

DECISION SCIENCES INSTITUTE

Big Data Capabilities Create Business Value: the Mediating Role of Decision-Making Impact

Shiwei Sun

Auburn University

Email: szs0100@auburn.edu

Dianne J. Hall

Auburn University

Email: halldia@auburn.edu

ABSTRACT

Firms in the current business environment face more challenges to make an effective strategic decision and cope with the market unprecedented turbulence. Big data capabilities can help firms gain business value by analyzing the massive volumes of data in real time. From a dynamic capability perspective, this study proposes a conceptual framework to discuss the relationships among big data capabilities, decision-making impact, and business value creation. We conclude decision-making impact plays a full mediating role.

KEYWORDS: Big data capabilities; Business value creation; Decision-making impact

INTRODUCTION

As the current business environment is becoming more volatile, firms are facing more challenges to make an effective strategic decision and cope with the market unprecedented turbulence. In this dancing, rugged, and competitive landscape, internal operations and external environment of the firm exacerbate the uncertainty for prediction. To achieve an effective decision-making, it requires timely processing of large volumes and varieties of information that can be enhanced by a number of IT-enabled supporting, monitoring, or learning systems. It is acknowledged that IS applications can be designed and used to enhance managerial capacity (Tanriverdi et al., 2010).

With the evolution of big data, rather than only to show the data pattern, big data has become a set of technologies and is more about pulling insights from data (Xu, Frankwick, & Ramirez, 2016). Firms' purpose to adopt big data is to get valuable intelligence by analyzing the massive volumes of data in real time. From an analytic method view, big data analytics are presented in three categories, including descriptive techniques, prescriptive techniques, and predictive techniques (Hazen et al., 2016). Correspondingly, big data unique capabilities can be divided into three parts, including analytical capability, predictive capability, and decision support capability. One of the purposes of developing these capabilities is to refine data and produce a more profitable decision-making. The analysis results can be used to support the quality of decision-making, and, in turn, create business value.

The role of big data has been well recognized for firms in operations research (Hazen et al., 2016), marketing (Arthur, 2013; He, Wang, & Akula, 2017), supply chain management (Chen, Preston, & Swink, 2015), and many other aspects. The capabilities of big data have become the focus both in information systems (IS) research and industry. However, most of current studies are conceptual work discussing how big data use can improve decision quality and then generate business value (e.g., Sharma, Mithas, and Kankanhalli, 2014). There is a lack of research to evaluate the business value creation by big data (Wamba, et al., 2015). How big data creates business value in supply chain (Cerchione & Esposito, 2016), customer relations, production and operations is still called to investigate. The process of how big data technology creates business value through improving decision quality has not yet been well explored. The fundamental purpose of our study is to conceptually explore relationships among big data capabilities, decision quality, and business value creation.

LITERATURE REVIEW

Big data capability

Big data is originally used to describe the large data sets (Chen, Chiang, & Storey, 2012). The big raw data itself cannot offer any value without being processed. Big data analytics are predictive and prescriptive analytics rather than a simple reporting. Big data technologies may include data storage (e.g., NoSQL databases), management (e.g., search and knowledge discovery), analysis (e.g., predictive analytics), and visualization technologies (e.g., data virtualization). We evaluate the role of big data in creating business value from three key dimensions: analytical capability, predictive capability, and decision support capability.

Analytical capability

Descriptive techniques are utilized for firms to answer the question of what is happening (Souza, 2014). The beginning work of big data is to identify the pattern of these data, which could be called descriptive analytics. Analytical capability as an organization's overall ability is to capture, store, and process/analyze large volumes of data at or near real-time rates. It is the data processing capability that can deal with the data that could not be processed by the traditional approach.

Big data can help firms analyze structured data (e.g., transaction data, financial data, etc.) and unstructured data (e.g., customer reviews, social media data, website clickstreams data, etc.). With the help of big data, firms can analyze high volumes of data and uncover previously unseen patterns by data analysis at a fast speed.

Predictive capability

Predictive capability is an organization's overall ability to use the analysis results for prediction at each organizational level. Forrester assessed the current big data technologies and found that predictive analytics is the only one technology that can bring high business value for a long lasting time (Press, 2016).

With the help of big data, firms can improve the accuracy of predictions and identify trends to make predictions in different areas (e.g., customer behaviors, marketing, product development, etc.). On the basis of a real-time prediction, the big data analysis results can also help firms improve the effectiveness of predictions.

Decision support capability

Decision support capability is an organization's overall ability to use big data analysis results to support managerial decision-making at each organizational level. The use of big data capabilities to create business value has become many organizations' strategic consideration (Lee et al., 2014). Big data has become a critical role to help firms develop a strategic blueprint (Whittington, 2014). With the support of big data, the analysis results can make firms get strategic, managerial, and operational decision-making that benefit a broad range of functions. A better business decision making can be produced by a real-time decision due to the use of big data. The data-driven decision-making culture can also more easily developed.

Decision-making impact

Decision making process refers to "the conversion of information into action" (McClure, 1978, p. 382). In the era of big data, data-driven decision-making is proved to have an important impact on firm performance. The study from Brynjolfsson, Hitt, and Kim (2011) statistically indicates that the more data-driven a firm is, the more productive the firm will become. McAfee and Brynjolfsson (2012)'s analysis also show that the more companies characterized themselves as data-driven, the better they performed on objective measures of financial and operational results. Scholars have widely acknowledged that big data is a business solution and can generate business value to improve data-driven decision-making (McGlinchey, 2013; LaValle et al., 2011). More and more researchers have begun to discuss how big data can improve the quality of decisions (Sharma, Mithas, and Kankanhalli, 2014).

In current data-rich environments, data has been likened to the new oil and is the next big thing for firms to make value (Rotella, 2012). Data are worthless for decision making until they are unlocked and become useful information (Gandomi & Haider, 2015). A business decision making is based on huge volumes of information. After getting reliable information sources, how to analyze and acquire the useful results becomes the focus for firms. Big data innovation is one of the effective solutions. Firms can derive value from the refined data to drive firms' growth. Recognizing the value of big data capability, more and more firms put large amounts of investment towards big data adoption.

Data-driven decision-making refers to the practice of basing decisions on the results of the analysis of data, rather than purely on subjective intuition (Provost & Fawcett, 2013). Currently, there is a growing tendency that firms are having more and more data. The challenge for firms is how to exploit these data more effectively. Decision makers more and more depend on data

support to gain a better decision result. One of the purposes to analyze business data is to make a timely business decision (Chen, Chiang, & Storey, 2012). The decision making speed and problem identification speed will be greatly improved. The extent of analysis in decision making can be expanded.

Business value creation

A successful use of information technology is fully needed to embed into organizational processes from manufacturing to marketing. As suggested by previous research, the value impacts of big data can be assessed at the business process level because this view has an advantage to explain organizational level of business value creation (Tallon, 2007). From this view, big data creating business value can be evaluated from various aspects. The big data analytics solutions help build an optimized knowledge management systems in supply chains to improve firm performance (Hazen et al., 2014; Schoenherr & Speier, 2015; Waller & Fawcett, 2013). According to a survey finding, firms using business analytics have five times better performance than those that don't use any business analytics (LaValle et al., 2011).

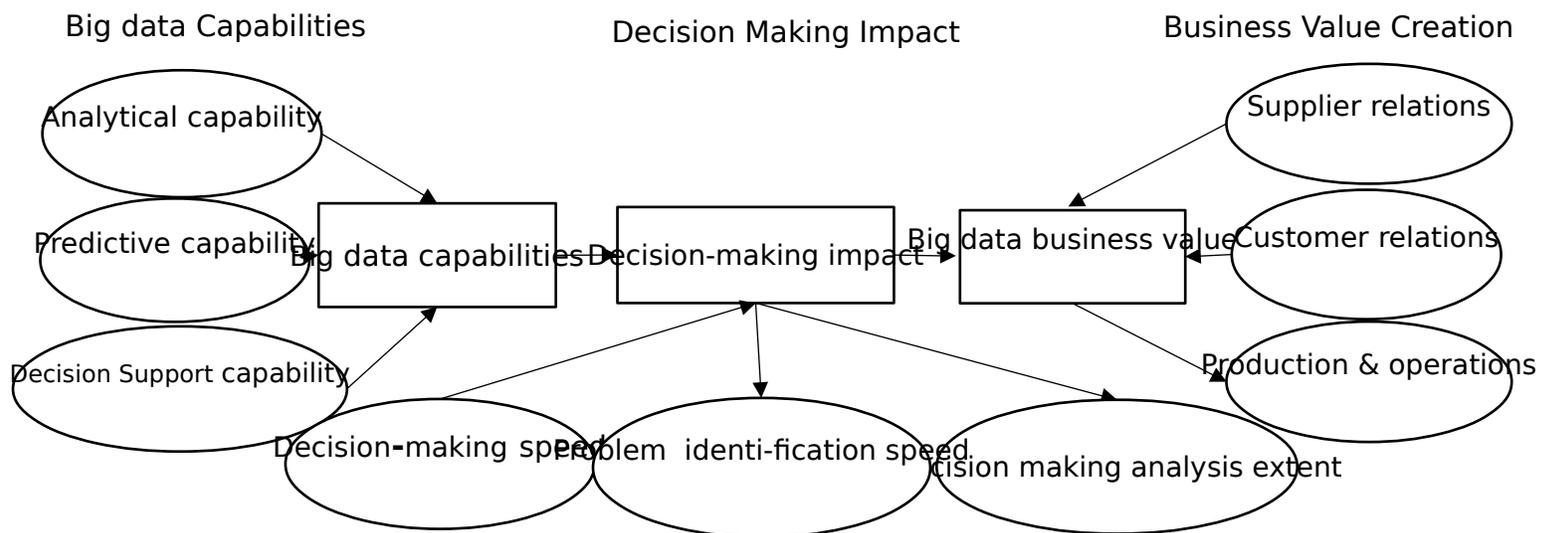
The business value created by big data are mainly presented from three aspects, supplier relations, production and operations, and customer relations. With the support of big data, firms can acquire more suppliers' credit, cost of production, and raw resources usage information, and gain leverage over its suppliers. Big data improves production and operations process by analyzing large volumes and varieties of information from equipment and machines. Big data capabilities also creates business value by improving customer relations. Schroeck et al. (2012) emphasized that big data is used to target customer-centric outcomes and make the organization more customer oriented. Customers today have more knowledge towards products and services selection than ever before. It is hard to acquire customers' need information and make an effective decision to satisfy them in the current business environment. The emergence of big data provides a good solution to solve this issue. I

CONCEPTUAL FRAMEWORK

Dynamic capabilities are "firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece, Pisano, & Shue, 1997, p. 516). Scholars have claimed that big data usage is an organizational dynamic capability to derive competitive advantage (Chen, Preston, & Swink, 2015). By generating business insights across

various activities, the use of big data can match and create market change. This is in accordance with the key characteristics of dynamic capabilities (Eisenhardt & Martin, 2000). Data-centric capability can support organizational decision processes. Big data as firms' important information assets is to enhance decision making and insights. We argue that big data capabilities can bring direct effects on organizational decision-making, and in turn on business value creation.

Figure 1: Conceptual framework



PROPOSITIONS

Based on our discussion and the conceptual model building work, we propose the following propositions.

The direct impact of big data capabilities on decision-making impact

Proposition 1a: Big data capabilities will positively influence the organizational decision-making speed

Proposition 1b: Big data capabilities will positively influence the organizational problem identification speed

Proposition 1c: Big data capabilities will positively influence the organizational decision-making analysis extent

The impact of decision-making on business value creation

Proposition 2a: Decision-making speed will positively influence the business value created from supplier relations

Proposition 2b: Decision-making speed will positively influence the business value created from customer relations

Proposition 2c: Decision-making speed will positively influence the business value created from production & operations

Proposition 3a: Problem identification speed will positively influence the business value created from supplier relations

Proposition 3b: Problem identification speed will positively influence the business value created from customer relations

Proposition 3c: Problem identification speed will positively influence the business value created from production & operations

Proposition 4a: Decision-making analysis extent will positively influence the business value created from supplier relations

Proposition 4b: Decision-making analysis extent will positively influence the business value created from customer relations

Proposition 4c: Decision-making analysis extent will positively influence the business value created from production & operations

The mediating role of decision making impact between big data capabilities and business value creation

Proposition 5: Decision making impact will play a full mediating role between big data capabilities and business value creation

Conclusion

Big data capabilities can help firms gain business value by analyzing the massive volumes of data in real time. Based on the discussion of the relationships among big data capabilities, decision-making impact, and business value creation, this study proposes a conceptual

modeling and put forward the full mediating role of decision-making impact. As we only offer the propositions and conceptual model, future empirical studies are called to make further investigation.

REFERENCES

Arthur, L. (2013). *Big data marketing: engage your customers more effectively and drive value*. John Wiley & Sons.

Brynjolfsson, E., Hitt, L. M., & Kim, H. H. (2011). Strength in Numbers: How Does Data-Driven Decision making Affect Firm Performance? Available at SSRN 1819486.

Cerchione, R., & Esposito, E. (2016). A systematic review of supply chain knowledge management research: State of the art and research opportunities. *International Journal of Production Economics*, 182, 276-292.

Chen, H., Chiang, R. H., & Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. *MIS Quarterly*, 36(4), 1165-1188.

Chen, D. Q., Preston, D. S., & Swink, M. (2015). How the Use of Big Data Analytics Affects Value Creation in Supply Chain Management. *Journal of Management Information Systems*, 32(4), 4-39.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: what are they?. *Strategic Management Journal*, 1105-1121.

Gandomi, A., & Haider, M. (2015). Beyond the hype: Big data concepts, methods, and analytics. *International Journal of Information Management*, 35(2), 137-144.

Hazen, B. T., Boone, C. A., Ezell, J. D., & Jones-Farmer, L. A. (2014). Data quality for data science, predictive analytics, and big data in supply chain management: An introduction to the problem and suggestions for research and applications. *International Journal of Production Economics*, 154, 72-80.

Hazen, B. T., Skipper, J. B., Boone, C. A., & Hill, R. R. (2016). Back in business: Operations research in support of big data analytics for operations and supply chain management. *Annals of Operations Research*, 1-11.

He, W., Wang, F. K., & Akula, V. (2017). Managing extracted knowledge from big social media data for business decision making. *Journal of Knowledge Management*, 21(2).

Press, G., Top 10 hot big data technologies, Assess on MAR 14, 2016 from <https://www.forbes.com/sites/gilpress/2016/03/14/top-10-hot-big-data-technologies/#39f839a365d7>

LaValle, S., Lesser, E., Shockley, R., Hopkins, M. S., & Kruschwitz, N. (2011). Big data, analytics and the path from insights to value. *MIT Sloan Management Review*, 52(2), 21.

Lee, Y., Madnick, S. E., Wang, R. Y., Wang, F., & Zhang, H. (2014). A Cubic Framework for the Chief Data Officer: Succeeding in a world of big data. *MIS Quarterly Executive*, 13(1), 1-13.

McAfee, A., & Brynjolfsson, E. (2012). Big data: the management revolution. *Harvard Business Review* (90), 60-66, 68, 128.

McClure, C. R. (1978). The information rich employee and information for decision making: Review and comments. *Information Processing & Management*, 14(6), 381-394.

McGlinchey, J. (2013). Putting the right processes in place to benefit from big data. *Computer Weekly*, 14-14.

Provost, F., & Fawcett, T. (2013). Data science and its relationship to big data and data-driven decision making. *Big Data*, 1(1), 51-59.

Rotella, Perry. (2012). Is data the new oil? Forbes.com. Retrieved from <http://www.forbes.com/sites/perryrotella/2012/04/02/is-data-the-new-oil/>, April 2.

Schoenherr, T., & Speier-Pero, C. (2015). Data science, predictive analytics, and big data in supply chain management: Current state and future potential. *Journal of Business Logistics*, 36(1), 120-132.

Schroeck, M., Shockley, R., Smart, J., Romero-Morales, D., & Tufano, P. (2012). Analytics: The real-world use of big data. IBM Global Business Services, 1-20.

Souza, G. C. (2014). Supply chain analytics. *Business Horizons*, 57(5), 595-605.

Tallon, P. P. (2007). A process-oriented perspective on the alignment of information technology and business strategy. *Journal of Management Information Systems*, 24(3), 227-268.

Tanriverdi, H., Rai, A., & Venkatraman, N. (2010). Research commentary-Reframing the dominant quests of information systems strategy research for complex adaptive business systems. *Information Systems Research*, 21(4), 822-834.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 509-533.

Waller, M. A., & Fawcett, S. E. (2013). Data science, predictive analytics, and big data: a revolution that will transform supply chain design and management. *Journal of Business Logistics*, 34(2), 77-84.

Whittington, R. (2014). Information systems strategy and strategy-as-practice: a joint agenda. *The Journal of Strategic Information Systems*, 23(1), 87-91.

Wamba, S. F., Akter, S., Edwards, A., Chopin, G., & Gnanzou, D. (2015). How 'big data' can make big impact: Findings from a systematic review and a longitudinal case study. *International Journal of Production Economics*, 165, 234-246.

Xu, Z., Frankwick, G. L., & Ramirez, E. (2016). Effects of big data analytics and traditional marketing analytics on new product success: A knowledge fusion perspective. *Journal of Business Research*, 69(5), 1562-1566.