



## Full length article

## The next wave of innovation—Review of smart cities intelligent operation systems

Leyla Zhuhadar <sup>a, \*</sup>, Evelyn Thrasher <sup>a</sup>, Scarlett Marklin <sup>b</sup>, Patricia Ordóñez de Pablos <sup>c</sup><sup>a</sup> 1906 College Heights Blvd., Bowling Green, KY, 42101, USA<sup>b</sup> Tallahassee, FL, Florida State University, USA<sup>c</sup> Business Administration Area: Business Organization, The University of Oviedo, Asturias, Spain

## ARTICLE INFO

## Article history:

Received 7 June 2016

Received in revised form

15 September 2016

Accepted 19 September 2016

Available online 4 October 2016

## Keywords:

Complex and intelligent systems

Intelligent Operation Center

Smart cities

Smart citizen

Simulation

## ABSTRACT

The use of new technologies in business models and infrastructure has been driven in part by the Internet and globalization. The next trend of innovations is likely to come from humans' ability to connect to machines and the data that comes from these connections. The IBM Intelligent Operation Center (IOC) is a "system of systems" that is not intended to replace an existing physical infrastructure that gathers raw data. Instead, it is intended to extract only the data necessary to optimize the operations of the organization. The types of data and integration into the IOC make efficient problem solving solutions readily available to city authorities. The user interface and standard operating procedure and the resource processing capabilities of the IOC indicate that this system is optimal for smart cities of the future with regard to improvement of quality of life and ease of navigation. The need for smart cities, universities, campuses, citizens, and students to drive growth of urban and regional economies is evident. In this article, a thorough analysis of the architectural design of an intelligent operational system is completed to present a smart solution for cities to unify departments and agencies under one umbrella.

© 2016 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

Within the past decade, the increased use of technology in all sectors of society has created a push for cities to integrate the latest and greatest into their city development both economically and politically (Albino, Berardi, & Dangelico, 2015). As cities gain greater control over their development and progression into the 21st century, they face a range of challenges and threats to sustainability in a variety of ways (Dirks, Keeling, & Dencik, 2009). As cities play a prime role in social and economic aspects worldwide and have a huge impact on the environment, it is easy to understand why cities are the key elements for the future (Albino et al. 2015; Keeling & Mooney, 2011; Zhuhadar, Carson, Daday, Thrasher, & Nasraoui, 2016a).

The world is at an unprecedented level of urbanization (Keeling & Mooney, 2011). In 2008, the United Nations noted that more than 50% of all people lived in urban areas (Albino et al. 2015). With

urbanization of city centers, the world economy is now globally integrated and services-based, accounting for two thirds of all global trade, with these city centers being the hub of commerce and concentrated capital both human (qualified staff) and physical (telecommunications) (Bhowmick et al. 2012). Having a higher share of workforce participation with tertiary educational attainment allows cities to be the focal point of innovation (Bhowmick et al. 2012). Growth, economic and competitive differentiation of cities will be derived from people and their skills, creativity, instrumentation and the capacity of the economy to create and absorb the innovation through application of advance information technology, analytics and systems (Dirks et al. 2009; Keeling & Mooney, 2011). Therefore, in order to capitalize on the opportunities made available through technological advancements for prosperity, cities must become 'smarter' to attract, create, enable and retain citizens with skills, knowledge and creativity needed for competition on the world stage. But what exactly makes a city smart? The traditional 'bricks and mortar' drivers of city economic growth are losing ground to an economy in which 'education and creativity' are the grounds for competitive prosperity, based on the ability of the workforce provided to create and acquire skills and innovation (i.e. the talent pool) (Dirks et al. 2009; Keeling & Mooney, 2011). Cities being the new hub of global economy are the focal points in which this transformation

\* Corresponding author.

E-mail addresses: [leyla.zhuhadar@wku.edu](mailto:leyla.zhuhadar@wku.edu) (L. Zhuhadar), [evelyn.thrasher@wku.edu](mailto:evelyn.thrasher@wku.edu) (E. Thrasher), [sm14as@my.fsu.edu](mailto:sm14as@my.fsu.edu) (S. Marklin), [patriop@uniovi.es](mailto:patriop@uniovi.es) (P.O. de Pablos).

from the secondary sector (industrialization) to the tertiary (services) and quaternary (intellectual activities) sectors is becoming reality. There have been numerous definitions given over the past decade for what smart cities are, but essentially smart cities are those cities that have the greatest quality of life and economic well-being for their citizens (Albino et al. 2015).

Building a smart city is a challenge. Ultimately this requires gaining additional insight into the core systems that cities operate off of which affect the decisions made; however, the key is the way in which these cities acquire access to the type of information required to help gather new insight (Carrato, Nesbitt, & Kehoe, 2012; Neirotti, De Marco, Cagliano, Mangano, & Scorrano, 2014). A key aim in creating a 'smarter' city is to provide real time information, the goal being to address new challenges and manage available resources as closely as possible (Carrato et al. 2012). A critical question facing cities is how do the cities incorporate technology in the most cost-efficient, and productive fashion? As Dirks, Gurdgiev and Keeling note there are four high-impact areas of improvement: reduction of congestion in transport systems, improvement of public safety through reduction of crime and increased emergency response times, streamlining and tailoring services with an emphasis on education and continuous training, and enabling appropriate access to healthcare data for increased population health (Dirks & Keeling, 2009). Cities will need to continue to build onto their core systems other agendas including energy, water and environmental sustainability, urban planning and (Dirks, Gurdgiev, & Keeling, 2010a). IBM defines these smart cities in terms of applying information technologies to various stages of planning, designing, building and operating a city's infrastructure.

Since 2010, IBM has offered a new initiative—IBM Academic Initiative,<sup>1</sup> where professors have full access to the 21st century technologies, resources, and platforms. This article provides a detailed analysis of the architectural design of IBM Intelligent Operations Center<sup>2</sup> (IBM IOC). The reason of focusing on the IBM IOC in this article is its availability for professors and students cost free. It provides solutions to environmental problems that can range from banking and retailers to energy providers and water management. As a result, students who have a passion for sustainable development or city planning will be better prepared for the 21st century challenges (Sarkar, 2016).

While the focus of this article is on the IBM IOC, IBM is not the only company to notice. Similar projects to the IBM IOC are also available for improved housing (Matayoshi et al. 2016; Polenov, Kostyuk, Muntyan, Guzik, & Lukyanov, 2016), including the 3-E Houses and Beca projects,<sup>3</sup> which provides tenants with an innovative energy efficient service via real time monitoring of the energy consumption, integrating renewable energies and creating resources to lower energy consumption.<sup>4</sup> The project allows tenants to develop or enhance their relationship with the utility, the environment, with the objective that saving energy is saving CO2 emissions (Zhou et al. 2016). Other smart services for housing include E3Soho and EDISON (Energy Distribution Infrastructure for Ssl Operative Networks), which work to limit CO2 emissions as well.<sup>5</sup> Projects such as green@hospital offer efficiency services for hospitals,<sup>6</sup> while SMARTBUILD offers smart IT services for building infrastructure.<sup>7</sup> Nevertheless, the *European Commission on Valuable*

*EneRgY School*<sup>8</sup> (VERYSchool) produced an intensive survey-based report on sustainable environment for a smart school (Caragliu, Del Bo, & Nijkamp, 2011; Galata et al. 2014; Vaquero & Saiz-Alvarez, 2016).

## 2. Literature review

### 2.1. The internet of things

The rise of interconnectedness has created a redistribution of wealth and redefined the workforce of the future (Davies, 2015). The shift in globalization has been largely propelled by the Internet, which has increased the rate at which people and business are connected, as well as, created a larger realm of competition where challengers can enter and disrupt economic markets and supply chains (Davies, 2015). As Davies notes, the Internet of Things references the mass connectivity of machine-augmented systems, processes and people to create value. As with all advancements in society, the Internet's growth and subsequent influential position into both economic and political arenas has been met with a mixture of enthusiasm and skepticism from businesses and institutions whose power and influence have been threatened (Allen, 2016; Chakrabarty & Engels, 2016; Ramaswami, Russell, Culligan, Sharma, & Kumar, 2016). Smart cities are critical to the digital economy and for the nation's capacity to compete globally, being those cities that exploit hyper-connectivity to meet real challenges such as mitigating the effects of urbanization, addressing added pressure for infrastructure and quality of life, along with environmental sustainability, increased safety and economic opportunity (Bhowmick et al. 2012; Marsh, Molinari, & Rizzo, 2016).

### 2.2. Problems of cities

For cities, problems arise due to the fact that the city is managed under multiple separate domains with no real ability to be condensed into one entity (Bhowmick et al. 2012). City managers have no single place to interact in real time regarding status or historical reports for city events. The physical systems of a city that need to be monitored include roads, energy, water, and sewer lines; but there is a lot of intangible data that, when analyzed and combined with other factors, provide critical, additional insight. Since the core of a city is composed of different networks, infrastructures and environments related to key functions including services, citizens, business, transport, communication, water and energy, public safety, health and education are central to whether a city offers up the quality of life desired by citizens smart (Chourabi et al. 2012; Neirotti et al. 2014). Simply put, the daily operations of cities generate vast amounts of data from a multitude of sources that create an inability to visualize and extract meaningful information. Cities must address the increased number of service coordination and planning challenges as a result of urban sprawl (Scuotto, Ferraris, & Bresciani, 2016). Citizens face healthcare threats including infant mortality and disease (Davies, 2015). For businesses, cities must balance regulatory requirements with the need to decrease costly administrative overhead, not to mention the inefficient transportation systems, which continue to drive up costs (Katsigiannis et al. 2014). Increasing communication and connectivity demands challenge the ability of cities to meet the needs of its citizens and businesses effectively (Galata et al. 2014). Water resources fall victim to leakage, theft and poor quality; and current energy systems are often insecure and inefficient (Galata et al.

<sup>1</sup> <https://developer.ibm.com/academic/>.

<sup>2</sup> <http://www-03.ibm.com/software/products/en/intelligent-operations-center>.

<sup>3</sup> [www.3ehouses.eu](http://www.3ehouses.eu).

<sup>4</sup> [www.beca-project.eu](http://www.beca-project.eu).

<sup>5</sup> [www.project-edison.eu](http://www.project-edison.eu).

<sup>6</sup> [www.greenhospital-project.eu](http://www.greenhospital-project.eu).

<sup>7</sup> [www.smartbuild.eu](http://www.smartbuild.eu).

<sup>8</sup> <http://www.veryschool.eu/>.

Download English Version:

<https://daneshyari.com/en/article/4937746>

Download Persian Version:

<https://daneshyari.com/article/4937746>

[Daneshyari.com](https://daneshyari.com)