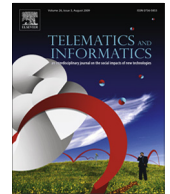




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## Ecological views of big data: Perspectives and issues

Dong-Hee Shin <sup>a,\*</sup>, Min Jae Choi <sup>b</sup><sup>a</sup> Dept. of Interaction Science, Sungkyunkwan University, 53 Myungryun-dong, Jongro-gu, Seoul, Republic of Korea<sup>b</sup> Korea Press Foundation, Jung-gu, Seoul 100-750, Republic of Korea

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## ABSTRACT

From the viewpoint of big data as a socio-technical phenomenon, this study examines the associated assumptions and biases critically and contextually. The research analyzes the big data phenomenon from a socio-technical systems theory perspective: cultural, technological, and scholarly phenomena that rest on the interplay of technology, analysis, and mythology provoking extensive utopian and dystopian rhetoric. It examines the development of big data by reviewing this theory, identifying key components of the big data ecosystem, and explaining how these components are likely to evolve over time. Despite extensive investment and proactive drive, uncertainty exists concerning the evolution of big data and the impact on the new information milieu. Significant concerns recently addressed are in the areas of privacy, data quality, access, curation, preservation, and use. This study provides insight into these challenges and opportunities through the lens of a socio-technical analysis of big data development, which includes social dynamics, political discourse, and technological choices inherent in the design and development of next-generation ICT ecology. The policy implications of big data are addressed using Korean information initiatives to highlight key considerations as the country progresses in this new ecology era.

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## 1. Introduction

The quantity of data is exploding worldwide, and the ability to analyze large datasets, so-called big data, is a central factor for competitiveness that is underpinning new waves of productivity, growth, and innovation (Kitchin, 2014). Advancements in big data analysis offer cost-effective opportunities for improvements in critical decision-making development areas such as health care, employment, economic productivity, crime, security, natural disasters, and resource management (Tinati et al., 2014). Big data technology is drastically revolutionizing commerce and society. The unlimited potential of a data-driven economy is widely recognized, and there is increasing enthusiasm for the notion of big data.

Although big data technology has the potential to provide powerful competitive advantages, governments and companies are struggling to establish effective governance and privacy in connection with big data initiatives. While the potential of big data technology is real, the realization is lagging (Eynon, 2013). For example, fundamental concerns exist concerning big data development despite high expectations and exorbitant financial investment. As Boyd and Crawford (2012) critically note, contemporary discussions concerning big data have been technologically biased and industry-oriented, leaning toward the technical aspects of its design. In recent years, the subject of big data has been a key item on the national agenda and is considered a significant part of technological infrastructure (Esposti, 2013). Until now, most big data development efforts

\* Corresponding author. Tel.: +82 2 740 1864/1856.

E-mail addresses: [dshin@skku.edu](mailto:dshin@skku.edu), [dshin1030@gmail.com](mailto:dshin1030@gmail.com) (D.-H. Shin), [mjchoi@kpf.or.kr](mailto:mjchoi@kpf.or.kr) (M.J. Choi).

have focused on the commercialization of data technologies and resources. Few efforts have addressed the immense repercussions of the social dynamics and organizational, political, and managerial decisions inherent in the development of big data (Maté and Llorens, 2012). Existing concerns with big data such as the invasion of privacy, imperfect security, and limited interoperability are rarely examined compared to other technology concerns. Such issues, including the social, cultural, and ethical impacts of how we develop and manage the evolution of big data will be critical to its success. This study argues that big data technology is a component of a social ecosystem and system development should focus on data integration with social and cultural milieu. This argument is consistent with the socio-technical theory that the design and analysis of technologies should be based on contextual understanding, that is, a context-based evaluation that determines the fitness of a technology within a specific context (Ramírez, 2007; Shin, 2014). This theory analyzes the processes of big data development, offers heuristics to improve the problem formulation, and equates superior design with improved problem formulation, understanding, and communication. These approaches are contextual in the sense that they heavily scrutinize the local features of aboriginal situations. The theory is aligned with the concept of a big data ecosystem: big data represents an interconnected, multilayered ecosystem of high-capacity networks, services, applications, and users.

From an ecology perspective, this study assesses the development, prospects, and limitations inherent with big data phenomena in the Korean context. By identifying uncertainty and opportunity, this study seeks an optimal solution for big data considering appropriate social norms, regulations, industry dynamics, and market receptiveness. This study examines the conceptualization and acceptance of big data in Korea and the associated social and regulatory factors. A socio-technical framework differentiates the technical and social understanding of big data and creates an interface for their interaction. The relationship between big data and the surrounding discourse provides insight into the design, framing, and development of big data. The Korean context offers excellent examples of big data dynamic interplay, where the government has been proactively involved in fostering technological initiatives that provide key lessons with respect to regulatory regimes, infrastructure development, demand promotion, and institutional configurations conducive to policy execution. At the same time, Korea's unique development of big data has created further *a priori* questions concerning planning and the design of big data in terms of its socio-technical perspectives. The answers from *a priori* questions can offer an *a posteriori* justification for big data development. It is sociologically meaningful and technically heuristic to examine the Korean approach to big data and the factors that affect Korea's big data design. From a socio-technical perspective, this study critically and contextually investigates the phenomenon using reflexive and theoretically informed research to explore, debate, innovate, question, and rethink big data with respect to a number of interrelated social-technical topics. Research on big data through socio-technical phenomena has prompted the following research questions:

RQ1: What obstacles and problems have been encountered with attempts to develop big data in Korea?

RQ2: To what extent have people adapted to the emergence of big data?

RQ3: To what extent have these dynamics affected individuals, groups, and society?

The socio-technical assessments included in this research examine the effects of big data on the representation (epistemologies), realization (ontologies), and governing (politics) of societies. This inquiry leads to the development of a new conceptual framework for a big data system. The framework provides an alternative paradigm based on an ecology model for superior big data practices.

## 2. Theory of socio-technical systems: data ecosystem

Big data is evolving into an all-encompassing concept; however, there is no clear definition of big data, the effect on industry and society, and how industry and society can prepare for the availability and use of increasing amounts of more complex data in the future (Crawford and Schultz, 2014). This trend may be related to the academic and industry perspectives of big data. The majority of studies and reports on big data have focused on particular technologies or solutions that reflect only a limited problem area (Tinati et al., 2014). Currently, big data have been approached from a technical tool perspective or marketing perspective. Industry views big data as pure opportunity: marketers use big data for targeted advertising, insurance providers use data to optimize their offerings, and financiers use data to assess and predict the markets. Cukier and Mayer-Schonberger (2013) consider big data a tool that will revolutionize our lives, unequivocally for the better. An opposing view comes from Boyd and Crawford (2012) among others, who criticize the technological benefits claiming that they are overstated and blind to embedded structural issues that cannot be solved by additional data.

There is no well-established terminology within the debate because big data has been defined in many ways by different groups (Ansolabehere and Hersh, 2012). Big data technology was originally the exclusive domain of advanced university research and national laboratories. Owing to massive technology advances, the term big data is now applied broadly to include social and commercial environments (Kwon et al., 2014).

Some of the datasets composed of big data are smaller than earlier datasets that were not considered big data. Much of the attention on big data has been focused erroneously on large volumes of data. This has led to a skewed and narrow perspective of the value of big data to organizations and society. Big data is less concerned with the volume or type of data than with the social practice and the value that the data can create. From a socio-technical perspective, big data represent

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