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## The Impact of Smart City Initiatives on Cities' Local Economic Development

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THE IMPACT OF SMART CITY INITIATIVES ON CITIES' LOCAL  
ECONOMIC DEVELOPMENT

A Thesis Presented to the Graduate Faculty  
of the Fort Hays State University in  
Partial Fulfillment of the Requirements for  
the Degree of Master of Liberal Studies

by

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Date 12/08/2017

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Chair, Graduate Council

## ABSTRACT

The problem explored in this mixed-method action research is that challenges to sustainable economic development and basic community services increase, as populations in cities and towns increase. A city is a human settlement with well-defined demarcation points. A city's infrastructure consists of complex systems, such as sewage treatment plants, water treatment plants, police stations, fire departments, utility services, schools, libraries, business, houses, etc. A smart city, on the other hand, is an urban vision that fosters citizens' engagement and technological integration of the city's infrastructure. The purpose of this mixed-method action research was to identify the characteristics of a smart city and determine to what extent smart city initiatives impact economic development. Using a comparative analysis methodology, the study examined five major smart cities. The research results revealed that cities apply smart solutions by focusing on 5 major areas: Economic Development, Public Safety, Energy & Environment, Infrastructure, and Transportation. The study concluded that Smart city initiatives contribute directly and indirectly to the economic growth of cities in the United States. The study indicated that smart cities are socially engaged, financially stable, business-oriented, data-driven, environmentally friendly, and energy-efficient cities. The study also concluded that smart city initiatives can alleviate cities' challenges, thus, enhancing economic development.

*Keywords:* Smart City, Economic Development, e-Government, Policy, Big Data, Urbanization

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## INTRODUCTION

A city is a human settlement with well-defined demarcation points. A city's infrastructure consists of complex systems, such as sewage treatment plants, water treatment plants, police stations, fire departments, utility services, schools, libraries, business, houses, etc. A smart city, on the other hand, is an urban vision that fosters citizens' engagement and technological integration of the city's infrastructure. The goal of building smart cities is to improve the quality of life by using technology to improve the efficiency of services and meet residents' needs; furthermore, smart cities bring new "eco-friendly" jobs (Kim, 2018). Technology is driving the way city-officials interact with the community and the city's infrastructure. By using real-time control systems and sensors, data are collected from citizens and sensors and then processed in real-time (Poslad, Athen, Zhenchen, & Haibo, 2015). The information and knowledge gathered are keys to tackling inefficiency, which leads to optimizing systems. A smart city offers technological solutions to tell what is happening in the city, how the city is evolving, and how to enable a better quality of life.

Economic development leads to economic growth and "increase in GDP" (Nafziger, 2012). The goal of economic development is 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

reported 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.” (Cleveland, 2017). As cities continue to urbanize, cities officials are obligated to boost economic development, expand access to health care, housing, job creation, education, and other social services; however, without proper planning and due to the rapid urbanization, cities 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 consumptions.

Urbanization refers to the increase in populations in cities and towns. Ever since the industrial revolution, humans have been urbanizing at an exponential rate. There are 100s of thousands of new dwellings being built every day. Every week, there are at least a million new people moving into cities, worldwide. By 2050, the United Nations (UN) is expecting that 6 billion people will be living in cities. North America is considered one of the most urbanized regions, as 82% of the population living in urban areas (United Nations, 2014). Figure 1 clearly shows that while the rural population is decreasing, the



urban population is increasing.

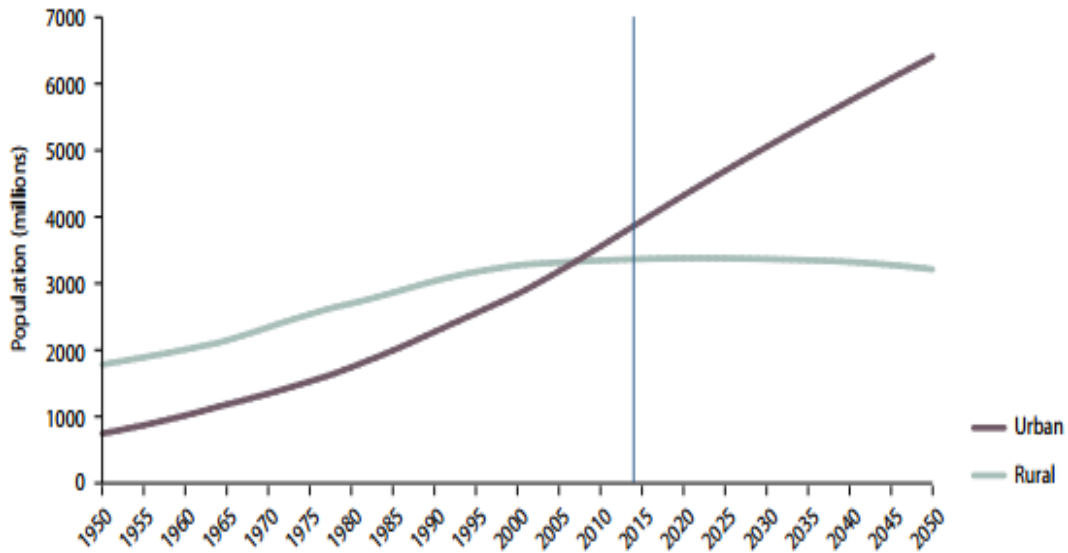


Figure 1 – Urban and Rural Population (data retrieved from un.org)

Air pollution is a major environmental hazard affecting city residents. China, India, and Nigeria all together are anticipated to account for 40% of the expected urban growth, worldwide. This exponential growth is adding stress on the city resources; furthermore, cities consume “as much as 80% of energy production worldwide and account for a roughly equal share of global greenhouse gas emission.” (World Bank, 2016). The World Bank 2016 annual report concluded that power plants and cars are among the leading causes of air pollution. The report also concluded that “air pollution is a threat to sustainable prosperity.” According to the World Health Organization (WHO) 2013 world health report, indoor and outdoor air pollution in both cities and rural areas “caused an estimated 6.5 million deaths worldwide in 2012.” The report also concluded that “around 1.25 million people died from road traffic injuries in 2013, with up to 50

million people sustaining non-fatal injuries because of road traffic collisions or crashes.” (WHO, 2013). In short, cities are facing many challenges. Local cities, States, and federal governments must collaborate and be creative to come up with innovative solutions to mitigate these challenges – to create a sustainable future for their citizens.

### RESEARCH QUESTION

What is the relationship between Smart City Initiatives and economic development impact?

### PURPOSE OF THE STUDY

The purpose of this mixed-method action research was to determine to what extent Smart City initiatives have an impact on the economic development in cities in the United States. The Smart City concept presented in this research focused on the use of Information Technology and the Internet to connect cities’ infrastructure. Sensors are used to connect cities and using data collected, cities can better manage their assets. The study examined and compared 5 major smart cities in the United States and further explore initiated smart projects, to determine the economic value.

### LITERATURE REVIEW

This study used a seven-step process recommended by Creswell and Clark (2010) in conducting literature review. The first step is identifying the key works in academic libraries. The second step is searching identified key works. The third step is locating reports of research in journals, books, and electronic databases. The fourth step is reviewing abstracts and chapters of the located papers. Step five is to identify useful

literature and design literature map, which is a visual picture of the research. The sixth step is summarizing relevant articles. The final step is assembling the literature review, and organizing it by the important concepts in the study.

### **Methods for Reviewing the Literature**

The research question is about finding the relationship between Smart City Initiatives and economic development impact. The hypothesis of this research is that smart city projects can enhance economic development and alleviate the challenges facing cities today. To find answers to the research question and examine the hypothesis, a thorough literature review was conducted. The researcher conducted a thorough literature review including research databases such as Ebscohost, ProQuest, and IEEE computer society digital library; in addition, the study used peer-reviewed journals, books, and government reports.

### **Economic Development and Technology**

Economic development requires the government's dedications, incentives, vision, and leadership (Liu, 2016). While economic development refers to economic growth, economic growth refers to "increase in GDP" (Nafziger, 2012). Smart economic development, on the other hand, leverages technology to increase efficiency, and reduce cost; it requires the government's dedications, incentives, vision, and leadership. Public Wi-Fi, for example, can be used as a tool to connect business and citizens by supporting business transactions; in addition, private investments and businesses play key roles in ensuring a strong economy (McConnell, Brue, & Flynn, 2009). The goal of economic

development is to reduce unemployment, create jobs, lower poverty, lower crime rate, and increase income, which may lead to a strong economy, better quality of life, and prosperity. Figure 2 illustrates the economic development process map. Community Planning, on the other hand, is a strategic process of creating innovative solutions to solve the community challenges, protect, and preserve the community's assets (infrastructure, attractions, business, utilities, libraries, schools, personal properties, and the people). The goals of community planning are building a community-based sustainable food system, manage water resources and develop conservation strategies, provide decent housing for residents, foster and expand economic opportunities (Nafziger, 2012).

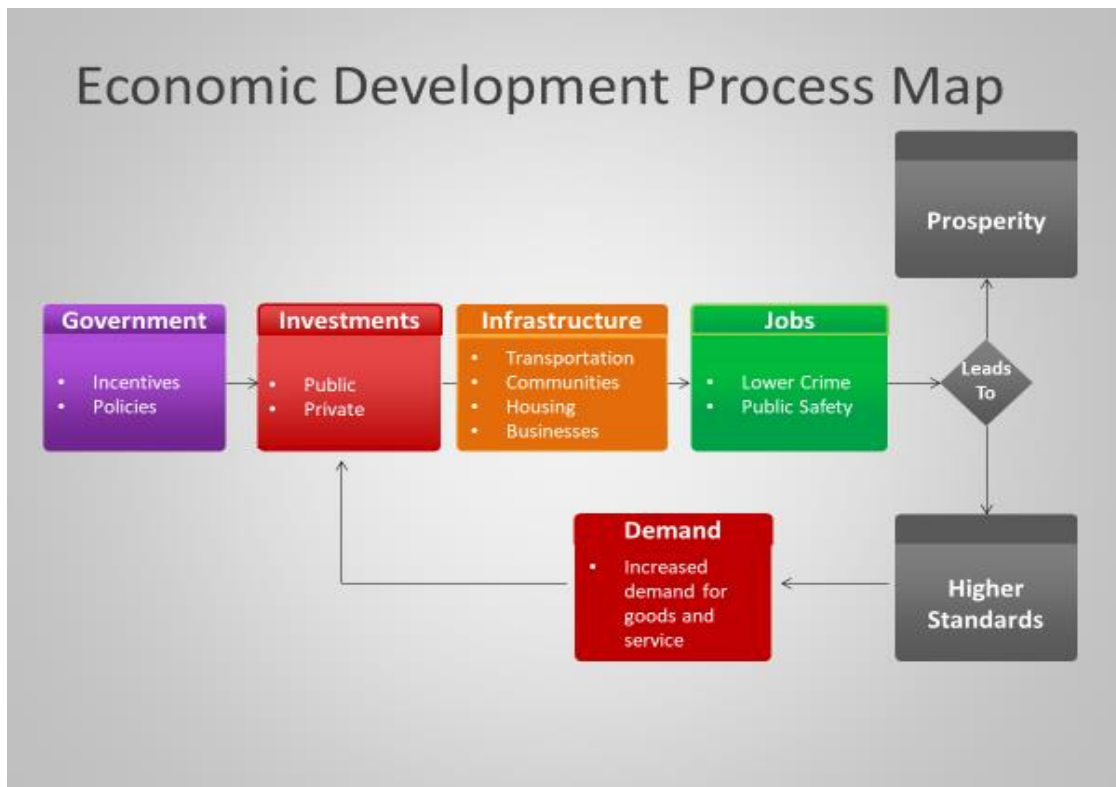


Figure 2 Economic Development Process Map

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 (Dillon, 2010). Growing cities could inject up to \$30 trillion a year into the world economy by 2025 (McKinsey Global Institute, 2012). Vardy (2016) believes that we should look to cities, not countries for global economic impact. McKinsey Global Institute report (2012) concluded that half of the global Gross Domestic Product (GDP) in 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, Richard Florida (2017) 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, Florida (2017) developed an economic power index based on five metrics: economic clout, financial power, global competitiveness, and equity and quality of life. Table 1 reflects Florida’s 2015 index of the 10 most economically powerful cities.

*Table 1 Florida's 2015 Index of 10 Most Economically Powerful Cities*

<b>2015 Rank</b>	<b>City/Metro</b>	<b>Total Score</b>	<b>No. Lists</b>	<b>2012 Rank</b>
<b>1</b>	New York	48	5	1
<b>2</b>	London	40	5	2
<b>3</b>	Tokyo	29	5	3
<b>4</b>	Hong Kong	21	3	4
<b>5</b>	Paris	19	4	4
<b>6</b>	Singapore	17	3	7
<b>7</b>	Los Angeles	13	2	9
<b>8</b>	Seoul	11	2	11
<b>9</b>	Vienna	10	1	-
<b>10 (tie)</b>	Stockholm	9	2	-
<b>10 (tie)</b>	Toronto	9	2	18

While the economy is the main determinant of smart city initiatives (Popescu,

2015), Information Technology is the core of smart city disclosure (Graham & Marvin, 2001). 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” (Kramer, Jenkins, & Katz, 2007). 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 (WEF, 2015). Figure 3 illustrates the components of a Smart City (Smart City Components) and how technology can be integrated with many sectors to enhance services. Smart technologies have changed cities in many ways, such as infrastructure, communications, education, and social interaction (Aribilsho & Usoro, 2016). Aribilsho and Usoro noted that from the governance perspective, smart technology makes a positive change in making a smart city.

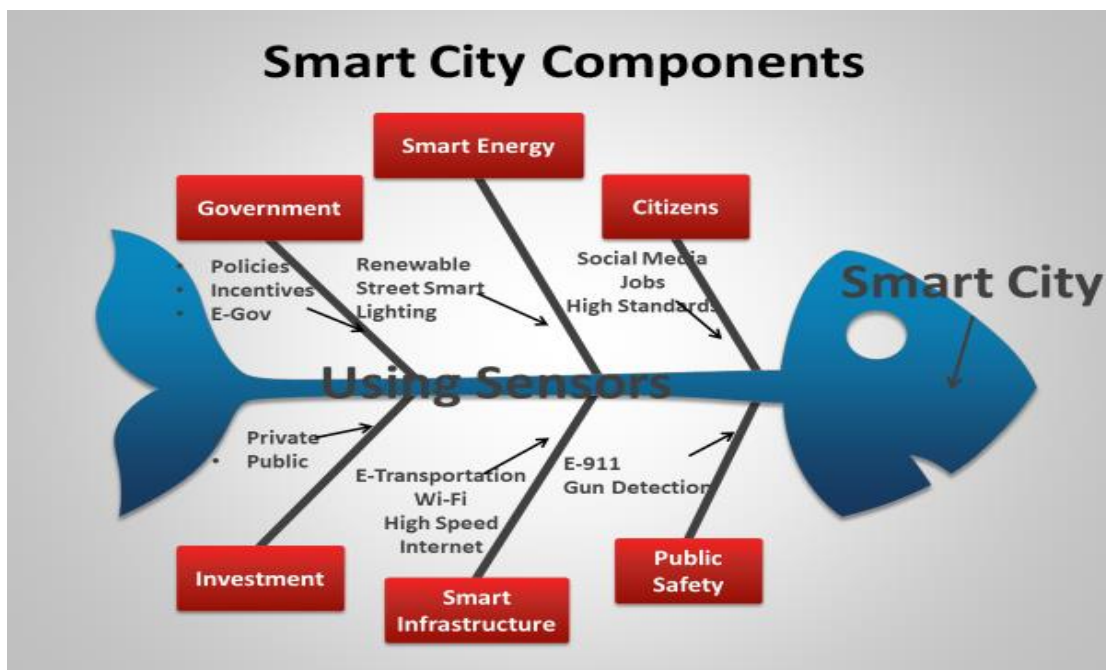


Figure 3 Smart City Components

Smart city technologies can have a profound impact on the prosperity of a region (Smart Cities Council, 2017). Smart city projects contribute to economic growth by establishing an economy of scales. The use of Information Technology in the production of goods and services, in particular, has a strong influence on productivity and economic growth. Rahm Emanuel, Mayor of Chicago, stated that “Innovation continues to fuel Chicago’s ambitions. Leaders in the public, private, and nonprofit sectors are working together to build stronger companies and a smarter city, using big data, civic engagement, and technology start-up incubation. We’re using cutting-edge technology to accelerate Chicago’s economic growth and create jobs while making the city more efficient and livable.” Similarly, Philadelphia has embraced smart city initiatives to help promote economic growth and equity (Smart Choice, 2017). Technology simply has an impact on productivity and economic growth.

### **Smart City**

A smart city offers technological solutions to tell what is happening in the city, how the city is evolving, and how to enable a better quality of life. A smart city is as an urban vision that fosters citizens’ engagement and technological integration of the city’s infrastructure (Musa, 2016). The United Kingdom Government Department for Business, Innovation, and Skills noted that “A smart city uses digital technologies to enhance performance and wellbeing, to reduce costs and resource consumption, also to engage more effectively and actively with its citizens.” Smart cities will bring positive social change by the adoption of Information and Communications Technology (ICT) governance enriching, and human capital among the citizenry (Kummitha & Crutzen,

2017). Smart cities open the door to great economic opportunities and public safety. Gun detectors and Geographic Information System (GIS) can be used to reduce crimes by geographically spotting areas with high crime rates, identifying specific crime patterns. Detotto and Otranto (2010) conducted a study to examine how crimes affect economic growth. The study concluded that higher crime rates discourages domestic and foreign direct investments and reallocates resources, creating uncertainty and inefficiency. The study also concluded that crimes play a role in determining a country's economic progress and negatively impact the economic performance.

Bob Bennett, Kansas City's CIO believes that data is the heart of a Smart City and data is considered "a commodity" in a smart city. Bennett believes that cities can be smart by "getting better control of their data". Bennett clarified that data, including data analysis and putting it into a decision platform, make a city smart. Big Data, on the other hand, is a term that refers to a large volume of data, such as traffic lights data, phones, Internet data, social media data, and the public service data collected by the city government. Big Data can be used positively and or negatively. The right use of big data can burst and ignite a smart city revolution, which will save the residents' time and money. Open data, on the other hand, is the data that can be freely used. A smart city is a city that supports open Big Data – open government that supports big data (Eleftheria, Georgios, Stavros, & Giannoula, 2015). Open data can burst and ignite a smart city revolution. Eleftheria et al. (2015) conducted a study to analyze the contribution of the open data to the development of smart cities. Their study concluded that the open data



projects “encourage citizens to develop applications and digital services” with the ability to reuse of public data, to improve the quality and of public services.

Joshi, Saxena, Godbole, and Shreya (2016) explained that technology has helped mankind to solve some of its difficulties. The authors believe that smart city is an innovative approach to alleviate obstacles triggered by ever-increasing population and fast urbanization which is going to benefit governments as well as the masses; an endeavor to make cities more efficient, sustainable and livable. Modern day cities are underprivileged of vital elements like the quality of life and socio-economic development which can be delivered by smart cities. The authors explained that smart city solutions can monitor and integrate the functionality of all the critical infrastructure like roads, tunnels, airways, waterways, railways, communication power supply, etc., control maintenance activities and can help in optimizing the resources while keeping an eye on the security issues as well. Joshi et al. (2016) research explored various aspects and dimensions of a smart city. To bridge the gap in the literature regarding the concept of smart cities and its implementation, their study developed a framework to get better insights about the idea of a smart city. The authors have identified six significant pillars for developing the framework as that constitutes a smart city: Social, Management, Economic, Legal, Technology, and Sustainability (SMELTS).

The purpose of building smart cities is to make the lives of the residents easier and safer. Applying smart solutions, and through urban design and planning in the smart city era, crimes can be prevented (Chiodi, 2016). Mayor Mike McGinn, City of Seattle,

announced that Seattle's predictive policing program saved lives and reduced the crime rate. He explained that the city uses smart solutions based on data analytics to predict the type of crimes and the location of crimes. Figure 4 illustrates a GIS map showing the crime types and where they are mostly to take place.

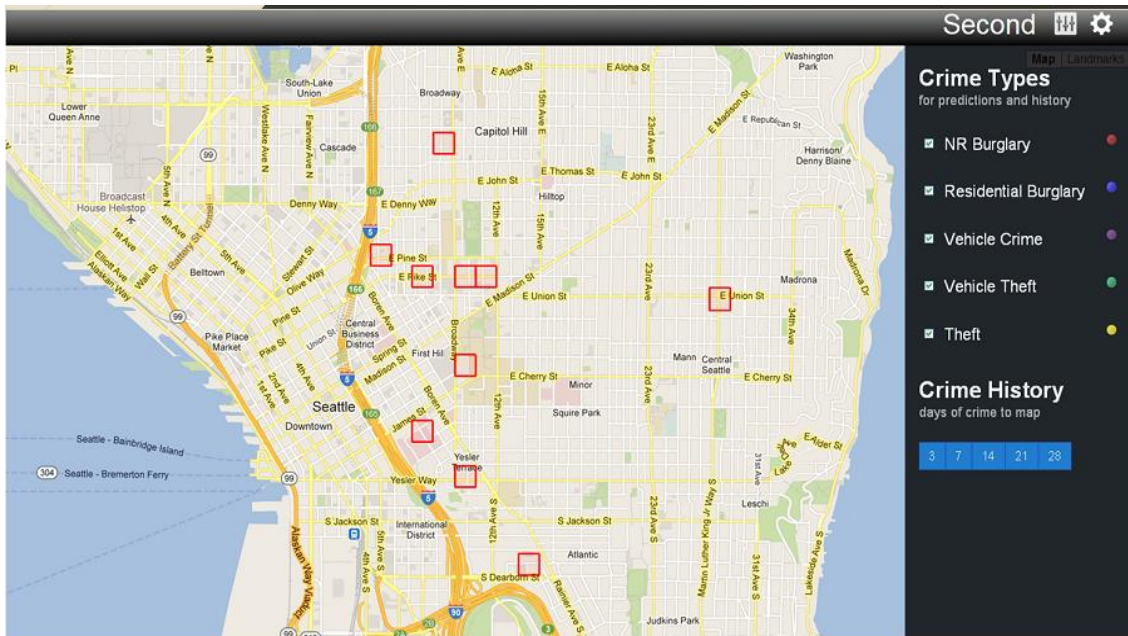


Figure 4 Seattle's Predictive Policing Program (retrieved from <http://datasmart.ash.harvard.edu>)

City officials are obligated to provide strategic leadership and quality of service, create a positive business climate, and provide incentives to business and economic growth (Liu, 2016). To avoid constraints on economic growth, “urban policymakers need to plan the urban environment to include sufficient housing and efficient transportation, ensure that sufficient finance is available to support both operational and capital spending on services including electricity, telecommunications, and water, and, through smart regulation, provide an environment that encourages entrepreneurialism and

business investment.” (McKinsey Global Institute, 2012). Cities’ ability to achieve smart status must begin at the planning stage (Tomer, 2014). In order to initiate effective smart solutions, Chief Information Officers (CIO) and city officials need to develop a smart city roadmap. The roadmap lays out the principles of city needs and drives all smart initiatives (City of Birmingham, 2014). Kummitha and Crutzen (2017) explained that smart cities begin with an economically-driven and technology-focused policy. The policy needs to define the roles, responsibilities, strategies, and objectives of smart cities. Another element that can be included in a smart city’s roadmap is studying the city’s demographics, lifestyle, spending, and social activities - including surveying and interviewing the residents and business.

Another critical element in developing a smart city roadmap is engaging citizens through the use of electronic government and effective governance. Electronic government (e-government) is defined as the use of technology to provide government services to the public. The goal of e-government is to improve governments’ service delivery methods and enhance citizens’ involvement in public services. E-government can help stimulate economic growth, promote effective natural resource management, and promote social engagement (United Nations, 2014). E-government solutions can be conducted to manage the market and operation in government agencies and smart city industries, such as urban disaster and environmental protection (Lv, Li, Wang, Zhang, Hu, & Feng, 2017). One Electronic Shop (One-E-Shop) is a critical element of e-government. One E-Shop offers online building permit services, building inspection, scheduling, building plans check status, permit history, zoning information, etc. - all

services are provided in one location. E-permits save businesses time and money by not driving to the county/city offices. E-permits systems allow business to apply and track online permits, such as building permits, inspection, building plans, and zoning information. Through the online permit center, cities can provide streamlined plan reviews and building permit issuance. Some cities, such as Sunnyvale, CA issues over 90% of all building permits online. Pima County AZ also issues over 50% of building permits online (PIMA County, 2014). After implementing e-permit at the city of Detroit, the number of issued permits increased by 150%. Similarly, Salt Lake City partnered with Microsoft to develop smart solutions that led to reducing plan review process time. Microsoft clarified that by moving the city's building permit preprocess to the web, "Utah's state capital has reduced time to gain permit approval by up to 50 percent." (Microsoft, 2017). The Salt Lake City director of building services stated that "We decided to move the whole system online to integrate departments, make the permit process easier and help reduce our carbo footprint." (Microsoft, 2017).

High-speed Internet is key to job creation (The World Bank, 2017). A critical element of e-government is high-speed (broadband) Internet and making Wi-Fi widely available, citywide. A 2012 study by the International Telecommunications Union, a United Nations agency, concluded that broad band Internet led to "efficiency and an increase in per-capita GDP of up to 1.38%" (ITU, 2012). Public Wi-Fi, on the other hand, offers many benefits. Kansas City, for example, partnered with Cisco and Sprint to roll out a smart city framework and a city-wide Wi-Fi network. Sprint Chief Technology Officer, Stephan Bye stated that "with a backbone of Wi-Fi and sensors rolled out across

93,000 street lights in the city, it would allow the city to manage parking, traffic, lighting, water, and waste management.” (Taylor, 2015). Open Wi-Fi is a tool to engage the residents of a city. Free Wi-Fi is a beneficial economic development tool that can be used by tourists and travelers (Smart Cities Council, 2017). Free Wi-Fi also makes it appealing to residents to be outside in public places, which in return stimulates the economy. A study conducted by iGR concluded that customers prefer visiting places that offer free Wi-Fi. The study also concluded that people end up staying much longer at places that offer free Wi-Fi, which in return end up buying more items by 20%. Similarly, in 2014, a study by Comcast conducted that customers spend more time in facilities when Wi-Fi is offered (Comcast, 2014); furthermore, free Wi-Fi has health benefits. Smart health monitoring, and other technologies, such as *telehealth*, can be used to relay real-time public health communications, using Wi-Fi.

### **Smart Cities and Job Creation**

The economic outcomes of smart city initiatives are “business creation, job creation, workforce development” (Granath, 2016). Jeanne Beliveau-Dunn, president and CEO of the Internet of Things, 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.” In addition, Piage Miller, the CEO of Smart Growth America, explained that as cities grow their smart technology and services capabilities, there are “several emerging employment opportunities” in sectors, such as infrastructure, cybersecurity, and data analytics. For

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 (Kim, 2018). Greed Alternatives, a nonprofit organization, promotes access to renewable energy jobs focusing on low-income communities by providing training to people to work in the rooftop solar industry. Kim (2018) explained that growing green economy is "injecting new life into jobs market". In short, smart growth equips cities and communities for new business opportunities, business growth, and job creation (Sharma & Rajput, 2017).

### **GIS and Economic Development**

Esri, a leading vendor in GIS with an annual revenue exceeding \$1.1 billion in 2016, defines GIS as a tool to assist in making decisions based on geography. GIS organizes geographic data so that cities reading maps can select data for a specific project or task (Esri, 2017). Esri's press director, Karen Richardson, explained that many cities rely on GIS for planning smart cities and making urban planning more efficient (Esri, 2017). Taw (2013) explained that economic developers need GIS, an effective decision-

making tool, to help disseminating results and making informed decisions. GIS technology plays a powerful and effective role in delivery functions to help economic developers sustain economic recovery and growth (Esri, 2017). The role of GIS in smart cities is to integrate different data acquired by sensors in real time and provide better decisions (Guney, 2016). For example, the City of Asheville, NC, uses GIS to foster economic development. The city created priority places, a web-based GIS tool that promotes economic development by enabling citizens, business owners, and investors to identify optimal locations for their activities. The city manager explained that choosing the right location is an important decision, as it can “ultimately determine the success or the failure of a new business.”

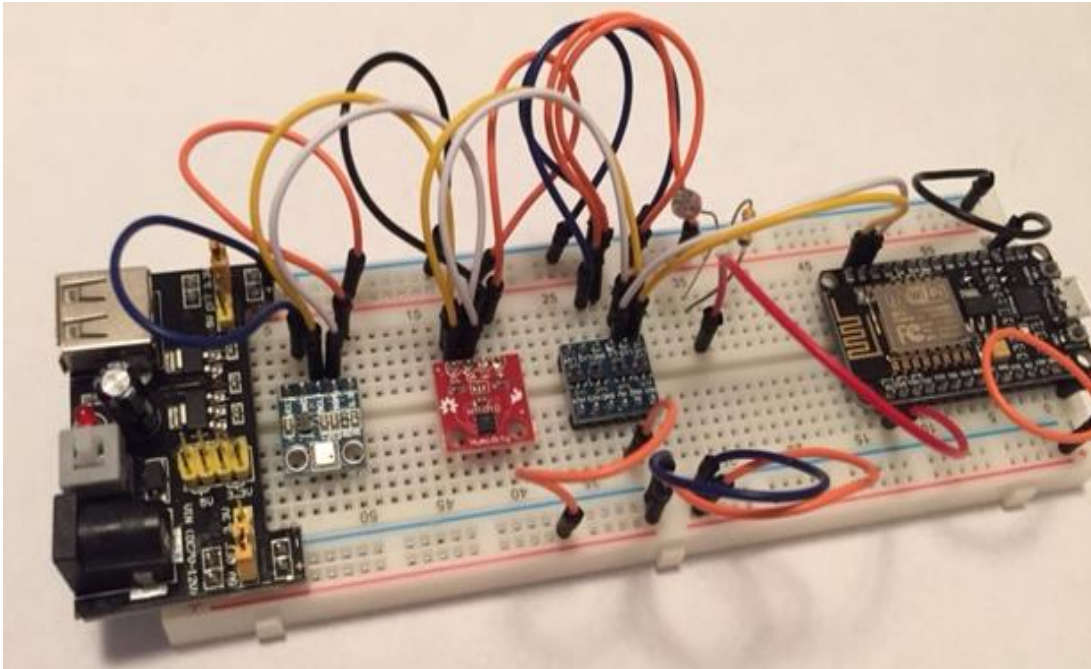
According to the United States Small Business Administration (SBA), small businesses create 60-80% of net new jobs. Pueblo County adopted an approach focusing on local businesses. The county uses GIS to grow its economy, said Christopher Markuson, the county’s GIS manager. Pueblo County uses GIS to identify customer information in and around a specific market to improve nationwide penetration. The county’s GIS manager clarified that the GIS department’s consulting services have business owners schedule appointments months in advance, to address their business concerns. Business owners meet with the GIS department to discuss concerns, interest, current efforts, target areas, etc. The county’s GIS team analyzes maps and demographic data to share with the business owners. The county uses GIS as a tool used to conduct feasibility studies. The County’s GIS manager explained that they use Esri ArcGIS to find employment characteristics, locating services, advertising, collecting average daily

traffic volumes, develop powerful reports, in just minutes. Markuson stated that “We feel we've been successful in our mission to help businesses grow and succeed. To date, we've tracked 58 new jobs emerging from the businesses we've helped grow, bringing over \$2.8 million in new revenue into the county. I'm especially thrilled that most of these new jobs pay livable wages—\$45,000 each on average—offer benefits, and have little potential to move out of our community in pursuit of a lower-cost alternative.”

### **IoT and Artificial Intelligence**

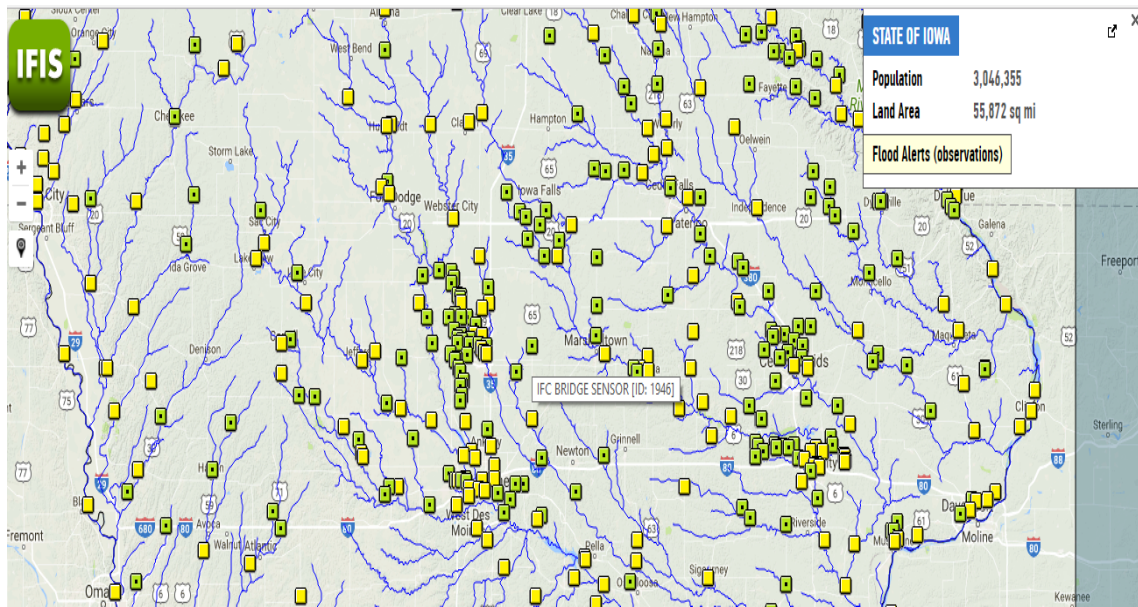
The Internet of Things (IoT) or the network of physical devices, works by collecting, exchanging and processing data from sensors and networked devices to tell what is happening in the city, and how the city is evolving. Sensors are the nervous system of the smart city initiative. The growth of IoT is driven by the growth of sensors' industry (McClellan, Jimenez, & Koutitas, 2018). Sensors are small measurement devices that can be integrated with electronics to detect certain sounds, smells, or levels of variations. Figure 5 illustrates an Arduino (IoT) weather station, which detects and reports the current weather then sends it to a centralized server.





*Figure 5* Arduino (IoT) Weather Station

Sensors are used to monitor water level by providing real-time flood warnings in many states. Iowa Flood Center (IFC) uses more than 200 Senix ultrasonic sensors to measure water levels in streams across the state. IFC uses the collected data from the sensors to integrate data into an advanced hydrological model. IFC director, Witold Krajewski, explained that Iowa State University initially started this sensors-project in response to the 2008 extensive flooding that demonstrated a need for mentoring of the state's rivers and streams in real time. Krajewski noted that the sensors were developed as a student project to design an affordable and effective way to measure streams and rivers heights. This reliable, real-time water data can be used to manage floods (IFC, 2017). Figure 6 illustrates real-time water levels of streams and rivers in the State of Iowa.



*Figure 6 Real-Time Water Levels - IFC Bridges – Image retrieved from Iowa Flood Center*

IoT can be used to improve the ability to plan (Gaur, Scotney, Parr, & McClean, 2015). IoT is also being used to extract useful knowledge, traffic forecasting methods to perform accurate prediction (Fernández-Ares, et al., 2017). For example, water smart meters can be used to collect information to better understand water issues, such as water leaks. City officials can use smart meter data to target water conservation campaign to areas where water is being abused. Data will also allow city officials to focus on improving infrastructure in areas where the water leak is experienced the most. Utility organizations also make use of smart meeting infrastructure. According to the U.S. Energy Information Administration, U.S. electric utilities installed about 65 million smart meters in 2015. A report by Edison Foundation, a utility think tank, concluded that there will be 90 million smart members in the U.S. by 2020 (Edison Foundation, 2016).

Artificial Intelligence (AI) is the field and science of using machines to make intelligent decisions in order to make human lives easier and safer. The word “Artificial” signifies a code or a programmed machine, and the word “Intelligence” refers to a human and the ability to make decisions. An IA example would be a robot/machine detecting a chemical spill, recognizing the type of chemical, realizing the hazardous nature of the substance, and acting by either contacting the authorized official to mitigate the risk or the machine itself cleans the spill and the hazardous material, as programmed. Kaplan (2017) explained that the public narrative about AI is that engineers are building machines that will take over jobs and will eventually surpass human capabilities. Kaplan explained that this is not the widely-shared perception by AI researchers. Robots are coming, but they are not going to take over us or obsolete us; the AI is simply a natural extension of the longstanding efforts to automate processes and tasks (Kaplan, 2017). Similarly, Halim, Kalsoom, Bashir, and Abbas (2016) explained that AI techniques are used for driving safety and vehicle crash prediction, where accidents can be predicted before they occur. AI is simply a critical element of a smart city structure, as its goal is to simplify tasks, increase efficiency, and save lives.

### **E-Transportation**

Electronic Transposition (E-Transportation) is the process of using technology to enhance transportation. Transportation systems face massive challenge and technology can be used as an enabler to find solutions. Chen, Ardilla-Gomez, and Frame (2017) explained that energy savings are achieved when users change their behaviors; thus, cities

should involve public and private players to collaborate and develop technologies in the context of smart city initiatives. The authors also explained that energy efficiency and emissions reduction are rational for smart city initiatives. Robust and accurate data can be used to manage residents' movements through the city. Smart technology is being used to identify the degree of conflicts between vehicles traffic and to modernize the way we count pedestrians crossing the streets (Li & Shahidehpour, 2017).

Traffic congestion has long been among the biggest economic problems in US metropolitan areas (Jin & Rafferty, 2017). Jin and Rafferty, professors at the University of Wisconsin-Madison, conducted a study to examine the interrelationship between traffic congestion, income, and employment. The results showed that traffic congestion growth negatively affects income growth and employment growth. The study suggested that transportation policies that aim to reduce traffic congestion could provide economic benefits in terms of increasing employment growth as well as income growth (Jin & Rafferty, 2017). Likewise, Emily Badger, a CityLab writer, explained that a city like Atlanta, might be economically hindered by freeway connection (Badger, 2013). Similarly, Sweet (2011) conducted a study on traffic congestion and results suggested that traffic congestion slows job growth. The World Health Organization 2013 report concluded that about 1.25 million people die each year because of road crashes. The report also highlighted that traffic crashes cost most countries about 3% of their gross domestic product (WHO, 2013). The U.S. Department of Transportation (DoT) report concluded that the economic costs of vehicle crashes in the United States totaled \$242 billion (DoT, 2014). The report also explained that traffic

accidents have a global and regional impact through lives loss and economic losses. Traffic cameras are also being used to monitor traffic and pedestrians' movements.

Technology is simply being used to allow city planners to develop more accurate and sophisticated transportation systems, which in return, saves lives and improves residents' quality of life. Weisbrod, Vary, and Treyz (2003) conducted a study to measure the economic costs of urban traffic concession to business. The study examined how various producers of economic goods and services are sensitive to congestion. The study concluded that traffic congestion may have a negative impact on business costs, productivity, and output levels. The city of NY, department of transportation, on the other hand, concluded that traffic data can be used to increase installed traffic lights or widen the sidewalks as needed. The NY City Department of Transportation's commissioner, Janette Sadik-Khan, stated that "Making the connection between transportation policy and economic development is critically important, with improvements to city streets potentially contributing to economic opportunity."

The use of smart technology in the transportation industry saves city workers' time and money as data can be collected and analyzed automatically in a real-time manner. City workers do not have to wait for hours on the street observing traffic or counting the number of pedestrians crossing a street. The use of GPS will allow transportation experts to determine the best location to build a new bridge or install a traffic light. Cameras are also being used in many cities as a mean to ease traffic by getting people to obey traffic laws. Traffic cameras are used for reporting speeds of

drivers who cross red lights. The results of using the traffic camera technology in the transportation system have led to increases in revenue for many cities, reduction in traffic accidents, and changing behaviors of reckless drivers. The result of using technology is to ease traffic, better plan street width, sidewalks, and traffic lights, and to accommodate the right number of vehicles and pedestrians' movements.

Cities can also implement a single transportation payment card and develop apps and sensors for tracking available parking spots. Cristea, Birsana, and Shuleski (2016) argued that non-smart cities are particularly challenged today if we consider transportation problems. The authors explained that smart cities, on the other hand, can find solutions to these problems. Atlanta, for example, implemented a Connected Transpiration Centers (CTC) network to create more access points into Atlanta's existing transpiration system. Figure 7 illustrates the Connected Transpiration Centers. The City of Atlanta explained that the CTC network solution provides five overarching benefits. The first benefit is granting people mobility by quickly and safely moving through Atlanta. The second benefit is Commercial Agility by achieving greater delivery efficiency and improving asset utilization. The third benefit is fast/last mile access by creating easy connections in and out of the city. The fourth benefit is connecting people using smarter tools. The last benefit is vibrant communities by "creating a vibrant, inviting community anchor point and reconnecting those neighborhoods to the broader city." (Cristea, Birsana, & Shuleski, 2016, p.34).



*Figure 7 Atlanta Electronic Connected Transportation Centers*

## **Policies and Regulations**

Today, nearly two-thirds of Americans are living in urban areas. In order to make it easier for federal, state, local governments, and universities to partner, in 2015, the United States federal government launched the Smart America Initiatives (White House, 2016). The goal of the initiative is to accelerate the usage of technology by using managed solutions addressing problems facing cities in the United States. President Barak Obama stated that “If we can reconceive of our government so that the interactions and the interplay between private sector, nonprofits, and government are opened up, and we use technology, data, social media in order to join forces around problems, then there’s no problem that we face in this country that is not soluble.” (White House

Archive, 2016). President Trump did not terminate the Smart America Initiatives; in fact, he has dedicated \$200 billion in 2018 budget for infrastructure to “modernize America” (White House, 2017). In 2016, the White House expanded over \$80 million in new federal investments and the National Science Foundation announced over \$60 million in new smart cities related grants (White House, 2016). Similarly, the Department of Energy and the Department of Transportation continued the previous administration’s smart initiatives by securing nearly “\$350 million in public and private funds for smart cities and advanced transportation technologies” (DoT, 2017).

In December 2016, the State of Illinois issued an executive order with the objective to make the state the first smart state in the US. Likewise, in August 2017, the State of Virginia established an executive work group to advance smart communities in Virginia. The state is planning to help cities with issues, such as city dashboard, data governance, energy, water, waste management, healthcare, public safety, public Wi-Fi/Broadband, and transportation. The states clarified that their objective is to develop a reliable model for Virginia Smart communities, identify partners and resources, align smart systems and devices from diverse sectors, and establish Virginia as a global leader in the development of smart communities.

Throughout the United States, cities have initiated and fostered smart cities policies and regulations to use digital technology to improve community life (Smart Cities Council, 2017). Baltimore, Philadelphia, Ocean City, San Francisco, and many other cities across the country have established policies and strategic objectives to make



their cities smart in order to enhance the quality of life. In late 2015, the U.S. Department of Transportation (DoT) launched the Smart City Challenge - the first of a kind smart city grant challenge. DoT stated that "The Smart City Challenge will allow the selected city to demonstrate how advanced data, technologies, and applications can be used to reduce congestion, keep travelers safe, protect the environment, respond to climate change, and support economic vitality." Kansas City was the finalist for the U.S. Department of Transportation's \$40 million Smart City Challenge, which will fund investments in driverless cars, connected vehicles and sensors across the city (Smart City Council, 2017). Kate Garman, the innovation officer for Kansas City, believes that smart city initiatives are "paradigm shift" in the way we think.

### **Summary of Literature Review**

The literature review revealed that more than 80% of the population in North America are living in urban areas. Cities consume more than 80% of energy production worldwide – this leads to increase in indoor and outdoor pollution was caused more than 6.5 million deaths worldwide. In 2013, more than 1.25 million people died from road traffic injuries. Furthermore, United States cities generated almost 85% of the country's GDP. Cities' officials focus on economic development initiatives to reduce unemployment, create jobs, lower poverty, lower crime rates, and to increase standards of living. Cities generate 85% of U.S. jobs. Thus, it is vital to focus on cities, not countries for global economic impact.

The literature review indicated that information technology has been a powerful catalyst in addressing economic challenges for cities. Information technology and high-

speed Internet shown a significant and positive impact on GDP. Smart technologies, on the other hand, have changed cities in many ways, such as infrastructure, communications, education, health, public safety, and social interaction. Smart city technologies can have a profound impact on the prosperity of communities. The literature review show that smart city initiatives can be used to promote economic growth and equity. Smart cities offer technological solutions to tell what is happening in the city, how the city is evolving, and how to enable a better quality of life; they open the door to great economic opportunities and public safety. States and cities across the country are using smart technologies, such as gun detectors and geographic information systems to reduce crimes by geographically spotting areas with high crime rates and by identifying specific crime patterns. Cities are also using sensors and IoT technologies to manage resources, monitor floods, water leaks, and to increase energy efficiency.

In summary, the literature review revealed that economic development and smart city initiatives have the same goal – public safety and prosperity. Economic development focuses on building communities and creating jobs that lead to prosperity, and smart city initiatives focus on technology to make communities safe and prosper. In short, the literature review revealed that smart city solutions can be used to lower crime rates, increase efficiency, reduce cost, make communities safer, and increase the quality of living.

## HYPOTHESIS

Smart city initiatives can alleviate cities' challenges, thus, enhancing economic development.

## METHOD

The research methodology for this study was based on a mixed-method action approach. Mixed-method research provides advancement that counterbalances the weaknesses of both quantitative and qualitative research (Creswell & Clark, 2011). Creswell and Clark (2011) recommended that a mixed methods approach involve collecting data via both numeric information and well as text information. Kumar (2011) clarified that action research is common with participatory research and collaborative analysis; it is more geared toward improving the quality of service.

### **Research Design**

The design of this action research relied on descriptive and participatory, and collaborative research. The research design was based on action mixed-methods. Creswell and Clark (2011) articulated that qualitative methods generally address the research questions relevant to an evidence-based or scholarly approach to a problem, and the quantitative methods reveal the return on investment. To capture data, the research design for this study used surveys and review of projects and reports of 5 major smart cities in the United States. The research design used the survey and comparative analyses methodology to assess the relationship between smart city initiatives and economic development. The comparative analyses of the smart initiatives reflected the relationship

between independent variable, the smart city projects, and the dependent variable, the economic development.

### **Variables**

A variable is defined as a “characteristic or attribute of an individual or an organization that can be measured or observed” (Creswell & Clark, 2011). Data have two major types: discrete and variable. While variable data constitute measurable characteristics, discrete data consist of attributions, such as categories and levels. This study involved independent and dependent variables. Independent variables simply cause influence or affect outcomes. Dependent variables, on the other hand, depend on the independent variables. For example, smart city initiatives are the independent variable. The effectiveness and the economic development is a dependent variable, since it is dependent on the success of the implementation of smart city projects. The relationship can be symbolized by using the following equation:

$Y = f(X)$ . The outcome is represented in “Y” and the root cause is known as “X”. This equation means that the value represented by the letter Y is determined as a function of the value X. For example, economic development (Y) = implementation of smart city projects (X).

### **Participants**

The study included five (5) cities to compare their completed smart city initiatives and to determine the areas of focus that constituted smart city initiatives. In conducting a secondary research, the study collected data from the 5 cities’ websites. Data were also

collected by means of survey questions using surveymonky.com. The survey was disseminated to 10 public CIOs – only three CIOs responded. The participation in the survey was voluntary.

### **Instrumentation**

This mixed-action study is based on a survey and a comparative analysis of 5 smart cities: Atlanta, GA, Boston, MA, Washington DC, Kansas City, MO, and San Francisco, CA. Table 2 illustrates the 5 cities reflecting the population, region, and the budget of each city.

*Table 2 Comparing five smart cities*

<b>City</b>	<b>Population (2016)</b>	<b>Region</b>	<b>City Budget (2017/2018)</b>
Atlanta	473,000	South East	\$649 million
Boston	673,000	North East	\$3.15 billion
Kansas City	475,000	North Central	\$1.59 billion
San Francisco	865,000	West	\$10.1 billion
Washington DC	672,000	East (South Atlantic)	\$13.9 billion

**Washington DC** government embarked on several smart city initiatives, such as smart portals, digital camera, green recycle, LED based street lights, public Wi-Fi, and e-permit online systems, which saved the city millions of dollars annually. DC government believes that a smart economic development will help the city to leverage information

technology across the city to drive “efficiencies, create opportunities, and reduce cost across the entire marketplace.” (DC.gov, 2017). Washington DC government has four (4) dimensions of a smart city: Resilient, Sustainable, Equitable & Citizen Focused, and Transparent & Collaborative. These four dimensions are translated into seven (7) focus areas: Economic Development, Healthcare, Public Safety, Energy & Environment, Infrastructure, and Transportation. Washington DC government has created a framework based on guiding principles for a more capable, inclusive and smarter DC (DC.gov, 2017). Table 3 illustrates the 7 focus areas and examples of smart city initiatives.

*Table 3 Washington DC focus areas and smart initiatives*

Focus	Smart City Initiatives
<b>Economic Development</b>	<ol style="list-style-type: none"> <li>1. Waste Tracking sensors to monitor waste capacity and enhance waste management</li> <li>2. Large-scale and special events permitting portal</li> <li>3. Online web portal to advise and inform vendors for contracts procurement</li> <li>4. Park DC Chinatown to manage parking using multimodal value pricing technology</li> <li>5. Street Light LED project – an energy savings model</li> <li>6. Urban Heat Island Mapping – using sensors to capture temperature</li> </ol>
<b>Energy &amp; Environment</b>	<ol style="list-style-type: none"> <li>1. Critical Customer Notification when an incident occurs</li> <li>2. Customer open data initiative to provide customers with access to data on line</li> <li>3. Water Distribution Management to increase number of pressure monitoring points</li> <li>4. Flood management systems using sensors and CCTV cameras</li> </ol>

	<ol style="list-style-type: none"> <li>5. Smart Devices (Valves, Hydrants, and Backflow Preventers)</li> <li>6. Smithsonian’s National Zoo Solar-Powered Park</li> <li>7. Water leak detection and water quality monitoring</li> </ol>
<b>Health Care</b>	<ol style="list-style-type: none"> <li>1. Smart health monitoring, telehealth, and other applications relying on public’s ability to use the Internet</li> <li>2. Real-time public health communications</li> </ol>
<b>Infrastructure</b>	<ol style="list-style-type: none"> <li>1. Customer open data initiative</li> <li>2. Water Distribution management system</li> <li>3. Expand national mall Wi-Fi</li> <li>4. PA 2040 – a proof of concept project to define Smart City Governance Framework</li> </ol>
<b>Public Safety</b>	<ol style="list-style-type: none"> <li>1. Metro Police Department CCTV network upgrade</li> </ol>
<b>Transportation</b>	<ol style="list-style-type: none"> <li>1. Movement analytics using video sensors to count city movement (people, bikes, cars)</li> </ol>
<b>Urban Planning</b>	<ol style="list-style-type: none"> <li>1. Use of GPS for zoning and planning</li> </ol>

**Kansas City**’s technology initiatives are a “catalyst for connecting communities and fostering economic development”. The city launched its Open Data Catalog at [data.kcmo.org](http://data.kcmo.org) to provide residents raw city data such as annual budgets, crime stats, traffic counts, and 311 service requests. Kansas City’s smart city dimension consists of five (5) major focus areas: Digital Inclusion, Open Government, Engagement, Industry, and Smart City. Table 4 illustrates the 7 focus areas and examples of smart city initiatives.

*Table 4 Kansas City focus areas and smart initiatives*

Focus	Smart City Initiatives
Open Government	<ol style="list-style-type: none"> <li>1. Open data Kansas City (KC)</li> <li>2. Open budget KC</li> </ol>
Engagement	<ol style="list-style-type: none"> <li>1. 311 digital calling platforms</li> <li>2. E-government and online self-services</li> <li>3. Social media services</li> </ol>
Industry	<ol style="list-style-type: none"> <li>1. Developed technologies to support startup infrastructure</li> <li>2. Created smart city living lab</li> <li>3. Partnerships with academic institutes</li> <li>4. Improving digital procurement process</li> <li>5. Interactive kiosks and smart street lights and sensors</li> </ol>
Smart City	<ol style="list-style-type: none"> <li>1. Smart city infrastructure investment</li> <li>2. Sensors for traffic and parking to improve efficiency and maintenance</li> <li>3. Data analytics tools to analyze real-time data of how the city is performing</li> <li>4. Created paperless city hall</li> <li>5. IoT, Artificial Intelligence, and Big Data initiatives</li> <li>6. Wi-Fi in libraries, civic buildings, and recreation centers</li> <li>7. Gigabit high speed Internet by Google</li> </ol>

**Atlanta** has decided to focus its smart city efforts on five (5) core pillars: mobility, public safety, environment, city operations efficiency, and public and business



engagement. The city of Atlanta has defined its smart strategic plan by defining five (5) specific goals: 1) Reduce street light energy cost, improve reliability, and enable sensing 2) reduce gunfire incident volume, improve incident response-time 3) reduce crime rate, increase clearance rate, and reduce case closure time 4) increase recycling participation rate, increase landfill diversion rate 5) reduce wastewater overflow events, improve work order response-time. Table 5 reflects the 5 focus areas and some of the reported smart city initiatives.

*Table 5 Atlanta focus areas and smart initiatives*

Focus	Smart City Initiatives
Mobility	<ol style="list-style-type: none"> <li>1. Deploy shot-spotter IoT sensor in high-crime zones</li> <li>2. Deploy online gunshot detection dashboard</li> <li>3. 100 sensor devices on North Ave</li> </ol>
Public Safety	<ol style="list-style-type: none"> <li>1. Smart public safety by building a machine learning algorithm (AI)</li> <li>2. VIC Fusion Center to support crime fighting apparatus</li> </ol>
Environment	<ol style="list-style-type: none"> <li>1. Autonomous vehicles capabilities</li> <li>2. Smart waste management by installing RFID readers and GPS</li> </ol>
City Operations Efficiency	<ol style="list-style-type: none"> <li>1. Scalable smart city data platform</li> <li>2. Smart water management through IoT sensors</li> </ol>
Public and Business Engagement	<ol style="list-style-type: none"> <li>1. High speed Wi-Fi</li> </ol>

**Boston** has initiated five major city projects that turned Boston into a true smart city. Smart streets by using sensors and cameras to learn more about how people “navigate and interact on and with the city’s streets”; hubway project is being used to allow public bike share system; self-driving cars; outdoor wireless network through free Wi-Fi; and numerous applications developed for e-government purposes. Boston also initiated the “Vision Zero Initiative” with a goal to end fatal and serious traffic crashes. The city is using smart solutions to understand how people act on roads; data will be used to improve street design and safety. Table 6 illustrates the 7 focus areas and examples of smart city initiatives.

*Table 6 Boston focus areas and smart initiatives*

Focus	Smart City Initiatives
Transportation	<ol style="list-style-type: none"> <li>1. Autonomous vehicles</li> <li>2. Smart parking sensors</li> <li>3. Smart street, smart lights</li> <li>4. Vision Zero Initiative</li> </ol>
Public Safety	<ol style="list-style-type: none"> <li>1. Local sense lab – sensors to detect pattern of public drug abuse</li> </ol>
Environment	<ol style="list-style-type: none"> <li>1. Urban trees and green infrastructure</li> </ol>
e-Government	<ol style="list-style-type: none"> <li>1. Smart mobile applications</li> <li>2. Boston Smart Utilities Project</li> </ol>
Transparency and Citizen Engagement	<ol style="list-style-type: none"> <li>1. Public Wi-Fi</li> </ol>

**San Francisco** has three major values that shape its smart city initiatives – Opportunity, Green, and Safe. The city’s goal is to use autonomous vehicles to address traffic and transportation problems. The city is also planning to reduce emissions by 40% by 2025 using renewable energy and connected autonomous electric vehicles. Table 7 illustrates the focus areas and smart city initiatives for the city and county of San Francisco.

*Table 7 Focus and Smart Initiatives*

Focus	Smart City Initiatives
Transportation	<ol style="list-style-type: none"> <li>1. Autonomous electric shuttles</li> <li>2. Smart traffic signals to address traffic congestion</li> <li>3. 442,000 Smart parking spaces</li> <li>4. Walking and Bicycling initiatives</li> <li>5. LED street light conversion projects</li> </ol>
Public Safety	<ol style="list-style-type: none"> <li>1. Crime mapping smart solutions to reduce crimes</li> <li>2. GIS and Gun detection tools</li> </ol>
Green	<ol style="list-style-type: none"> <li>1. Electric vehicles to reduce the carbon footprint</li> <li>2. Highest densities of LEED certified buildings</li> <li>3. Smart technology to achieve zero waste by 2020</li> </ol>
Citizen Engagement	<ol style="list-style-type: none"> <li>1. Public Wi-Fi</li> <li>2. 311 centralized services, online government services</li> <li>3. Open data and open government smart initiatives</li> </ol>

## **Survey Analysis**

The survey was given to 10 people, however, only three took the survey; therefore, the completion rate is 30%. The study collected three samples (from the three participants) by asking 4 questions.

Survey Question 1: What are the top challenges your city is facing today?

Survey Question 2: What do you consider the top 10 attributes of a smart city?

Survey Question 3: Please give some examples of implemented smart city projects

Survey Question 4: How did smart city projects contribute to the city's economic growth?

## **RESULTS**

This chapter presents the results of the study. It provides details regarding survey results, the research problem statement, the research questions, and how they were answered are described in this chapter. The research question is about finding the relationship between smart city initiatives and economic development impact. The hypothesis of this research is that smart city projects can enhance economic development and alleviate the challenges facing cities today. To find answers to the research question and examine the hypothesis, a thorough literature review was conducted, 5 cities were examined, and a survey was conducted.

### **Results of the Research Question**

The research question asked what the relationship is between smart city initiatives and economic development impact. The survey results and the comparative analysis of 5

smart cities indicated that smart city initiatives contribute directly and indirectly to the economic growth. Direct contribution is achieved through (a) direct investment in the infrastructure (b) improved transit that leads to less time on roads, less crashes, and thriving local trades (c) sufficient energy use, such as smart lighting and smart air conditioning (d) better social infrastructures, such as hospitals, schools, libraries, etc. (e) financial incentives for businesses and (f) efficient regulations for new technologies, such as autonomous electric cars, and IoT. Indirect contribution, on the other hand, can be achieved through (a) improving the overall quality of lives (b) citizens are less frustrated and more productive (c) engaging citizens to have a sense of civic ownership and (d) building relationships with private sectors. The results of the survey questions are listed below; the questions were geared to answer the research question, and the responses used to formulate the results.

### **Results of Survey Question 1:**

The purpose of this question was to determine the top challenges cities are facing. The survey responses reported the following as the top challenges (not in any specific order): unemployment, reduced economic development, poverty, aged infrastructure, cyber terrorism, traffic congestion, high crime rates, lack of clean water, environmental hazards, and slow bureaucratic city systems.

### **Results of Survey Question 2:**

The purpose of this question was to determine the attributes of a smart city and what constitutes a smart city to chief information officers. The survey responses reported

the following (in order of importance): data-driven city, e-government solutions, electronically connected city, supports open-data, energy efficient and environmentally clean city, socially engaged city, cybersecurity and privacy-oriented city, safe city with low crimes, economic development driven/focused, business-oriented city with incentives for businesses and start-ups, financially stable city, and finally healthy city (walking, biking, parks, recreation facilities and outdoor activities).

### **Results of Survey Question 3:**

The purpose of this question was to identify the types of smart projects cities have been implementing. The survey responses reported the following (not in any specific order): customer-centric system integrated with department work systems, gig-speed wireless, e-government, 311 centralized phone systems, mobile applications, online portal, dashboards, community metrics, online permits, open data community architecture and demonstration for all governments to enter into Big Data, and smart lighting.

### **Results of Survey Question 4:**

The purpose of this question was to determine how smart city projects contribute to the city's economic growth. While the participants indicated that "it is difficult to assess", they responded that there are direct investments from the projects into the infrastructure services sectors. The participants also explained that service efficiencies and improved services due the implementation of smart projects are the true rewards, which ultimately will lead to cost savings, safe city, and sustainable city.

## Hypothesis Test and Result

The hypothesis proposed a positive relationship existed between smart city initiatives and economic development. The survey and the five cities' comparative analysis indicated that there is a positive direct and indirect relationship between economic development and smart city initiatives. Smart projects, such as smart traffic lights, crime detection artificial intelligence tools, and gun detection solutions led to fewer crimes in some cities. Smart solutions required hiring specialized employees, thus, increased job opportunities, start-up businesses, and citizens engagement, which in return lead to a better quality of life. Figure 8 illustrates the cause and effect relationship diagram.

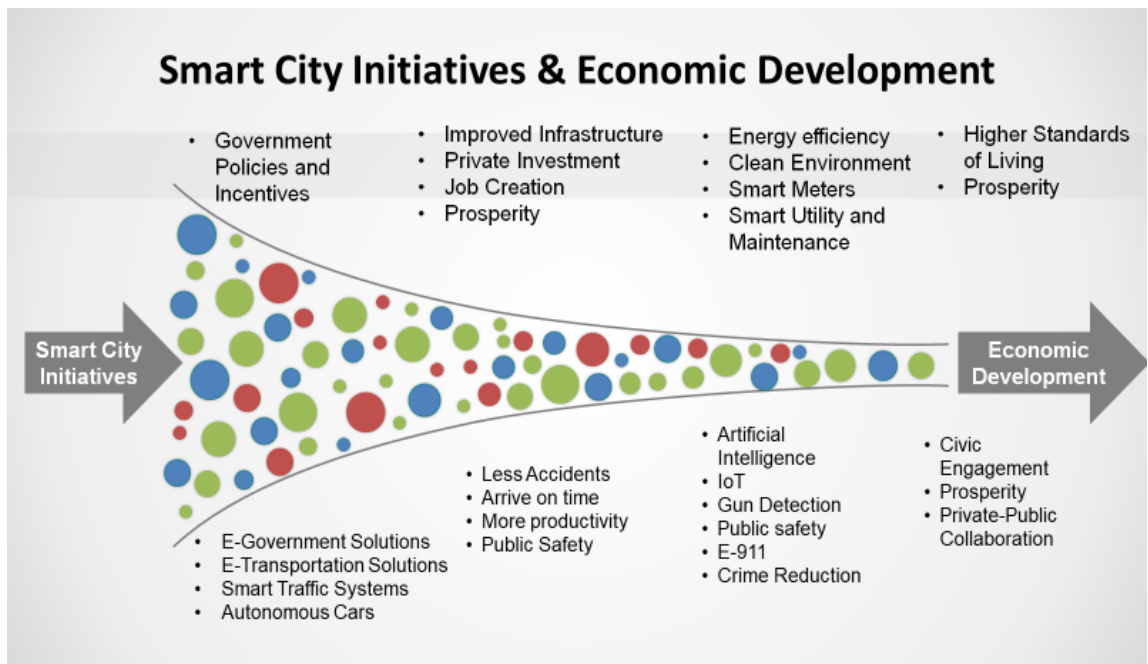


Figure 8 Smart City and Economic Development Relationship

## **Summary of Results**

In summary, it was hypothesized that smart city initiatives can alleviate cities' challenges thus enhancing economic development. The collected data resulting from the survey participants indicate that there is a positive impact (directly and indirectly) of smart city initiatives on economic development. The direct positive impact can be achieved through enhanced infrastructure, private investment in smart technologies, electronic traffic systems, reduction in traffic accidents, reduction in crime rates, and an increase in employment; thus, leading to higher standards of living and enhanced economic development. The comparative analysis of the 5 cities indicated that cities apply smart solutions by focusing on five (5) major areas: Economic Development, Public Safety, Energy & Environment, Infrastructure, and Transportation.

## **CONCLUSION**

In the United States, there is about 80% of the population living in urban areas (United Nations, 2014). More people live in cities every day. As populations in cities and towns increase, challenges to sustainable economic development and basic community services also increase. The study concluded that some of the top challenges cities are facing include unemployment, reduced economic development, poverty, aged infrastructure, traffic congestion, high crime rates, and lack of clean water; furthermore, cities play important role in world's economy. Cities account for nearly 90% of the United States' total economic output and generate 85% of the U.S. jobs; cities are the



center of economic power (Florida, 2017). As far as global economic impact is concerned, it is better to focus on cities than countries. The goal of economic development is to reduce unemployment, create jobs, lower poverty, lower crime rate, and increase income, which may lead to a strong economy, better quality of life, and prosperity. Information technology, on the other hand, has been a powerful catalyst in addressing economic challenges. Smart technological solutions can be integrated with many sectors to enhance services. Smart technologies have changed cities in many ways, such as infrastructure, communications, education, and social interaction; smart technology makes a positive change in making a smart city.

Smart cities present a 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. The goal of building smart cities is 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 reallocates 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, there are emerging employment opportunities; smart cities bring new eco-friendly jobs. Gun detectors and Geographic Information System (GIS) can be used to reduce crimes by geographically spotting areas with high crime rates, identifying specific crime patterns.

High crimes impact economic growth, discourage domestic and foreign direct investments, reallocate resources, creating uncertainty, and inefficiency. Smart city solutions, such as gun detection and GIS can be used to 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 impact economic development negatively. Traffic crashes cost most countries about 3% of their gross domestic product (WHO, 2013). The economic costs of vehicle crashes in the United States totaled \$242 billion (DoT, 2014). Traffic accidents have a global and regional impact through lives loss 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 are used for reporting speeds of drivers who cross red lights. The results of using the traffic camera technology in the transportation system have led to increases in revenue for many cities, reduction in traffic accidents, and changing behaviors of reckless drivers.

**The key findings for this action research are as follow:**

1. Economic development and smart city initiatives have the same goal – public safety and prosperity. Economic development focuses on building communities and creating jobs that lead to prosperity, and smart city initiatives focus on technology to make communities safe and prosper.

2. Smart city initiatives contribute directly and indirectly to the economic growth of cities in the United States. Direct contribution is achieved through (a) job growth by hiring technical engineers and technicians with smart technologies expertise (b) direct investment in the infrastructure (c) improved transit that leads to less time on roads, less crashes, and thriving local trades (d) sufficient energy use, such as smart lighting and smart air conditioning (e) better social infrastructures, such as hospitals, schools, libraries, etc. (f) effective regulations for new technologies, such as autonomous electric cars, and IoT. Indirect contribution, on the other hand, can be achieved through (a) saving and protecting lives from environmental damage and crime incidents (b) improving the overall quality of lives (c) citizens are less frustrated and more productive (d) engaging citizens to have a sense of civic ownership and (e) building relationships with private sectors.
3. Cities apply smart solutions by focusing on 5 major areas: Economic Development, Public Safety, Energy & Environment, Infrastructure, and Transportation.
4. Top smart solutions applied by smart cities include autonomous electric vehicles, smart traffic lights with sensors, smart street lights with sensors, water leaking detecting sensors, GIS, gun detection tools, public Wi-Fi, high speed Internet, 311 phone services, and electronic government services, such as online procurement, tax payment, and building permits.

Smart technologies can connect the infrastructure, but it takes more than technology to establish a resilient and smart community. Citizens engagement is a critical element in achieving a smart community. City officials are encouraged to engage citizens in the decision-making process, especially in matters involving planning and policies. In order to put smart solutions into work effectively across sectors, city officials need to develop a smart city roadmap. The roadmap needs to have three major dimensions. The first dimension is to recognize the problem and a need for a smart solution. Residents, businesses, and other key stakeholders can be consulted to understand their requirements and needs. The second dimension is through policy development. The policy is needed to drive the smart city initiatives, to define roles and responsibility, and to create plans and strategies on how the goals will be achieved. The third dimension is to engage the citizens through the use of e-government solutions, open data, free Wi-Fi, sports events, etc. In conclusion, a smart city is a digitally connected city that fosters open data to benefit start-ups and to ensure transparency. A smart city is environmentally friendly and energy efficient city that invests in clean energy, LED lighting, electronic vehicles, and electronic transportation systems. A smart city is a safe city that foster technical solutions to reduce crimes, create smart traffic system to reduce the loss of lives, and a city that uses artificial intelligence to predict crimes and prevent them before taken place. A smart city is a financially stable city with good credit and solid history of achievements. A smart city is a socially engaged city where the public has a sense of civic ownership and care about their community by interacting electronically with their city officials. A smart city is a city that uses technology to

enhance economic development through direct investment in infrastructure and by increasing specialized expertise in different technical fields. In short, cities are facing many challenges, such as unemployment, traffic congestion, high crimes, and aged infrastructures. Smart city initiatives can alleviate cities' challenges by reducing crimes, reducing traffic accidents and congestion, and by injecting new job opportunities into communities; smart technologies equip cities and communities for business growth and job creation.

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