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Using Big Data Analytics for Competitive Advantage

Bharat Arora

Research Scholar, Department of Management Studies, Indian Institute of Technology, Roorkee, India

Dr. Zillur Rahman

Faculty, Department of Management Studies, Indian Institute of Technology, Roorkee, India

Abstract:

Big Data provides considerable opportunities to firms to serve customers better in unique ways, and, therefore, achieve sustained profitability. In this paper, we develop a conceptual model on how to use big data to improve business performance. Using resource based view as a theoretical lens to analyze this model, we demonstrate that (1) different sources of data that make up big data can be combined in unique ways to provide competitive advantage, and (2) data scientists specifically and other human IT resources in general can provide strategic advantage to firms.

Keywords: *Information technology, Big data analytics, Resource based view, Business value of IT, Competitive advantage, Business intelligence*

1. Introduction

Investments in information technology (IT) form a substantial portion of capital expenditure of firms [1, 2], and organizations continue to invest in IT in anticipation of benefits like improved productivity, profitability, and market share [3]. Although there is a general agreement among IS and strategy researchers that IT improves productivity [4], they differ on the question whether IT can provide sustained competitive advantage [5]. Some researchers suggest that IT used to provide competitive advantage in earlier days when it was costly and not available to everyone in the industry, however, declining costs of computing, availability of standard software packages (such as Enterprise Resource Planning systems), and proliferation of the Internet has made IT ubiquitous, and, therefore, diminished its strategic value [6, 7].

Proponents of IT argue that although IT has become ubiquitous, it is the way in which IT is used together with other firm resources that provide competitive advantage [8, 9]. This stream of researchers have suggested several ways in which IT can be used together with complementary organizational resources to improve market position [10]. However, there is scarcity of research papers that assess the use of big data for providing competitive advantage. In present paper, we have tried to narrow this gap by developing a conceptual model to explain how Big Data can provide competitive advantage to firms.

Big Data provides considerable opportunities to firms to serve customers better in unique ways, and, therefore, achieve sustained profitability. Big data analytics can be used to improve performance in several domains such as e-commerce, e-governance, science and technology, healthcare, and public safety [11]. For instance, for companies that are in businesses of running museums, theme park, cinema theatres, etc., it will be useful to know whether customers buy tickets in advance or whether they buy tickets when they reach the gate, whether they buy a parking picket during their visit, whether they attend a special attraction or a show during their visit, what kind of food items or other products do they buy, whether they use mobile applications to navigate attractions or benefit from special promotions, and whether they post photographs of their visit on social media web sites [12]. This information that can be provided by big data analytics, can give useful insights into customer behavior and preferences which could be used by firms to market their products and services, and, therefore, enhance revenues and profitability.

Firms continue to invest in big data in order to gain business insights that will assist them in taking decisions to improve business performance. In a survey of 437 global organizations research firm Gartner found that more than 75% firms are either investing or planning to invest in big data in the next two years [13]. A surprising finding of this survey is that several firms (43% of the firms that are planning to invest and 38% of the firms that have already invested) are not sure whether they will be able to derive a positive return from their investments in big data. This shows that many firms are still not sure about how to invest in big data so as to improve business performance. The conceptual model presented in this paper can help firms in this regard.

Rest of this paper is arranged as follows. Section II provides theoretical background of concepts that we use in this paper, section III explains the conceptual model, section IV describes how big data analytics can be used to gain competitive advantage, section V provides summary of this paper, and section VI lists the limitations and provides directions for future research.

2. Theoretical Background

We use resource-based view (RBV) as a theoretical lens to conceptually analyze how big data can provide competitive advantage to firms. According to resource based view, unique firm-specific resources (assets, knowledge, capabilities, and organization processes) that are valuable, rare and difficult to imitate or substitute can provide sustainable competitive advantage [14, 15].

In context of IT, key resources are: (i) the IT infrastructure that includes hardware, software, and communication technologies, (ii) the human IT resources which include the technical and managerial IT skills, and (iii) IT-enabled intangible assets such as knowledge assets. Past research has indicated that superior managerial IT skills are rare and difficult to imitate, and, therefore, can provide sustained competitive advantage [16, 17]. On similar lines, knowledge assets of firms are also considered as unique, valuable, rare, and inimitable and, therefore, can provide long-term profitability [18, 19].

3. Conceptual Model

Big data is a loosely defined term that describes the large volume of data (both structured and unstructured) that is beyond the capacity of commonly used software tools to capture, cleanse, and analyze [20]. Big data is usually characterized by high volume (large amount of data), high velocity (high speed of data creation), and high variety (different types of data) [21]. Fig. 1 illustrates the conceptual model that we propose to demonstrate how big data can provide competitive advantage. As illustrated in fig. 1, big data comprises of several data sources such as data from sensors, transaction data specific to the firm, data from social media websites, and data from several other sources such as weather related data. We discuss these in brief.

- Data from sensors: Installing sensors in the products and continuously monitoring and analyzing data from these sensors can provide several benefits to firms. For instance, in power turbine business, General Electric (GE) uses data from sensors to proactively deploy a technician ahead of a machine failure. Reducing downtime by proactive monitoring of data from sensors enables GE to charge \$500 to \$600 per hour for a technician in an industry where competitors are not able to charge more than \$90 to \$110 for same technician [3].
- Transaction data: This is primarily the data that a firm captures through its routine transactions with customers and suppliers. Examples of transaction data include point of sales data, invoices, purchase orders, etc. Traditionally, firms have used this data to get insights into customer purchase behavior [21].
- Data from social media: This is the data that can be captured through social media sites such as Facebook. The challenge while analyzing this data is that a lot of it is unstructured data. However, if firms can develop mechanisms to capture and analyze this data, it can help a lot to boost sales. For instance, if a person posts on a social media web site about his/her intention to visit a tourist place in forthcoming holidays, this data can be utilized by firms to sell travel related products such as hotel stay, air tickets, etc.
- Data from other sources: This includes data from other sources such as weather related data, GPS signals from mobile phones, etc. Firms can use this data in innovative ways to boost sales. For example, location specific data from mobile phones can indicate how many people are there in a party (or any other event), and this data can be used by a cab service company to proactively make its cars available for hire.

As shown in fig. 1, firms need relevant software tools and data scientists (IT human resources) to analyze big data in order to generate valuable information that can be used by decision makers to make appropriate business decisions so as to gain competitive advantage.

4. Competitive Advantage from Big Data

We now analyze the components of big data analytics that can provide competitive advantage to a firm. According to resource based view, unique firm specific resources that are rare, valuable, inimitable, and cannot be easily substituted can provide sustainable competitive advantage. Data from social media web sites, and from sources such as weather data and GPS signals from mobile phones can potentially be available to all firms, and therefore, cannot provide competitive advantage. Similarly, there are standard software and hardware available to capture transaction data. Thus, on standalone basis, none of these data can provide competitive advantage.

However, if these individual data sources can be combined in ways that are aligned with firm strategy, competitors will find it difficult to imitate. For example, a retailer can use location specific data from customer's mobile phone, weather related data of that specific location, and data on previous purchase behavior from its internal database to offer products that are available at its store at that location. By combining data from different sources, and using it in conjunction with other complementary assets, the retailer can gain competitive advantage because competitors will find it hard to understand and imitate this combination of resources.

Software tools that are needed to analyze big data can be acquired by any firm, and, therefore, cannot be a source of competitive advantage. For instance, web analytic tools such as Google Analytics that can provide data on click-stream and online shopping pattern of users [11] can be purchased by any firm that is financially capable of buying it. However, data scientists needed to conduct big data analysis are difficult to imitate and, therefore, can provide competitive edge. Past research also suggests that human IT resources are difficult to acquire and imitate and, therefore, can provide competitive advantage [17, 14]. Further, over a period of time, these data scientists develop a good working relationship (trust and mutual understanding) with other IT and business partners [16]. Due to social complexity, competitors find this working relationship hard to imitate. Thus, due to its potential in providing competitive advantage, firms should give high attention towards hiring, training, and retaining these data scientists and other human IT resources.

5. Summary

Big data analytics has potential to provide competitive advantage to firms. Data driven firms perform better than competitors in terms of productivity as well as profitability [21]. In this paper, we developed a conceptual model that explains how to use big data to improve business performance. We then discussed different constructs used in this model and identified the constructs that can provide competitive advantage. Using resource based view as a theoretical lens to analyze this model, we demonstrated that (1) although individual sources of data that form big data cannot provide competitive advantage, these can be used jointly in conjunction with other complementary organization assets to gain competitive advantage, (2) data scientists specifically, and other human IT resources in general can provide strategic advantage to firms.

6. Limitations and Directions for Future Research

While developing and analyzing our conceptual model, we supported our arguments using past literature from strategy and information systems domain. However, to test the robustness of any model, it should be empirically tested under different circumstances. Future research should attempt to test this model empirically.

Another important area where more research is required is related to protection of customer's data. With advances in technology, companies now have access to much more data about users, such as the websites that they visit, their shopping preferences, information about their family and finances, etc. If this information goes in wrong hands, it can compromise the privacy of customers and will eventually tarnish the image of the company involved. Firms should therefore give special attention to safeguard the data that they collect from different sources. However, research in this field is still lacking. Future research should try to find different ways and means by which firms can protect their data at reasonable cost.

7. References

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Annexure

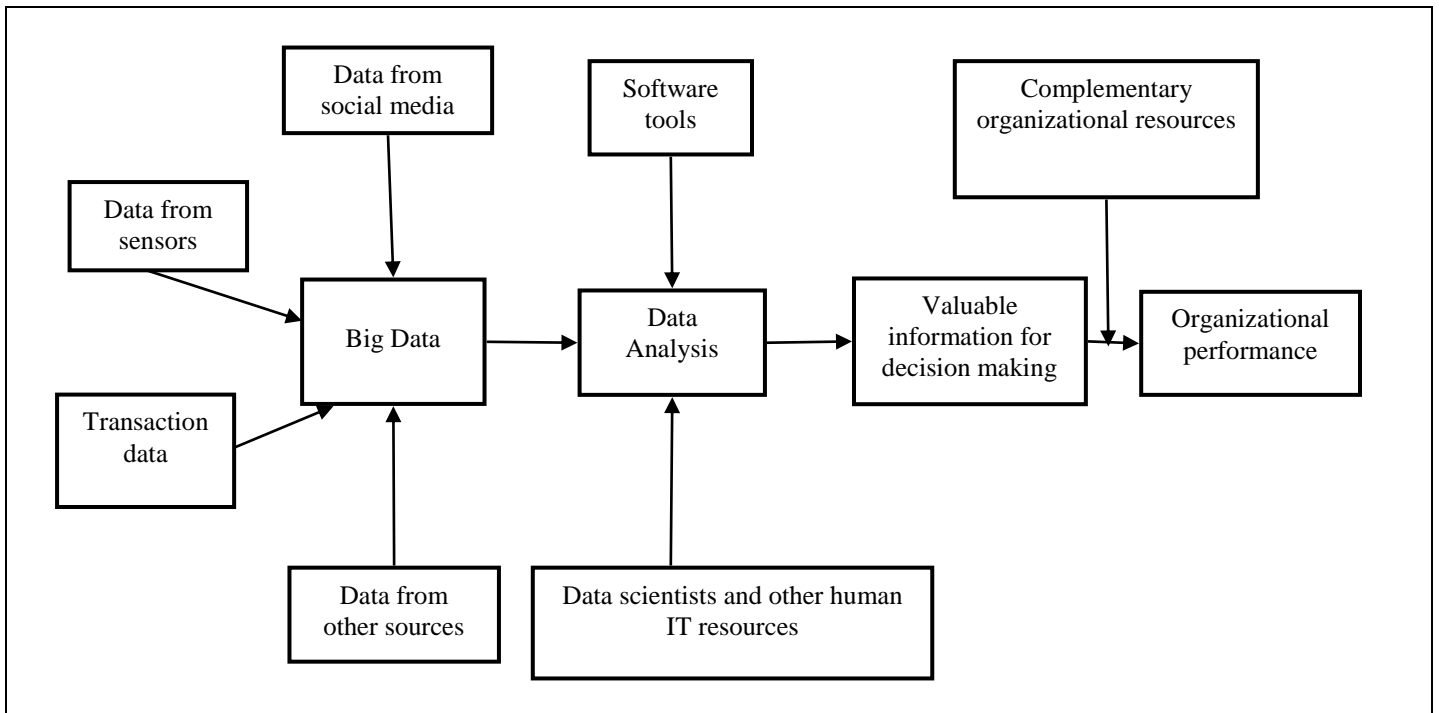


Figure 1: Conceptual model for using Big Data Analytics to improve organizational performance