

Smart Cities - A Roadmap for Development

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Abstract

Ever since the industrial revolution, humans have been urbanizing at an exponential rate. There are 100s of thousands of new dwellings are being built every day. As of 2015, there is about 52% of the world population living in cities. 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; furthermore, cities consume about 70% of the global energy use; as a result, the strain on resources and the magnitude of challenges that cities face is phenomenal. It is imperative to develop solutions that improve the liveability of cities while vividly reducing resource consumption. There is a need for a city-wide smart, secure, and resilient transformation. Technological transformation is one option that governments can rely on to mitigate many of the risks and challenges they are facing. Local governments in general and the Chief Information Officers (CIO) in particular, have many objectives to achieve successful electronic government, such as studying the community, engaging the residents, allowing access to high-speed Internet, and adopting an open government philosophy. In short, government officials must develop a road map for building smart cities, in order to leverage and integrate technologies to create real economic opportunities and save lives.

Keywords: Smart city; e-Government; CIO; Internet of things

Introduction

A smart city is defined as a city that engages its citizens and connects its infrastructure electronically. A smart city has the ability to integrate multiple technological solutions, in a secure fashion, to manage the city's assets-the city's assets include, but not limited to, local departments' information systems, schools, libraries, transportation systems, hospitals, power plants, law enforcement, and other community services. The goal of building a smart city is to improve the quality of life by using technology to improve the efficiency of services and meet residents' needs. Business drives technology and large-scale urbanization drives innovation and new technologies. Technology is driving the way city officials interact with the community and the city's infrastructure. Through the use of real-time control systems and sensors, data are collected from citizens and sensors and then processed in real-time [1]. 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.

Purpose

The purpose of building smart cities is to make the lives of the residents easier and safer. Technology can be used as an instrument to protect lives and improve services and businesses processes; furthermore, it can be used to protect Personally Identifiable Information (PII) and cities critical infrastructures, such as transportation, hospitals, power plants, and water treatment systems. Technology can be used to reduce crimes by geographically spotting areas with high crime rates, identifying specific crime patterns, or by detecting gun sounds and reporting it to law enforcement immediately-many of these services are achieved by using sensors. Sensors are small measurement devices that can be integrated with electronics to detect certain sounds, smells, or levels of variations. Sensors can be passive or active. Passive sensors do not necessarily take action; they simply collect data, and they are used mainly to measure weather conditions, such as wind speed, ground Ozone levels, or the sun's ultraviolet levels. Active sensor devices, on the other hand, use electronics to process data and take action. For example, the traffic lights or parking sensors, using electronics, calculate the collected data and then take action based

on meeting certain threshold [2]. Raspberry Pi, a credit-card sized computer, is used in many sensor devices. It uses Linux or Windows 10 IoT Core operating systems (Figure 1) illustrate the components of it.

The network of physical devices or "things" that work collaboratively by collecting, exchanging and processing data is known as the Internet of Things. Cities remotely control these sensors through wired or wireless networks. The Internet of Things can be used to improve the ability to plan [3]. 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 water leak is experienced the most.

Transforming cities to be resilient technologically is another method that can be used to protect lives and improve cities. A technologically

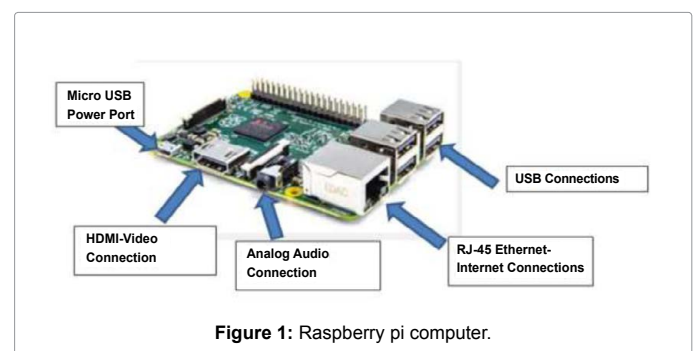


Figure 1: Raspberry pi computer.

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resilient city focuses on the economy, society, infrastructure, mobility, strategic planning, and healthy relationship with the residents. Mobility is defined as the ability to perform services using mobile devices from anywhere at any time. Building a sustainable technological infrastructure that provides reliable communications and mobility is one attribute of a resilient city. Cities face stresses and shocks, such as unemployment, inefficient public transportation, earthquakes, floods, terrorist attacks, or cyber-attacks. These stresses and shocks weaken the infrastructure of the city. Resilient cities demonstrate many qualities and attributes that allow them to withstand and adapt more readily to shocks and stresses [4]. Resilient cities can enhance their capability by reflecting on their past experience and lessons learned, in order to inform safer future decisions and to be protected from stresses and shocks. Emergency preparedness, awareness training, Internet lines redundancy, and data backup are considered attributes of a resilient city. Figure 2 illustrates the component of a Smart City and how technology can be integrated with many sectors to enhance services.

In order to build a smart and secure city, technology can certainly play a critical role, but technology alone is not enough-the city's employees and the community have an equally important role to play. The city officials need to empower the public by engaging them in the decision-making process. Cities need to value their citizens' feedback by encouraging them to participate and contribute to solving problems; moreover, local citizens must be fully aware of the community challenges and must be engaged in shaping the budget allocations, local taxes, etc. A 2014 study conducted by the Inter-American Development Bank concluded that citizens' engagement around budget process led to improvement and satisfaction in creating measurable tax collection [5].

The Chief Technology Officer (CTO) or Chief Information Officer (CIO) is typically the title of the individual that leads the smart city initiatives. The role of a city CIO is to lead the city's efforts to develop creative and effective technology solutions to address challenges. The CIO is expected to collaborate with residents and elected officials to design effective solutions. Effective solutions may include the use of technology to increase the capacity of existing infrastructure and services, integrate approaches, and involve citizens through committees and commissions to discuss issues impacting the community. For example, the city of Cupertino created teens, adults, and senior's commissions to address community challenges [6]. The city CIO is expected to create and foster productive work teams, identify best

practices, enhance services delivery, and implement citizens focused initiatives-after all, it is all about the citizens. In short, CIOs must study their communities, know what is needed to meet their citizens' needs, plan and execute related initiatives, and continue improving service delivery methods.

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 the government 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. Local cities and counties are responsible for initiating technological programs to help communities tackle local challenges and improve services. Cities' leaderships, represented in Mayors, the board of supervisors, and CIOs must be visionary and have the desire, the ability, and the capability to build a safe and secure smart environment.

Local governments that are thinking about embarking smart city initiatives need to start by developing a roadmap. The top three components to develop a roadmap for a smart city are studying the community, developing a smart city policy, and engaging the community through e-government and a solid citywide Wi-Fi infrastructure. Figure 3 illustrates the three-step roadmap process.

The first step in establishing a road map for a smart city is to know why there is a need for a smart city initiative. This can be done by studying the city's demographics, including the residents who are the principal stakeholders in the city. People love to live in cities that are convenient, liveable, vibrant, and connected, so they can get anywhere whenever they want. Knowing the ages of the citizens, their educational background, their hobbies, the city attractions, the businesses, and the resources of the community are all key steps in getting to know the community and why there is a need to build a smart city-Geographic Information System (GIS) tools can be used to achieve this step. GIS is an essential economic development tool that many cities use for planning, analyses, and building lively communities that attract businesses and residents; furthermore, people expect and demand their governments to provide a wide range of services. The government and the citizens' relationship is a supply and demand type of a relationship; the more services the citizens demand, the more services the government is obligated to deliver-as long as the citizens are willing to pay of course. Figure 4 illustrates the Citizens-Governments relationship-the figure expresses that the citizens' demands for services are kept in balance by the transfer of funds (taxes) from the citizens to the government.

The second step in establishing a smart city roadmap is by developing a policy that drives the whole initiatives. The policy needs to define the roles, responsibilities, strategies, and objectives of the smart cities. A project charter needs to be developed to give the CIO

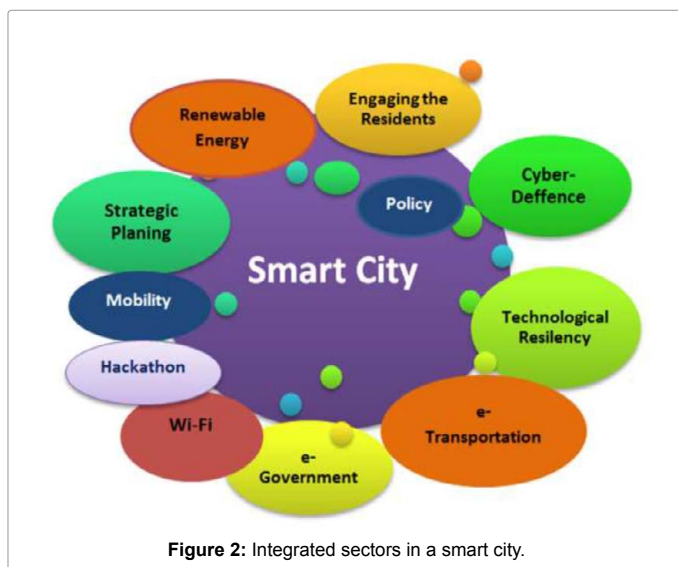


Figure 2: Integrated sectors in a smart city.

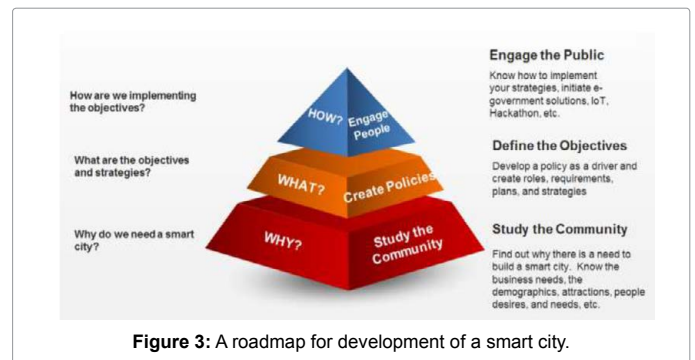
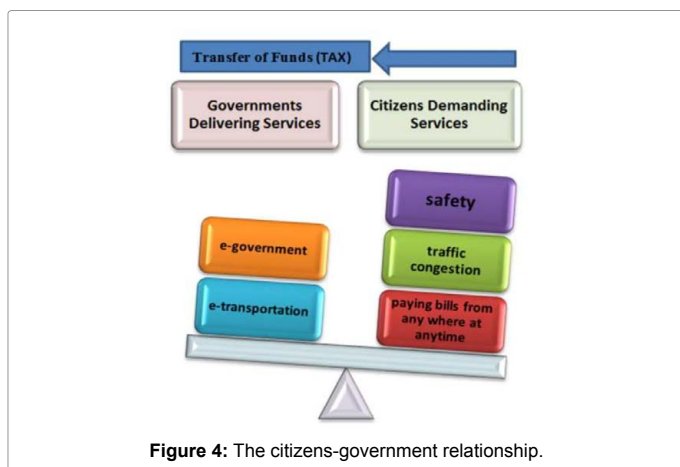


Figure 3: A roadmap for development of a smart city.



the appropriate power, money, and resources to get the job done. It is the CIO's responsibility to develop and provide direction on how to use technology to make it easier for citizens and business to interact with the government, save money, and create real economic opportunities.

The third element in developing a smart city roadmap is engaging the citizens through the use of e-government and effective governance, which leads to the increase of efficiency and enhancing delivery of services. One goal of engaging the citizens is to build trust and make them part of the solution. Open data through the use of mobile applications is one way to establish such an engagement-mobility is a gateway to building a civic engagement, as it allows the public to connect to the city's infrastructure to perform services whenever they want from wherever they are. Cities are developing new ways in engaging the public with the government to find solutions to challenges. For example, the City of Palo Alto, California developed a mobile application that allows the citizens to report problems, such as broken light, or water damage [7]. The city of Boston worked with local universities to create applications that allow the public to automatically detect and report the issue to the local city. The local city in return generates a service request and when the issue is resolved, a notice gets sent back to the person informing them that the problem has been resolved. The city of Cupertino is relying on sports events to initiate civic engagements. The city is hosting the big bunny 5K race (3.1 miles) to encourage the residents to be healthy, positive, and connected [6]. The city is using the money for charities that focus on bringing clean water worldwide. Such an engagement can be used to build trust with the public. By increasing engagement, the city is creating an opportunity for the residents to know each other. This is a brilliant way to get people to start caring about each other and their city.

Another method to engage the citizens is by granting access to high-speed Internet and building Wi-Fi wireless infrastructure city-wide. Affordable and reliable Internet connectivity needs to be available and accessible from anywhere in the city. Open Wi-Fi has economic, social, environmental, educational, and safety benefits. Free Wi-Fi is a beneficial economic development tool that can be used by tourists and travellers. Free Wi-Fi also makes it appealing to residents to be outside in public places, which in return stimulates the economy; furthermore,

it benefits emergency services as Wi-Fi networks are used to aid rescue workers. Wi-Fi is even used by federal agencies for emergency and border patrol purposes. For example, Department of Homeland Security funded a free Wi-Fi service along Interstate 19 in Arizona, which is used by the community and federal agencies for emergency services. Open Wi-Fi is simply a win-win solution, as it supports the growth of new businesses, virtual learning, and mobile entertainment; in addition, the city can make a use of its wide wireless infrastructure to build the Internet of Things.

Conclusion

Cities and Counties face many challenges and risks, such as unemployment, poverty, traffic congestion, high crime rates, cyber-attacks, and slow bureaucratic city systems for processing business transactions. People, Processes, and Technology are three pillars of smart city initiatives that can be utilized to alleviate such a challenge. Cities and counties are expected to study their community, create policies, and implement technological solutions to meet the citizens and community's needs. Local, state, and federal governments must be innovative and need to develop a roadmap to address and provide solutions to mitigate risks and challenges, in order to create a sustainable future for their citizens. Digital transformation is one option that governments can rely on to overcome many of these challenges; other options may include adopting e-Government, engaging the citizens, and building resilient cities. In short, government officials must build a coalition to collaborate, leverage, and integrate technologies to create real economic opportunities by fostering a city-wide smart, secure, and resilient transformation.

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