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Networked Digital Technologies and Urban Big Data Analytics for Internet of Things-enabled Smart Governance

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Abstract

By employing recent research results covering Internet of Things-enabled smart governance, and building our argument by drawing on data collected from Black & Veatch, ESI ThoughtLab, KPMG, McKinsey, and Osborne Clarke, we performed analyses and made estimates regarding networked digital technologies and urban big data analytics. Structural equation modeling was used to analyze the collected data.

Keywords: networked, Internet of Things, urban, governance, big data.

JEL Classification: L81, O14, O32, Q55

1. Introduction

Smart cities should be reconceptualized in cutting-edge manners that pave the way for technologies to be adopted in order to bolster urban management, while being not so much technocratic and more wide-ranging in tendency, without dealing only with the concerns of capital and elites. Setting up comprehensive and equitable smart cities brings about a rigorous reassessment of how such urban governance systems are fashioned and carried out (Kitchin et al., 2019).

2. Problem Statement

Smart cities should make data available, comprehensible, and purposeful (Ainsworth-Rowen, 2019; Drennan-Stevenson, 2019; Fincham, 2019; Gutberlet, 2019; Kral et al., 2019; Meyers et al., 2019; Noack, 2019; Zhuravleva et al., 2019a, b) while making prearranged ethical decisions with respect to the deployment of data provided by urban sensor systems. Coordinated and structured smart cities

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represent a cutting-edge architecture (Bargh, 2019; Dubman, 2019; Flygare, 2019; Gutschow, 2019; Ludbrook et al., 2019; Mircică, 2019; Olsen, 2019) which advances technological support to urban issues and a continuous endeavor to develop innovative market prospects for groundbreaking sectors (Cosgrave, 2019; Eskridge, 2019; Goethals, 2019; Heuston, 2019; Nica, 2019; Plumpton, 2019) at heterogeneous networked and jointly contingent levels of operation and production. Smart cities are both a user and a spot for the advancement, production, sharing, and consumption (Dolan-Canning, 2019; Felstead, 2019; Groener, 2019; Kovacova et al., 2019; Nica et al., 2019; Wilson, 2019) of the designed and developed manufacturing items and services (Clark, 2020).

3. Research Questions/Aims of the research

Q1 Citizens and organizations are constructed so as to acquire networks of services and objects, being the target consumerism for the sensor patterns and structures that constitute the mainstay of smart cities deployments. Q2 Smart city services are provided on the platform of an elaborate, regulated, and heterogeneous built setting. Q3 Smart city data are produced, gathered, stored, aggregated, inspected, and harnessed by a fluid set of private- and public-sector participants. The objective of research is to prove that by employing the gathered data, smart cities can develop cutting-edge products and technology-driven knowledge services that can be furnished to citizens as customers in the capitalist space economy. For smart cities, the relevance of data starts with the capacity for enhancing current services supplied to citizens and subsequently advances to furthering the setting up of innovative services (Clark, 2020).

4. Research Methods

Building our argument by drawing on data collected from Black & Veatch, ESI ThoughtLab, KPMG, McKinsey, and Osborne Clarke, we performed analyses and made estimates regarding networked digital technologies and urban big data analytics. We used the structural equation modeling to analyze the collected data. The interviews were conducted online and data were weighted by five variables (age, race/ethnicity, gender, education, and geographic region) using the Census Bureau's American Community Survey to reflect reliably and accurately the demographic composition of the United States. Sampling errors and test of statistical significance take into account the effect of weighting. Stratified sampling methods were used and weights were trimmed not to exceed 3. Average margins of error, at the 95% confidence level, are +/-2%. For tabulation purposes, percentage points are rounded to the nearest whole number. The precision of the online polls was measured using a Bayesian credibility interval. An Internet-based survey software program was utilized for the delivery and collection of responses.

5. Findings

Supervision of urban undertakings and behaviors by use of pervasive, networked sensors, responsive objects, and Internet networking catalyze urban undertakings into valuable data. Urban interactions assessed through data-driven analytics illustrate smart cities as information-driven alert and response systems, resulting in the appraisal and datafication of densely populated settings by use of surveillance technologies. Reacting to, adjusting to, and predicting citizens' needs and behaviors, smart cities are sensitized spots where digital media are purposively assimilated as infrastructure and software to gather, inspect, and share huge amounts of data in real-time to handle and inform decisions as regards urban settings and undertakings. Acquiring more algorithmically assessed data concerning public service delivery and deployment will result in optimized city services (Halegoua, 2020). (Tables 1-10)

Table 1. What benefits is your city now gaining from its smart city investments? (%)

Attracts residents and tourists	46
Better public services	57
Attracts business and private investment	62
Safety and security	57
Economic competitiveness	67
Ability to adapt and innovate	71
Productivity of city workers	73
Productivity of businesses and residents	72
Additional revenue	68
Easier commute and access to services	46

Sources: ESI ThoughtLab; our survey among 4,600 individuals conducted March 2020.

Table 2. Please rank the following city agencies in terms of which benefit most from a "smart city" initiative (%)

	First	Second	Third	Fourth	Fifth	Sixth
Transportation (streets, parking, mass transit, etc.)	24	22	19	17	13	7
Electric utility	22	20	19	18	11	10
Public works (maintenance)	19	20	18	17	15	11
Water/Sewer utility	18	19	19	18	14	12
Law enforcement	14	13	15	18	19	21
City administration	15	13	14	14	19	25

Sources: Black & Veatch; our survey among 4,600 individuals conducted March 2020.

Table 3. Key actions needed to improve smart cities' living environment (%)

Improve balance of land use (commercial space, residential space and public space)	67
Encourage recycling and efficient energy use	77
Update or renovate ageing buildings and redeveloping underused land	67
Encourage construction of "green" buildings and development of green building standards	73
Build more green space/parks	77
Encourage use of electric vehicles and other carbon-neutral vehicles	84
Reduce the number of private cars and vehicles within city limits	74
Make the city more bicycle or pedestrian-friendly	75
Build more entertainment and cultural venues (sports, performing arts, museums, etc.)	64
Install more cameras/sensors to regulate traffic and improve public safety	78

Sources: KPMG; our survey among 4,600 individuals conducted March 2020.

Table 4. How smart cities can be catalysts for better health and wellness (%)

Remote patient monitoring	3.9
Lifestyle wearables	0.6
Telemedicine	1.1
Data-based health interventions: Maternal and child health	3.8
First aid alert applications	0.2
Infectious disease surveillance	3.7
Real-time air quality information	0.6
Data-based health interventions: Sanitation and hygiene	0.4
Emergency response optimization	0.4
Data-driven building inspections	0.3
Predictive policing	0.5
Real-time crime mapping	0.4
Gunshot detection	0.3
Congestion pricing	0.2
Demand-based microtransit	0.2
Water quality monitoring	0.4

Sources: McKinsey; our estimates.

Table 5. Where stakeholders want that the cities invest more (%)

	Citizens	**Businesses**
Providing data to make businesses/consumers more aware of energy use	62	56
Installing smart grids that use embedded sensors to manage waters, gas, and electric services	59	54
Installing environmental sensors to provide continuous monitoring of air quality, pollution, etc.	58	51
Improving coordination of power generation and power demand	58	47
Using predictive maintenance planning to focus on key environmental areas	56	45
Offering incentives for installing responsive devices and appliances	55	44
Focusing on distributed generation from renewable sources and micro-grids	53	42

Sources: ESI ThoughtLab; our survey among 4,600 individuals conducted March 2020.

Table 6. The return on investments in smart city pillars by maturity stage (%)

	Beginner	Transitioning	Leader
Environment	2.4	7.8	23.8
Mobility	4.8	7.6	18.4
Public health	0.6	6.8	12.6
Economy	0.4	5.6	6.8
Governance	7.8	11.8	6.6
Infrastructure	10.4	12.6	6.5
Payment systems	4.7	5.8	6.4
Public safety	4.5	5.9	6.3
Talent/Education	0.4	4.6	6.2
Budget/Financing	0.3	4.4	0.3

Sources: ESI ThoughtLab; our survey among 4,600 individuals conducted March 2020.

Table 7. How cities are planning to fund their smart city programs (%)

Philanthropic support	63
Public–private partnerships	67
Department budgets	58
Pay-for-success	57
Revenue share financing	54
As a service financing	56
Concession financing	55
Consumption-based financing	54
State support	39
User fees	35
Sales and leaseback	33
Franchise or shared revenue model	28
Federal support	30
Debt	28

Sources: ESI ThoughtLab; our survey among 4,600 individuals conducted March 2020.

Table 8. The components of a smart city which are most likely to reduce energy consumption (%)

Intelligent transport systems	12
Building efficiency/control systems	44
Smart grids (including smart meters)	31
Energy storage	13

Sources: Osborne Clarke; our survey among 4,600 individuals conducted March 2020.

Table 9. How smart city technologies can make daily commutes faster and less frustrating (%)

Commute time ***% decrease in average commute time by application***	
Real-time public transit information	4.3
Predictive maintenance of transit system	2.2
Intelligent traffic signals	5.1
Smart parking	2.4
Real-time road navigation	2.5
Demand-based microtransit	2.9
Bike sharing	0.5
Congestion pricing	1.4
Digital payment in public transit	2.4
Smart parcel lockers	0.6
Parcel load pooling	0.5
Integrated multimodal information	0.5
Car sharing	-0.3
E-hailing (private and pooled)	-1.3
Time spent interacting with government and healthcare system ***% reduction in time spent by application***	
Digital administrative citizen services	40
Telemedicine	8
Online care search and scheduling	5
Integrated patient flow management systems	4

Sources: McKinsey; our estimates.

Table 10. Citizens' feeling about the need for investment in energy technologies (%)

Focusing on distributed generation from renewable sources and micro-grids	66
Improving coordination of power generation and power demand	61
Installing smart grids that use embedded sensors to manage water, gas, and electric services	72
Providing data to help make businesses and consumers more aware of their energy use	69

Sources: ESI ThoughtLab; our survey among 4,600 individuals conducted March 2020.

6. Conclusions

Organized, systematized, and responsive layers of monitored technological systems exemplarily configure smart cities, as awareness and responsiveness are implemented by use of the surveillance of urban undertakings, business relations, and mobilities in data-driven environments. Harnessing efficiently computational capacity, tracking devices, and geolocative wearable technologies lead to the converting of urban behaviors into measurable quantitative data. Using digital media infrastructures, smart city administration patterns depend on the assessment and conceptualization of urban undertakings as advanced data streams. The assimilation of digital infrastructure, integrated technologies, and predictive analytics used to drive urban administration is associated with high-speed networks and ubiquitous connectivity (Halegoua, 2020).

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