
Big data and global markets: Using external data resources to influence decision making

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Abstract

The availability of “Big Data” has given rise to the examination of the use of data in support of organizational decision making. Managers are leveraging the power of analytics to support operations to gain a strategic competitive advantage. Since Big Data is recently being explored, there is little research on what data resources organizations should utilize external to their organizational environment. This paper analyzes different literature, identifies and compiles a list of external sources of data for organizations to utilize. From this analysis, a conceptual framework was developed to understand the data processes involved to give organizations fundamental groundwork to consider external data. The framework - provides decision makers with important external factors they will need to consider in their decision making in order to gain a competitive advantage to compete in a global market.

Keywords: *big data, external data, decision-making, competitive advantage*

Big Data and Global Markets: Using External Data Resources to Influence Strategic Decision Making

Big Data is a new research discipline that is evolving and being established. The emergence of Big Data is a catalyst for disruptive change and enables organizations to uncover unforeseen patterns (Xie, Wu, Xiao, & Hu, 2016, p. 1034). A review of the literature was conducted in order to establish the concepts of decision-making, as well as how technology has developed and how it can be utilized in the process. A conceptual framework grounded on the literature was drawn in order to summarize relevant concepts. A systematic review was then performed with the aim of identifying these external resources and further to develop a process which is beneficial to organizational leadership when considering the application of external data to their strategic decision making. A common lacking feature in existing literature is that none of them identifies the external resources available to organizational leaders, yet these data sources can profoundly impact the way global organizations make decisions in order to gain a competitive advantage. The research question to be answered is: What big data sources, external to the organization, impact the decision-making process in order to gain a competitive advantage in the global markets? Big data has the potential to transform the decision-making process and this paper plays a role in conceptualizing the decision-making process using external data.

Literature Review

Strategic decision-making is the foundation of what organizational leaders do. Barnard (1938) presents the concept of prioritizing decision making as a core of the executive function and states, "The fine art of executive decision consists in not deciding questions that are not now pertinent, in not deciding prematurely, in not making decision that cannot be made effective, and in not making decisions that others should make." (p. 194). Herbert Simon builds upon this concept with the bounded rationality of decision making. Simon (1957) stated:

... capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems whose solution is required for objectively rational behavior in the real world — or even for a reasonable approximation to such objective rationality (p. 198).

Simon notes that solving complex issues based on making decisions, is a large task for the human mind yet this is the scope of organizational leaders' function within an organization. Therefore, utilizing other resources to aid in the decision-making process is a fundamental part of the process for efficiency and precision.

There are multiple ways in which decision-makers arrive at their decisions. With the advancing of technology, the application of these tools is providing the much needed resources for decision makers in order to improve the process. Simon (1987) explains that there is both intuition and analytical processes that complement each other in effective decision making. Intuition is based on judgement and experience with "no awareness of how the judgement is evoked" (Simon, 1987, p. 59). The experienced manager has a large amount of knowledge gained and organized in terms of recognizable chunks and associated information (Simon, 1987, p. 61). It is these recognizable patterns that technology can recognize in order to aid in the decision-making process. Simon (1987) states, "Increasingly, we will see decision aids for managers that will be highly interactive with both knowledge and intelligence being shared between the human and the automated components of the system" (p. 61). Simon expresses that more needs to be explored on how to improve the decision-making process by imputing data into systems of technology that will guide leaders of organizations. In order to make strategic decisions: managers need to analyze problems systematically with the aid of modern analytical tools, have a command of the whole range of skills and apply them when appropriate (Simon, 1987, p. 63).

Apart from making decisions, leaders must also be able to formulate plans into effect in order to produce the desired outcomes from the decision being made. Cyert and March present the behavioral theory of organizations and provide mechanisms for making and implementing decisions. They say, "in order to understand contemporary economic decision making, we need to study; the development of goals, the formation of expectations, and the execution of choices." (Cyert & March, 1963, p. 1). Their aim is to bridge behavior of the firm with economics which is important in a global environment. Cyert and March (1963) indicate that one must consider the cognitive limits of humans together with uncertainty and that decision making involves different people at different levels (p. 3). This

theory of thought guides leaders in the implementation process by constructing three simple components of focus in order to put the decision into action.

Vroom (2000) builds upon this work by introducing a contingency framework to situational leadership that is a model created to help leaders identify leadership styles to adapt based on a given situation. Vroom believes that managers behave situationally and adapt to the situations they face (Vroom, 2000, p. 92). He focuses on the participation of teams within organizations. Vroom (2000) outlines four things that impact the increase of higher involvement of teams in organizations. These include: 1. External environments with greater change and more complexity. 2. A greater span of control which results in difficulties with hierarchical control. 3. The growth of information technology making it easier to get information and 4. The changing nature of labor forces such as higher education and increased need for independence (p. 92). These factors are important to organizations when faced with questions of strategic decision making.

Allen Newell formed a partnership with Simon and together they developed the 'thinkable machine' also known as Artificial Intelligence (AI). This was to simulate human processes by using computers to aid in the decision-making process and to perform problem-solving tasks (Newell & Simon, 1976, p.113). It was the introduction of technology that changed the way decisions were made. Human cognition can be described in terms of a symbol system, and they have developed detailed theories for human problem solving, verbal learning and inductive behavior in a number of task domains, using computer programs embodying these theories to simulate the human behavior (Newell & Simon, 1976, p. 114).

A shift occurred due to the emergence of the World Wide Web. Effective decisions are dependent on the accessibility of real-time and reliable information (Leidner & Elam, 1995, p. 645). Decision making was then incorporating technology and data into making better-informed decisions. However, it is important that leaders focus on reliable data to come up with accurate decisions and to minimize the complexity of the decision-making process (Tank, 2015, p. 43). There is a rapid adoption of organizations using data in their decision-making process. Recently, this has turned into the concept of "Big Data" due to the volume and complexity of the data.

Based on the literature, the term Big Data has evolved over the years. Mihai (2015) explains that companies acting at a global level are processing big data which is defined as the 3 Vs: volume, velocity, and variety. These characteristics are an innovative form of information processing for enhanced insight and decision-making (Mihai, 2015, p. 153). In the more recent literature, Sivarajah, Kamal, Irani, and Weerakkody (2017) identify seven characteristics of Big Data adding 4Vs which are: value, veracity, variability, and visualization (p. 265).

Technology has been a source of competition for years and now, Big Data is changing the way in which businesses must compete. In a competitive global business market, organizations must adapt to the constantly changing environment. Big Data offers these opportunities of identifying hidden patterns, better decision making, improving business processes and developing new business models (Halaweh, & El Massry, 2015, p. 24). However, the concept of more data does not always lead to better decisions and strategies. Improving tools and data provide part of the picture of how businesses can use the systems in practice and the complementary resources needed to exploit them (Gillon, Aral, Lin, Mithas, & Zozulia, 2014, p. p. 291).

There is a wide range of factors that influence decision-making and this makes the process complex and hard to manage. In situations where several influences are involved, it is hard for leaders to oversee the entire process from setting goals and expectations to implementation and execution once a decision is made. Organizations can utilize technology as a tool in order to be more effective in their strategic decision-making. This is where data adds value in order to create actionable decisions that can be measured and refined. Big Data offers businesses the possibility of obtaining unparalleled insights into customers' needs and competitors' strategies. It also transforms the way in which businesses are run, with hard data rather than intuition-driving decisions (Kimble & Milolidakis, 2015, p. 31). This review of the literature lays a foundation of why many organizational leaders should explore the value of utilizing technology and Big Data to aid in the strategic decision-making process. This concept will be expanded upon for practitioners to gain a deeper understanding of the impact external data sources can have on the success of the organization.

Conceptual Framework

Due to competition, Big Data is what global organizations should utilize in order to gain a competitive advantage. To understand the impact it can have, one must gain a grasp on the concept of Big Data. Big Data can be defined using the 3 Vs; Volume, Variety, and Velocity. A chart with the literature definitions can be seen in Appendix 3. To understand these characteristics in greater detail, Stoicescu (2016) defines them as: Volume- a large quantity of data, Variety- multiple types of data, Velocity- the speed in which the data is changing (p. 33). It is important to understand the context of Big Data in order for leaders of organizations to create actionable insights with measurable outcomes to make the most effective use of Big Data as a tool.

To get to this point of incorporating data into the decision-making process, the literature was assessed based on the main concepts they presented in order to develop a conceptual framework. Vroom (2000) presents his developing concept of situational leadership, that decision-makers must be adaptable based on the situation at hand. The situation is always changing, and therefore the decision-maker must be adaptable (p. 86). Additionally, Cyert and March (1963) consider three things when looking at decision making “the development of goals, the formation of expectations, and the execution of choices” (p. 1). These three components are a part of the decision-makers responsibility when assessing a situation in order to make a decision. These concepts are visually addressed in Figure 1 below.

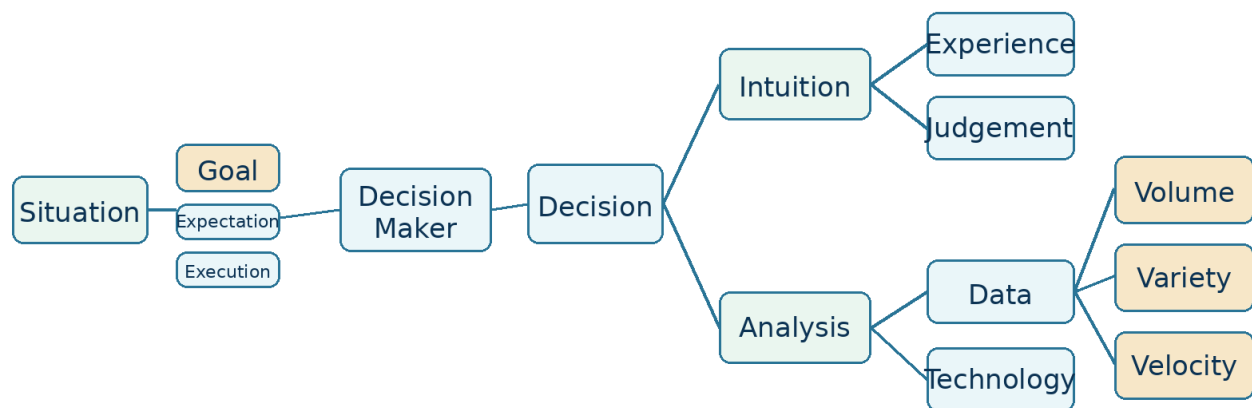


Figure 1. *Incorporating Big Data in the Decision-Making Process*

After considering the situation, the decision maker makes a decision based on intuition or analytical processes as pointed out in concepts presented by Simon. Intuition is based on experience and judgement, whereas the analytical process depends on data and technology (Simon, 1987). Technology has developed in aiding decision-makers in their process, however, this is limited based on inputs of data. Data is now a focus for organizations to utilize in order to gain a competitive advantage. This research paper focuses on this conceptual framework, the paper will urge organizations to gain a deeper understanding of the value of using data.

Claim

The purpose of this research is to identify external data opportunities that organizations can use in the decision-making processes when competing in the global market. By identifying opportunities to use Big Data from external environments, organizations will make better strategic decisions and gain a competitive advantage in the global market.

Methods

Two phases were adopted in this methodological approach. First, a literature review was performed in order to understand the foundation of incorporating Big Data into decision-making and to develop a conceptual framework that portrays the effect that technology is having on the decision-making process. The second phase consists of a systematic review process which was selected from the methods that apply in order to be transparent and rigorous in

the process of research. Gough, Oliver, and Thomas (2012) identify three key components, these are: describing the relevant research, critically appraising the research in a systematic manner, and bringing the findings together into a coherent statement by creating something new from different elements (p. 5).

In order to process the articles systematically, the following boundaries were developed based on the resources available:

- Geographical Context: Only articles written in the English language were included due to time and limited resources.
- Timeframe: Any date. However, due to the relatively new topic of Big Data, articles were only found starting from 2010 to current.
- Search Limitations: UMUC one search, full text, and scholarly peer-reviewed journals.
- Search Terms: ("Big Data") AND (competitive) AND (decision). These are the 3 main components of the research question and therefore, they are the most important aspects to include in the search terms.

A thematic analysis was executed to gain insight and knowledge from the articles. This was applied to move from a broad reading of the data towards discovering patterns in the literature that attempt to answer the research question. Coding with themes helps to identify the common priorities and provide focus to the process of analyzing qualitative data (Vaughn, & Turner, 2016, p. 50). The line by line approach to coding, to reveal a deeper meaning of the concepts which include: Data into Knowledge, Actionable Decision Making, External Resources, Benchmarking, Asking the Right Questions, Infrastructure and Privacy & Security was used.

Results

The search concluded 62 results. Removed from the search results were duplicates, reports, and conferences which left 51 articles. The articles titles and abstracts were reviewed for key indicators of the three main components based on the claim which are Big Data, competitive advantage, and decision making. This narrowed the results to 22 articles. The full text of the 22 articles was then evaluated to see if they applied to the research by including external data resources and if the application could be applied globally. The key indicators for the global aspects looked for aspects such as economics, transnational organizations, distribution, selling techniques, and if culture was explained. However, the articles were not so specific that they could not be generalizable for the general application of identifying external data sources. A PRISMA diagram represented in Appendix 1 outlines the narrowing of the final 16 results after the full text was evaluated. The excluded articles can also be seen in Appendix 2 with the detailed reasoning for the exclusions.

Findings

The findings of the research are presented in different subcategories. These present the key insights from the thematic analysis.

Data into Knowledge

An organization must have tools to convert data into improved decision making. This takes knowledge. Pigni, Piccoli, and Watson (2016) defines knowledge as the capacity to recognize what information would be useful for making decisions and can interpret information and use it in decision making. This developed the notion that data must be converted into knowledge based on information to be used in decision making (p. 20). Big Data requires analysis tools to explore the information for the purpose of obtaining useful knowledge (Mihai, 2015, p. 153). From this theoretical concept based on the literature, an input-process-output model was developed for this research as, Data-Information-Knowledge. This means that organizations must have the data, process it into information, and apply knowledge to the strategic decision making.

Actionable Decision-Making

To take this a step further, Sivarajah et al (2016), claims that Big Data is a source that when appropriately managed, processed, and analyzed, can generate new knowledge, thus

proposing innovative and actionable insights (p. 264). Moraru (2015) agrees with this line of thinking, stating that companies that convert information into actionable intelligence will end up winning among competitors (p. 111). Organizations that want to succeed must measure some type of performance based on carefully selected metrics. Leading organizations use these analytical processes to develop new meaningful metrics (Sanders, 2016, p. 39). The visual representation in Figure 2 shows the single loop process that provides the findings presented in an easy-to-comprehend format.

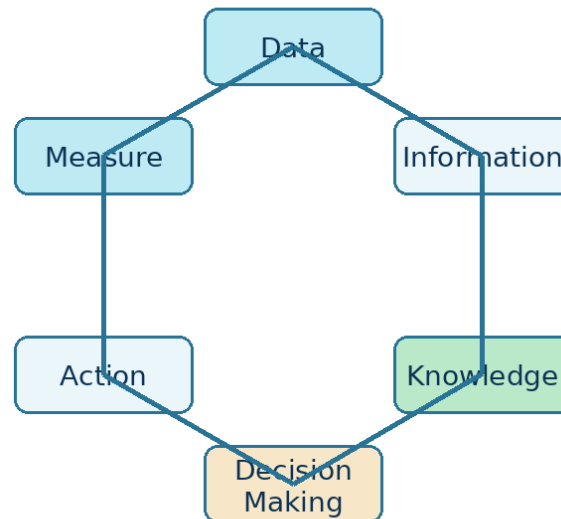


Figure 2. *Data Process*

External Resources

The external sources were identified and a full chart of the resources can be seen in Appendix 4. This data is analyzed and categorized into eight categories as seen in Figure 3:



Figure 3. *External Sources Categories*

1. Competitor- 25% of the articles suggested taking a look at competitor data. This type of information is becoming more readily available and accepted through application programming interfaces (APIs) (Kimble & Milolidakis, 2015, p. 26).
2. Market- this includes many aspects of the market such as information, pricing, condition, and trends that will allow organizations to jump into new business opportunities (Halaweh, & El Massry, 2015, p. 24).
3. Supply chain- logistics applications move goods through the supply chain, generating huge amounts of data such as; distribution centers, supply routes, minimizing transportation costs etc, that organizations can turn into intelligence through analytics. This data can segment suppliers based on characteristics that help with sourcing strategy and balancing cost versus risk (Sanders, 2016 pp. 27; 31-32).
4. Customer- 50% of the articles evaluated brought up customers as data to be considered. From this, two ways that customers can be used are identified, these are; 1. Unknowingly or 2. Knowingly as a resource, building a complete image of what consumers buy or an understanding why they buy a certain product (Stoicescu, 2016, p. 39). Most of this data is collected unknowingly based on consumer behavioral data. Xie et al., (2016) point out that customers can be active participants. When customers play the intermediary role for transferring data, this

generates trans-boundary Big Data. Trans-boundary Big Data refers to data generated by customers who share different service ecosystems and facilitate the export and import of knowledge across different ecosystem boundaries (p. 1040).

5. Media- this includes “social media sites, such as Facebook, You-Tube, and Twitter, which business fail to use effectively, the media holds a special promise in this respect. Firms are using social media to interact with their customers and to build their brand identity as well as to monitor their rivals (Kimble, & Milolidakis, 2015, p. 23).
6. Public- Examples of this include: weather data, governmental data such as the census, and any other forms of public records. There are also organizations that aggregate data generated through governmental data and make it available through APIs to the public. The value proposition of these aggregators is to link disparate data streams and to make useful to moderate strategic risks (Pigni, et al., 2016, p. 16)
7. Third party- Sanders (2016) states “the idea here is that it may be possible to gain a competitive advantage by partnering with those outside of one’s industry” (p. 44)
8. Technology- due to rapid technology development everyone has virtually the same access to information, making it relatively inexpensive and easy to obtain (Moraru, 2015, p. 114). Technology based data includes data collected from technology such as point of sale (POS), Global Positioning System (GPS), and Radio Frequency Identification (RFID) (Sanders, 2016 p. 27). An example of this would be the data that a phone app such as Google maps collects to track traffic patterns.

Benchmarking

Knowing the competition and understanding what they do in the market is an important ability for organizations. Learning from the success and failures of these competitors can be an efficient way to process information. Competitive benchmarking is a practice used by organizations to compare their activities with the competitors and learn from others to act properly (Moraru, 2015, p. 115). Ketter, Peters, Collins, and Gupta (2015) explain that

“[A] research method [...] helps interdisciplinary research communities tackle complex challenges of societal scale by using different types of data from a variety of sources such as usage data from customers, production patterns from producers, public policy and regulatory constraints etc. for a given instantiation (p. 1067). Learning from the experience of others as well as best practices allows for a transfer of knowledge that is based on evidence rather than on assumptions and can be background information for managers during the decision-making process. An example would be measuring the process performances of an airline company related to others, with the opportunity to improve one’s processes in accordance to the best practices available at the moment (Mihai, 2015, p. 156).

Asking the Right Questions

The conversion of data into knowledge starts with the right person asking the right questions. An organizational ability to transform resources to improve business strategies represents a dynamic capability that enables firms to quickly adapt to fluctuating environments (Xie et al., 2016 p. 1042). Good data and tools alone will not guarantee that managers reach better decisions. First, one must pose good questions and interpret the outputs of data analysis with their deep domain of knowledge and judgment, which often comes with years of experience (Gillon et al., 2014, p. 293). It is important that leaders formulate the right questions to be asked in order to make the best use of the data that is available. Often times, those with the domain knowledge and technical experts that know how to apply technical skills to make a list of important research questions (Ketter et al., 2015, p. 1070). Technology is now able to ask questions too through algorithms that can detect relationships between variables. The computer is able to ask interesting questions and refine them without active human intervention. They have become active participants in the inquiry process and are becoming capable of creating new knowledge and making discoveries on its own (Sanders, 2016 p. 28).

Infrastructure

Organizations must have the tools capable of finding answers, and these are referred to as the infrastructure. They might have to develop a customized infrastructure enabling them to take advantage of Big Data (Janssen, van der

Voort, & Wahyudi, 2017, p. 339). Infrastructure tools have the capacity to store and process the data. For example, the Cloud is an infrastructure that provides low-cost solutions for dynamic storage and processing. “The raw data generated by the sources are stored in various servers and may also be possibly replicated for ensuring high robustness and increased availability of the system” (Biswas, & Sen, 2017, p. 13). Infrastructure supports the technology and data aspect, and it is important that organizations prioritize their infrastructure as part of the information process.

Security & Privacy

Although Big Data has potential, the literature outlines a major limitation that arises on a global level. Big data on a global level raises the concern of security and privacy on multiple levels. This includes regulations that govern individuals’ privacy and the organizational need to maintain security to protect their data against attacks (Halaweh, & El Massry, 2015, p. 29). Data can be manipulated and this is a significant privacy concern based on ill intention or inadvertent misuse of data by organizations. Gillon et al., (2014) point out:

...to the extent that laws and governance processes are often found lagging or lacking sufficient protection, there is a role for practitioners and academics to come together to inform public discourse in this area. They should also craft prudent policies that protect individual privacy while fostering innovation (p. 293).

Data is often collected without the knowledge of the individual. This could mean anything from phone logs, to GPS tracking, to purchasing records and any type of insight into personal behavior. Hence, it is clear that Big Data may pose a direct threat to individuals’ privacy and security (Halaweh, & El Massry, 2015, p. 27).

Competitive Advantage

According to Sivarajah et al., (2017) research shows the substantial value and competitive advantages that can be attained when organizational strategies involve effective decisions based on data (p. 265). This process has developed a wide range of activities that organizational leaders undertake to understand their internal and external environment (Kimble, & Milolidakis, 2015, p. 23). Sanders (2016) states that the academic sector is looking to Big Data to better understand the world and businesses are looking for a technology-based competitive advantage (p. 26). Using Big Data correctly can be a key to organizations asserting themselves in a global crowded market. Using information generated by Big Data will adjust the business strategy of a company, helping it to make informed decisions in order to survive in the unpredictable economic environment (Stoicescu, 2016, p. 37).

Discussion

The processing of Big Data has recently been sought out by organizations to create value for their organization. Due to the advancement of technology, the decision-making process has changed to include data and Big Data processing capabilities have increased, leading to more informed decisions. However, not all organizations know where to source this information and how to process the data if they obtain it and this process can be very overwhelming. The models developed within this research will help managers and organizations understand where to gather data external to the organization, and how to process the data gathered in order to answer the research question.

It is important that organizations look outside themselves for information that will help them gain a competitive advantage. Evaluating these external sources identified in the findings, for data, is extremely important to organizations that are looking to compete on a global scale. The Internet has intensified the market competition globally and increased the ability for firms to maintain strategic competitive advantages. Using Big Data in the right context, with the right tools and knowledge will help inform decisions and reveal new opportunities.

Taking a look at the findings, Figures 3 and 4 were combined to form Figure 5 in order to give a visual model that is valuable in answering the research question presented. This is what Gough et al., (2012) indicates as the third part of the systematic review process by bringing the findings together into a coherent statement, thus building a model, by creating something new from different elements (p. 5). This model was constructed to make sense of the findings and to create a visual model that represents the processes that are easy for leaders to follow. The outer circle of Figure 4 represents the 8 categories of sources to gather external data. The arrow between the outer ring and the second ring represents this flow of external sources of data into the process model through the data step.

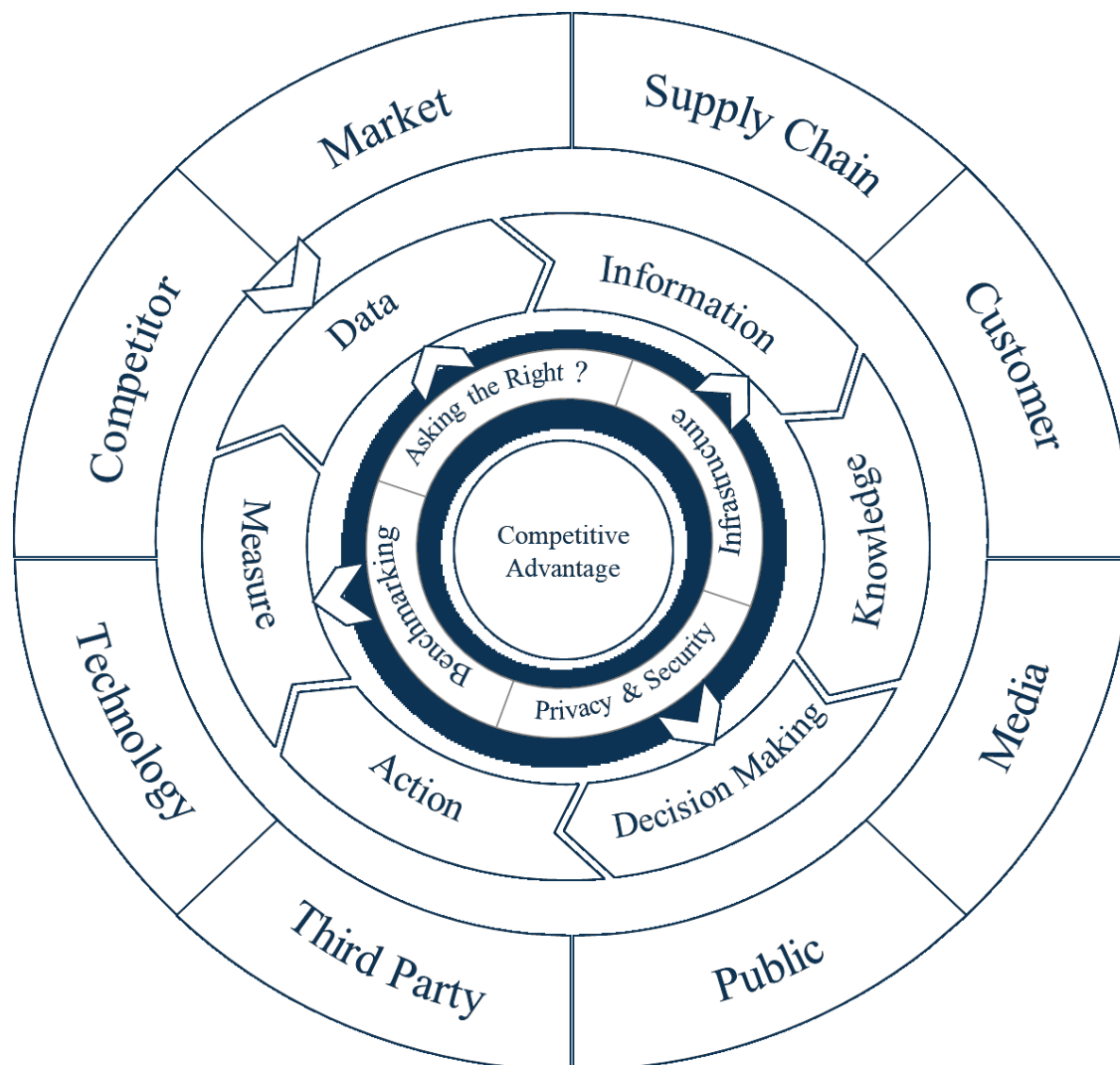


Figure 4. *Model of Findings*

The findings indicate that data requires a transformation in order to be of value to organizations. This is done through the data process model flow which shows a single loop process that is represented with the chevron-arrow circular loop in the second level. This indicates the continuous pattern of processing data to further guide the analytics efforts. As pointed out in the findings, data must be processed into knowledge for the strategic decision-making process. This is then put into action based on measurable outcomes that can be put back into the data process to understand the effectiveness. If that new input of data corresponds to the

objectives of the organization, then they should receive positive feedback in their data metrics. However, organizations need to constantly analyze the new data in order to adapt their business strategy. The third circle from the outside with the four arrows pointing towards the data processes loop represents components of processing the data to turn it into knowledge that is useful in decision-making and that can be measured. As with all research, processing the data starts with asking the right question. In order to support the data received from asking the right question, having the right infrastructure in place supports the conversion of data into knowledge. This leads into privacy and security of the information which is important to consider when making decisions. The last component is the benchmarking. This can be seen as a comparison of activities with those of the competitors (Moraru, 2015, p. 115). This would be one important aspect of the measurement processes.

The final “bullseye” of the model represents what every organization is aiming to gain based on their efforts, which is a competitive advantage. The findings provided insight into how organizations can harness external data and process it to optimize their chances of gaining a competitive advantage. It raises the issue of Big Data application in multiple areas, including supporting decisions and the improved efficiency of the whole decision-making process.

Thus, to excavate the external environment, evaluating things such as customer data and analyzing potential demand ahead of the competition, are fundamental requirements for firms in the fiercely competitive global market (Xie et al., 2016 p. 1036).

This answers the question: What Big Data sources, external to the organization, impact the decision-making process in order to gain a competitive advantage in the global market? in three steps. First, it shows what sources of external data can be useful to organizations that compete in a global marketplace. Secondly, the findings show the decision-making process which organizational leaders must go through in order to incorporate Big Data into the organization. Lastly, it outlines the value that the utilization of Big Data can have in gaining competitive advantage.

Limitations

First, it is important to address that there are limitations to Big Data. Some of these limitations are a function of the characteristics of Big Data and some come through the analysis methods and models of the data processing systems that organizations implement. For example, it is easy to manipulate. Also, major privacy concerns arise among people, such as consumers, regarding protection from misuse. From the research, it is understood that the use of Big Data by organizations does not guarantee better decisions by management. There are also limitations of Big Data as a whole and once practitioners understand these limitations, they can better understand how to implement these into the decision-making process. While the search included a number of academic journals, the search was limited to one search function, and therefore, was not exhaustive. Also, the analysis of the literature is based on a subjective interpretation of the research presented.

Implications for Management

This study offers useful insights into Big Data and how it is defined and conceptualized transitioning from the Industrial Revolution to the digital era of global competitors. The prime emphasis is on data that is external to the organizations, with analytical analysis of studies with a derived conceptual framework from the literature that is useful for management. Due to the

emerging nature of Big Data, there is a need to understand how it can impact the strategic organizational decision-making processes. Decision-making based on Big Data means that organizations have to understand the context, in order to have the understanding to make it useful for decision-making. This requires an overview of external data sources and how they are collective in understanding this context.

The models created in this research presents a way through which management can understand this context by processing data that is external to their organization. First, managers must look for opportunities of data that could be beneficial and that which is external to the organization. Second, management must follow the data process model of turning data into knowledge and making decisions that are actionable based on the knowledge that can be measured. Lastly, organizations must apply the framework, constantly refining the processes to gain a competitive advantage in order to compete in a global market.

These models present a starting point for organizations when considering external data. The results presented show that if Big Data is used correctly, a competitive advantage can be gained. This paper extends research literature by analyzing the key trends of external data in the research related to decision-making, to address the fierce competition in a global setting. It provides practitioners the guidance to align their organization, with data sets existing outside of the organization, that would be most beneficial to their firm in gaining competitive advantages.

Conclusion

Organizations are interested in Big Data to gain competitive advantage. Today, one way through which organizations gain a competitive advantage is by working with Big Data for extraction of useful information that can support managers in decision making (Biswas, & Sen, 2017, p. 1). Big Data technology seeks to integrate disparate data, turning it into information and delivering it to the decision-maker to process. These processing capabilities help firms to act on the Big Data, transforming decision-making from reactive to proactive and optimizes the phases of exploration, development, and production (Baaziz, & Quoniam, 2013, p. 19). As capabilities become highly sophisticated and the amount of data continues to increase, the opportunities for generating value and competitive

advantage will grow (Gillon et al., 2014, p. 290). A proper approach to using Big Data to turn information into knowledge will be key to global organizations asserting themselves in the crowding markets.

Big Data has far-reaching implications for organizations and is recognized as a new form of capital for organizations. The more the research on Big Data, the greater the insights on decision making will be gained. Based on the research findings, there is much primary research to be developed in the field of Big Data and external environments. The review of the selected articles reveals that the opportunity exists, to strengthen the available quantitative data. It would be valuable to expand the scope of the subject area, in identifying other external data opportunities that exist for organizations to explore. Further research in this area would provide a valuable platform for the practitioners of organizations interested in using Big Data to gain a competitive advantage.

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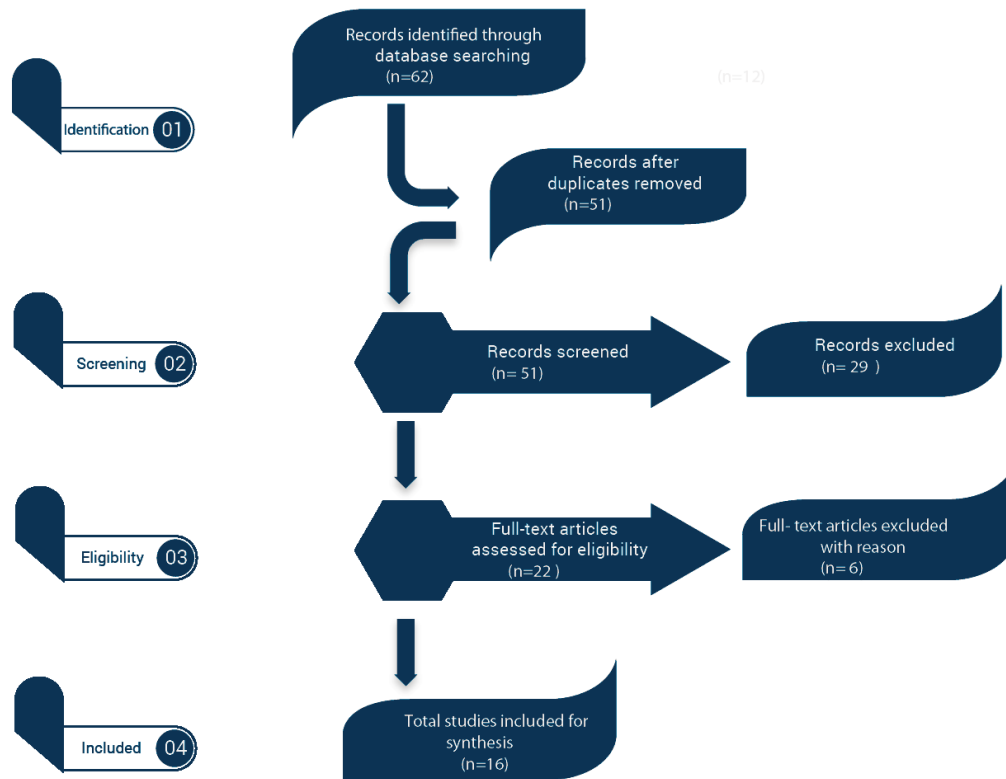
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** indicates references used in the literature review but they are not part of the systematic review*

Appendix 1

PRISMA Diagram

PRISMA 2009 Flow Diagram



Appendix 2

Excluded SR Articles with Reasons

Reason for exclusion	Reference
Based on synthetic data sets not applicable to all	Cao, N. (2015). Trustworthy answers for top-k queries on uncertain Big Data in decision making. <i>Information Sciences</i> , 318, 73-90. doi:10.1016/j.ins.2014.08.065
Focus is too narrow as it is based specifically on the volume of data	Dinu, B., & Iovan, S. (2014). Harnessing Big Data volumes. <i>Fiability & Durability</i> , (1), 250-256.
Lacks evidence and does not meet quality assessment standards	Sprongl, P. (2013). Gaining competitive advantage through business analytics. <i>Acta Universitatis Agriculturae Et Silviculturae Mendelianae Brunensis</i> , Vol 61, Iss 7, Pp 2779-2785 (2013), (7), 2779. doi:10.11118/actaun201361072779
Limited based on IT&C infrastructure in Romania. Not generalizable.	Valerica, M., & Daniel, M. M. (2010). IT&C policies and strategies of the modern Romanian society. <i>Annals of The University of Oradea, Economic Science Series</i> , 19(1), 821-826.
Focuses on key business areas that are not external to the organization	Vidgen, R., Shaw, S., & Grant, D. B. (2017). Decision Support: Management challenges in creating value from business analytics. <i>European Journal of Operational Research</i> , 261626-639. doi:10.1016/j.ejor.2017.02.023
No Big Data component and only focuses on decision making	Vizgaitytė, G., & Skyrius, R. (2012). Business intelligence in the process of decision making: Changes and trends. <i>Ekonomika / Economics</i> , 91(3), 147-157.

Exclusion Based on Quality and Relevance Review

Appendix 3

The Definition of Big Data

	V's	Big Data Definition
Baaziz & Quoniam, L. (2013)	5v's: Volume + Velocity + Variety + Value + Veracity	By combining the three definitions, we obtain a more complete definition called "5V": Volume, Velocity, Variety, Value and Veracity. (p. 20)
Chluski & Ziora (2015)	4v's: Volume + Variety+ Velocity + Veracity	• "Volume – large amounts of data. • Variety – the data comes in different forms, including traditional databases, images, documents, and complex records. • Velocity – the content of the data is constantly changing, through the absorption of complementary data collections, through the introduction of previously archived data or legacy collections, and from streamed data arriving from multiple sources" • Veracity – "the massive amounts of data collected for Big Data purposes can lead to statistical errors and misinterpretation of the collected information. Purity of the information is critical for value" (p. 11).
Halaweh & El Massry (2015)	3v's: Volume + Velocity + Variety	The definition refers to the 3Vs (volume, velocity and variety) which are the three-dimensional characteristics of Big Data. (p. 22)
Janssen, van der Voor, & Wahyudi (2017)	6v's: Volume + Velocity + Variety + Value + Variability + Veracity	Commonly characterized with three or more Vs: Volume, Velocity, Variety. Add three other Vs to this list; Value, Variability and Veracity. (p. 339)
Kimble,, & Milolidakis (2015)	3v's: Volume + Velocity + Variety	"Three Vs"—volume, velocity, and variety—describing the changes related to the growth of e-commerce showing why. (p. 25)
Mihai (2015)	4v's: Volume + Velocity + Variety + Veracity	One of the companies acting at a global level on the information technologies area, as "high-volume, high-velocity and high-variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making (p. 153). There is a fourth one that can be mentioned: veracity (p. 154)

Sanders (2016)	3v's: Volume + Velocity + Variety	Big Data is unique because of the volume, variety, and velocity of the data, which today is widely available and much less expensive to access and store (p. 29)
Sivarajah, Kamal, Irani, & Weerakkody (2017)	7v's: Volume + Velocity + Variety + Value + Veracity + Variability + Visualization	In analyzing the different articles reviewed in this SLR, the authors identified 7Vs – seven characteristics of data [volume (DC_VOLM) → C = 90 (39.64% of 227 articles), variety (DC_VART) → C=59 (25.9%), veracity (DC_VERT) → C = 44 (19.4%), value (DC_VALE) → C = 30 (13.2%), velocity (DC_VELO) → C = 18 (7.9%), visualization (DC_VISU) → C = 6 (2.6%) and variability (DC_VARB) → C=4 (1.8%)] (p. 269)
Stoicescu (2015)	3v's: Volume + Variety+ Velocity	Big Data is commonly defined as the combination of volume (a large quantity of data), variety (multiple types of data) and velocity (the speed at which data is created) (p. 33).
Xie, Wu, Xiao, & Hu (2016)	3v's: Volume + Velocity+ Variety	Big Data generated by customers has the typical characteristics of 3-Vs (volume, velocity, and variety) (p. 1037)

Appendix 4

External	
Baaziz, & Quoniam, 2013, p. 19	Combining data from multiple sources to infer events or patterns that indicate a current or imminent threat
Biswas & Sen, 2017, p. 6	Customer information, sales information, market and competitor information, product and service level requirement, promotion/brand information, demand forecasting, inventory, capacity utilization, process planning and control information, skill inventory, human information, sourcing/vendor information, networking information, logistics, warehouse planning, pricing and fund flow/working capital information
Chang et al., 2015 p. 277	Exchanging with others as a “social exchange”
Chluski, & Ziora, 2015, p. 12	Customer behavior, volatile market conditions
Janssen et al., 2017, p. 341	Domain experts- example of tax and fiscal experts in the field
Halaweh, & El Massry, 2015, pp.23-24; 27	Social media logs, government records, documents from competitors, third party data
Ketter et al., 2015, p. 1067	Customers, production patterns from producers, public policy, regulatory constraints
Kimble, & Milolidakis, 2015, p. 24	Competitors, customers, markets, products, strategy, and technology and even business counter intelligence
Mihai, 2015, p. 154	Passenger information, weather data, market information
Moraru, 2015, p. 113	Competition and their moves on the market
Pigni et al., 2016, p. 6	Market trends and customer preference
Sanders, 2016, p. 31	Market pricing, supply chain- such as transportation and routing, customer preferences, buying behaviors
Sivarajah et al., 2017, p. 27	Supply chain, market pricing
Stoicescu, 2015, p. 31	Buying process based on consumer behavior
Xie et al., 2016 p. 1040	Customer information developed using their knowledge, resources, and skills

External Resources Identified