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Defining a smart nation: the case of Singapore

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Abstract

Purpose – The purpose of this paper is to identify the key characteristics and propose a working definition of a smart nation.

Design/methodology/approach – A case study of Singapore through an analysis of the key speeches made by senior Singapore leaders, publicly available government documents and news reports since the launch of the smart nation initiative in December 2014 was carried out.

Findings – Just like smart cities, the idea of a smart nation is an evolving concept. However, there are some emerging characteristics that define a smart nation.

Research limitations/implications – The paper provides an initial understanding of the key characteristics and definition of a smart nation at the nascent stage and a foundation for further research on the topic.

Originality/value – This paper contributes to the existing smart cities and smart nation literature by providing insights to the key characteristics of smart nation and proposing a working definition of the term.

Keywords Innovation, Government, Collaboration, Big data, Digital technology, Smart cities

Paper type Conceptual paper

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Introduction

With the increasing number of the world's population moving to and living in cities, there has been a growing movement for smart cities. The rapid growth of smart cities has reignited interest on the topic and generated much discussion. As the study on smart cities expands, new ideas and terms such as smart nation are added to the literature. However, it is noted that the conceptual understanding and empirical research of a smart city are still at a relatively early stage of development (Kitchin, 2015). Thus, there is a need to deepen the understanding of a smart city and clarify newly coined terms such as smart nation.

This article aims to present a study of a smart nation. It uses the case research method to examine Singapore. The main reason why Singapore was selected is because the city-state has recently announced and launched a "smart nation initiative" (Lee, 2014). As part of the case discussion, key speeches by senior Singapore leaders, publicly available government documents and news reports since the launch of the initiative in December 2014 and up to the beginning of 2016 will be examined. This article identifies the key characteristics of a smart nation and proposes a working definition based on Singapore's experience.

The article is organised as follows. Firstly, a review of the current literature on smart cities and digital technology trends is presented. Secondly, an analysis of Singapore's information and communication technology (ICT) journey and smart nation initiative is carried out. Thirdly, a discussion on the key characteristics of a smart nation and a proposed definition of the term are presented. Finally, managerial implications, limitations of the study and areas for future research are highlighted.

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Literature review

Smart cities revisited

The origin of the concept of a smart city could be, traditionally, traced back to the 1980s. The urban planners, then, had advocated for the development of well-managed and entrepreneurial cities (Logan and Molotch, 1987). Such cities would be able to compete globally by being highly responsive to market changes. There seems to be some emphasis for smart cities to embrace innovation and take some risks to stay competitive. Thus, it can be said that the initial idea leading to the development of a smart city was to encourage innovation as a form of competitive advantage. Towards the late 1990s, when climate change and global warming challenges were high on the public's agenda, smart cities took on the additional meaning of sustainable urban development (Bollier, 1998). Smart city development, thus, necessitated elements such as green construction and renewable energy sources.

By the 2000s, many governments have started to champion technology-led growth in their key cities (Glasmeier and Christopherson, 2015). By using technology as an engine of growth, smart cities are able to attract large amounts of private and public investments. Smart citied such as Songdo in South Korea and PlanIT Valley in Portugal are important test beds for many new technologies (Carvalho, 2015). An interesting parallel development is the introduction of community experimentation where citizens are involved in the design of public infrastructure. As part of the collaboration and user experience design, tools such as process mapping and customer journey mapping are used (Cruickshank and Deakin, 2011). As the idea of a smart city further develops, there is now increasing weightage given to social inclusion as an outcome (De Santis *et al.*, 2014). Through smart cities, people would be better able to gain access to services and participate more fully in society.

With a technological slant, it is not surprising that definitions of smart cities always point to the use of technology to enhance services to improve lives of the residents (De Santis *et al.*, 2014). Technology has, since time immemorial, provided the extra edge for humankind to beat the odds and thrive in very harsh and competitive environments. Over time, other similar ideas such as intelligent cities, digital cities, cyber cities and wired cities spawned (Dutton *et al.*, 1987; Graham and Marvin, 2001; Ishida and Isbister, 2000; Komninos, 2002).

Smart cities may be going through three generations of improvements, namely, technology-driven, technology-enabled and city-led, and citizen co-creation (Cohen, 2015). The first generation of smart cities is characterised by companies providing the impetus for cities to adopt technology. This supplier- or vendor-led approach is common at the initial stages of smart city development because some governments may not be fully aware of the benefits of using ICT. The second generation of smart cities features cities taking the lead to harness technology. With an enhanced understanding of ICT, governments begin to direct the key areas for ICT change. The next generation of smart cities involves actively engaging citizens in the co-design of solutions. It is a demand-led and citizen-centric approach where people's needs take precedence and any ICT solutions would be jointly developed with the government. Smart cities cover many aspects of a citizen's life. Typically, the areas covered include competitiveness, quality of life, transport and ICT, natural resources, social and human capital and participation. One model of smart cites has grouped them into six areas, namely, smart economy,

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smart living, smart mobility, smart environment, smart people and smart governance (Giffinger *et al.*, 2007).

Regardless of the perspectives, there are some common themes that run through the definition of a smart city. Firstly, the application of technological innovations for efficient utilisation of resources as a key factor (Hwang and Choe, 2013; Kitchin, 2015). Secondly, the desired outcome to improve the quality of life of the people socio-economically. Thirdly, and increasingly becoming more popular, the creation of an ecosystem where citizens and other stakeholders collaborate to co-design and co-create solutions.

Despite the numerous attempts to identify the characteristics and derive a definition of smart city, the term remains a nebulous idea which means different things to different people depending on the context and type of technologies applied. Truth be said, smart cities undergo different stages of growth and development. The needs of one smart city would vary very significantly from another. Smart cities confront a wide range of issues ranging from basic infrastructure such as waste management and public transport to advanced policy development such as robust ICT connectivity and personal data governance (Kalsi and Kiran, 2013).

Digital technology trends

Broadly, technology refers to the collection of techniques, skills, methods and processes. Technology opens up many possibilities and has always inspired mankind to peer into the future. Whether it is the artificial intelligence found in Iron Man's suit in Marvel comics or the cities of the future featured in the *Minority Report* movie, technology has the potential to enrich people's lives in the future. From a smart city perspective, such technologies could range from water filtration system and green building to mobile and wearable devices. Just the ICT field alone, the advent of the Internet has already created tremendous changes to governments and societies (Campbell-Kelly and Garcia-Swartz, 2013).

There are many types of technology that can be applied in smart cities. One of the major ICT trends is digital technology. With the advent of the digital age, there is a proliferation of digital technologies that can transform the way one lives, works and plays in the future. Such digital technologies include sensors, wireless networks, cloud-based computing, smart devices and real-time data sharing (Carvalho, 2015; Rabari and Storpera, 2015). Sensors and wireless networks help to link physical objects to the Internet, creating a digital world. This Internet of Things (IoT), whereby everyday devices are connected and share data through a network, will have significant effect on society. Traditionally, computing power resided in mainframe computers, and then it moved to a client-server architecture, where it is distributed between two parts. With cloud-based computing, on-demand computing capability is now easily available through the Internet. Coupled with an increased penetration of smart devices such as mobile and instantaneous information, computing power is further distributed to the individuals (Hunter and Crotty, 2015). Another growth area is big data. While the use of data for traditional analysis is not new, the processing of large-scale and complex data involving billions of data points, in multiples of terabytes, is fast increasing in popularity. Applied to visualisation and geo-spatial analysis, big data analytics has broad-based application to areas such as health care and transport. Of course, with the proliferation of data, the key challenge would be to be able to capture, store and manage the relevant data that allow for meaningful examination. In addition, advances in digital technologies also lead to the development of intelligent systems and robotics. Imagine

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robots that are able to learn from the environment and adapt to new situations as a result of new data being processed. Originated from the military, robotic devices are already being used in many commercial settings such as manufacturing and warehousing.

The implications of such digital technologies are far reaching. Essentially, every individual who is holding a smartphone is carrying a "miniature personal computer" embedded with sensors that tap into a global network of computers and individuals to transact information. Digital technology is also changing the way how traditional industries function. Uber and GrabTaxi are transforming the taxi business, with the former also venturing into driverless cars (Christensen *et al.*, 2015). Such innovations solve a peak-hour congestion problem, help to revive a stagnating rental car sector and empower some people to work as part-time drivers, creating a new income source in a sharing economy. Another example is the disruptive change to freight transport sector because of 3D printing. Goods would now be transmitted digitally and sent across the globe without having to be physically transported by land, air or sea. The possibilities are, indeed, only limited by one's imagination.

Case study

Singapore's ICT journey

Less than a century ago, Singapore was a small swamp-filled island on the southernmost tip of continental Asia. Founded as a trading post in 1819, Singapore gained independence from the British in 1965. In a span of less than 50 years, the city-state has transformed into a major global commerce, financial and transportation hub. With a population of about 5.5 million living on a land area of 718 km^2, Singapore currently enjoys one of the highest gross domestic product per capita among the countries in the world.

Singapore has had a long history of being a major user of ICT. There have been a number of national information technology (IT) plans formulated to transform the government, industry and society in general (Centre for Liveable Cities, 2014). The ICT journey began in 1980 with the launch of the "National Computerisation Plan". The aim then was to computerise the public sector. The "National IT Plan" in 1986 pursued a strategy to grow the local IT sector and laid the foundation for a national broadband infrastructure. In 1992, the "IT2000" plan sought to further harness IT in all other sectors. The "Infocom 21" plan in 2000 was to develop an IT-savvy economy and society. The "Connected Singapore" plan in 2003 promoted value-creation. The "Intelligent Nation 2015" plan created many opportunities for the ICT workforce and paved the way for the next-generation wireless and wired infrastructure (Infocomm Development Authority of Singapore, 2006). Building on this foundation, the "Infocomm Media 2025" plan targets to harness media and complements the smart nation initiative (Ministry of Communications and Information [MCI], 2015).

The nation has traditionally exploited ICT to spearhead the drive for efficiency and productivity and, to a certain extent, economic growth. As a leader in the use of ICT, Singapore continues in its effort to make the country more digitally ready for the future (Dutta *et al.*, 2015).

Smart nation initiative

The tackling of strategic issues or problems has always been a hallmark of the role of the Singapore government. This ability to respond and adapt to changes has been a rallying

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call since the founding of modern Singapore (Lee, 1967). As a small nation, Singapore lacks natural resources and a hinterland. Coupled with a limited and shrinking workforce, these constraints pose a serious challenge to the competitiveness of the country (Iswaran, 2015). The government has identified economy, ageing population and national identity as the three areas of focus for Singapore to survive the next 50 years (Lee, 2015b). Technology and innovation has helped propel Singapore to first-world status. Moving forward, the government intends to continue to adopt this approach to grow the economy (Tharman, 2015).

In December 2014, the Prime Minister of Singapore announced the city-state's vision of a smart nation. The vision is to improve people's lives and create more opportunities through ICT (Lee, 2014). The smart nation initiative is an effort by the government to co-create innovative people-centric solutions with the industry and citizens. A national-level programme office, led by a cabinet minister, was set-up to coordinate the effort.

The three priority areas, underpinned by cybersecurity, are elderly, transportation and data (Lee, 2015a). The reasons for focusing on these challenges are obvious. With a fast greying population expected to reach 900,000 by 2030, there is an urgent need to create facilities in the workplace, home and hospitals that can cater to the needs of the elderly. Also, as a cosmopolitan city, sustainable urban mobility solutions are required to solve the problems of congestion. Finally, the availability and ease of access to data would vastly improve decision-making (Balakrishnan, 2015b). The protection of information systems and data from misuse is fundamental to the effective functioning of a smart nation. Thus, cybersecurity would be incorporated in the early stages of ICT implementation (Loke, 2015).

The smart nation initiative is a whole-of-nation approach to enhance the quality of living for the country. It involves developing an entire ecosystem supported by infrastructure, technologies, policies, culture and capabilities (Smart Nation Programme Office [SNPO], 2015). Infrastructure-wise, the "Smart Nation Platform" will extend existing network with ultra-high-speed optical fibres for even greater pervasive connectivity. While the smart nation initiative is not about technology, technology does play a big role. Some of the enabling technologies mentioned that have huge potential and would make an impact include IoT, 3D printing, big data and robotics (Balakrishnan, 2015c).

One of the key areas of the initiative is the sharing of government data to the public to encourage co-creation of solutions. The government is reviewing its policies to allow public access from various ministries and agencies (Balakrishnan, 2014). Earlier, data sets from more than 70 public agencies have already been made available to the public via the government's open data portal. The aim is to empower the public to identify problem areas which need improvement and co-create solutions. In terms of culture, there is now a greater emphasis on experimentation and risk-taking to increase the odds of innovation. By doing so, the government hopes to promote a problem-solving mindset and more independent citizenry.

Capabilities development is another major tenet of the smart nation initiative (Balakrishnan, 2015a). With the many changes, many new skills would be needed. In fact, over the past 10 years, there has been an emergence of new jobs such as application developers, social media officers and search engine optimisation specialists (Ang, 2015). To support the development of ICT talents, more training schemes would be made

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available. To this end, the government has announced a national scheme where every Singaporean aged 25 and above would receive S$500 of SkillsFuture credit to be used on a range of courses. The credit does not expire and would be topped up at regular intervals (Chong, 2015).

Building administrative capacity

The Singapore government has also started to develop its administrative capacity to drive the initiative. A new cyber security agency has been set-up to coordinate programmes to protect national systems in key sectors and potential breaches of citizen data from rogue organizations. Another two new statutory boards, SkillsFuture Singapore and Workforce Singapore, would be formed to look into the national SkillsFuture initiative and to ensure competitiveness and quality jobs for Singaporeans. To take advantage of the changing digital technology landscape, the Infocomm Development Authority of Singapore and the Media Development Authority would be restructured into an Infocommunications Media Development Authority and the Government Technology Agency (Kwang, 2016). The former would focus on the development and regulation of the infocommunications and media sectors, while the latter would continue to drive digital transformation in the public sector in areas such as IoT and big data.

Discussion

Key characteristics

In this article, Singapore was used as a case study on the emerging concept of a smart nation. As part of the analysis, key speeches of senior Singapore leaders, publicly available government document and news reports were reviewed to determine the goals, direction and aspirations on Singapore's push towards a smart nation. Some of the emerging characteristics that define a smart nation are discussed next.

Firstly, a smart nation endeavours to tackle strategic issues or problems that have a long-term impact on its survival. If the problems are not properly managed, there will be far-reaching consequences for the country as a whole. These issues cover a wide range of topics such as economics, demographics, utilities, urban development and health care. Basically, all country-level, macro issues fall under this characteristic. Singapore has been described as "The City of Nation Building" (Bell and De-Shalit, 2011). To this end, Singapore has always sought to overcome its limitations such as greying population by confronting the problems head-on. Thus, a key characteristic of a smart nation would be the ability to identify strategic issues and provide innovative solutions.

Secondly, a smart nation applies digital technology and data to drive innovations. Without a doubt, technology helps to create new ways of doing things. Whether it is Fortune 500 companies such as Apple, Amazon, Microsoft and Google or "unicorns" such as Uber, Xiaomi, Airbnb and Snapchat, technology, in the form of ICT, continues to present a vast array of opportunities to improve the quality of life. In the current context, digital technologies are already transforming the work place and social spaces by offering a wide range of possibilities. For example, from smartphones to "smart everything", people and objects are almost all inter-connected. Also, the application of big data allows the decision-makers to derive valuable insights into issues which were not possible previously. Adopting a data-driven approach, as opposed to an intuitive

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approach, to problem-solving provides for a more evidence-based and robust means to tackle human-centric issues. Data could be used as a strategic asset to engage the citizens (Susha *et al.*, 2015).

Thirdly, a smart nation adopts a whole-of-government approach rather than a municipal or single agency approach to solve problems. Tackling complex national issues requires the support from multiple agencies (Conteh, 2012; Waheduzzaman and Miah, 2015). There is a need to break away from the "silo mentality". To achieve a shared goal, all the relevant government agencies must be involved to address the issues arising in a holistic and systemic manner. Government unity and collaboration are important factors to solve "wicked problems" which have complex interdependencies (Churchman, 1967). A whole-of-government approach is also important from a resource perspective. In the case of Singapore, coordinating ministers for national security, economic and social policies and infrastructure have been appointed to translate policies down to the various levels of government such as ministries and statutory boards. This would further strengthen the collaborative effort of the various public sector agencies to address national issues. A minor point on the distinction between a smart city and a smart nation rests on the availability of resources and political legitimacy. Regardless of the size and wealth, a city would naturally lack the resources and "big picture" perspective of a nation to tackle national issues in a holistic way. For example, a city may be limited by the small talent pool within the urban population. Even if this issue could be overcome by the arrival of people outside the city, there are other constraints such as transnational regulations and national laws which only a nation as a sovereign entity could deal with.

Finally, a smart nation collaborates with different stakeholders beyond the public sector to create innovations and breakthrough results. Traditionally, the government adopts a top-down and vision-led approach to collaborate with stakeholders such as multinational companies, research institutes and institutes of higher learning. Increasing, there is an emerging trend in which start-ups, not-for-profit organisations, small and medium-sized companies and citizens work with the government to co-create innovative solutions. This is a bottom-up approach where the industry and citizens take the lead (Nabili, 2015; Schaffers *et al.*, 2012). Generally, strategic issues tend to be multi-dimensional in nature and no one single player would have the solution. All the ideas need to be pooled together. Consequently, citizen participation in such projects is key (Sáez-Martín *et al.*, 2014). The creative, innovative and entrepreneurial strengths of the population should be harnessed. The government could then play the role of a mediator to bring these stakeholders to work together (Brorström, 2015). A nation is smart because the people are able to solve problems creatively. Collaboration with citizens implies co-creation and co-design of solutions that are human-centric. From this collaboration perspective, Singapore is aligned to the next generation of smart cities (Cohen, 2015). The growth of start-ups could be taken as a sign of the bottom-up approach to innovation. This is because their survivability and sustainability really depend on correctly identifying and providing an innovative solution to human-centric issues. New start-up companies may very well be the tipping point which propel the economy in a smart nation. In the case of Singapore, start-ups in areas such as smart health and financial technology or fintech have been earmarked as a key focus for the Committee on the Future Economy (Hui, 2015).

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A working definition

Having identified and discussed the four key characteristics of a smart nation, a working definition is proposed as follows: "A smart nation applies digital technology and data to address strategic issues through a whole-of-government approach and in collaboration with citizens". Thus, the distinguishing characteristics of a smart nation are strategic issues, digital technology and data, whole-of-government and collaboration with citizens. It is strategic because a smart nation tackles long-term survival issues which affect the nation. It applies digital technology and data because current technological trends are pointing to "digitalization" as the "next big thing" and using data to drive decision-making and engage the citizens. It uses a whole-of-government approach instead of just tackling problems at the urban, municipal, city or provincial level. Finally, it involves collaborating with citizens to co-design and co-create human-centric solutions which tap into the creativity of the population.

The smart nation definition is not a one-size-fits-all definition. A nation is "smart" in so far as it is able to solve its own unique problems with the entire government tapping on the creativity of the population through the apt application of digital technology and data. This requires true innovation rather than mundane upgrades of technology. Just like a smart city, a smart nation is a multi-dimensional concept and includes somewhat similar characteristics. The main differentiation is the extent to which each characteristic manifests itself.

Managerial implications

The main motivations of the article are to identify and understand the key characteristics of a smart nation and propose a working definition. Having established a working definition and baseline for discussion, there are various managerial implications moving forward. Firstly, if the concept of a smart nation involves the application of digital technology and data to solve strategic problems, then the pace of policymaking would be an important aspect of any smart national inititative. Anecdotally, it is suggested that advances in technology generally outpace the regulatory framework. For example, laws to regulate driver-less vehicles. Thus, there is a strong need for the public sector to develop and design policies to facilitate rather than hinder application of digital technology and data.

Secondly, the collaboration with and engagement of citizens. To tap on the creativity of the entire population, outreach and other mechanisms need to be put in place that involve the citizens. It is a bottom-up approach to problem-solving. One way is the extent to which data are made available to the public to enable research and analysis on problems. Sometimes, this raises the issue of efficiency versus privacy of data. As the application of data to drive decision-making becomes more mainstream, both the users and providers of personal data would need to maintain a careful balance between being able to decide on and doing things quickly due to the availability of data and the loss of personal privacy. Consequently, guidelines and regulations on the safe guarding of personal data would be another area for the public sector to focus on.

Limitations and implications for future research

There are some limitations associated with this case study. As a single case analysis, it lacks generalisability. The smart nation is a new concept which builds on the idea of smart cities. As more governments embark on such initiatives, multiple cases can be studied to enhance the understanding of smart nations. As a corollary, the article is also

theory-based. More empirical evidence is needed to support some of the claims on key characteristics. As the concept of smart nations enters into a new stage of development, more empirical studies would be needed to identify the performance of smart nation and challenges posed on policies, people and data. Future researchers could look at territories of similar size such as Hong Kong and Malta or continental states such as Finland, Estonia, Latvia and Lithuania as subjects for interest and models for investigation. Their research could also focus on areas such as policy innovations and citizen engagements as part of a collaborative ecosystem in a smart city or nation.

Conclusion

The smart nation concept opens up a new area and paradigm where digital technology and data are applied to address strategic issues through a whole-of-government approach and in collaboration with citizens. Singapore has been extremely successful economically over the past 50 years. It is now embarking on the next phase of growth. Thus, it is timely for the government and citizens to discuss and debate about what they want the future of the city-state to be and how technology can make it truly exceptional among nations around world. A unique model of a smart nation may emerge and propel the city-state not just for the immediate future but the next 50 years.

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