (2026), PDPC Officers And Report Any Suspicious Activities To The Police, Available From: Https://Www.Pdpc.Gov.Sg/Overview-Of-Pdpa/The-Legislation/Personal-Data-Protection-Act, Accessed On 04 Jan 2026

[97] William Goddard, (2021), Smart City Solutions To Consider, Available From: Https://Itchronicles.Com/Smart-City/Smart-City-Solutions-To-Consider/, Accessed On 04 Jan 2026

[98] Atul, (2024), Smart Cities: Integrating Technology Into Urban Infrastructure, Available From: Https://Professionalinsight.Tech/Smart-Cities-Integrating-Technology-Into-Urban-Infrastructure/, Accessed On Jan 26, 2026

[99] Schaffers H., Komninos N, Pallot M., Trousse B., Nilsson M., & Oliveira A. (2011). Smart Cities And The Future Internet: Towards Cooperation Frameworks For Open Innovation. In Domingue, J. Et Al. (Eds.) Future Internet Assembly, LNCS 6656, Pp.431-446, Springer Accessed On Jan 22, 2026

[100] Hin, L. T., & Subramaniam, R. (2012). Creating Smart Cities With Intelligent Transportation Solutions: Experiences From Singapore. In O. Ercoskun (Ed.), Green And Ecological Technologies For Urban Planning: Creating Smart Cities (Pp. 174-190). Hershey, PA: Information Science Reference, Accessed On Jan 22, 2026

[101] Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., & Pichler-Milanovic, N. (2007). Smart Cities-Ranking Of European Medium-Sized Cities. Vienna: Centre Of Regional Science, Available From: Http://Www.Smart-Cities.Eu/Download/Smart_Cities_Final_Report.Pdf, Accessed On Jan 22, 2026

[102] Institute For The Future (2011). The Future Of Cities, Information, And Inclusion. A Planet Of Civic Laboratories. Retrieved From Http://Www.Iftf.Org/Inclusion, Accessed On Jan 29, 2026

[103] Saxenian, A. (1994). Lessons From Silicon Valley. Technology Review, 97(5): 42-51, Accessed On Jan 29, 2026

[104] Caragliu, A., Del Bo, C., & Nijkamp, P. (2011). Smart Cities In Europe. Journal Of Urban Technology, 18(2): 65-82, Accessed On Jan 29, 2026

[105] United Nations. (2014). World Urbanization Problem. Available From: Http://Esa.Un.Org/Unpd/Wup/Highlights/WUP2014-Highlights.Pdf, Accessed On Jan 29, 2026

[106] FIREBALL (2012). Landscape And Roadmap Of Future Internet And Smart Cities. FP7-ICT-2009-5, Accessed Jan 22, 2026

[107] Etzkowitz, H. (2008). The Triple Helix: University-Industry-Government Innovation In Action. London, UK: Routledge, Accessed On Jan 29, 2026

[108] Roy, J. (2005). E-Governance And International Relations: A Consideration Of Newly Emerging Capacities In A Multi-Level World. Journal Of Electronic Commerce Research, 6(1): 44-55, Accessed On Jan 29, 2026

[109] Etzkowitz, H. (2008). The Triple Helix: University-Industry-Government Innovation In Action. London, UK: Routledge, Accessed On Jan 22, 2026

[110] Carayannis, E. G., Barth, T. R., & Campbell, D. F. J. (2012). The Quintuple Helix Innovation Model: Global Warming As A Challenge And Driver For Innovation. Journal Of Innovation And Entrepreneurship, 1-2. Accessed On Jan 22, 2026

[111] Bannister, F. & Connolly, R. (2012). The Trouble With Transparency: A Critical Review Of Openness In E-Government. Policy & Internet, 3. Accessed On Jan 22, 2026

[112] Nam, T.; Pardo, T.A. Conceptualizing Smart City With Dimensions Of Technology, People, And Institutions. In Proceedings Of The 12th Annual International Digital Government Research Conference: Digital Government Innovation In Challenging Times, College Park, MD, USA, 12–15 June 2011; Pp. 282–291, Accessed Jan 22, 2026

[113] Tripathi G, Abdul Ahad M, Paiva S. SMS: A Secure Healthcare Model For Smart Cities. Electronics. 2020 Jul13;9(7):1135, Accessed Jan 22, 2026

[114] Poongodi M, Sharma A, Hamdi M, Maode M, Chilamkurti N. Smart Healthcare In Smart Cities: Wireless Patient Monitoring System Using Iot. The Journal Of Supercomputing. 2021 Nov;77(11):12230-55, Accessed Jan 22, 2026

[115] AJEEVI, (2022), AJEEVI Smart Cities, Available From: Https://Ajeevi.Com/Industries/Smart-Cities/, Accessed Jan 22, 2026