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Smart Cities and Smart Infrastructure

Two Megatrends Affecting Global Societies

Alexander Labrie

alexander.labrie@snhu.edu

Southern New Hampshire University

Introduction

There are many things that influence and shape the world, but only few that can be pinpointed and examined. This paper examines two megatrends that have the ability to change the world, in the most efficient, economic and smartest ways possible. The implementation of Smart Cities and Smart Infrastructure are a megatrend right now, because as countries face the pressure to go *green*, the concept of going *Smart* has become a priority of countries around the world. Incorporating *Smart* takes the concepts of going green and expands upon those foundations to create a city that is essentially connected through a Smart Grid which connects every structure back to a central hub. Mega trends can be defined as, *"Global, sustained macroeconomic forces of development that impact business, economy, cultures, careers and personal lives, thereby defining our future world and its increasing pace of change"* (Frost & Sullivan, 2011). As a result of Frost & Sullivan's research, the term *Smart*, which is emerging as the new *Green*, becomes the mega trend of Smart Cities and Smart Infrastructure. Throughout the course of this paper, some of the topics that will be explored are: the global influence *smart* has on the world, the utilization of *smart technology,* countries that have already incorporated *smart* as well as the benefits and consequences of *smart technology*.

Defining Smart Cities and Smart Infrastructure

The foundations of going green drive Smart Cities and Smart Infrastructure, however, they are tremendously complex concepts that go far beyond simply *going green.* Smart Cities and Smart Infrastructure coincide with one another, because without a Smart Infrastructure there can be no Smart City. The International Data Corporation (IDC), is a Massachusetts based consultant firm, which defines a Smart City as, "A local entity—a district, city, region or small country—which takes a holistic approach to employ information technologies with real-time analysis that encourages sustainable economic development" (Jung, 2011). While a Smart City strives to maintain a strong economy, the Smart Infrastructure ensures that the city is running properly in the most efficient manner possible. Steve Lohr (2009) of The New York Times writes, "Smart infrastructure is a more efficient and environmentally friendlier systems for managing, among other things, commuter traffic, food distribution, electric grids and waterways." With a Smart Infrastructure, a Smart City will be able to prosper, as everything will operate exceptionally well. The concept of Smart Cities and Smart Infrastructures are hard to imagine. Figure 1 below will help with the understanding of the two.

Figure 1: The Smart City

Source: http://www.smartgrid.epri.com/App_Themes/Default/Images/SmartGrid-graphic.jpg

The Smart City is connected to a central hub that makes sure that everything is running smoothly. A Smart Grid is able to control both the power and water output from a central hub. One of the leaders in the creation of Smart Grids is General Electric (GE). According to Jesse Berst (2009): "By all rights, General Electric should have been a Smart Grid Pioneer. It had the technology, it had the breadth, and by all accounts, it had the industry experience." While in 2009, the company may not have been at the forefront of smart grid technology; in 2011 they took a huge step towards becoming the *Smart Grid Pioneer*. In July of 2011, GE acquired Ireland-based FMC-Tech, the firm is, "A leading provider of smart grid technology equipment providing real-time power line monitoring capabilities" (GE, 2011). Things are progressing for the innovative company, since their acquisition of FMC-Tech, and after nearly a century, their smart grid is getting a makeover. The main component in GE's smart grid makeover is the Smart Meter, which is the brain behind the Smart Grid. These meters are able to let homeowners know when peak hours are, therefore, they would know not to use electricity at that time, because it will cost them more (GE, 2012). The Smart Meter is a small device, with tremendous impacts on a Smart Grid, which controls a Smart City. Looking at figure one, it displays that all the structures in the city are connected to a central hub via the grid, the idea behind this is that if power were to go out in one section of the town, the hub would be able to respond quickly and prevent any other sections of the town from losing power as well. Implementing a grid such as this into a city could potentially save the city millions of dollars in disaster recovery. When General Electric acquired the firm in Ireland, they created a way of learning new and innovative ways of smart grid technology on a global scale, which provides a competitive edge.

Global Influence

For Smart Cities and Smart Infrastructure to be a mega trend, they must be able to influence and shape the world dramatically. Susan Dirks and Mary Keeling of International Business Machines (IBM) writes: "A century ago, fewer than 20 cities around the world had populations in excess of 1 million people. Today, that number has swelled to 450 and will continue to grow for the foreseeable future" (2009, para. 2). With cities growing so drastically, the need to build and maintain an efficient economy is very important. With all those people in one city, the carbon footprint becomes drastically larger. According to the IDC, "Only half of the world's population lives in cities but they create 70 percent of carbon dioxide emissions" (Jung, 2011, para. 6). When 70 percent of the carbon dioxide emissions stem from the cities around the world, it is amazing that those cities keep on growing. Now, it is clear why Frost & Sullivan deemed *Smart* as one of the top mega trends and why it is so important that going *Smart* becomes an initiative of countries around the world.

Citizens and Smart Technology

According to Dirks and Keeling of IBM (2009), "The way a city works, operationally, is based on a number of primary systems composed of different networks, infrastructures and environments with relation to key functions such as: city services, citizens, business, transport, communication, water and energy" (para 4). The system for which the citizens live by contains: public safety, health and education, and striving to deliver the best quality of life possible. The business system by which a city operates under refers to the environment that businesses operate under the regulations from the government. Cities allow their people to move around (transportation), and exchange information electronically (communication). Cities also provide water and energy—vital to all economic and social activity (Dirks & Keeling, 2009). With such a complex group of systems, the organization of these systems is crucial. Hence, Smart Infrastructure is vital to supporting all the activities going on in the city.

Business and Smart Technology

While a Smart City and Smart Infrastructure are such a large influence on how a city operates, one can only imagine the impact of *Smart* on businesses. According to Dirks & Keeling (2009) when it comes to business, cities must balance their regulations while decreasing overhead. With so many systems to manage, it is easy to see why businesses can be affected by a poorly run city. When the systems that run a city are poorly run, customers will not be able to get to the stores on time. When they get there the food will be bad and eventually they will get sick, gradually filling up the hospitals. Hence, when a city suffers, the businesses suffer, because all their customers are sick in the hospital. In a smart city, however, the hospitals would be prepared for such an epidemic. On the other hand, if a city were truly smart it would have been able to clear the streets better so the customers could get to the store on time before the fruit spoiled. Internationally—if consumers were to fly to a Smart City in another country and the system that runs their airports is horrendous, planes could be delayed, which means planes from other airports would be delayed. One Smart City or non-Smart City has the ability to affect the entire world with the efficiency or lack of efficiency in their city's management systems.

Smart Cities and Smart Infrastructure are the key drivers to success in business. Businesses operate by people and without those employees there is no business. Hence, it is imperative that

the people who are in charge of the cities' management system be trained for any scenario that may come up. Susanne Dirks, Constantin Gurdgiev and Mary Keeling of IBM write:

> *In the twenty-first century, growth, economic value and competitive differentiation of cities will increasingly be derived from people and their skills, creativity and knowledge, as well as the capacity of the economy to create and absorb innovation. To compete in this new economic environment, cities will need to better apply advanced information technology, analytics and systems thinking to develop a more citizen-centric approach to services. By doing so, they can better attract, create, enable and retain their citizens' skills, knowledge and creativity (2009, para. 1).*

People with skills, creativity and knowledge will drive innovation, creating new products for businesses around the world. When people live in a cleaner, healthier, and more structured city, they will be able to think better. Around the world, the faster a country implements *Smart* to their cities and infrastructures, the faster the people will invent new and innovative technologies and the faster businesses make money, which will help them create a competitive edge on their competitors around the world.

The Positions Within the Business

The IBM researchers (2009) also gave the following insight on jobs. It is imperative for cities to create jobs that serve a purpose and have meaning, rather than just placing people in positions for the sake of *filling positions*. It is also important for cities to be ahead of their competitors (other cities), due to the fact that cities in other economies are growing rapidly (Dirks, Gurdgiev, Keeling, 2009, para. 21). While trying to stay ahead of their competitors, cities must not lose sight of their long-term goals. They must remember to hire people with an array of skills that will contribute to society as a whole. By creating jobs that have meaning, cities will be able to hire people for the long-term goal. This means that people should work in one place for a while and not short-term, that way they can share the knowledge they already have while learning from their colleagues. In addition, by hiring people with an array of skills, the technological advances and innovation opportunities are endless since there will be people from many backgrounds with many different skills all contributing to the business as a whole and working as a team.

In Search of Smart Cities

It is imperative that when a government seeks to implement this technology into their cities, that they do their research beforehand. Around the world, Smart Cities are being implemented and planned. One of the biggest ways in which a country could become informed on the topic would be by attending some of the conferences that are being held around the world. Smart Cities 2012 was a two-day event that brought together urban planning leaders and infrastructure management to discuss important issues facing cities around the world. They planned to improve public safety, ease congestion, and maximize energy efficiency. They also planned on discussing the use of technology to transform urban spaces into better places to live with the best urban planning approaches possible (Smart Cities Global, 2011). From February 21 to 22 of 2012, in Amsterdam, Smart Cities 2012 brought together city officials, contractors, and helped attendees address key issues in the development of smart cities (Smart Cities Global, 2011). When implementing these cities it is important that the goals and issues of a city are addressed. Some

of the items to address would be: the outcomes of implementing a smart city, the cost of a smart city, why it would be a benefit to utilize this technology and how will the citizens respond. Smart Cities Global writes: "Inefficient transport services, outdated water and waste networks, rising pollution levels and an increased demand for energy: all are challenges that need to be confronted by today's city planners" (Smart Cities Global, 2011). The Smart Cities Global conference did a great job addressing some of the key issues that lay the foundations of why a city may want to implement these technologies. The conference addressed the fact that billions of dollars are being spent globally each year on infrastructure projects, and they will make sure these investments are part of a holistic vision that will optimally make use of information technology and communications in order to strive for efficiency and protect the environment (Smart Cities Global, 2011, para 4). This shows that it is important for a city to monitor when a city utilizes these technologies and invests billions of dollars, to ensure that the visions are defined clearly. On the path to fixing an infrastructure, a city must not lose sight of the holistic approach that a *smart city* must follow. Around the world, Smart Cities and Smart Infrastructure are becoming the top priority, but managing these cities are what countries will find to be difficult.

Spain—The Leader in Smart Cities

Part of researching smart cities is by looking at countries around the world that have been successful in implementing them. Spain is one of the top leaders when it comes to smart cities, including Málaga, Barcelona, Santander, Madrid, and Donostia-San Sebastián (Jung, 2011, pp. 1-3). Five parts of Spain that have been successful in these technologies proves to be a great example for countries to look further into how Spain became so successful. Málaga is currently the smartest city in Spain, due to its high scores in the smartness dimensions—smart energy, environment, and smart services (Jung, 2011, para. 10). Málaga strives to reduce energy by 20 percent by utilizing certain functions. These functions range from achieving optimal integration of renewable energies into the power grid, bringing generators closer to consumers and leveraging new smart meters like that of GE, creating new advanced communication systems and establishing new energy management (Jung, 2011, para. 11). Part of Spain's success is the fact that they were able to define the functions in which they deemed to be part of a smart cities holistic approach to improving their infrastructure. By Málaga being able to use renewable energy, they will save consumers a lot of money. Smart meters will connect people in a more efficient way and it will also save energy, because the energy flowing throughout the grid will mostly be reused. Controlling the energy within the networks, smart meters will connect people in a way they never thought imaginable. If lighting struck one side of town, the other side would not be affected as the smart grid would turn of all meters preventing new energy from entering the electric lines and then the generators would kick in. Smart Grids are very advanced technologies, but a technology that Spain has been able to master.

According to Jayne Jung (2011) the second smartest city in Spain is Barcelona—revolutionizing transport by utilizing electric vehicles. Barcelona utilizes a program called "LIVE," which supports the development of electric vehicles in a metropolitan area. This is another great initiative that Barcelona took, because by creating programs and giving them names it creates a way of *marketing* the technologies that *smart* uses. In the long run this will attract people and get them involved in the programs. The third smartest city in Spain is Santander, known for its smart buildings, smart energy, and smart environment. In public safety, Santander's police and fire

services were able to arrive at an emergency in less than 8 minutes. By creating a place that is safe, *smart* hopeful countries will be able to show citizens that safety in these cities is of top priority. The fourth smartest city in Spain is Madrid—the most economically powerful city in Spain. Madrid is very focused on improving mobility and its traffic situation. Mobility and traffic are related to the safety of citizens, which again, emphasizes the safety within these cities. The fifth smartest city in Spain is Donostia-San Sebastián—with a good balance between the people and the economy. Being able to balance people and the economy is a tough task, even though Spain is not currently in the best economic situation, they have been able to excel in a smart technologies. Jung's article shows how Spain has mastered the utilization of *Smart* and countries could model some of the ways that Spain has mastered that utilization. By examining the functions each part of Spain has mastered in depth, countries would be able to see whether or not those functions would suit the region in which they are planning to incorporate these technologies.

Europe and The Implementations of Smart Cities

In addition to Global Cities 2012, nonpolluting trucks will soon sweep Amsterdam, with electric displays at local bus stops powered by solar sun panels (Scott, 2009,). These are more examples of how countries in Europe are implementing innovative technologies that underlay the foundations of a smart city. IBM and CISCO will also implement a series of 500 households with energy-saving systems, which will ultimately cut electricity costs. In addition, more than 700 homes will have access to financing from the Dutch banks to buy everything they need from light bulbs, to energy saving insulation (Scott, 2009). This cooperation of the banks being able to help people and work with the government to promote a smarter way of living is a great example of how cities will build better relationships with the citizens. Focusing on cutting emissions could affect the battle against global warming, as the result of placing more pressure on countries to limit their carbon output (Scott, 2009). Mark Spellman says: "There's been an under emphasis on what cities can do to cut emissions" (Scott, 2009). By implementing new laws regarding emissions, businesses will need to find new ways of completing tasks—adhering to the *Smart* standards.

Benefits and Consequences of Smart Technology

A Smart City is connected by the Smart Grid, which as the model above shows every house is connected to the central hub. People may have concerns about privacy invasions. When houses are connected to the central hub, the hub can essentially have the power to turn on and off any component of the house that is connected to the Smart Meter, mainly water and electricity. People are worried that the idea of being connected to a central hub could potentially invade their personal privacy. This is however not true, as Seth Wheeler the spokesman for a utility company says: "We refute any claims that meters in any way are infringing on privacy" (Tracy, 2012, p. 5). However, as a Smart City promotes cutting-edge technological advances the opportunity for hacking is a tremendous risk. In the 21st century, viruses, identity theft and cyber hacking are at an ultimate high. In this *Smart* society people are encouraged to learn innovative concepts and create a new way of doing things. With this comes the opportunity for people to use the skills and knowledge they possess in a good or bad way. With an entire city connected by one Smart

Grid, it will be up to the government to create a grid that contains the most technologically advanced software that will fight off any potential *threats.*

Smart Cities and Smart Infrastructure will globally shape the future of business. There is, however, a hefty price to create a Smart City, billions and billions of dollars are required to create and maintain a Smart City. Around $380 million will be invested in a Smart Grid that uses network sensors to cut electricity use (Scott, 2009). With $300 million being invested in Smart Grids, some could argue that the cost of going *Smart* may not be fiscally possible. What this means for businesses and citizens is that *Smart* licenses or permits will cost a lot of money. Another question is, where will the money come from? This increases the fear of increased taxes. However, the risk of succeeding and getting their money back is very much worth the risk, because in the event of not being smart, a city would leave the door open for illnesses—filling up the hospitals. If a catastrophic event from Mother Nature were to hit the city, it would not be prepared for such an emergency, forcing emergency personal to panic—reducing the efficiency of their public safety. If an international firm lost customers, they would fall under and eventually lose their customers abroad. If a country is ever weighing the options of investing in a Smart City versus a non-Smart City, the Smart City is most likely their best option. When looking for an example, Spain is at the forefront of *Smart*. On the other hand, the unemployment rate in Spain is extremely high, which could be due to the fact that a Smart City does not require as many jobs that a non Smart City does. The idea of implementing a Smart City is to reduce the number of *jobs* that people fill, giving them more time to focus on an expertise and area that is not so highly studied. Smart Cities are meant to give people the opportunity to be at the leading edge of innovation and ahead of their competitors.

Conclusion

The foundations of going green drive Smart Cities, but the complexity that lies beneath *smart technology*, has the ability to "Employ information technologies with real-time analysis that encourages sustainable economic development" (Jung, 2011). Smart Cities will create a place where people can live cleanly, efficiently, less crowded; have faster transportation, excellent health, and an immediate response of emergency crews. In addition, public safety will be at its best and people will have the piece of mind knowing they live in a smart city where there is no crime or crime is kept to a minimum. One hundred years down the road after implementing a smart city, the city will be just as clean as it was when it first became *smart.* The idea of smart is confusing and complex, but when the basic goals of Smart Cities and Smart Infrastructure are made clear it is very easy to understand. When there is a city that takes into account every aspect of life—holistically—and then implements technologies that encourage sustainable economic growth and prosperity, then the city will know smart. When there is an efficient and environmentally friendly system of managing the smart grid to reduce carbon emissions and electricity saving consumers money, then the city will know smart. When a city knows how to apply smart technology, it will attract the brightest, well educated, talented, and creative individuals, which will then become residents of the smart city. Eventually, jobs will be filled with talent, and when the world knows smart, the world will be filled with talented, and innovative minds that will find ways to sustain the environment and a prosperous way of living for the years to come.

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