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Big Data and Strategy: Theoretical Foundations and New Opportunities

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Abstract

The digitization of products, processes, and business models—and the corresponding explosion of big data—has led to an evolution within business organizations. Reaching far beyond information technology’s traditional role in business strategy, the implications of this big data phenomenon are considered through an exploration into what big data is, how it is currently being used by existing firms, and how it factors into strategic thinking. As different organizational approaches have developed toward big data, we use resource-based theory and organizational learning as anchoring perspectives to link this phenomenon with traditional strategic management. We also identify four avenues for future scholarship as the nature of business moves increasingly digital.

Keywords: big data, strategy, theory, resource-based view, organizational learning

1. Introduction

The global digitization of products, processes, and business models is reshaping the very nature of business. Entire industries are rapidly evolving as more firms take advantage of increases in clicks, sensors, and technological innovation. Due to advancing technological infrastructure and the advent of the so-called “Internet of Things,” companies continue to innovate, finding new ways to capture and leverage ever-expanding amounts of data. With storage costs becoming increasingly affordable and the lure of new (or fear of missed) opportunities, more and more firms are integrating information technology (IT) planning into their strategic thinking.

Given these advances, firms are increasingly aware that every person (or device) is a potential *data generator*. Consumers leave an extensive digital trail as they go about their daily lives. Whether shopping for groceries or fashion, traveling on a daily commute, or mulling around in their own home, individuals’ activities are generating consumable data. Connected devices are also doing more to communicate with one another, including the tracking and transfer of data to value chain partners.

In a similar manner, organizations have become *information processors*. They are making considerable investments into analytic capabilities and data science talent to exploit opportunities presented by digitization, seeking to create or capture value and develop competitive advantage. In secrecy or in plain sight, organizations are working diligently to obtain consumer data and attempting to interpret and apply it to their strategic decision making [1].

The concept of “big data”—large data volumes generated and made available on the internet and through current digital media ecosystems [2]—has heralded increasing attention as having important implications for growth, profitability, and survival. Strategy theorists and practitioners alike are currently struggling to understand big data’s role in the digitization of business models and how big data initiatives influence functional decisions within organizations, shape entirely new markets, and establish unique new strategies for organizations that break down traditional barriers of existing industries [3].

Executives across a multitude of industries are plunging resources into big data projects with aims to better monitor, measure, and manage their businesses. These strategic leaders are leveraging information to exploit current markets with incremental innovations that influence marketing efforts, product selection, and operational processes. Yet a small number of organizations employ a different role for data within their strategic approach. These firms recognize that information is at the core of most modern radical innovations [4]; their approach is resulting in the unforeseen entry into existing market spaces using innovative business models, the creation of new markets, and the invalidation of long-standing assumptions in traditional strategic thinking.

Scholars in the field of strategic management have an opportunity to play a major role in developing an understanding of how the emergence of big data is changing the nature of competition. Though the conversation has begun, management scholars have yet to build theory around the role of big data in the world of modern day corporate- and business-level strategy. As noted in recent research, big data has the promise of bringing new theories and practices to the organizational sciences, and is likely to play a central role in the development of new strategic approaches to firm governance and leadership [5]. We add to this promising literature through an integrative perspective of familiar organizational theories while triggering broader discussions for management research.

We identify theoretical foundations necessary for an examination of the emergence of big data in strategic decision making through the lenses of resource-based theory (RBT) and organizational learning. Informed by common characteristics used to conceptualize big data, this framework focuses on different applications of big data depending upon management’s aspirations as well as the development and maturity of their organization’s infrastructure and capabilities (authenticity). The result of such an approach is the realization that the field of strategy needs to be flexible enough to accommodate a new understanding of the interplay among data, technology, and strategy. As the economy turns increasingly digital, scholarship must adapt to better explain new and unique phenomena of interest.

The primary objective for this work is to stimulate the research agenda surrounding the integration of big data and corporate strategy. We aim to engage a broad variety of management scholars via our contributions, spurring on new theories and models to describe the disruption of value chains, supporting the development and reconceptualization of successful outcomes in business, and orchestrating linkages between business analytics methodologies and strategy scholarship methods. While setting forth a theoretically grounded framework that will allow strategy researchers to begin tackling important questions in the field, we introduce components of the discussion that are heretofore absent in the management literature and offer numerous avenues for future scholarship.

2. Background

The term “big data” is used to describe large, diverse, complex, and/or longitudinal datasets generated from a variety of instruments, sensors, and/or

computer-based transactions [6]. Big data applies to huge troves of raw data (structured, semi-structured, and unstructured) that cannot be processed or analyzed using traditional methods or tools, leading to increasing challenges in how value is to be extracted [7]. Though the origination of the term is still muddled and under debate, the concept of big data has become a topic of great interest, often under the assumption that it serves as a potential source for competitive advantage in many industries [8].

To understand the evolution leading to the current era of big data, the foundation lies in the development of database management and warehousing [9]. Collecting and storing mostly structured data in relational database management systems was increasingly employed by organizations in the 1990s, with data mining techniques and basic statistical analyses applied as a means to gain insight into growing volumes of information. As the Internet gained prominence and widespread use, more data collection and analytical research and development opportunities were created, with new challenges of text and web analytics for unstructured web content moving to the forefront [3, 9]. Social media forums, web logs, social networking sites, and clickstream data logs created the means for businesses to treat the market as a “conversation” between businesses and customers instead of the traditional business-to-customer, one-way “marketing” [10]. The increasing number of mobile connected devices and other sensor-based, Internet-enabled gadgets are pushing analytical capabilities even further, trapping organizations in a race to adapt to the challenges in collecting, processing, analyzing, and visualizing such large-scale and fluid mobile and sensor data [9]. The compilation and advancement of these technological innovations are increasing organizational competencies, defining new sources of competitive advantage, transforming business models, and opening new windows of entrepreneurial opportunity.

Under the promise of innovation and operational efficiency, big data investments have exploded at major corporations. With McKinsey Global Institute [11] predicting significant benefits to individual industries (e.g., a \$300 billion annual impact to the U.S. healthcare industry alone, 60 percent increases in operating margin for U.S. retailers), a considerable and consistent flow of resources into big data projects is expected to continue in the coming decade. Despite noted challenges facing firms with regard to technological advances [12]—or perhaps because of them—a thriving industry has emerged that specializes in the capture, storage, analysis, and interpretation of big data. Niche firms are building platforms and proprietary software to serve clients in both public and private sectors, offering analytic tools and capabilities unable to be matched in-house. Also of note, data-related research centers are springing up at universities across the globe. Nine figure investments in data science programs are becoming commonplace as universities seek new knowledge and aim to produce students with skills sought by an increasing number of organizations. To date, much of the knowledge of the big data phenomenon has been derived by data scientists in both corporate and academic environments through an exploration of essential big data attributes, which have come to be known as the “Vs” of big data.

2.1 The “Vs” of big data

Early conceptualizations of big data were built around three central characteristics: volume, velocity, and variety [13]. *Volume* represents the “big” in big data. The sheer volume of data is exploding, with some organizations collecting as much as a terabyte of data each and every hour, every single day [7]. With societal trends toward social media and remarkable advancements in technology, partnered with decreasing storage costs that have made it more economically feasible to manage, data volume is likely to continue rising. The second core element, *velocity*, deals

with the rate at which the data arrives, is stored, and retrieved for processing. With more sensors available, the growing introduction of connected devices, and an ever-rising number of codified transactions occurring globally, we are seeing increasing speed in data flow [14]. With technological advancements allowing for the tracking of data in a multitude of mediums, we are also seeing changes in the *variety* of the data. Beyond traditional numeric data, we are now seeing raw, semi-structured, and unstructured data sourced from web pages, web log files, search indexes, social media forums, email, documents, sensor data, images, video footage, GPS signals, and many other outlets [7, 15].

As the big data phenomenon has evolved to include the identification of additional characteristics of consequence, researchers have suggested several more “Vs” as fundamental to the discussion. There is growing consensus to include the *veracity* of data as a relevant characteristic. Veracity relates to data quality [6, 8], with some segregating data quality into separate dimensions for timeliness, accuracy, consistency, and completeness [16]. Others have distinguished consistency as its own characteristic, choosing to deal with the changing nature of data as an issue of *variability* [17]. In this light, the definition or meaning of data is changing, as evolving forms of media (e.g., blogs, social media, and video) have created new challenges in collecting, codifying, and storing unstructured data.

In a similar notion, some have argued that the relevance of data is another important factor. Such relevance, or *viability*, concerns the possibility of the data to be analyzed in a manner to make it decision-relevant for the firm, i.e., that data selected for analysis is likely to predict outcomes of consequence to the organization [18, 19]. Similarly, *visualization* also has been brought forth and defined as a potentially significant characteristic. Visualization refers to making data comprehensible in a manner that is easily understandable [17].

A final element that is receiving increasing attention, and proves most interesting from a strategic perspective, is the *value* of big data [6, 17, 20]. In essence, this factor is about how data can be leveraged for benefit in the form of financial gain or some other outcome of organizational import, such as operational efficiency or knowledge creation. The propensity of certain data to be used in solving operational challenges and increasing effectiveness of an organization significantly impacts its value to the focal firm. Though, while proprietary data may in and of itself provide value (for consumption or to be sold), the interaction with analytical tools and capabilities allows data to become increasingly useful and valuable [21]. **Table 1** summarizes these eight common Vs described in the big data literature.

Though these individual elements are still being disputed as to their specific validity, there is little debate as to the growing influence big data is having on and

Attribute	Description
Volume	Massive amount of data collected
Velocity	Rate at which data arrives, is stored, and retrieved for processing
Variety	Diverse structure and forms of data
Veracity	Trustworthiness of data
Variability	Changing nature of data
Viability	Relevance of the data
Visualization	Comprehensibility of data
Value	Data translated into learning, knowledge creation, and/or economic gain

Table 1.
Eight common Vs of big data.

within organizations today. Ubiquitous conversation and escalating investments signal the current and future importance of big data in shaping strategic thought and direction in organizations [22].

2.2 The evolving influence of big data on corporate strategy

Nearly every industry has made or is making substantial investments in big data. Despite this increasing emphasis, corporate decision makers are often left disconnected from the exact value proposition from big data investments in their strategic decision making. As such, the role of technology, data, information, and knowledge officers in corporate strategic decisions continues to evolve [23, 24]. Standards and best practices have not yet been formed, leading decision-makers to seek guidance wherever possible.

Though data-driven business models are still evolving and somewhat unproven, research suggests that IT capabilities positively influence firm performance [25]. More specific to our line of inquiry, a recent study found that organizations that claim to have achieved a competitive advantage through their data analytic capabilities are over two times more likely to substantially outperform their industry peers [26]. This same study determined that top performing firms were twice as likely to use insights gleaned from big data analytics to guide day-to-day operations and twice as likely to use analytics to guide future strategies.

Such findings would suggest that firms might take different approaches to their big data strategies and seek value through different means and ends [27]. Many, likely most, firms in the new digital economy are currently focused on solving traditional problems in traditional markets with new and creative solutions using big data analytics. These firms are seeking innovations to improve day-to-day decision-making, drawing technology resources out of a centralized IT department and distributing them throughout other value chain functions [28]. Marketing, procurement, inventory management, operations, and customer service operate more efficiently and effectively through various product and process innovations, all driven by information generated by big data investments. As an example, retail companies are utilizing digitized marketing analytics to deliver more effective advertising, incremental product improvements, and increasing rates of customer acquisition and retention. Similar improvements are being made in nearly every industry.

Scholarly works, practitioner manuscripts, and private sector whitepapers describe an evolving competitive landscape and would also suggest that another subset of firms has emerged [11, 27, 29, 30]. These organizations have adopted a data-driven, information-centric focus that subsumes all aspects and decisions for their firm, including measuring how successful certain projects are beyond profitability. Such emphasis has allowed these firms to build extraordinary data stocks and data flows. Access to inordinate amounts of data increases opportunities for learning, transforming new knowledge and ideas into fresh opportunities for exploration, often outside traditional markets. These learning organizations build ecosystems with constantly increasing data flows, developing advanced technical and analytic capabilities and tools along the way, which can be leveraged as they compete with traditional competitors and diversify into new markets.

3. Theoretical foundations

As major corporations, hedge funds, and entrepreneurs are struggling with the emergence of big data, academicians continue working to understand its role in business, the inputs and outputs of big data, and how big data projects are best

executed. While active research streams have developed in the information systems (e.g., [31]) and supply chain (e.g., [16]) literatures, there has been a paucity of contributions from the management field [5], and more specifically the field of strategic management. Most contributions to date have been through consulting white papers (e.g., McKinsey, Oracle, and EY) and practitioner-oriented outlets (e.g., [15, 30]). Hence, there is a need for strategy scholars to develop theoretical approaches to better comprehend how big data is shaping strategic decision making and at the core of novel business models that challenge traditional strategic conceptualizations.

Drawing upon the influential Vs of big data vernacular, we move to ground the big data phenomenon in accepted strategic management theory. Recognizing current practices by a wide variety of firms, we arrive at two long-standing theoretical lenses: RBT and organizational learning. Witnessing a vast majority of organizations employing analytics within functional areas of their firm in an effort to achieve sustainable competitive advantage, we draw upon RBT. Noting the organizational philosophies adopted by the minority of firms with truly advanced analytic capabilities, we also recognize the contributions of the organizational learning perspective.

3.1 Resource-based theory and the big data phenomenon

Much of the practitioner-based literature focuses on increasing efficiency and effectiveness in existing markets, and is therefore best viewed through the lens of RBT. Following traditional RBT principles—and with an assumption of resource heterogeneity across competitors—a firm's data stocks (in particular, their proprietary data stocks) are conceptualized as being valuable, rare, difficult to imitate, and nonsubstitutable (i.e., VRIN), and therefore a potential source of advantage relative to competitors [8, 32, 33]. More compelling to RBT arguments are the ability of firms to bundle data resources with analytic capabilities and strategic decision making. The significance of data increases immensely when combined with the dynamic capabilities of a firm that maximize its ability to extract and apply knowledge and insight from the data to the exploitation of business models [34].

Consistent with traditional tenets of RBT, mounting research into opportunities presented through big data initiatives in most every sector would seem to imply considerable value potential [11]. Market conditions exist for the buying and selling of data as well as analytical services, signaling a more definitive value [35]. Further, the proprietary nature of any data stocks or capabilities would suggest a level of rareness. Firms without similar capabilities or infrastructure might also find it extremely costly and difficult to imitate. Finally, empirical research into the linkage between big data, IT capabilities, and firm performance (e.g., [26]) would seem to infer that a reliance on instinctual decision making is no longer substitutable for data-driven strategic and operational planning.

Given the above characteristics, big data and the complementary capabilities associated with handling, analyzing, and applying massive amounts of data can serve as a means for achieving and sustaining competitive advantage. Managers at a significant number of firms are making investments in capabilities that allow them to use big data to generate deeper business insights and optimize existing processes. These firms are typically focused on creating and exploiting advantages in current markets, seeking resolution to traditional problems that have plagued their operations in the quest for profitability. For example, Capital One has used big data to better evaluate consumer spending patterns and connect with individualized consumer needs. Their efforts have led to new customized programming, while also helping to manage repayment risk [36]. Similarly, Progressive Insurance has

improved its ability to identify hazardous driving behavior through the use of real-time analytics derived from in-vehicle telecommunications devices [37]. Seeking similar knowledge advances, Coca-Cola has used big data to improve supply chain and innovation. Using Freestyle fountain platforms, the company captures data on geographic and time-related consumption, innovative new flavor mixtures, and inventory replenishment [38].

Through these examples, big data can be viewed as an extension of business intelligence and analytics, enhancing the efficiency and effectiveness of existing functional competencies and fitting with established practices in the use of technology [31]. Such a vision is not using data or advanced analytics to alter strategy, but rather to better execute a chosen strategy. Inasmuch, the relevant data is selected based on a strategy, particular measurements are defined and driven by the strategy, and results allow for organizational leaders to better monitor and control on the basis of the strategy.

Nevertheless, increases in technology, online activity, and mobile computing have led more firms to engage in efforts to secure proprietary data through big data initiatives. These mimetic responses would seem to suggest that firm-specific advantages related to data stocks are, over time, decreasingly sustainable (i.e., diminishing in value and scarcity) [3]. However, a subset of firms with leading analytic capabilities have shifted focus beyond existing capabilities, adopting a more dynamic approach that is changing the nature of business, with impacts evident across multiple types of innovation (e.g., product, process, business model), supply chain management, and diversification. The firms have become increasingly focused on data flows rather than data stocks [28], with an aim for continuous learning. These firms are not beyond using data to exploit existing competencies in traditional markets, but are persistently seeking to learn from new data flows and willing to explore new markets [39]. As such, we now look at the influences of organizational learning on the phenomenon of interest.

3.2 Organizational learning and the big data phenomenon

Organizational learning has been applied broadly across management literatures, though definitional consensus remains elusive [40]. Because we are looking at organization-level innovation and strategic renewal within the context of a general movement toward big data, our arguments most closely align with those by Crossan and colleagues [41]. Relying on premises brought forth by March [39], these authors state that renewal requires that organizations explore and learn new ways while concurrently exploiting what they have already learned. From this perspective, they promote a framework of four subprocesses: intuiting, interpreting, integrating, and institutionalizing. In short, intuiting is the recognition of patterns and/or possibilities; interpreting is the explanation of an insight or idea; integrating is the process of developing a shared understanding among individuals and taking coordinated action, and institutionalizing is the process of ensuring that routinized actions occur.

While the work by Crossan and colleagues argues for a multi-level framework—involving individuals, groups, and the organization itself—we see increasing potential for the collapsing of this framework through advances in technology attributable to the big data phenomenon. With artificial intelligence and machine learning, patterns and possibilities are now being recognized through analytics and coding rather than through individuals' personal experiences. Big data allows for this process of intuiting to occur not through one individual's experiences, but rather through mass analysis of tremendous volumes and variety of data. Interpretation is simplified through data visualization tools common in firms with a mature

understanding and application of big data analytics. Though the integration of knowledge across organizational lines still requires entrepreneurial thinking, visionary leadership, and organizational buy-in across groups, this is simplified if an analytical mindset is embraced within the firm.

Complementary scholarship within this literature stream focuses on specific elements of organizational learning, such as knowledge creation/acquisition and knowledge transfer/distribution [40]. Organizational knowledge is created through a continuous dialog between tacit and explicit knowledge [42], and amidst a balance between search and experimentation and the contrary activities of refinement and execution [39]. As such, knowledge acquisition occurs through a process of learning from experience and the recording or probing for information about the organization's environment or performance [40]. Learning is leveraged further when knowledge is transferred to more of an organization's components, who are also afforded mechanisms to enhance the ability, motivation, and opportunity to recognize that knowledge as potentially useful [43]. Hence, due to the complexities and difficulty in instituting or imitating, the creation and effective transfer of knowledge internally stand as a potential basis for competitive advantage [44].

With this understanding of knowledge management capabilities, it is easy to infer that RBT is encompassed within an organizational learning framework. While new knowledge is developed by individuals (and, increasingly, through technology), organizations (and their strategic leaders) play a critical role in articulating and amplifying that knowledge [42]. Advanced technical capabilities, ever-expanding data stocks, and excessively large financial coffers serve as resources that allow learning organizations to eschew established competencies and circumvent traditional industry boundaries and barriers to entry [27]. For example, Alphabet (nee Google) continues to explore and diversify into new markets, expanding well beyond web search and advertising as they seek to capture new data and knowledge [45]. Apple and Amazon are other well-recognized companies also focused on advancing ecosystems, new markets, and the development of analytical and learning capabilities [46]. Leaders at these organizations cultivate a growth mindset and entrepreneurial culture, embracing new technologies and tolerating risk in the pursuit of new knowledge that can push the organization forward in new and unforeseen ways. Exploration and exploitation decisions in these organizations are not solely predicated on profitability; instead, these firms are concerned with enhancing data flows, with the intent to develop innovative service modules that can be easily combined with existing platforms to execute increasing levels of service [8].

In essence, the focus on data flows presents opportunities for learning organizations to build dynamic capabilities through the extension of digital ecosystems, finding new ways to digitize and monetize evolving products and services. Strategic decisions on new product and service offerings are made based upon the potential for human capital development, multiplicative and exponential learning, and an expanding ecosystem of consumer influence. Organizations embracing a learning perspective view data not only as an available resource to be exploited for improving existing value chains, but also anticipate the untapped value of data, seeing unique sources from which to collect new data. They envision how that data can be used to gain novel and original knowledge and explore new markets and opportunities for future business endeavors [47]. From this synopsis, we now move on to an exploration for how the characteristics of big data can be interpreted through the theoretical lenses offered by RBT and organizational learning.

4. Viewing the Vs through RBT and organizational learning

Reflecting upon the Vs customarily espoused within the big data literature, volume, variety, and velocity are seen as primary drivers. Access to more (and more diverse) data, generated at ever-increasing speeds, directly effects a firm's ability to make decisions and allows it to increase its competitiveness versus firms without access to similar data stocks. Firms actively employing a data-driven strategy require significant investment in data collection and storage capabilities, as well as the development of improved analytics to handle the large, diverse, and complex datasets. Due to the nature of volume, variety, and velocity aspects, an investment must be made in the development of necessary infrastructure. Such a commitment of resources (e.g., human capital, financial capital, technological capital), properly deployed, leads to a level of efficiency and greater predictive and analytic capabilities in order to exploit advantages relative to firms without similar investments.

Firms focused on the enhancement of existing capabilities (i.e., a resource-based orientation) build such infrastructure and capabilities as to seek improvement in solving existing problems. It is also reasonable that these firms may outsource some or all of the infrastructure or analytic capabilities to strategic partners who have greater strengths and/or efficiencies in big data-related tasks, still working to accomplish the same goals for the focal firm. Regardless, these big data initiatives, whether outsourced or in-house, are typically localized to functional areas, creating successes to definitive and specific challenges but not sharing them across business units or divisions.

In a similar fashion, firms with a learning-based orientation strive for gains in efficiency and traditional value chain improvements. However, this group of firms tend to stretch their commitments into human, financial, and technical (and, increasingly, social) capital to greater heights. Substantial investments in building immense data storage warehouses, intra- and inter-firm networks, computing power, and analytic capabilities are warranted, with a continuous push toward increasing and diversifying data inputs [28]. While there is value in focusing efforts and big data innovations within specific value chain activities, true strategic impact can only happen with management having a holistic view of the digital threats and opportunities as well as associates buying in to an overall vision for how big data can reshape the firm and its competitive landscape [48]. The learning mindset and big data aspirations embraced by these firms allow for increasing abilities to search for new product or market opportunities in non-traditional spaces. Rather than simply looking for greater volume, variety, or velocity with big data investments, decisions by learning organizations are based upon the belief that greater data flows will translate to increased veracity, variability, viability, visualization, and value of data stocks. Accordingly, an expanded view of the Vs becomes increasingly relevant as the resource-based and learning perspectives are contrasted. Because firms with a resource-based orientation are focused on exploiting advantages primarily in current markets, the remaining Vs are viewed in light of this limitation.

Data veracity is important for firms with a resource-based orientation due to the fact of working with traditional metrics and processes. They need to trust the quality of the data in order to follow through and make the gains in productivity and profitability they are seeking, but are limited by their own aspirations and through their ability to monitor, analyze, and control based upon their data collection and analysis. Because their chosen corporate- and business-level strategy pre-determines the data and metrics of interest, resource-focused firms proceed without the benefit of viewing the potential of enhanced data stocks and data flows. In much the same way, data variability can often be overlooked by firms with a

resource-based orientation, due to discretionary bias and dominant logics confining the firm to rigidities in traditional proprietary thinking. These firms are focused on existing value chain processes and metrics, and are therefore looking for and expecting consistency in their data to be measured and tracked over time to gauge improvements.

Awareness of data quality and data evolution is critically important to learning organizations, as it affords these firms unique perspective on opportunities to engage in ever-expanding data flows. As learning organizations are open to new opportunities and strategic renewal based upon their understanding of the data, it is incredibly important that they develop a level of comfort with the data and its sources because of the time-conscious decisions and indelible investments that follow. Even though these firms are more willing to take data-related risks, because of the sheer volume of data amassed through their ever-increasing data stocks and data flows, they are able to quickly make assessments in data quality. Their quest to increase data flows also comes with an expectation that the data will change over time, both in its source and its meaning, and so the firm develops capabilities around adapting and learning from these changes in order to parlay them into new business opportunities. Heightened alertness and responsiveness to the quality and changing nature of data contribute to the development of better organizational capabilities that identify trends in a broad array of markets, progressively monetizing data resources via entry into new markets as they extend analytic and predictive capabilities often ignored or underdeveloped by traditional firms [8].

The viability and visualization of data is also limited in firms with resource-based orientations due to contextual factors, as situational analyses are hindered by conventional views of the organization and their markets. In reality, this is restricted by the abilities of senior leadership to see its importance [49] and to break down data silos within the firm [48, 50]. The data is discernably relevant for decision-making purposes because prior decisions on strategy dictate what is to be captured, collected, and analyzed. While tools to help visualize trends in the data prove helpful, it is only for the function of addressing previously determined metrics.

Conversely, in learning-oriented firms, leaders direct their resources to collect data from many data flows, making it more challenging to determine relevance. However, capabilities are developed within these firms to help identify, interpret, and predict new opportunities, even those potentially outside traditional markets. Such efforts may require the learning or development of novel or unfamiliar metrics. It should not be construed that these learning organizations are blindly looking for data and opportunities anywhere and everywhere; there are still likely to be well-defined social, industrial, or organizational challenges that are being pursued. It is simply that the learning orientation of these firms allows them to capture and look at far-reaching data to find the most accurate and data-supported solutions, even if it means developing new and diverse perspectives and taking risks in diversifying to new markets that offer the potential for tremendous pay off [51]. It is in this way that deft visualization actually helps management see the viability of certain data, and organizations are not left to stand solely on the instinctual decision-making of organizational leaders.

Beyond all of the other Vs, it is paramount, of course, that firms actively engaged in data-driven decision making are also seeking and receiving value from their investments in big data initiatives. Resource-centric firms create value from big data through better business decisions that improve and exploit traditional capabilities. They learn to increase the efficiency of employees, improve inventory logistics for suppliers and distribution, and better service their customers. To some degree then, the value through a resource-oriented approach is concentrated on the

<i>Attribute</i>	<i>Influences on firms w/ resource-based orientation</i>	<i>Influences on firms w/ learning-based orientation</i>
<i>Volume</i>	Requires proper infrastructure, commitment of resources, and a level of efficiency in organizational processes as well as greater predictive and analytic capabilities (than firms without digital strategies) in order to exploit current advantages	Same as resource-based orientation, but human and financial resource commitment stretches to greater heights amid ever-increasing data flows, allowing for ability to search for new product or market opportunities in non-traditional spaces
<i>Velocity</i>		
<i>Variety</i>		
<i>Veracity</i>	Immediate high value placed here due to fact of working with traditional metrics and processes	Takes time to analyze and determine; firm must be willing to take risks here to analyze and uncover value in data; capabilities of analysis to determine veracity may be source of competitive advantage as it may influence survivability
<i>Variability</i>	Limited due to extensive attention and focus placed on existing value chain processes and metrics	Expansive due to quest for increasing data flows; valuable due to firm's adaptability and ability to learn as trends change
<i>Viability</i>	Only measure specific predetermined data elements, therefore all are relevant (but potentially limited)	Collect data from many data flows, therefore must cull and codify for analyses and make determination on relevance; unique capabilities to see and predict new opportunities, potentially outside traditional markets (which may require using new and diverse perspectives to view and analyze the data); i.e., may not be relevant to traditional markets, but could be tremendous new opportunity
<i>Visualization</i>	Aids in measurement and interpretation to solve key issues in traditional processes and markets	Analytical techniques that also helps interpret broad data sources to draw attention to trends and new opportunities to enhance survivability
<i>Value</i>	Created through development of better business decisions in traditional value chain functions and with economically quicker means via advanced and predictive analytics that create and exploit existing and new competitive advantages in traditional markets	Created through ability to analyze data in new ways to enhance knowledge and develop dynamic capabilities to learn, recognize, and act upon large economic and sociocultural patterns and trends, often with such scale as to offset traditional competitive forces in order to create, enter, and/or develop new markets and/or industries with profitable business models

Table 2.
How the eight Vs of big data impact digital business strategy based upon firm orientation.

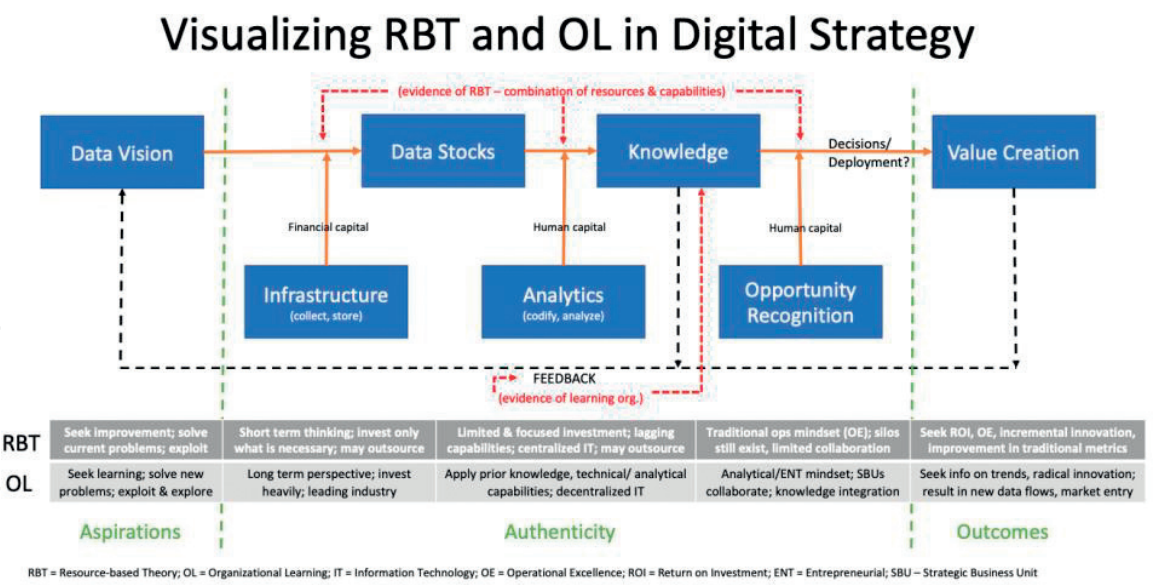


Figure 1.
Visualizing RBT and OL in Digital Strategy.

improved relationships with key stakeholders. Such relationships can be recognized and measured through a variety of financial and operational metrics likely already in service throughout an industry.

For the learning-oriented firm, value is captured through the development of knowledge and dynamic capabilities to recognize, learn from, and act on large socio-cultural patterns, often with such scale as to offset traditional competitive forces in the creation, entrance, and/or development of new markets or industries with innovative business models. They are able to effectively integrate and disseminate new knowledge across organizational silos to drive further innovation and entrepreneurship. Their business models look to expand existing lines of business, building an increasing ecosystem of services that benefit customers and build brand loyalty [30]. Accordingly, these learning organizations follow a pattern that not only builds what they know into their business models, but also incorporates a means to facilitate learning while relentlessly increasing the data gap over competitors. Despite these benefits, it is still evident that most industries still have not even scratched the surface of realizing the potential value of big data and analytics [11, 52].

Table 2 summarizes how the Vs commonly attributed to big data influence firms resource- and learning-based orientations when employing digital business strategies. **Figure 1** offers a visual to further describe how these orientations are staged across organizations.

5. Future management scholarship and the big data phenomenon

Digitization and the increasing value of big data analytics have led to a global disruption of immense proportions, similar to what was experienced during the industrial revolution. Business models and strategic thinking are changing as a result. Communication and computing technologies have developed so radically over the last 20 years that it is easy to forget we are living in an entirely new world. Decades ago, computers sat in rooms and on desktops, not in the palm of one’s hand. Inboxes sat on desks, rather than residing in software. Data processing was a long, expensive, and arduous task. Accordingly, the context in which we conduct

organizational research—and even *how* such research is conducted [5]—needs to change. What is more, it seems imperative to reflect and examine whether existing frameworks, variables, and measurements are still relevant in today's digitalized business environment. Through such reflection, the evidence of earlier paradigms—specifically the important role that RBT plays—in today's digital era and the relationship with organizational learning is apparent. Yet scholars are now presented with an opportunity to conduct a renewed examination of how technology interacts with strategy. Although leaders of the field have iterated a call for research and theory development in this area, significant movement has lagged. To assist in the advancement toward this end, we present a number of avenues to begin addressing these gaps, not only in strategy, but across the field of management.

5.1 Avenue A: theoretical development across management

Through this paper, we extend theoretical development by looking at how the big data phenomenon is interacting with RBT and organizational learning in new and novel ways. These are overtly and perceptibly not the only theoretical underpinnings found within the big data phenomenon, nor are they the only ones that may be challenged by the changing competitive landscape. As such, scholars have an exceptional opportunity to identify unique applications for existing theories, create new proposed boundary conditions across the field of management, or develop novel theoretical frameworks and extensions, such as in the domains of strategy, entrepreneurship, or human resources.

We make the case to further develop theory around existing streams of research in the extant knowledge creation, knowledge management, and exploration/exploitation literatures. The likelihood that management theories are universally true across all periods of time, contextual situations, and especially after radical innovations have been brought forth to the market is highly unlikely. It is our contention that when the assumptions used in developing theory are challenged by existing realities of the world, the management field should reconsider “what it knows” and look at its theories to drive forward more relevant understandings of the world. This is not to suggest that traditional theories of management will be invalidated. Rather, it is necessary to revisit paradigms, challenge assumptions, and explore alternative explanations. The digitization of business models, fueled by the big data phenomenon, is a massive economic transformation; therefore, a new and concerted effort to look at the underlying theories of our respective fields should be considered at this time.

5.2 Avenue B: investigating antecedents to data- and analytic-related capabilities

Beyond applying theory to better understand the nature of organizational decision making in the era of big data, it is imperative to explore the context and antecedents that allowed these organizations to leverage data and analytics for competitive advantage. What is it that allows for firms to transition into data-savvy organizations? Are there characteristics or nuances that propel firms and allow for the transformation into learning organizations? Externally, are their environmental factors that specifically trigger such adaptation?

Undoubtedly, we see application for traditional explanations such as visionary leadership, organizational culture, strategic resource heterogeneity, and environmental hostility. Yet scholarly examination should better explore the true characteristics and environmental stressors that elicit impactful organizational change that increases data and analytic capabilities. Tracking firms globally and

longitudinally—through both qualitative and quantitative investigation—is necessary to properly uncover specifics about firms developing competitive advantage through a combination of big data analytics and strategic thinking. Are CEOs business school educated or do they have STEM (science, technology, engineering, and/or mathematics) backgrounds? Do they have brief or extended tenures in their organization? Were they founders? How was culture characterized before the shift, or was analytics core to the identity of the firm from inception? What was the nature of the industry cycle? Were resources plentiful in the environment? Was the company an industry leader, or falling behind? Were there disruptive innovations occurring (beyond digitization)? There is ample room for discovery of these and many more aspects to better understand the full scope of big data's impact on organizations.

5.3 Avenue C: reconsidering outcomes and consequences

Big data's emergence, in combination with disruptive business model innovations, has created an opportunity to reconceptualize organizational performance. Industry no longer uses a simple measure of profitability or traditional financial ratios, as success now relates to quantities of users on platforms, the richness of data flows, the collection of data stocks, or the knowledge created through the business activity. If we reconceptualize organizational performance more holistically, how does that open the definition of competitive advantage up to include the realities of a new contextual business environment?

Without understanding how senior management at digital-savvy firms perceive performance with regard to certain offerings, our current measurements may not allow us to properly test the hypothetical connections and theories that the big data phenomenon allows us to predict. Deep dive qualitative studies and case analyses surrounding digital transformations, as well as companies that have been founded digital, should be conducted to examine how these firms measure success. Additionally, companies that are founded and run by technological or analytical leaders should be more intimately compared and contrasted with companies founded and run by traditional operational management to better understand the underlying differences and subsequent impact on performance.

5.4 Avenue D: refining and specifying the measurement of variables

The uses and application of big data have so thoroughly transformed methods and processes in the business environment that it is now necessary to not only reconceptualize theory, but also transform how we measure and model behavior, whether at the firm, meso-, or microlevel [5]. In the previous section, the change in how firms define desirable business outcomes was discussed, but future research will derive additional value when firm-level performance is measured in a manner that brings together the divergent ways that firm performance is now viewed by learning-oriented firms.

The same novel tools and data stocks that have digitized businesses can also be used for the qualitative testing of management theories. Therefore, macro level constructs that relied on poor proxies (or simply were unable to be measured) could come within scholars' range as they begin to open their perspectives to how business is conducted, what data stocks and flows are generated, and how they could capture them anonymously. Relying on changes in strategic human resource analytics capabilities in firms to create and predict behaviors will significantly impact our ability to understand organizational phenomenon beyond current

methodologies. Learning-organizations have large scale human resource analytics capabilities developed through the recruitment of Ph.D.-level employees and research fellows. For insight into this, we need not look further than the great interest of managers, scholars, and students in Google's people analytics, where HR professionals work hand-in-hand with organizational scientists to identify the most effective fact-based solutions, rather than relying on individual experience and debate.

More precise measurements in management are not only important from the perspective of the scholar hoping to create new knowledge, but also as a means to better understand both the phenomena of big data and, more generally, organizational entities. This translates into better research, teaching, and practice of business strategy and management. As scholars are able to more precisely measure what it is they are defining, the insight gained from research increases by magnitudes in its translation into teaching and practice, resulting in an important reconnection to the community, where business scholarship has strayed over the last several of decades. We believe that the big data being collected en masse by today's firms will be the scholar's playground tomorrow if the field positions itself to advance the practice as well as the theory of organizations. The big data phenomenon has the potential to bring organizational science back to life in a way that should be exciting to a diverse group of individuals, including future scholars.

6. Conclusion

The link between the firm's IT and competitive advantage has long been discussed in the literature (e.g., [53–55]), but we proffer that technological resources and capabilities are now dictating which strategic approach a firm can and will take to the market [27]. How firms choose to explore new markets is not done through traditional strategic planning, but instead evolves through opportunity recognition based largely upon information gleaned from consistently analyzing more and richer data flows and stocks. The emphasis on data and data analytics as strategically important to a firm's success has the potential to contribute to important developments in understanding organizations in a world where digital is rapidly overtaking traditional business models. While there is the possibility for considerable debate over whether big data practices can provide a sustainable competitive advantage, arguments can be made that continued advancements and innovation in infrastructure, analytical capabilities, and organizational processes will leave plenty of opportunity for proactive firms. What is more, while individual data stocks may be imitable, bundles that include proprietary data, dynamic data analytic capabilities, effective strategic decision making, and an entrepreneurial spirit will likely remain unique to a particular firm and translate into the creation of new knowledge and ambidextrous execution (i.e., both exploiting existing markets and exploring new opportunities).

Reinvestigating the interplay between technology and organizational strategy is needed, as big data is likely to play a role in changing the landscape of social and economic policy and research [5]. As such, the importance of beginning this line of study within the strategy literature is imperative. Closing the gap between traditional strategic thinking and how strategy is currently employed in superior performing firms will test the ability of the field to match management theory with reality. In doing so, scholars can erase the perceived naiveté surrounding management theories and demonstrate the complexity witnessed in the real world through contemporary and meaningful scholarship [56].

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Conflict of interest

The authors state there are no conflicts of interest with regard to this manuscript.

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