International Journal of Science Academic Research
Vol. 07, Issue 03, pp.447-466, March 2026
Available online at http://www.scienceijsar.com
ISSN: 2582-6425

Research Article

EVALUATION OF SMART CITIES CHALLENGES AND SOLUTIONS IN HIGH TECH ERA

***Dr. Hossain, K.A.**

Vice Chancellor of Bangladesh Maritime University (BMU), Dhaka, Bangladesh

Received 18th January 2026; **Accepted** 20th February 2026; **Published online** 20th March 2026

Abstract

The high-tech era embodies the current period and may be defined by the rapid advancement and cutting-edge technologies such as mobile phone technology, digital/quantum computers, camera surveillance, robotics, Internet of Things (IoT), artificial intelligence (AI), machine learning (ML), Big Data, Digital Twin, and many more into daily life, business, service, agriculture, finance, government and industry. It has revolutionized communication, transformed architectural design with exposed, functional structures, and shifted global economic power towards tech-driven innovation, creating both unprecedented connectivity and intense competition. Today the use of those smart technology presents many distinct prospects along with significant challenges. Those prospects include transforming industries, improving the agricultural and service sectors, enhancing daily life, and improving sustainability. These technologies, which include smart homes, cities, and healthcare, leverage connectivity to operate autonomously and improve efficiency. On the other hand, those challenges include technological, economic, legal, and ethical facets, primarily centered on data privacy, security, and accountability. The influence of current digital technologies on human activities, including politics, education, economy, service, business, and enterprises worldwide, is so disturbing. Those have changed radically of human culture, law, religion, work, etc., and that have greatly up-sated the normal order of things in the society. The deployment of these smart technologies in smart cities and corporate businesses has faced significant technical, financial, legal, and ethical ramifications. Smart cities in the in this century employ smart technologies and data analytics to promote sustainability, efficiency, and quality of life, addressing rising urbanization and climate issues to support peaceful and smart living. Important possibilities include intelligent traffic, smart grids, and citizen-centric services, while high implementation costs, critical legal aspect and cybersecurity threats remain substantial issues. This study will assess the challenges including ethical aspects, of the widespread use of smart technology to develop smart cities. Beyond many prospects, there are major challenges, including security, legal and ethical issues, that require balancing technological innovation with the protection of individual rights and societal values. This article has depicted the contemporary race in contest to present global diversification along with suggestion for successful smart city in high tech era.

Keywords: Smart technology, ICT, IoT, AI, Smart city, Cybersecurity, Sustainability.

INTRODUCTION

In high tech era, with innovations of smart technology like Internet of Things (IoT), artificial intelligence (AI), machine learning (ML), big data, and quantum computing, the legal field isn't untouched by these advancements. Today, AI, ML, IoT, 5G, advanced robotics, and data science are reshaping industries, service, education, health, transportation, and financial sector by clouding physical, digital, and biological lines. However, technological progress brings the need to address ethical issues in technology. Legal ethics now involves understanding how these innovations impact confidentiality, accuracy, and privacy [1].Technology makes our lives more convenient and easier. 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 used in legal systems to automate tasks such as document creation and research assistance. This integration raises questions about legal responsibility, especially when AI makes autonomous decisions.

Corresponding Author:** ***Dr. Hossain, K.A.
Vice Chancellor of Bangladesh Maritime University (BMU), Dhaka, Bangladesh

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 such as IoT, AI, and ML to provide residents with better environmental cleanliness and safety. To meet residents' needs and improve service delivery, some cities also use IoT or AI devices [4]. Cybersecurity threats are among the many challenges smart cities face, despite their high levels of connectivity and security. However, possible threats and attacks can be avoided with appropriate safety precautions [6, 18]. Smart cities are a product of the growing importance of orienting our lives toward sustainability. These municipalities use infrastructure, innovation, and technology to lower energy consumption and reduce CO2 emissions. There are various qualities by which a city grades more highly than another. To do this, several key elements are explored. Such as: Governance, urban planning, public administration, technology, environment, international projection, social cohesion, mobility and transportation, human capital, and economics [62]. The main objective of a smart city is to enhance municipal operations, increase economic growth, and boost people's quality of life through smart technology and improved data analysis. The value relies on how this technology is applied [63]. This high-tech era has changed how people work and live, creating new roles for tech professionals while introducing challenges related to data privacy and a

'high-tech cold war' in global trade. 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 achieving a low-carbon future, even as urbanization continues to contribute to rising carbon emissions worldwide. Cities are now taking the initiative to create plans to address the effects of climate change, given the lack of legally enforceable international climate action and weak leadership in many state governments. Cities are, in many ways, our best chance to combat climate change (World Urbanization Problem, United Nations, 2014) [8, 154]. By 2030, 70% of the world's population will live in our global cities, which currently account for 80% of global 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 way, because the appearance of these cities will affect the global environment [9]. Future consequences include optimized energy use and improved mobility, but also pose serious challenges related to data privacy, cybersecurity risks, the digital divide, and significant uncertainties [7, 94].

The concept of smart cities, or city 4.0, should not be mistaken for sustainable cities, which aim to reduce their carbon footprint and promote efficient consumption and production patterns, taking into account geographic, social, economic, and cultural factors. Smart cities, or advanced cities, leverage technology-based tools and practices to foster a fairer, safer, more efficient, and environmentally friendly future. They offer effective solutions to common urban challenges, including mobility, the economy, public services, employment, and citizen engagement [5, 16]. The complex needs of urban living have driven the development of smart cities as innovative solutions. This shift is powered by ICT, which integrates public services, infrastructure, and environmental sustainability. While AI, ML, robotics, IoT, and big data improve urban planning, optimize resource use, and strengthen governance, the computing continuum has become a key paradigm for effective resource management within ICT. The six main areas of the smart city concept are natural resources and energy, transportation and mobility, infrastructure, governance, economics, and people, along with their sub-domains. To understand the connections among geological, urban, demographic, human resources, ecological, and innovation issues, a dataset of logical components has been created, and degradation assessments have been performed. In reality, there is no universally accepted definition of smart cities, and recent innovations and examples often depend on local context. City planners are encouraged to understand these variables to develop suitable strategies for their smart cities. Recently, the concept has gained significant attention and is likely to continue doing so, with urban authorities issuing plans, hosting events, and producing more literature. Smart technologies can help cities manage traffic, reduce fossil fuel consumption, and save costs [55, 33]. However, the complexity of planning has slowed progress, partly because various stakeholders local experts, residents, innovation organizations, academics each have different ideas of what a smart city entails. Much of the debate focuses on defining what "smart" means rather than on how technology can help cities achieve their goals. Today the focus is moving from traditional manufacturing and service to a digital economy where data processing and smart system, self-monitoring machines drive efficiency and effectiveness. Over the past century, there has been a notable improvement in the quality of life, particularly in access to services. However, administrators, architects, and urban planners have faced significant challenges due to rapid growth in industry and population in urban areas. In the 21st century, a major focus is on 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 the creation of responsive urban environments. Real-time data collection enhances public services, such as traffic management and public transport. Future development emphasizes engaging citizens to ensure that solutions meet actual needs, rather than relying on technology-driven initiatives. On the other hand, a heavy dependence on connected infrastructure introduces vulnerabilities, making cybersecurity a top concern [11, 12]. Many of these cities face difficulties due to the enormous capital required 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 issues vary, including dignity, conscience, right and wrong, and addiction. The biggest legal problems focus on adapting current law to new, complex technologies and ensuring compliance with evolving laws. Evaluating smart city initiatives becomes difficult without agreement on parameters [14]. Furthermore, it becomes harder to compare projects and identify best practices. Transforming smart cities into "smart regions," for example by encouraging greater collaboration between the public and private sectors, represents the future path [15]. A smart city leverages information and communication technologies to develop, implement, and promote solutions that address urban issues and foster integrated, technologically advanced, and sustainable infrastructure [63]. This article will evaluate and assess the opportunities and challenges facing by smart cities in this high-tech era. It will also examine the complexities of balancing the use of smart technology with the protection of individual and collective rights, alongside societal values in today's global context. In this high-tech era, this study will investigate the challenges and complexities arise in smart cities due to extensive use of smart technology along with suggestion for successful smart city. Paper will also explore how much technical skills and competence needed for forthcoming citizens for safer and comfortable smart cities and that enhance future employability.

LITERATURE REVIEW

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 [55]. 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 [59]. Like an Innovative Triangle, a smart city business model flips the conventional municipal business model on its head.

The aim of smart cities is to improve residents' quality of life through technology, nurturing sustainable and comfortable communities. This collaborative effort involves various sectors of society to safely and strategically incorporate technology, information, and data solutions [5]. While digitization drives major economic, cultural, political, and sociological changes in smart cities, it also brings both benefits and risks. Although streamlined procedures have transformed urban living, they also introduce significant cyberattack risks. Consequently, it is crucial to rethink security in the digital era. Maintaining and managing digital infrastructure around the clock is vital for safeguarding smart cities. Achieving a secure digital infrastructure in a smart city depends on prioritizing people. After years of experimentation, leaders recognize that the goal is to harness technology and data intentionally to improve decision-making and quality of life. we need to explore what a smart city truly is and how digital solutions can help build a secure digital society within smart cities. [6]. Because IoT devices and AI system are interconnected; as a result, smart cities are vulnerable to cyberattacks. It is crucial to safeguard the infrastructure against potential threats and secure the data sent between devices. To prevent unauthorized access and preserve the integrity of the data collected, smart cities must implement robust cybersecurity measures, such as encryption, frequent software updates, and intrusion detection systems [25]. IoT and AI are major forces behind efficiency and creativity in the age of linked technology and smart cities. However, the importance of cybersecurity cannot be overstated, given the growth of smart cities and the proliferation of connected devices. 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. 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]. Productivity and efficiency are the keys to success in the fast-paced world of business. 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 occupations, simulations, computations, and other operations can be performed 100 times faster by computers, IoT devices, and AI systems than by the human brain. Digitalization and the use of smart technologies improve production and distribution, as well as the creation of products and services, comparably easy, accurate, and rapid. Contemporary technology is built to be versatile. It can respond to changes in the business environment, price, quality, quantity, and sort of products or services due of its independent and effective nature [86]. The new price labels in a supermarket may be readily reprogrammed and learned by current computer or AI systems. Therefore, contemporary technology is a strength since it maintains the organization, company, business, or even the daily job of a smart citizen current and present regardless of changes that take place in the course of business or strange happenings. There are drawbacks to using this technology, particularly regarding 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 gives rise to ethical issues surrounding the use of smart and contemporary technology. Smart cities face cybersecurity risks because of the interconnected IoT devices powered by AI. Protecting data transmissions and defending infrastructure from potential threats are essential. Implementing robust cybersecurity practices, including encryption, regular software updates, and intrusion detection, is necessary to prevent unauthorized access and maintain data integrity [25]. Nonetheless, as smart cities grow and more connected devices appear, the importance of cybersecurity becomes even more critical. Technology affects our behavior, challenges conventions, alters our capabilities, and produces biased results [64]. There are drawbacks to using those high-tech, particularly regarding human privacy and emotional and financial security. Technology use has the potential to influence and elevate political issues, moral concerns, and several legal challenges. The use of modern technology raises ethical questions due to the confluence of various technologies and their negative impacts.

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 [105]. Smart 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. With over 95% of the world's population now connected to mobile networks in this high-tech era. Today, information communication technology (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 ways previously unimaginable. Smart technologies influence politics, election processes, financial and economic analysis, social interactions, healthcare, education, energy, and religious perspectives. With advancements like AI and automation, effective human-technology interaction is now possible in this high-tech era. Various regional and global frameworks regulate data privacy and security. For example, the European Union's General Data Protection Regulation (GDPR) mandates user consent, data minimization, transparency, and the right to be forgotten. In California, the California Consumer Privacy Act (CCPA) grants consumers the right to know what data is collected about them and to request its deletion. In the U.S., the Health Insurance Portability and Accountability Act (HIPAA) governs the privacy and security of personal health data from smart health devices. Although Singapore's Personal Data Protection Act (PDPA) and Australia's Privacy Act are national laws protecting personal data, their enforcement and scope differ. Australia's Privacy Act, based on 13 Australian Privacy Principles (APPs), regulates the handling of personal information across industries, emphasizing individual access and transparency. Singapore's PDPA, overseen by the Personal Data Protection Commission (PDPC), outlines fundamental principles for data collection, use, and disclosure, recently enhancing penalties and breach reporting standards. Both frameworks aim to balance organizational data needs with security and privacy protections. [86].

Numerous controversies and public debates have been prompted by the increasing environmental issues. Degradation of the environment is becoming a global concern. An estimated trillion tons of carbon dioxide would be added by 2050 if present emission rates continue, according to the literature, which might have a severe influence on human survival [115]. In recent years, there has been study on the role and relevance of ICT for different economic outcomes. Increased use of ICT has been shown to have positive economic effects [41, 86]. 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 [65, 106]. Environmental threats may be predicted and handled with the use of ICT technology. Computerized simulation tools, for instance, may make "learning by simulation" simpler in order to speed up decision-making processes and prevent the detrimental impacts of trial and error. The "internet network" is another component of ICT that increases environmental awareness. Due to their ability to lower greenhouse gas emissions, ICT-based solutions are regarded as beneficial for environmental sustainability [115]. 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 [84, 128]. 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.

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 [120, 77]. 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 [78]. 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 many risks associated with ICT and smart technology use in businesses and service: old or malfunctioning hardware, software, or network components that can cause system crashes, data loss, service interruptions, inadequate redundancy or backup solutions to guarantee the uninterrupted availability of vital IT resources in the event of emergencies or failures [79]. Once more, the widespread usage

of smart gazettes, devices, and systems will raise significant ethical and legal concerns in the future mainly in the smart cities. This paper will depict and answer the questions of contemporary challenges of smart cities in contest to current global diversification and the suitable suggestions for successful smart city in high tech era.

Figure 1. Smart technology is revolutionizing solutions to modern problems [114]

SMART CITY AND CONSEQUENCE OF THIS HIGH-TECH ERA

A smart city is a city that incorporates digital technology into its networks, services, and infrastructure in order to become more efficient and livable, eventually benefiting people and corporations. According to the European Commission, a smart city requires: Smart urban transit networks; Improved water supply and waste disposal services; More effective technologies to light and heat buildings; More engaged and proactive municipal governance; Safer public places. In other words, a smart and sustainable city employs ICT to increase quality of life, efficiency, and competitiveness, while guaranteeing that the requirements of current and future generations are addressed. According to the United Nations Economic Commission for Europe (UNECE), the notion of a smart city encompasses characteristics such as broad home connection and Wi-Fi in public places, smart infrastructure, smart meters, the use of open data, and e-government solutions [17]. The concept of a Smart City has become vital in sustainable urban development. It encompasses various urban planning ideas offering significant benefits such as efficient resource management, quick policy deployment, seamless communication, and numerous environmental advantages. A city's "smartness" is assessed based on qualities like technology-based infrastructure, environmental initiatives, effective public transit, advanced urban planning, and residents' ability to live and work utilizing available resources. The key to a smart city's success lies in the collaboration between the public and private sectors, as much of the effort involves creating and maintaining a data-driven environment. Furthermore, data analysts play a crucial role in reviewing information generated by smart city systems to identify and fix issues and implement improvements. [63]. Today, smart cities are expanding worldwide, with Singapore, Copenhagen, Amsterdam, and Oslo leading the way in this emerging trend. Here are four key smart city technologies that are gaining significant momentum and are widely adopted in current smart city developments. [46].

A smart city is a metropolitan area that leverages advanced technology and sensor data. This data helps in efficiently managing resources, assets, and services, supporting various city operations [17]. It includes information from residents, devices, buildings, and resources, which is processed and analyzed to oversee and optimize systems like AI, web platforms, mobile technology, telecommunications, e-commerce, and e-business. All these technologies are integrated within smart cities and businesses to enhance functionality. [18]. As shown in Figure 2, the fields of utilization include services for citizens and users, such as utilities, e-health, transportation, and infrastructure. Information and communication technologies (ICTs) are used in smart cities to scale services such as transportation and utilities to serve a growing population. Growing urbanization and population are igniting renewed interest in integrating technology into municipal service planning, which is what "smart cities" are all about [19]. To detect variables such as temperature, moisture, allergens, contaminants, traffic, and power matrix status, smart cities rely heavily on sensors. These parameter values provide context that helps a system understand a citizen's condition at any given time [16]. 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. 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 [96]. 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.

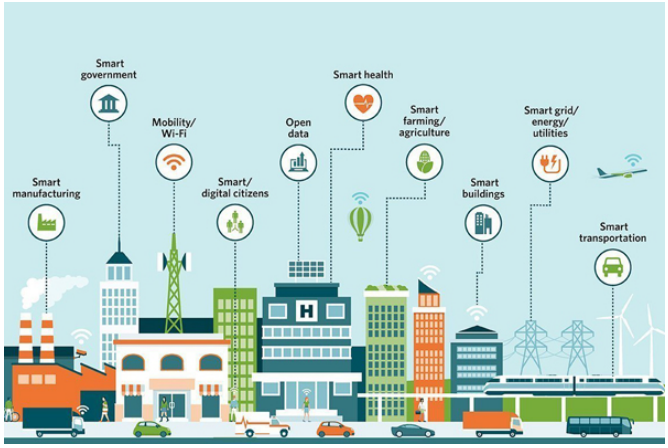

Figure 2. Elements, Features, Technology and efficient utilities in smart cities [113]

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. 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 5G technology. Unlike 4G, 5G is ten times faster, offers low latency with only a 1 to 1,000 millisecond delay after an instruction, and supports millions of devices and sensors within a one-kilometer square area, whereas 4G has limited connections. Essential to establishing a smart city are various 5G-related technologies. For instance, cities install IoT sensors to monitor traffic, and the data collected is transmitted via the 5G network. Blockchain technology can ensure secure data sharing during this process. Traffic management authorities use edge computing analytics to analyze real-time data, enabling them to predict traffic patterns and implement measures like rerouting or adjusting traffic signals. AI handles large volumes of Big Data efficiently, and the data is stored securely on cloud servers for future use. Many individuals and factors contribute to turning smart city concepts 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.

Figure 3. Technology, infrastructure and people make smart city Smart City [81]

The character of cities has always been diverse. 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 fast progress into the twenty-first century, it becomes evident that in order to keep up with the rising population and limited resources, a city's complete 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 projects are always a "work in progress," towns globally have a higher chance of obtaining the most livable award when they are carried out

with genuine business outcomes and the unique needs of end users in mind. Therefore, via international trade systems like those offered by the WTO, smart cities as they are today defined and understood have great potential to open up in the global commercial arena. Though descriptions and visions of the future city will still reflect the competitive dynamics between cities and the companies and organizations that want to serve them, the debate about future cities is becoming more diverse, 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 impacts on individuals, the future city will have an influence on economies and wider global ecosystems. Economically speaking, the greatest urban markets have already exceeded those of other nations. This essay discusses the relevance and new opportunities of smart cities for global corporations to tackle the difficulties of the twenty-first century, bearing in mind the aforementioned vision of smart cities.

BENEFITS OF SMART CITIES

We may be able to live and work in safer, faster, and more convenient ways owing to smart cities. We anticipate long-term, secular development will benefit the industries and enterprises that can supply Smart City solutions. The Internet of Things (IoT) is a crucial driver of efficiency and innovation in the era of connected technologies and smart cities. However, the vital importance of cybersecurity cannot be underestimated given the advent of smart cities and the proliferation of connected devices. In the context of IoT, AI, and smart cities, cybersecurity is vital, researching possible risks and creating best practices to secure infrastructure and data. A smart city is an urban model that makes use of technology, human resources, and governance to increase social inclusion, efficiency, and sustainability all of which are viewed as goals for cities of the future [23, 27]. Digital technology is employed by smart cities to deliver services and collect data. IoT and smart technology integration provides previously unheard-of potential for greater productivity, sustainability, and quality of life as smart cities emerge. The benefits are vast, ranging from smart grids enhancing energy management to linked devices optimizing traffic flow. However, new and complicated cybersecurity risks are also made feasible by this interconnection. The move to smart cities demands for a fundamental restructuring of municipal operations and administration, focused on citizen engagement and public service delivery techniques. Planning, administration, and operational processes must alter in order to become a smart city. In order to maximize urban services and identify regions for development, this data may be evaluated [54]. "Smart cities" were imagined as a consequence of the quick usage of information and communication technologies 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 same characteristics that make smart cities clever and responsive such as real-time data exchange and remote-control capabilities can be exploited if they are not effectively safeguarded [28].

A smart city consists of three layers: an innovation foundation that includes sensors and cell phones connected to rapid communication organizations, apps that turn raw data into knowledge, and use by urban communities and society at large. It is entirely anticipated that the growing popularity of 5G, the widespread adoption of cellphones, and the growing acceptance of IoT will accelerate and elevate smart city developments. This opens up new avenues for creativity to transform urban neighborhoods. The local community has undoubtedly played a significant role in improving inhabitants' well-being as a result of the pandemic. By facilitating diagnosis and treatment as well as preventive self-care, intelligent advancements can reduce the strain on medical services' natural systems. This shifts the focus from medical treatment that is individual-focused to a local area approach. People and their families can receive medical care that is tailored to them based on information analysis. Given that smart health is a subset of e-health, The Intramuros of the acknowledged smart city is comparable to s-health. In any case, s-health and m-health are distinct from one another. For instance, it is possible that the recognized key correspondence in s-health is not transferable. In practice, it may include dispersed outfoxed sensors in a significant number of cases. In spite of pollution to which the patient is sensitive, the patient receives information or information from an interactive information pole to check the amount of dust and residue. Additionally, the information helps individuals avoid areas that may be dangerous for their medical issues. The information shaft aids in providing the patient with guidance on the most effective path to reach a goal [98]. Therefore, every resident of a smart city greatly benefits from smart healthcare.

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. By 2028, according to Gartner, 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]. 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 [133].

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 digital services that encourage citizen collaboration and contribute to the growth of e-democracy. Additionally, local e-professional centers, online retraining programs, and the digitalization of corporate functions such as burden filing and permitting contribute to financial growth and an innovative business environment [141]. 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 [132]. Effective trash management keeps the city clean and healthy for its residents.

With its early acceptance of a sustainable, environmentally friendly agenda and concentration on public transportation and urban infrastructure, Europe has long led the way in Smart City projects, despite having many historic cities with legacy infrastructure systems. Intramodality, which integrates various public transit choices into a pleasant travel experience, has been a priority of European transport policy, according to a 2018 McKinsey report. Rapid technological advancement has also fostered electronic services like ticketing systems. One feature of Smart Cities in the West is that development is largely bottom-up, with individuals and the private sector actively engaged in building efforts to promote quality of life, boost economic growth, and conserve the environment. In 2018, for example, the federal government of Canada urged around 200 towns countrywide to engage a competition wherein technological innovations may be applied to increase people's quality of life. In order to identify demands and offer local authorities a plan for creating future traffic and public transportation infrastructure, the Intelligent Cities program hosted citizen workshops. There must be a cultural revolution in the way cities are run and controlled in addition to the participation and contribution of local inhabitants [15]. Additionally, municipal IT systems must be more accessible and not held in unconnected "silos" that are unable to operate together. More than 40 municipal agencies were working on separate, uncoordinated digital platforms when Los Angeles Mayor Eric Garcetti studied the introduction of Smart City solutions. 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 [100]. 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 [103, 107]. 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 [102, 109]. 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 created and implemented some of the most cutting-edge urban solutions in the world, ranging from energy management and water treatment to public housing and transportation. The city has successfully transformed the difficulties of urban development into lucrative business opportunities because to progressive leadership and a strong dedication to sustainable development. Other cities have successfully implemented and duplicated some of those solutions. Singapore is already considered a "smart" city, but the government is constantly looking for ways to make it smarter. The focus on "life-ability," or building a city where people are glad to live, the integration of policies, and the wise use of ICT are important components of this strategy. Singapore is a highly developed nation that depends on advanced technology, a highly skilled labor force, high productivity, and sound economic policies implemented by the government. Its emphasis is on innovation as a growth driver, much like the Netherlands. Thus, it makes significant R&D investments. The foundation of Singapore's development over the past few decades has been the attraction of foreign direct investment. The Economic Development Board (EDB), which oversees foreign direct investment, offers incentive schemes to entice businesses in particular industries. 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 [101]. To draw gifted students and academics from the area and beyond, it offers unique programs.

CHALLENGES IN SMART CITIES

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 sensitive attributes, or introducing fake information to obscure honest qualities are ways to achieve K-anonymity [104, 107]. allowing sensitive information to be "concealed in the group." Because information is multifunctional, periodically changing identifiers is an alternative to maintaining a single, consistent identifier for each client. Long-term and spatial client tracking becomes challenging as a result of this shift. When a client enters a location with k-1 additional clients, it's the best opportunity to modify the identity. Thus, it won't be feasible to fast link existing and new IDs. Third, the output of information mining algorithms may be adjusted to prevent sensitive material from leaking. Once again, a gathering calculation's reasonability may be sufficiently decreased to meet execution limitations while lowering the possibility of being used to identify people. 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 [108, 113].

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 [85, 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 [109, 110]. 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 combine numerous disciplines, including

transportation, energy, health, education, agriculture, business, social, banking, economics and government, to create an integrated and intelligent urban environment. The combination of smart technology and data-driven solutions in smart cities has the potential to change urban life by offering inhabitants with tailored and accessible services. However, the implementation also brings problems, including data privacy issues, uneven access to technology, and the need for cooperation across corporate, public, and government sectors [98]. 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 [53]**.**
- **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 [85].

Deakin defines a smart city as one that leverages ICT to meet the needs of its residents through community engagement [57]. Instead of attempting broad, often vague definitions, studies of smart city initiatives can help clarify the concept [58]. Data is collected from humans, devices, buildings, or cameras. Smart cities are used in various applications such as traffic management, power plants, utilities, urban forestry, water supply, waste disposal, law enforcement, information systems, and community services like schools, libraries, and hospitals [30]. The core of a smart city is the integration of people, technology, and processes, which interact across sectors including infrastructure, healthcare, transportation, and education [31]. The distinctive features of smart cities include monitoring, analysis, planning, and regulation by local governments. Data sharing involves businesses, residents, and other stakeholders who benefit from its use [32]. As of 2022, the main costs for smart cities were outdoor lighting, public transit, and surveillance [33, 34]. To optimize municipal services and engage citizens, smart cities combine ICT (Information and Communication Technologies) with IoT-connected devices [35]. ICT enhances the quality, performance, and interactivity of urban services, reduces resource use and costs, and facilitates communication between the public and government. Smart city applications manage urban flows and enable real-time responses [36].

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, 124]. 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 plans to quickly address cybersecurity incidents. A clear plan in place speeds up recovery efforts and lessens the impact of a security incident [48,49].
- **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 4. Use of smart technology and future smart city in global perspective in this high-tech era [60, 61]

LEGAL AND ETHICAL CHALLENGES OF 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, IoT developers can build AI and IoT systems that are user-friendly, secure, and scalable on a global scale [131, 130]. 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 [132, 119].

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 [111, 112]. 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 [122]. 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 [114].

False data injection attacks in IoT tracking devices threaten the integrity and reliability of the entire Home Digital Twin ecosystem. Attackers deliberately introduce false or misleading information into the system, affecting the data collected and transmitted by IoT devices. Instead of disabling devices, attackers may manipulate the data these devices receive or share to influence system decisions or behavior in malicious contexts. The impact of such attacks can range from minor disruptions to complete system failures, depending on the purpose of the data and the criticality of the decisions based on it. A common method involves intercepting and altering communications between IoT devices and control systems or cloud platforms [139, 140]. For example, a smart home IoT sensor monitoring energy use, humidity, or temperature could

be fed fake data, causing the system to misjudge environmental conditions. An attacker might, for instance, trick a thermostat into thinking the house is hotter than it actually is by redirecting heat across different floors or areas. In severe cases, this can lead to catastrophic failures like home system breakdowns or serious safety hazards, such as false fire alarms triggered by data breaches. Cross-checking and redundancy across multiple devices are essential defenses against such fake data attacks [137, 138]. These mechanisms not only detect inconsistencies among sensors recording the same data but can also identify outliers as likely falsified information. For example, if several smart thermostats detect abnormal temperature differences, they may collectively trigger an inspection to verify data accuracy. This approach is particularly important in sectors like security and health monitoring, where data manipulation can have serious consequences. Multiple sensors providing similar data can help identify attempts at falsification. Additionally, machine learning algorithms can be employed to detect suspicious patterns of false data injection. These models learn normal behavior and quickly spot irregular data points that deviate from expected patterns [87]. Using historical device data further helps reveal trends indicative of tampering, offering a comprehensive understanding of typical device operation use.

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 [133, 134]. 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 [85]. 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 [86]. 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 [135, 136].

The ethical adoption of IoT and AI-powered smart homes is significantly impacted by the legal and regulatory framework, particularly in emerging nations like Bangladesh and any rising digital economy. We need some form of digital or smart economy policy and strategy, which should give a detailed framework that secures and strikes a balance between innovation and the preservation of individual rights. This needs for rigorous and proper regulation, regulatory sandpiles, and robust institutional collaboration [84]. Ethical IoT, AI, data governance, and cybersecurity must be given high priority in the policy in order to ensure that smart home technologies work in an environment that respects human rights and is people-centered [4]. by granting regulatory institutions like the national cybersecurity authority and the national data protection commission/authority additional powers. They should be in charge of the smooth digital transformation of important smart technology use sectors and must encourage public awareness and stakeholder involvement. In addition to promoting fair growth, digital literacy, personal safety, data/digital security, and the creation of a robust, meaningful, and sustainable digital or smart economy, such a comprehensive plan is in accordance with international best practices [7]. IoT, AI, data protection, and cybersecurity regulations must be logical and well-balanced in order to handle the delicate interplay between innovation and each person's freedom to use the internet. Transparency, equality, and accountability are among the ideals mentioned in the UNESCO guideline on the ethics of IoT and AI [5]. Once again, due of the pace at which technology is advancing, there will be issues in the future in regulating and deploying IoT and AI-powered smart appliances. Therefore, it is vital to make modifications and continual updates to the rules, as well as create a balance between the danger of strangling innovation and strong restrictions.

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 [83]. 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 [119, 120]. 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 [142]. 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 [121]. In order to resolve complex legal or ethical crises or challenges in the near future, technology specialists and legal professionals must collaborate in this high-tech era. AI, ML, 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 [82]. 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 [122, 123]. 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.

In this high-tech era, it is essential for policymakers of developing nations to consider developing 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 [81].

Figure 5. Singapore and Zurich are two examples of the smartest cities in the world [120, 123]

These could include offering incentives for businesses to invest in employees' ongoing education or implementing urban development plans that seamlessly integrate technology and learning spaces into the cityscape [92].So, effective strategies like investing in employee training programs, promoting cross-departmental projects, facilitating mentorship and knowledge-sharing sessions to develop smart skills for citizens are very important. For all stakeholders, including citizens of smart cities, the relevant study emphasizes the importance of a 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 [91]. Additionally,developing and accessing specific policy and educational initiatives need to be informed by stakeholders to create effective programs for lifelong learning and smart skill development across diverse demographics and career stages in smart city environments in this high-tech era [90].

ANALYSIS AND RECOMMENDATION TOWARDS SUCCESSFUL SMART CITIES

Despite its recent popularity as an urban planning paradigm in both the academic and policy domains, there is a stunning lack of clarity on the meaning of the word ‘smart city.’ The broad use of ICT infrastructure to promote urban development via increased service delivery, environmentally friendly building, and the creation of social capital is frequently referred to as a smart city. Nevertheless, a large majority of the literature on smart cities is framed from a single standpoint, with a strong emphasis on the technological, environmental, or social components. The governance component is disregarded, and more complete definitions have just recently developed. The six traits Hin and Subramaniam (2012) mentioned were specified by Giffinger et al. (2007) to measure the ‘smartness’ of medium-sized cities throughout Europe: people, living, economy, mobility, environment, and governance [129, 130]. Townsend's ‘smart city’ vision, which is similarly extensive, illustrates the melding of urbanization with omnipresent digital technology. This paradigm is defined by four fundamental ‘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 as ‘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 [128]. The physical smart city is backed by the following fundamental ICTs: public interfaces, cloud computing, open data infrastructures, smart personal devices, and pervasive internet access [131].

In this high-tech era the Sustainability Magazine rating identifies the top integrated technology and sustainability plans after examining their housing restrictions and identifying their major business partners [97, 105]. In the research it has been determined that Helsinki of Finland holds the top rank for its citizen-focused approach and its digital project Helsinki 3D+, in conjunction with Nokia. Dubai of UAE follows, an example of technological ambition with its Core42 autonomous cabs and AI-based apps as its private sector ally, despite more than 40 percent of its residential properties are held by non-residents. And Seoul of South Korea, which combines connectivity and smart transportation (Samsung SDS), notwithstanding a disparity between core and periphery

pricing, causing the displacement of the younger population. However, London of UK with Arup acting as the firm in its joint venture, emphasizing open data, AI, and social involvement with the assistance of digital infrastructure, while battling traffic congestion and high pricing. Ahead of New York of USA (IBM) for wireless management, is Tokyo of Japan (Hitachi) for its capacity to detect and react to natural disasters, Copenhagen of Denmark (Siemens) for its public transport, Amsterdam of Netherlands (Philips) for energy efficiency, Singapore (ST Engineering) for its urban mobility, and Barcelona of Spain (Cisco) for its high level of digital democracy. Smart technologies support a community's economic growth by enabling new business models, lowering energy costs, and enhancing quality of life [120, 124]. Developing smart cities involves more than just installing numerous sensors and expecting improved living conditions; it requires understanding that IoT solutions are complex and must be recognized as such. The ability to respond instantly has sparked a revolution in urban development. To implement IoT in smart cities effectively, cities need access to data on sustainability, resilience, and artificial intelligence to analyze information properly and improve urban living.

Sustainable smart cities contribute to better infrastructure, reduce traffic congestion, and save energy [80]. These systems can monitor air quality, connected vehicles, and smart waste management, as demonstrated by cities like Singapore and Zurich Oslo [88]. IoT smart city technology can be widely integrated into municipal infrastructure. For example, smart fire sensors can detect fires and coordinate rescue robots, significantly enhancing the safety of city residents. Other IoT applications are similarly eco-friendly and energy-efficient; they can also monitor speed limits and other factors affecting quality of life. With advanced sensors, IoT solutions can assist in developing sustainable corporate strategies, enabling cities to build better infrastructure and services [79]. Currently, the number of sustainable smart cities worldwide is increasing, focusing on air quality monitoring, renewable energy, green energy systems, traffic flow optimization, smart waste management, and other urban sustainability initiatives. IoT device technologies are crucial in turning these innovative smart infrastructure ideas into reality, underscoring their importance for urban development. According to the United Nations, 54.5% of the global population lives in urban areas, and this figure is expected to reach 60% by 2030. One in three people will live in a city of at least 500,000 residents. To accommodate this growth, cities worldwide are adopting a wide range of technologies to transform into smart cities, aiming to enhance citizen services and safety [115, 116]. The International Data Corporation reports that global spending on smart city initiatives hit about $124 billion in 2020, with projections reaching $135 billion in 2023 [41]. Consequently, future cities will be smart. For a smart city initiative to succeed, it must be carefully planned and organized across multiple levels. The future city should address its residents' needs, tackling issues such as crime, congestion, emergency response, waste management, active mobility, police security, utility shortages, public transportation, and subpar housing and governance [95]. With intense competition for talent in urban areas, dissatisfied residents might relocate seeking a better environment [114]. A smart city should foster an urban setting that provides a good quality of life while supporting economic growth. This involves offering integrated services with lower infrastructure costs, especially as urban populations grow and efficient use of infrastructure and resources becomes critical. Smart city services and applications will enable these improvements, ultimately enhancing residents' quality of life [62, 63]. To succeed, urban leaders should prioritize prosperity, sustainability, and other essential needs of inhabitants.Using geospatial technology can help city authorities fully realize their smart city goals by transforming location data into actionable insights and enhancing quality-of-life and safety initiatives. For instance, intelligent monitoring of power and water systems can enable early detection of outages, allowing public utilities to restore services quickly. This promotes more efficient infrastructure operation and management [38].A smart city benefits from providing relevant geospatial data, processes, and analytics to any device used by local government, service providers, and residents who aim to improve the city. By integrating this technology across various services, municipal authorities can monitor evolving conditions more effectively and be better prepared for future challenges that come [94]. Identifying the responsible community for smart city development is essential to creating a smart city. This helps smart sustainable cities harness the potential of new information and technologies. It is also crucial to understand the community's characteristics to build a successful smart city [46]. Additionally, examining the social environment is vital for effective management and integration of smart systems. Geospatial technology can help city authorities realize their smart city visions by converting location data into actionable insights that improve the quality of life and safety. For instance, smart monitoring of electricity and water networks can detect outages early and restore services quickly, leading to more efficient utility management and infrastructure operations. [38].

Investment management is a crucial aspect of developing smart infrastructure. The challenges are significant, and overcoming them requires a strategic plan. Sometimes, budget constraints can prevent communities from initiating smart city projects. The city must allocate funds to a range of smart technologies, such as AI, smart city applications, IoT, and other smart tool devices.Smart city transportation revolves around digital solutions that enhance the movement of people, from tourists and commuters relying on real-time transit data on their smartphones to green fleet initiatives [93]. The popularity of smart parking is increasing, as it allows tracking and monitoring parking spots in garages and on streets. This technology also helps reduce traffic congestion and pollution, resulting in a better experience for citizens. Many local leaders aim to make cities smarter, safer, and more sustainable. Besides air quality monitoring, tracking energy consumption, electricity, water, and waste provide vital data for sustainable policy-making. Ensuring residents' safety and security is crucial today. Smart city safety solutions include sensors, video analytics, citizen reporting, and cross-department coordination for incident response, offering a wide range of features to enhance security. [41]. City leaders need to develop clear policies that will improve the quality of life for their citizens. To achieve this, smart cities should implement equitable policies that benefit all residents. Small cities, especially those in emerging countries, must also adopt public policies to protect the environment, as over half of them face environmental challenges [38]. By providing innovative municipal services that enable real-time data analysis, governments can better serve their populations and leverage the data to improve the city overall. Through sustainable strategies, smart cities can generate new revenue streams and reduce costs. Improving air quality in cities through smart city

technology can significantly enhance residents' lives. Fortunately, advancements in air quality sensors for smart cities have been substantial [41]. Since water and electricity systems are vital infrastructure components, modern smart water and power technologies enable quick responses and real-time coordination across departments during incidents such as burst water pipes or power outages in a city.A comprehensive smart home infrastructure solution is essential. It should include systems for monitoring various household changes, such as humidity, temperature, light, movement, and other environmental factors within homes, businesses, and community spaces. Equipment to track CO_2 and dust particles is necessary to continuously improve indoor air quality across different settings [89]. The solution should also streamline management tasks such as room occupancy, meeting scheduling, and conference planning by leveraging extensive historical data and advanced analytics. There needs to be a proficient and innovative business in advanced technology capable of providing devices, IoT, and AI platform solutions. These companies should specialize in applications across smart cities, agriculture, transportation, finance, healthcare, and more, offering devices that can track, monitor, and manage assets even in challenging RF environments such as medical facilities at both global and local levels [46].Furthermore, suitable cloud solutions must be available for various vertical applications. These should include gateways, sensors, and wireless network management systems adaptable to multiple frequency bands. The company's smart products should be highly reliable and scalable, offering the lowest total cost of ownership. Additionally, they should develop tailored smart city solutions for our clients [63]. Finally, a smart city can only be considered sustainable if it successfully strikes a balance between economic, social, and environmental factors, while simultaneously utilizing innovation and technology to boost productivity, reduce its negative effects on the environment, and improve the lives of its residents [61].

CONCLUSION

In this high-tech era, we live amidst advanced and intricate technologies. By 2030, AI is expected to transform between 75 million and 375 million jobs worldwide, according to MGI Research. This study also points to the creation of new roles and responsibilities. Scholars from the American Economic Association concur with these estimates, noting that while some tasks may be automated, only a few jobs can be entirely mechanized. The world is increasingly interconnected, functioning as part of a global economic and financial system. The 2008 financial crisis severely impacted emerging and developing economies, leading to economic downturns, social and political upheavals, and declining living standards. Clearly, setbacks in one region affect the global economy as a whole, which remains vulnerable to crashes. Alongside digital and smart technologies such as IoT, AI, ML, DL, big data, and blockchain, businesses in this high-tech era have become more sophisticated in the information and communication sectors. These changes have altered interpersonal relationships, communication patterns, professional lives, and skills. Warren Buffett emphasizes that intelligent technologies, especially AI, are powerful but also pose significant risks and ethical issues comparable to those of nuclear proliferation. He insists that technological development should serve a purpose and uphold ethical standards like accountability and integrity. Mark Zuckerberg highlights that a focus on deeper social interactions, trust, and stronger connections fosters transparency and openness. We are transitioning from a transaction-centric world to one grounded in relationships. Rapid urbanization this century has brought both benefits and challenges and drawbacks. However, Cities may save a lot of energy by implementing smart street lighting since it uses less electricity to operate. Depending on the time of day, LED lights can be brightened or muted to extend their lifespan. Bicycle-friendly roads and walkable neighborhoods are features of smart city designs. With efficient public transportation, walkable areas, and ride-sharing services, there will be fewer cars on the roadway.Smart cities need to to measure the quality of the air and pinpoint the sources of pollution by utilizing smart air quality monitors.

Despite the numerous benefits of smart cities, challenges remain. Governments must enable significant interaction from residents. Collaboration between businesses and government sectors is essential for community contribution. Smart city initiatives should be transparent and accessible through open data sites or mobile apps, allowing residents to pay bills, find transportation options, and monitor energy use at home. This requires reliable, secure data collection and storage to prevent hacking or exploitation. Data must also be anonymized to protect privacy. A major challenge is connectivity, with thousands or millions of IoT devices needing to work together seamlessly. This coordination enables integrated services and continuous updates as demand evolves. Additionally, the future of waste and energy management though less glamorous and is vital. Currently, waste collection, overconsumption, and carbon footprint are critical issues cities face. The IoT, computing continuum, big data, AI, ML, etc., are converging in this era, making smart cities a reality. Data localization, scalability, and responsiveness are handled across the computing continuum like edge, fog, cloud, Currently, 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 enabled by incorporating 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 is 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. Data displaying changes from smart city buildings can be delivered by smart sensors. City leaders can prevent costly repairs and infrastructure failure by using predictive analytics to identify areas that require inspection and maintenance. Every city prioritizes safety and security in ways. Governments can better monitor citizen safety with CCTV cameras and smart devices that are equipped with motion and smoke detectors, fire alarms, and facial recognition software. Smart cities can use smart technologies to reduce traffic jams and give residents real-time information that makes it easier for them to navigate the roads and ensure that people, commodities, and services are transported in an efficient and clean manner. In this high-tech, the rapidly metamorphosing urban environment, the pivotal role of human capital, especially the acquisition and application of smart and advanced skills, is increasingly pronounced. These competencies, which encompass a diverse spectrum of skills, including but not limited to critical thinking, creativity, collaborative prowess, and digital literacy, are deemed essential for individuals to navigate and excel amid

the ongoing flux of urban transformation and technological progression. The acquisition and refinement of these smart skills are instrumental in fostering a workforce that is not only adaptable but also adept at driving innovation and productivity within the smart city ecosystem. As technological changes accelerate to meet increasing public demand, smart city solutions must respond quickly and cost-effectively. This requires improving the efficiency of urban operations and services while also preparing for future generations. Therefore, any smart city technology should be future-oriented and easily adaptable as the city expands. Today, cities are at the forefront of innovations that enhance residents' quality of life. A recent United Nations study predicts that five out of ten people worldwide will eventually live in urban areas. This calls for new methods of managing sensitive data and automating city activities. These technologies can help communities optimize energy use, distribution, and sustainability. Additionally, cloud-based IoT and AI can process large datasets in real time, enabling faster decision-making. IoT can automate various city functions and improve public safety. For example, cities can use IoT to monitor citizens' health indicators, which is vital for a healthy environment. These services are crucial for creating a better urban environment and improving residents' lives. Therefore, integrating IoT devices and AI into city infrastructure is essential for enhancing the quality of life and comfort. Now is the moment to move toward the future of smart living.

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. (2025f). 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. Mudhra 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, (2019), ‘Internet of things to network smart devices for ecosystem monitoring’ (2019) 64 Science Bulletin (17) 1234, Available from: https://www.sciencedirect.com/science/article/abs/pii/S2095927319304013, accessed on Jan 29, 2026
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. Jangjarat K., Kraiwanit T., Limna P., and Sonsuphap R., (2023), Public perceptions towards ChatGPT as the robo-assistant, Online Journal of Communication and Media Technologies. (2023) 13, no. 3, article e202338, https://doi.org/10.30935/ojcmt/13366, accessed on 19 Jan 2026, 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. (2025e). 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 Jan 29, 2026
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. 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 Jan 29, 2026
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 Jan 29, 2026
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:2018IPot...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 Forecasts Smart Cities Spending to Reach $158 Billion in 2022, with Singapore, Tokyo, and New York City Among Top Spenders". www.businesswire.com. 23 July 2018, accessed on 11 Jul 2025
35. https://www.scirp.org/journal/paperinformation?paperid=135309, accessed on 11 Jul 2025
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 Electronics and Communication Engineering Research, Quest Journal, accessed on 30Dec 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. https://energie-digitalisieren.de/knowhow/smart-city-intelligent-vernetzt-und-effizient/, accessed Jan 29, 2026
61. Trivedi,(2021), The concept of sustainable Smart City, Available from:https://nclurbandesign.org/sustainable-horizons-navigating-the-future-of-smart-cities/, accessed on 12 Feb 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. 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/smartcities 6050124, 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 Jan 29, 2026
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 Jan 29, 2026
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 11 Jul 2025
74. Kellerman, B. (2004). Bad leadership: What it is, how it happens, why it matters. Harvard Business Press,accessed Jan 29, 2026
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. Klein, A.Z. (2022) Ethical Issues of Digital Transformation. Organizacoes & Sociedade Journal, 29, 443-448,accessed Jan 29, 2026
77. Trevino, L.K. (1986) Ethical Decision Making in Organizations: A Person-Situation Interactionist Model. Academy o Management Review, 11, 601-617,accessed Jan 29, 2026
78. 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 Jan 29, 2026
79. FM Contributors (2023) Compliance Challenges in a Digital World: Regtech's Role in Evolving Regulations, FinanceMagnates,https://www.financemagnates.com/institutional-forex/regulation/compliance-challenges-in-a-digital-world-regtechs-role-in-evolving-regulations/,accessed Jan 29, 2026
80. 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 Jan 29, 2026
81. HT Correspondent, (Jan 31, 2016), Technology, infrastructure or people: What makes a city smart, Hindustan Times, Available from: https://www. hindustantimes.com/india/technology-infrastructure-or-people-what-makes-a-city-smart/story-qOy8XbjDVkHJmmx8m8OacK.html, accessed on 03 Feb 2026
82. Pacheco Rocha N, Dias A, Santinha G, Rodrigues M,Queirós A, Rodrigues C., (2019), Smart cities and healthcare: Asystematic review. Technologies. 2019 Aug 16;7(3):58, accessed Jan 24 2026
83. Hossain, K. A., (2023b), Evaluation of Influence of Internet of Things (IOT) Technologies and Devices in 21 Century, Scientific Research Journal 11 (7), ISSN: 2201-2796, Jul 2023, accessed on 11 Jul 2025
84. 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
85. Watson, T. (2020). What is a Smart City – Technologies, Applications, Benefits, and Examples. [online] Skywell Software. Available at: https://skywell.software/blog/what-

is-a-smart-city-technologies-applications-benefits-examples/, accessed on 13 Dec 2025
86. 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
87. 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 Jan 29, 2026
88. FutureBuilt, (2019), Oslo leads the way in green and inclusive smart cities, Available from: https://www. theagilityeffect.com/en/case/oslo-leads-the-way-in-green-and-inclusive-smart-cities/, accessed Jan 29, 2026
89. LoRaWAN Sensors, (2025),Ready to Deploy IoT Sensors for Real World Insights, TEKTELIC, Available from: https://tektelic.com/products/sensors/, accessed Jan 29, 2026
90. Mahmud M. M. and Wong S. F., (2022), Stakeholder's perspectives of the twenty-first century skills, Frontiers in Education, 7, article 931488, https://doi.org/10.3389/ feduc.2022.931488, accessed Jan 29, 2026
91. Ratten V., (2017), Entrepreneurship, Innovation and Smart Cities, 1st edition, Routledge, https://doi.org/10.4324/ 9781315407463, 2-s2.0-85020660529, accessed Jan 25, 2026
92. Ahmad K., Maabreh M., Ghaly M., Khan K., Qadir J., and Al-Fuqaha A., (2022), Developing future human-centered smart cities: critical analysis of smart city security, data management, and ethical challenges, Computer Science Review, 43, article 100452, https://doi.org/10.1016/ j.cosrev.2021.100452, accessed Jan 25, 2026
93. Adel A., (2023), Unlocking the future: fostering human–machine collaboration and driving intelligent automation through industry 5.0 in smart cities, Smart Cities, 6, no. 5, 2742–2782, https://doi.org/10.3390/smartcities6050124, accessed Jan 25, 2026
94. Ghonge M. M., Pradeep N., Jhanjhi N. Z., and Kulkarni P. M., (2024), Advances in Explainable AI Applications for Smart Cities, 2024, IGI Global, https://doi.org/10.4018/ 978-1-6684-6361-1, accessed Jan 25, 2026
95. Sibiya B., (2023), Digital Transformation of Cities through Emerging Industry 4.0 Smart Technologies and Infrastructure in South Africa, 2023, Dissertation, University of Johannesburg, https://hdl.handle.net/ 10210/504660, accessed Jan 25, 2026
96. Rochet C. and Belemlih A., J. C. Augusto, (2020), Social emergence, cornerstone of smart city governance as a complex citizen-centric system, Handbook of Smart Cities, 2020, Springer, Cham, https://doi.org/10.1007/978-3-030-15145-4_29-1, accessed Jan 25, 2026
97. Eremia M., Toma L., and Sanduleac M., (2017), The smart city concept in the 21st century, Procedia Engineering. (2017) 181, 12–19, https://doi.org/10.1016/j.proeng.2017. 02.357, 2-s2.0-85020681632, accessed Jan 25, 2026
98. Bibri S. E., (2019), The anatomy of the data-driven smart sustainable city: instrumentation, datafication, computerization and related applications, Journal of Big Data. (2019) 6, no. 1, 1–43, https://doi.org/10.1186/ s40537 -019-0221-4, 2-s2.0-85068758273, accessed Jan 25, 2026
99. Moeveglobal, (2025), Smart cities innovation sustainability mobility, Available from: https://www.moeveglobal.com/ en/planet-energy/2030-goals/smart-cities-innovation-sustainability-mobility, accessed Jan 25, 2026
100. Selvan, C.; Senthil Kumar, R.; Swamidason, I.T.J.; Malin Bruntha, P.; Amanullah, M.; Arulkumar, V., (2025), Traffic Prediction Using GPS Based Cloud Data Through RNN-LSTM-CNN Models: Addressing Road Congestion, Safety, and Sustainability in Smart Cities. SN Comput. Sci. 2025, 6, 159, accessed Jan 25, 2026
101. Chen, X.; Deng, Y.; Ding, H.; Qu, G.; Zhang, H.; Li, P.; Fang, Y., (2024), Vehicle as a service (VaaS): Leverage vehicles to build service networks and capabilities for smart cities. IEEE Commun. Surv. Tutor. 2024, 26, 2048–2081, accessed Jan 24, 2026
102. HYPER, (2024), AI Project. Revolutionizing big data processing applications with self-abstracted and self-coordinated cloud-to-edge resources. 2024. Available online: https://hyper-ai-project.eu/, accessed Jan 24, 2026
103. Zekić-Sušac, M.; Mitrović, S.; Has, A. Machine learning based system for managing energy efficiency of public sector as an approach towards smart cities. Int. J. Inf. Manag. 2021, 58, 102074, accessed Jan 24, 2026
104. Hong, V.N.H.; Anh, L.T. Development Trends of Smart Cities in the Future Potential Security Risks and Responsive Solutions. Adv. Sci. Technol. Eng. Syst. J. 2020, 5, 548–556, accessed Jan 23, 2026
105. Zhang, C., & Liu, C. (2015). The Impact of ICT Industry on CO2 Emissions: A Regional Analysis in China. Renewable and Sustainable Energy Reviews, 44(1), 12-19, accessed Jan 24, 2026
106. Webb, M. (2008). Smart 2020: Enabling the low carbon economy in the informationage. The Climate Group. London, 1(1), 1-1, accessed Jan 23, 2026
107. Hossain, K. A. (2025a). Problem of Toxic Leadership Instead of Modern Leadership at New Age in 21st Century, Open Journal of Leadership, 2025., 14(3), accessed on 17 Dec 2025
108. Majeed, M. T., & Ayub, T. (2018). Information and Communication Technology (ICT)and Economic Growth Nexus: A Comparative Global Analysis. Pakistan Journal of Commerce and Social Sciences, 12(2), 443-476, accessed Jan 23, 2026
109. Lashkarizadeh, M., & Salatin, P. (2012). The Effects of Information and Communications Technology (ICT) on Air Pollution, Elixir Pollution, 46, 8058-8064, accessed Jan 23, 2026
110. Dante D. Sanchez-Gallegos, Diana E. Carrizales-Espinoza, Catherine Torres-Charles and Jesus Carretero, (2025), Smart Cities: A Systematic Review of Emerging Technologies,Smart Cities2025, 8(5), 173; https://doi.org/10.3390/smartcities8050173, accessed Jan 22, 2026
111. Deakin, M.; Al Waer, H. From Intelligent to Smart Cities. Intell. Build. Int. 2011, 3, 140–152, accessed Jan 22, 2026
112. 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
113. Constro Facilitato, (2021),Smart City – Elements, Features, Technology and Govt. Approach, Available from: https://constrofacilitator.com/smart-city-elements-features-technology-and-govt-approach/, accessed Jan 22, 2026
114. Gary Davis, (2024),How Technology is Revolutionizing Solutions to Modern Problems, Available from:

https://www.intelligentliving.co/technology-solutions-modern-problems/accessed on 17 Dec 2025
115. Hossain, K. A. (2025b). Study on Entrepreneurship and Quality of Successful Entrepreneurs: Global Perspective, Journal of Liberal Arts and Humanities (JLAH), Issue: Vol. 6; No. 5; October 2025. (pp. 1-79), Available from: https://doi.org/10.48150/jlah.v6no5. 2025.a1, accessed on 06 Feb 2026, accessed on 17 Dec 2025
116. 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 Jan 29, 2026
117. 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
118. 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
119. 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
120. Philippen Maisonneuve, (2024),How Singapore Became the World's First Super-Smart City,Available from:https://www.fireraven.ai/blog/posts/Singapore-the-World%E2%80%99s-First-Super-Intelligent-City, accessed Jan 29, 2026
121. Maxwell, L., (2021), How to ensure that your smart city strategy is inclusive, Available from: https://hub.beesmart.city/en/strategy/how-to-ensure-that-your-smart-city-strategy-is-inclusive,accessed Jan 29, 2026
122. Hossain K. A., (2025), Investigating Study on Future Port Perception, Transactions on Engineering and Computing Sciences - Vol. 13, No. 04 Publication Date: July 25, 2025 DOI:10.14738/tmlai.1304.19128,accessed on 31 Dec 2025
123. Taryn White, (2024), This European City Was Just Named the World's 'Smartest' Here's Why? Available from:https://www.travelandleisure.com/zurich-switzerland-named-worlds-smartest-8649035, accessed Jan 29, 2026
124. https://www.oaic.gov.au/about-the-OAIC/our-corporate-information/memorandums-of-understanding/current-memorandums-of-understanding/mou-with-the-personal-data-protection-commission-of-the-republic-of-singapore, accessed on 31 Dec 2025
125. https://www.pdpc.gov.sg/overview-of-pdpa/the-legislation/personal-data-protection-act, accessed on 04 Jan 2026
126. https://itchronicles.com/smart-city/5-smart-city-vulnerabilities/, accessed on 04 Jan 2026
127. Javed A. R., Shahzad F., ur Rehman S., Zikria Y. B., Razzak I., Jalil Z., and Xu G., (2022), Future smart cities: requirements, emerging technologies, applications, challenges, and future aspects, Cities. (2022) 129, article 103794, https://doi.org/10.1016/j.cities.2022.103794, accessed Jan 22, 2026
128. 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 Jan 22, 2026
129. 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 Jan 22, 2026
130. 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 at: http://www.smart-cities.eu/download/smart_cities_final_report.pdf, accessed Jan 22, 2026
131. 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 Jan 22, 2026
132. Saxenian, A. (1994). Lessons from Silicon Valley. Technology Review, 97(5): 42-51,accessed Jan 29, 2026
133. Caragliu, A., Del Bo, C., & Nijkamp, P. (2011). Smart cities in Europe. Journal of Urban Technology, 18(2): 65-82,accessed Jan 29, 2026
134. United Nations. (2014). World Urbanization Problem. Available at: http://esa.un.org/unpd/wup/Highlights/WUP2014-Highlights.pdf, accessed Jan 29, 2026
135. FIREBALL (2012). Landscape and Roadmap of Future Internet and Smart Cities. FP7-ICT-2009-5, accessed Jan 22, 2026
136. Lixia Zheng, Jinjuan Zhang and Haiyu Liu, (2025), Evaluation of new smart cities and its influencing factors in the era of mobile internet: empirical evidence from China, Available from: https://iopscience.iop.org/article/10.1088/2515-7620/adcc83,accessed Jan 22, 2026
137. 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 Jan 22, 2026
138. Etzkowitz, H. (2008). The Triple Helix: University-Industry-Government Innovation in Action. London, UK: Routledge, accessed Jan 22, 2026
139. 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 Jan 22, 2026
140. Bannister, F. & Connolly, R. (2012). The trouble with transparency: A critical review of openness in e-government. Policy & Internet, 3. accessed Jan 22, 2026
141. 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
142. Hossain, K. A., (2025), Emotional and Artificial Intelligence: Narrative of Human and Machine Relation,Transactions on Engineering and Computing Sciences - Vol. 13, No. 05 Publication Date: September 07, 2025 DOI:10.14738/tmlai.1305.19324, accessed Feb 10, 2026

****