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A Review on Impact of IoT on Urban Economics

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Abstract

The Internet of Things (IoT) is a world of connected objects (e.g., smart objects or smart products) that understand, act, and communicate among themselves and their environment. Additionally, IoT provides the ability to directly share information and respond to real/physical events worldwide by creating processes and services with or without intervention. In addition to its ability to reduce environmental problems, the IOT can also enhance people's capabilities and support economic growth. These are just some ways the IOT is changing business and business growth. Some example are, manufacturing, machine to machine communication opens up a world of growth for manufacturing. Many industries, from health care to retail, IoT has the potential to improve many industries and increase competitiveness. Developing countries, IoT is easy to use and can provide significant cost savings to organizations, making it a good choice for businesses in developing countries. Increased tax revenue, by supporting the IOT, governments can increase their local industries' competitiveness while generating additional revenue. Productivity improvements, IoT technology can change how businesses operate and make businesses smarter, requiring fewer working hours. New business models, the IOT can help companies create new business and revenue streams, such as subscription based services or maintenance models.

Keywords: Urban economic development, Smart cities, Planning city, Sustainable models of smart cities.

1 | Introduction

In the coeval landscape of technological progress, the widespread incorporation of the Internet of Things (IoT) has emerged as a diverse aspect of our daily lives. The IoT revolution has made this world irreplaceable by advancing sensor networks, mobile devices, wireless communication, networking, and cloud technologies. The chances of fault tolerance in this case may be predictable or unpredictable. This research searches for urban economics to unravel the economic impact wielded by IoT technologies on urban development, business ecosystems, job creation, innovation hubs, and economic growth.

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Economic development leads to economic growth and an "increase in GDP" [1]. Economic development aims to reduce unemployment, lower poverty, and increase income, which may lead to a better quality of life. As populations in cities and towns increase, challenges to sustainable economic development and basic community services also increase. The city of Cleveland, OH, for example, is facing many economic development challenges. The city's annual economic development two report stated that among the challenges Cleveland faces in the area of economic development include industrial sites with access to rail or water but without direct access to freeways; inadequate supply of workers with high-tech skills; and population lacking basic literacy and math skills [2]. As cities continue to urbanize, city officials are obligated to boost economic development and expand access to health care, housing, job creation, education, and other social services; however, without proper planning and due to the rapid urbanization, city officials do not have adequate time to plan accordingly. Cities and counties face many challenges, such as unemployment, reduced economic development, poverty, aged infrastructure, traffic congestion, high crime rates, lack of clean water, environmental hazards, and slow bureaucratic city systems for processing business transactions; furthermore, there are tremendous cybersecurity challenges facing cities, such as cyber-terrorism that could have a profound impact on cities' infrastructure and the safety of residents. It is imperative to develop smart solutions that improve the livability of cities and enhance economic development while vividly reducing resource consumption. IoT has an emerging role in urban development as our cities evolve into smart ecosystems and are interconnected by smart devices, which helps them understand economic complexity and make the world a better place for policymakers, businesses, and residents alike. IoT and urban economics interplay today, illuminating how deploying smart technologies influences resource allocation, productivity, and overall economic dynamics within urban environments.

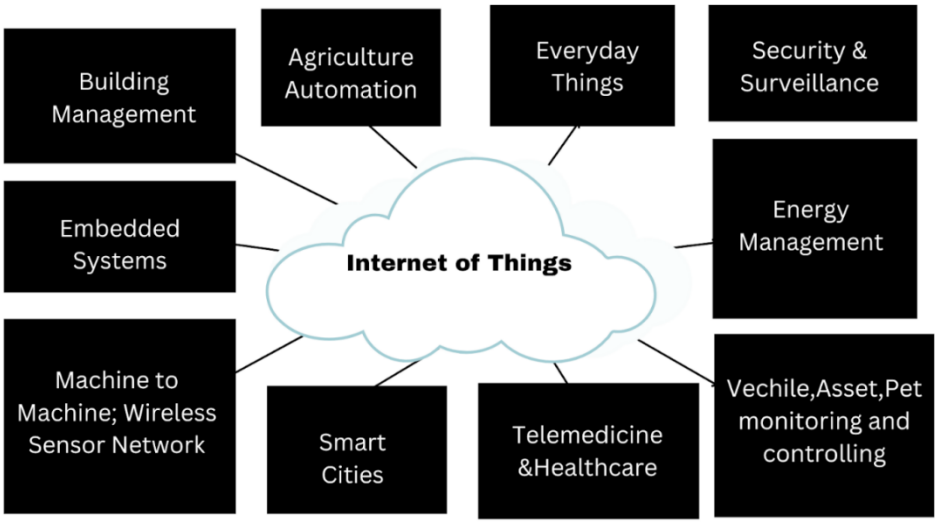

Fig. 1. IoT in smart cities.

2 | Literature Review

The advent of the IoT has brought about significant transformations in various sectors, including urban economics. IoT technologies enable physical devices and systems to connect to the internet, facilitating data collection, analysis, and automation. In urban contexts, IoT applications range from smart infrastructure and transportation systems to efficient resource management and public service delivery. It aims to explore the economic implications of IoT adoption in urban settings, highlighting key findings, methodologies, and gaps in existing research. IoT-enabled smart infrastructure: studies have shown that IoT-enabled smart infrastructure in urban areas can lead to substantial cost savings and operational efficiencies. For instance, sensors embedded in buildings, roads, and utilities facilitate real-time monitoring and maintenance, reducing maintenance costs and prolonging infrastructure lifespan [3]. The deployment of IoT in urban infrastructure also enhances resource allocation and utilization, resulting in improved energy efficiency, waste management, and water conservation. IoT and transportation systems. IoT technologies are crucial in optimizing urban

transportation systems, reducing congestion, enhancing safety, and lowering environmental impact. Smart traffic management systems, enabled by IoT sensors and data analytics, can dynamically adjust traffic flow, thereby minimizing travel time and fuel consumption [4]. Furthermore, IoT-enabled vehicle tracking and fleet management solutions offer cost-effective logistics operations and route optimization opportunities, benefiting businesses and consumers alike [5]. Economic development and innovation: integrating IoT into urban environments fosters economic development and innovation by creating new business opportunities and enhancing productivity across various sectors. IoT-driven initiatives, such as smart cities and digital marketplaces, attract investments, promote entrepreneurship, and stimulate job growth [6]. Moreover, the availability of IoT-generated data facilitates evidence-based decision-making and policy formulation, enabling governments and businesses to address urban challenges more effectively [7].

3 | Challenges and Consideration

Despite the promising economic benefits, the widespread adoption of IoT in urban economics faces several challenges, including privacy concerns, cybersecurity risks, and digital divide issues [8]. Safeguarding economic development requires the government's dedication, incentives, vision, and leadership [9]. While economic development refers to economic growth, economic growth refers to an increase in GDP [1]. On the other hand, smart economic development leverages technology to increase efficiency and reduce cost; it requires the government's dedication, incentives, vision, and leadership. Public Wi-Fi, for example, can connect businesses and citizens by supporting business transactions; private investments and businesses also play key roles in ensuring a strong economy [10]. Economic development aims to reduce unemployment, create jobs, lower poverty, lower crime rates, and increase income, which may lead to a strong economy, better quality of life, and prosperity. *Fig. 2* illustrates the economic development process map.

On the other hand, community planning is a strategic process of creating innovative solutions to solve community challenges and protect and preserve the community's assets (infrastructure, attractions, businesses, utilities, libraries, schools, personal properties, and the people). The goals of community planning are building a community-based sustainable food system, managing water resources and developing conservation strategies, providing decent housing for residents, and fostering and expanding economic opportunities [1]. *Fig. 2* economic development process map Cities have historically been the center of economic power – at the national and international levels, primarily due to the economics of scale that they command [11]. Growing cities could inject up to $30 trillion annually into the world economy by 2025 [12]. Vardy [13] believes we should look to cities, not countries, for global economic impact. McKinsey Global Institute [14] concluded that half of the global Gross Domestic Product (GDP) 2007 came from 360 cities in developed regions. The report also highlighted that large United States cities generated almost 85% of the country's GDP.

Similarly, Vergara Perucich [15] concluded that cities account for nearly 90% of the united states' total economic output and generate 85% of U.S. jobs. To measure the impact of the world's leading cities, Vergara Perucich [15] developed an economic power index based on five metrics: economic clout, financial power, global competitiveness, and equity and quality of life. While the economy is the main determinant of smart city initiatives [16], information technology is the core of smart city disclosure [17]. Information technology has been a powerful catalyst in addressing economic challenges for cities, and it has simply become the foundation of every sector of every economy [18]. According to the world economic forum's 2015 global information technology report, several studies have shown a significant and positive impact on GDP from information technology.

4 | Proposed Work

This section presents a proposed model that centers on developing a robust framework that integrates IoT applications seamlessly into urban infrastructure, thereby fostering a smarter, more interconnected urban environment. This framework involves the deployment of IoT-enabled sensors, devices, and systems across

critical sectors such as transportation, energy, healthcare, and public services. By collecting and analyzing real-time data, cities can optimize resource allocation, enhance operational efficiency, and mitigate challenges associated with urbanization. Furthermore, the proposed solution emphasizes the importance of creating a supportive ecosystem for innovation and entrepreneurship. Encouraging collaboration between local governments, businesses, and research institutions will facilitate the development of IoT solutions tailored to the unique economic landscape of each urban area [19]. This collaborative approach will drive economic growth and foster job creation as the demand for skilled professionals in IoT-related fields continues to rise. Additionally, the proposed solution underscores the need for a proactive regulatory framework to address privacy concerns, security issues, and ethical considerations associated with the widespread deployment of IoT devices in urban settings. Striking a balance between innovation and safeguarding individual rights is crucial for building public trust and ensuring the sustained success of IoT-driven economic initiatives.

In contrast to ordinary networks, a system containing head nodes splits their originating forecast information fields into those transmitted and cached by ordinary access points. The sub-cluster head collects the data delivered by the nodes in the same way as the initial forecast data column before the first prediction model is performed. Measurements & dimension units vary widely among evaluation criteria. This circumstance will have an impact on the evaluation of the information. Data normalization is necessary to remove the dimensional effect among variables [20]. Ordinary nodes begin to execute the predictive model described in this chapter and utilize the real data generated columns to forecast the arrival of the successive generation of data collection, contrasting the predicted value to the node's information gathering. The nodes would modify the initial forecast information field and then deliver the raw data to sub-cluster head nodes if the variance is greater than or equal to a defined threshold. If not, the information and forecast framework need to be refreshed. The percentage error seen between anticipated information and the data set is considered. The network layer will not communicate the gathered data a second time if it falls below a prescribed limit, considering it will send the fore-casted information straight to the base station [21]. Whereas if the error percentage exceeds the threshold, the receiving node would take the information acquired by the nodes, cache it, and then upgrade the forecasting models to generate the prediction again. Resume the prediction procedure by going to the previous step. It is clear from the prediction phase that the predictive algorithm is the center of a fusion of prediction data. A better predictive system may not only decrease the power required to execute the models on the nodes, but it may also increase prediction precision, shorten the duration it takes for data to be transmitted, and conserve network energy.

Fig. 2. Displays the smart city visualization along with detectors.

5 | Limitations and Future Scopes

The economic outcomes of smart city initiatives are business creation, job creation, workforce development [22]. Jeanne Beliveau-Dunn, president and CEO of the IOT, cisco Inc., explained that as cities get smarter, it could result not only in the creation of thousands of traditional technical jobs but also new hybrid positions

that utilize skills across two or more job categories [23]. The CEO of smart growth america, explained that as cities grow their smart technology and services capabilities, there are several emerging employment opportunities in infrastructure, cybersecurity, and data analytics. For 16 example, there is a need for large teams to deploy sensors across the city's infrastructure, such as smart traffic lights, bridges, water monitoring sensors, etc.; there is a need for cybersecurity specialists to ensure the security of digitally connected assets; and there is also a need for IT specialists to collect, analyze, and recommend solutions based on the sensors' collected data. Beliveau-dunn explained that she expects new job roles to be in demand in the smart city of the future, such as robotics specialist, cyber security analyst, 3D print technician, virtual reality design, machine learning scientists, neuro implant technician, and urban innovation/urban mechanics. Furthermore, smart cities bring new eco-friendly jobs [24]. Greed alternatives, a nonprofit organization, promotes access to renewable energy jobs focusing on low-income communities by training people to work in the rooftop solar industry. Kim [24] explained that a growing green economy is injecting new life into the jobs market. In short, smart growth equips cities and communities for new business opportunities, business growth, and job creation [25].

6 | Conclusion

IoT technology can revolutionize our current reality and show a smarter, more interconnected future. With the ability to address crucial problems such as climate change, environmental preservation, and resource management, IoT promises a brighter and more sustainable future. Moreover, IoT can significantly impact the economy by improving productivity, increasing competitiveness, and generating additional tax revenue. IoT is a revolutionary technology for both individuals and companies. Smart cities break from the rigid bureaucratic systems in managing cities' assets. A smart city is an urban vision that fosters citizens' engagement and technological integration of the city's infrastructure. Building smart cities aims to improve the quality of life by using technology to improve the efficiency of services and meet residents' needs. Smart city technologies can have a profound impact on the prosperity of a region. The use of information technology in the production of goods and services has a strong influence on productivity and economic growth. Higher crime rates discourage domestic and foreign direct investments and reallocate resources, creating uncertainty and inefficiency. Smart cities, on the other hand, open the door to great economic opportunities and public safety. As cities grow their smart technologies, employment opportunities exist; smart cities bring new eco-friendly jobs. Gun detectors and Geographic Information Systems (GIS) can reduce crimes by geographically spotting areas with high crime rates and identifying specific crime patterns. The 44 high crimes impact economic growth, discourage domestic and foreign direct investments, and reallocate resources, creating uncertainty and inefficiency. Smart city solutions, such as gun detection and GIS, can lower crime rates, increase efficiency, reduce cost, make communities safer, and increase the quality of living. Traffic congestion, on the other hand, negatively affects income growth and employment growth. Road crashes also slow job growth and negatively impact economic development.

Traffic crashes cost most countries about 3% of their GDP [26]. The economic costs of vehicle crashes in the United States totaled $242 billion [27]. Traffic accidents have a global and regional impact through life and economic losses. Sensors and smart solutions can alleviate transportation challenges. Sensors' data can be used to increase installed traffic lights or widen the sidewalks as needed. GIS solutions allow transportation experts to determine the best location to build a new bridge or install a traffic light. Smart traffic cameras report the speeds of drivers who cross red lights. The results of using traffic camera technology in the transportation system have led to increases in revenue for many cities, a reduction in traffic accidents, and changing behaviors of reckless driving.

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