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Emerging economies, emerging challenges: Mobilising and capturing value from big data

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ABSTRACT

As technology advances and voluminous new data are generated on a daily basis, the ability to harness and utilise big data not only enhances firms' competitiveness but also equips governments for the twenty-first century. This study examines how governments can utilise big data to combat health challenges. The study focuses specifically on the Ebola outbreak in West Africa to illustrate how various technologies and techniques were utilised jointly to combat and contain the outbreak. An integrated technology roadmappping approach was developed which encompasses digital surveillance systems and traditional monitoring techniques to articulate how governments can capture value from big data to combat such contagious diseases. Policy and practical implications are identified and discussed.

1. Introduction

In recent years, the advancement of information technology coupled with globalisation of the world's economy has ushered in the dawn of the field of big data (Goes, 2014; McAfee and Brynjolfsson, 2012; Woerner and Wixom, 2015). The emergence of large and often unstructured data has become an increasingly common feature of the global economy. As such, harnessing and utilising insights from big data cannot only enhance firms' competitiveness but also lead to effective government policies (Amankwah-Amoah, 2015; Wamba et al., 2015; Bhimani, 2015). The dawn of big data has been accompanied by increasing consensus that government can play a pivotal role in utilising big data to not only protect the public but also formulate effective public policy (Davidian and Louis, 2012).

Although past studies have indicated that the time when public policymakers and top executives "could profess ignorance about the power of data has long passed" (EIU (Economist Intelligence Unit), 2012, p. 19), the precise mechanisms for governments and policymakers to harness and utilise big data to combat social issues remain unclear. Surprisingly, much of the academic literature on big data has focused mainly on techniques and methods without articulating how it can be utilised to combat health issues.

Accordingly, the objective in this paper is to explore how government can utilise big data to combat healthcare issues. The study focuses specifically on combating contagious diseases and reviews the technologies utilised. The paper utilises the recent Ebola outbreak in West Africa as a lens through which to demonstrate how big data aided the drive to report, contain, control and halt the spread of the virus. The focus is mainly on the Ebola outbreak in West Africa, but not exclusively.

The study makes at least two key contributions to big data and technology roadmappping literature. First, although scholars recognised that big data should play a pivotal role in combating diseases (Hay et al., 2013), the roadmap for doing so has thus far been inchoate. In this direction, the study fills this gap in the literature by integrating the streams of research on technology roadmapping (Phaal et al., 2004) and big data (George et al., 2014; McAfee and Brynjolfsson, 2012) to demonstrate how technology roadmapping can equip governments and public policymakers in responding to such adverse shocks. The paper employed the case of the Ebola outbreak to offer a step forwards in demonstrating how big data can be harnessed to solve social issues.

Second, in spite of the recognition among scholars that technology roadmap is a powerful tool of strategic planning (Phaal et al., 2004; Geum et al., 2015), there remains a limited insight into how it can be utilised to help emerging economies combat emerging challenges. The study juxtaposes the two streams of research on big data and technology roadmappping to develop a framework with potential to further illuminate our understanding of the subjects. The study also provides unique insights on how governments can mobilise and capture value from big data.

The rest of the article is structured as follows. In the next section, a review of the existing literature on technology roadmapping and big data is presented. Then the method of data collection is explained. The penultimate section presents an overview of a range of tools/techniques utilised towards predicting and containing the Ebola outbreak. The final section discusses the implications of the findings for public policy.

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2. Technology roadmapping and big data: a review

A roadmap can be seen as a "layout of paths or routes that exists (or could exist) in some particular geographical space" or a "traveller's tool that provides essential understanding, proximity, direction, and some degree of certainty in travel planning" (Kostoff and Schaller, 2001, p. 132). Roadmaps encompass the identification of tools and techniques required to address issues/problems as well as enhancing preparedness of organisation and agencies for future eventualities (Galvin, 2004; Lee et al., 2015). Technology roadmaps can be viewed as a tool for strategic planning which entails linking resources and expertise to future courses of action (Kostoff and Schaller, 2001; Phaal et al., 2004; Galvin, 2004). A technology roadmap can be defined as an "extended look at the future of a chosen field of inquiry drawn from the collective knowledge and imagination of the groups and individuals driving change in that field" (Galvin, 2004, p. 101). The term technology roadmapping refers to the process inherent in the evolution of roadmaps which helps fine-tune decisions and concentrate resources on key areas (Kostoff and Schaller, 2001). It can be seen as a unique framework for mapping processes and approaches towards achieving particular short- and long-term objectives. Over the years, the scope of technological roadmapping has been expanded to include the role of the state in formulating public policy (Vishnevskiy et al., 2015; Walsh, 2004).

One important stream of research has uncovered that technology roadmapping can help firms' better respond to adverse environmental shocks by providing routes for scanning the business environment as well as tracking the performance of employees (Phaal et al., 2004). Indeed, it is widely recognised that technology roadmaps and the roadmapping processes can enhance "a firm's, regions, or industry's competitive advantage by providing a process that senses the competitive landscape, identifying opportunities, risks, threats, and competitor ability" (Walsh, 2004, p. 162; Geum et al., 2015). This also helps in the public policy arena by helping governments to channel their limited resources more effectively and by pinpointing areas with pressing needs (Kerr et al., 2013).

Another line of research has demonstrated that roadmapping can help to garner support and forge consensus around the technology requirements and future needs, and in so doing produces synergistic benefits (Kostoff and Schaller, 2001; Garcia and Bray, 1997). Consequently, roadmapping can equip decision makers with the tools and approaches to make better investment decisions (Kostoff and Schaller, 2001). Some scholars have indicated that technology roadmapping can enhance a country's or organisation's preparedness in meeting future challenges (Garcia and Bray, 1997). However, inability to map out a clear path to the future can affect a country's ability to develop and disseminate valuable knowledge as well as prepare for future challenges (see McDowall, 2012). Indeed, such failure can lead to declining performance of governments and firms.

2.1. Technology and evolution of big data

Since the turn of the century, the term big data has gained wider currency not only within academic circles but also among practitioners (Lohr, 2012b; Hay et al., 2013). The concept big data has emerged from the corridors of technology firms to take centre stage within the mainstream management discourse (George et al., 2014). Big data can be defined as the "ultralarge bodies of data that have not been prospectively limited in size or scope by the intent to address specific research questions or disease conditions, and that grow continuously and rapidly" (Ghani, Zheng, Wei & Friedman, 2014, p. 976).

Big data includes information from sources such as social networks, tweets, blogs and cellphones. Some of the distinctive features of big data include the volume, variety and velocity (Chen et al., 2012). The notion of big data encompasses not only data collection but also analysis of data on a large scale to inform organisational decisions and public policies (McAfee and Brynjolfsson, 2012). The collections and management of large data are not new and can be traced back more than 7000 years (EIU (Economist Intelligence Unit), 2011).

However, the speed and mechanisms through which data can reach governments and businesses have changed. The digital age has been accompanied by a surge in the amount of data available to governments and businesses (Brennan et al., 2014). It has been suggested that the world creates around five exabytes of data every 48 h which is equivalent to the amount of data created between the beginning of civilisation and 2003 (EIU (Economist Intelligence Unit), 2012; Wakefield, 2013). In this fast-changing world, big data is now at the cornerstone of not only public policy formulation but also business strategies and marketing tools (Amankwah-Amoah, 2015). Big data also presents an opportunity to better understand complexities inherent in today's world.

Past studies have demonstrated that the ability to collect, analyse and comprehend both structured and unstructured data can enhance firms' competitive advantage and a country's preparedness for future crises (McAfee and Brynjolfsson, 2012). A stream of research indicates that big data methods necessitate the use of advanced techniques and technologies to facilitate data capture, storage, distribution and analysis to help make informed managerial and health decisions (Ghani et al., 2014). Business analytics entails "the techniques, technologies, systems, practices, methodologies, and applications" employed to analyse big data (Chen et al., 2012, p. 1166). The techniques encompass machine learning and data mining (Ghani et al., 2014).

Big data analytics encompasses assembling of multiple data and analysing them to identify unique patterns to make decisions and inform public policy. By monitoring individual behaviour and activities, data can be utilised to assemble experts such as doctors and nurses in a timely manner. By using the power of modern computing, countries can make a leap forward in solving problems such as crime, terrorism and public health (Marcus and Davis, 2014). Juxtaposing the technology roadmapping and big data literatures, Fig. 1 was developed. The figure demonstrates technology roadmapping as a mechanism for making sense of big data, identifying patterns, sources of learning and mechanisms for knowledge diffusion.

Recent studies have indicated that the integration of the global economy has been accompanied by new and old contagion risks, and this poses major challenges to governments (World Bank, 2013). The incidence of global epidemics had brought to the fore the need to harness big data to help tackle such risks. For governments, the advent of large databases means that extracting value from big data is essential for future success. Although past studies have illuminated our understanding of roadmaps, little insights have been provided on how governments can marshal technologies in meeting future challenges.

More recently, some scholars have suggested that "the next step of roadmapping applications involved using this tool to introduce new and emerging technological solutions to social goals" (Vishnevskiy et al., 2015, p. 434). Over the past few years, more governments' resources have been deployed to not only assemble but also analyse big data as the basis for informed public policy (DBIS (Department for Business, Innovation and Skills), 2013). Despite these important observations, scholars have made little progress in the application of the technology roadmapping approach to combating social issues. This study seeks to fill this gap in the literature.

3. Research design and data sources

3.1. The research setting: Ebola

The epicentre of the Ebola outbreak was in three countries, namely Guinea, Liberia and Sierra Leone. This setting is appropriate partly because it provides a background to demonstrate how governments and agencies utilised multiple arrays of data sources to address healthcare issues and emergence. At the time of the outbreak, the health systems in the three severely countries were generally seen as under-resourced, understaffed and disjointed to contain such outbreaks or