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Internet of Things-enabled Smart Sustainable Cities: Big Data-based Urban Governance, Wireless Sensor Networks, and Automated Algorithmic Decision-Making Processes

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ABSTRACT. The purpose of this study was to empirically examine Internet of Things-enabled smart sustainable cities. Building my argument by drawing on data collected from ICMA, McKinsey, RICS, and SCC, I performed analyses and made estimates regarding big data-based urban governance, wireless sensor networks, and automated algorithmic decision-making processes. The structural equation modeling technique was used to test the research model.

Keywords: Internet of Things; smart sustainable city; big data; urban governance

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1. Introduction

Smart city networks influence the sustainable governance of urban institutions. (Frantzeskaki, 2019) The Internet of Things infrastructures are advancing heterogeneous industrial applications in Internet of Things-enabled smart sustainable cities. (Singh et al., 2020) Coherently administering smart cities involves achieving economic, low-carbon, and social sustainability performance. (Argento et al., 2020) Data-driven smart sustainable cities harness groundbreaking technologies to optimize their management, configuration, operational activity analysis, and advancement. (Bibri, 2020)

2. Conceptual Framework and Literature Review

Smart and sustainable urban undertakings are likely to reinforce neoliberal arrangements of government typified by principles of business expertise and responsibilization. (Levenda, 2019) A smart city operates in a sustainable and autonomous manner, by assimilating all of its underpinnings and services in an interconnected fashion (Andrei et al., 2016; Kliestik et al., 2018; Lăzăroiu et al., 2020a, b; Peters et al., 2020; Popescu et al., 2018; Tkachuk et al., 2020) by harnessing connected devices for monitoring and regulation, to ensure coherence and superior standard of living its citizens. (Suresh et al., 2020) Smart cities have to deploy perceptual devices to heterogeneous urban facilities (Cuicui, 2019; Kliestik et al., 2020a, b; Nica et al., 2014; Popescu et al., 2017a, b, c; Popescu et al., 2019; Zhulega et al., 2019) to constitute and integrate a large-scale Internet of Things by use of groundbreaking super-computers to carry out data handling, inspection, and maintenance of the front-end Internet of Things to mirror the reorganization of built-up administration and services provided by smart cities. (Zhang, 2020) Edge sensing information in smart grid offers huge volumes of important data, which reinforces cutting-edge power applications in Internet of Things-enabled smart sustainable cities. (Liu et al., 2020) Growing concern for and investment in public harnessing of Internet of Things technologies associated with the gathering, deployment, and sharing of data are decisive in configuring smart cities. (Cottrill et al., 2020)

3. Methodology and Empirical Analysis

Building my argument by drawing on data collected from ICMA, McKinsey, RICS, and SCC, I performed analyses and made estimates regarding big data-based urban governance, wireless sensor networks, and automated algorithmic decision-making processes. The structural equation modeling technique was used to test the research model.

4. Results and Discussion

Smart cities integrate heterogeneous sensors, wireless communication devices, network access points, in addition to specially designed hardware and software that have to be assimilated in the urban infrastructure and strengthened to ensure systems are not compromised and pivotal services are functional. (Ismagilova et al., 2020) Smart cities develop on sensors and actuators incorporated in connected devices that sense the environment for furthering adequate decision making and whose microcontrollers are computed to react automatically by using the data received from the sensors. (Ahad et al., 2020) (Tables 1–3)

Table 1 Smart applications and emerging technologies poised to have effect on cities (%, relevance)

Security	
Predictive policing	88
Real-time crime mapping	86
Gunshot detection	84
Smart surveillance	82
Emergency response optimization	81
Body-worn cameras	79
Disaster early-warning systems	86
Personal alert applications	85
Home security systems	84
Data-driven building inspections	80
Crowd management	78
Healthcare	
Telemedicine	88
Remote patient monitoring	86
Lifestyle wearables	84
First aid alerts	86
Real-time air quality information	79
Infectious disease surveillance	86
Data-based public health interventions: Maternal and child health	74
Data-based public health interventions: Sanitation and hygiene	72
Online care search and scheduling	70
Integrated patient flow management systems	87
Mobility	
Real-time public transit information	84
Digital public transit payment	82
Autonomous vehicles	79
Predictive maintenance of transportation infrastructure	77
Intelligent traffic signals	75
Congestion pricing	73
Demand-based micro-transit	72
Smart parking	70
E-hailing (private and pooled)/Car sharing	68
Bike sharing	67
Integrated multimodal information	65
Real-time road navigation	72
Parcel load pooling	67
Smart parcel lockers	63
Energy	
Building automation systems	87
Home energy automation systems	85
Home energy consumption tracking	83
Smart streetlights	81
Dynamic electricity pricing	78

Distribution automation systems	77
Water	
Water consumption tracking	86
Leakage detection and control	84
Smart irrigation	83
Water quality monitoring	81
Waste	
Digital tracking and payment for waste disposal	86
Optimization of waste collection routes	84
Economic development and housing	
Digital business licensing and permitting	82
Digital business tax	80
Online retraining programs	79
Personalized education	77
Local e-career centers	76
Digital land-use and building permitting	74
Open cadastral database	72
Peer-to-peer accommodation platforms	70
Engagement and community	
Local civic engagement applications	83
Local connection platforms	82
Digital citizen services	79

Sources: McKinsey; my survey among 4,600 individuals conducted June 2020.

Table 2 Issues representing barriers for your community in implementing smart city technologies (%, relevance)

Need better understanding of how to get started	77
Need more internal capacity	75
Need more supportive policies	74
Complexity of procurement	72
Budget limitations	69
Need more supporting infrastructure	71
Need more technical expertise	70
Too reliant on legacy systems	69
Difficulty of systems integration / interoperability	67
Difficulty of coordinating across departments	66
Need more long-term vision or plan	64
Need more project management capabilities	62
Need to gain leadership support	59
Need to gain community support	55

Sources: ICMA; SCC; my survey among 4,600 individuals conducted June 2020.

Table 3 Big data barriers in smart cities (%, relevance)

Fragmented ownership of the data	87
Unreliability of data sources	84
Different types of data being held in different formats	82
Inconsistency and irregularity in data generation	79

Sources: RICS; my survey among 4,600 individuals conducted June 2020.

5. Conclusions and Implications

Internet of Things-equipped and integrated systems can enhance the infrastructure of smart cities by use of connected devices. (Qureshi et al., 2020) The operations of wide-ranging, self-ruling city-building are more relevant than an algorithmic performance and should adjust their urban mechanisms as a consequence to harness cutting-edge smart city technologies. (Johnson et al., 2020)

Survey method

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. Confirmatory factor analysis was employed to test for the reliability and validity of measurement instruments. An Internet-based survey software program was utilized for the delivery and collection of responses.

Data and materials availability

All research mentioned has been published and data is available from respective outlets.

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Author contributions

The author confirms being the sole contributor of this work and approved it for publication.

Conflict of interest statement

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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