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**BIG DATA RESOURCES, MARKETING CAPABILITIES, AND
FIRM PERFORMANCE.**

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Big Data Resources, Marketing Capabilities, and Firm Performance.

INTRODUCTION

“Big data” refers to techniques, technologies, systems, practices, methodologies, and applications related to the acquisition, storage, integration, analysis, and deployment of massive amounts of diverse data to support business decision-making (Chen et al. 2012, Jelinek and Bergey 2013; McAfee and Brynjolfsson 2012). Big data is praised as the next big thing to provide competitive advantage for firms through improved efficiency, effectiveness, and innovativeness. Given its promise, the vendor market for big data technologies has grown 40% annually, from \$3.2 billion in 2010 to \$16.9 billion in 2015, and growth is expected to continue at 23% over 2015-2019 with annual spending reaching \$48.6 billion in 2019 (IDC 2015).

While no firm business function remains untouched by big data opportunities, marketing (marketing, sales and customer service) is the top driver of big data initiatives (Gartner 2013). The combination of big data technologies, and the greater willingness of consumers to share their personal information through web-based channels, generates customer insight that was not previously possible (Chen et al. 2012; Day 2011). By analysing finely-grained data to identify subtle trends and patterns in individual customer attitudes and behavior, often in real-time, big data is taking firms from knowing their customers as a demographic segment to understanding them as individuals. Big data insights thus put managers in a superior position to design timely, automated, highly personalised offerings, with human expertise remaining critical but in a supporting role (Einav and Levin 2013; LaValle et al. 2011; McAfee and Brynjolfsson 2012).

Anecdotal evidence from industry press suggests that in an increasing number of firms, big data is regarded as the key driver of marketing strategy (Gartner 2013). However, many firms are unsure how to make use of big data, are cautious to invest into new

information technologies, or simply find big data analytics too complicated (Barton and Court 2012). To overcome technological, skill-based and organisational challenges, firms need to acquire various big data-related IT resources (Cap Gemini 2012; Day 2011). Despite this need to understand how marketing organisations may become big data-driven, academic research has not empirically investigated how strategic big data resources, and to what extent, influence strategic marketing capabilities and, by extension, firm performance (McAfee and Brynjolfsson 2012). The primary objective of this research is to remedy this crucial knowledge gap.

RESOURCE-BASED VIEW OF THE FIRM

To theoretically inform our study, we rely on the resource-based view of the firm (RBV). The theoretical arguments of RBV (Wernerfelt 1984) concentrate on the management of firm resources as the basic units of analysis, and resource heterogeneity across firms is offered as an explanation for differential performance (Barney 1991; Peteraf 1993). RBV literature uses a set of criteria to determine whether a resource may be a source of sustainable competitive advantage in terms of its value, rarity, imperfect imitability and substitutability, and organisational exploitation (VRIO) (Barney and Hesterly 2012; Peteraf 1993). However, resources seldom operate or lead to differential performance in isolation; RBV's resource complementarity argument posits that resources should be considered jointly rather than independently because the presence of one resource commonly enhances the value of another (Barney 1991). The value of a resource is thus ultimately determined by its contribution when combined with other resources into unique, higher-order resource bundles (Melville et al. 2004). Such bundles form a *strategic resource* if it accounts for a significant portion of the firm's investment base, and is not freely available in factor markets (Clemons and Row 1991).

For strategic resources to become a source of competitive advantage, they must be leveraged by capabilities in organisational processes that create value for the firm (Barney and

Hesterley 2012; Kozlenkova et al. 2014). A *capability* is a special type of resource that enables the firm to leverage other resources advantageously in organisational processes to create value (e.g., Barney and Hesterly 2012). Specifically, capabilities are a complex set of skills and routines deeply embedded organisational processes and routines. As such, capabilities are potential sources of competitive advantage (Day 1994).

In sum, strategic resources may lead to competitive advantage when they are leveraged by capabilities in the firm's value-creating processes. We now turn our attention to core concepts in this study, namely, big data resources and marketing capabilities.

Big Data Resources

Building on RBV's underpinnings, IT business value research investigates the impact of information technology on firm performance (Clemons and Row 1991; Hitt and Brynjolfsson 1996; Melville et al. 2004). This discourse posits that diverse IT-related resources are combined into unique resource bundles that enhance firm performance and provide for competitive advantage (Bhatt and Grover 2005; Melville et al. 2004). As a strategic, firm-level IT resource, we define *big data resources (BDR)* as a combination of complementary IT resources relevant to the utilisation of big data to enhance firm performance.

IT business value research has identified three general types of IT resources: technology resources, human IT resources, and organisational IT resources (Bharadwaj 2000; Mata et al. 1995). These resources represent necessary and complementary dimensions, and if combined appropriately, provide for superior performance (Melville et al. 2004; Pavlou and El Sawy 2006). Consistent with RBV and based on a review of conceptual studies (e.g., Chen et al. 2012; McAfee and Brynjolfsson 2012), we identify three distinct IT resources that form firm-level, strategic BDR: (1) big data technology resources; (2) big data analytics skills; and (3) organisational big data resources.

Big data technology resources refers to novel information technologies that are necessary to handle big data, i.e., varieties of data formats and data types derived from interactions between people and machines, which is beyond the ability of current relational databases and legacy systems (Chen et al. 2012). Such technologies include non-relational databases, middleware, datawarehousing, and analytic tools, which enable firms to capture, integrate and synthesize big data in real-time, and deliver analysis results in accessible and understandable form to executives to support business decision-making (Jelinek and Bergey 2013; Nunan and DiDomenico 2013).

Once the technological infrastructure is in place, firms often struggle to make effective use of big data (Barton and Court 2012; Einav and Levin 2013). *Big data analytics skills* refers to human resources, acquired from internal or external partner sources, who have the knowledge to derive market insights from big data (Germann et al. 2013). Firms need “data scientists” who can find patterns in large quantities of multistructured data, and transform into useful and actionable insight. These people possess rare combinations of skills in math, programming, business knowledge, interpersonal skills, and customer focus (Davenport and Patil 2012; LaValle et al. 2011; McAfee and Brynjolfsson 2012).

Building a strategic big data resource asset requires a transformation in organisational culture and top management support to embed big data as part of daily operations (Barton and Court 2012; McAfee and Brynjolfsson 2012). *Organisational big data resources* refers to organisational culture and top management support that is favorable toward big data. More specifically, big data culture encompasses shared values, beliefs and norms that encourage decision-makers to utilise big data-driven insights (Germann et al. 2013). A data-driven culture is reflected as an openness to systematically apply big data analytics to solve business problems. Top management support, in turn, provides leadership and vision that is crucial to ensure that managers are aligned to support big data because people are not naturally inclined

to trust or understand data-based models (Barton and Court 2012; Bloomberg 2012). Effective users are almost always found in firms where top management places great importance on big data (Bloomberg 2012; Cap Gemini 2012).

We posit that these stand-alone big data resources should be conceptualised holistically in order to identify the combinations of IT resources required for achieving desired performance outcomes (Melville et al. 2004; Pavlou and El Sawy 2006). While big data-related resources can be purchased from strategic factor markets, higher-order BDR is difficult to copy and imitate. Consistent with RBV's resource complementarity argument, we posit that these diverse resources act in a synergistic fashion.

Marketing Capabilities

RBV is an influential theory in marketing research to examine the link between market-based resources and capabilities, firm performance and competitive advantage. Several typologies of marketing resources and capabilities have been proposed in extant literature (for an extensive review, see Kozlenkova et al. 2014). To inform our firm-level study, we chose the broadest classification that presents marketing capabilities as a strategic firm capability (Krasnikov and Jayachandran 2008; Morgan et al. 2009; Vorhies and Morgan 2005). We define *marketing capabilities (MC)* as the firm's ability to understand and meet customer needs better than competition, and to effectively deliver its products and services to customers (Day 1994; Krasnikov and Jayachandran 2008).

Firm-level, strategic MC encompasses eight distinct lower-level, operational marketing capabilities (Vorhies and Morgan 2005). Four are of them are related to transforming resources into product and services based on the firm's marketing mix processes that include *pricing, product development, channel management, and marketing communications*. Three other marketing capabilities (*market information management, marketing planning, and marketing implementation*) are used to manage marketing mix

capabilities and resource allocations related to their execution. Finally, *selling* capabilities are processes carried out to obtain customer purchases (Vorhies and Morgan 2005).

These lower-level marketing capabilities are interdependent and work in a synergistic fashion (Morgan et al. 2009; Vorhies and Morgan 2005). Similar to BDR, we posit that MC should be conceptualised holistically to account for the joint effects of lower-level marketing capabilities on firm outcomes.

RESEARCH MODEL AND HYPOTHESES

As depicted in Figure 1, we advance a resource-based view (RBV) of how big data resources act to enhance marketing-related capabilities and, ultimately, firm performance.

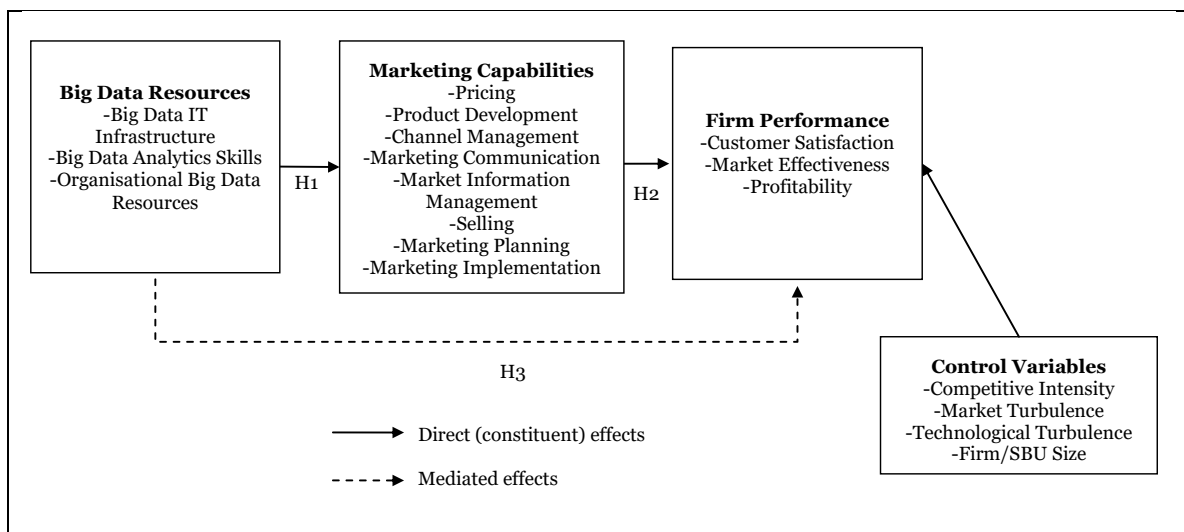


Figure 1. Research Model

IT business value research (Hitt and Brynjolfsson 1996) has adopted resource complementarity arguments to explain the interactions between IT and non-IT resources and capabilities, and how IT impacts performance (Melville et al. 2004). Strategic IT resources do not generally lead to superior firm performance, but those that influence other strategic complementary resources within business processes may gain competitive advantage (Bhatt and Grover 2005). Based on this logic, BDR is an enabler of marketing-related capabilities.

More specifically, BDR enables firms to gain market insights, continuously sense and act on market changes that are critical to execute marketing capabilities successfully (Day

2011). For example, big data resources enable firms to better innovate and optimise any given element of the marketing mix with big data-driven predictive models and experiments (Chen et al. 2012; Einav and Levin 2013; Jelinek 2013). Firms are thus able to tap into customer opinions, understand customer behavior, and converse with customers unlike traditional one-way marketing (Chen et al. 2012; Day 2011). In addition, person-, context-, and location-specific offerings can be tailored based on big data-driven insights (Chaudhuri et al. 2011). Furthermore, data is available in real-time, and at a significantly lower cost than traditional means to tap into customer needs (Jelinek and Bergey 2013). Data-driven firms thus find it easier, faster and cheaper to experiment with the marketing mix to set optimal levels more accurately.

In sum, prior RBV studies suggest that IT resources have a positive effect on non-IT organisational capabilities (Bharadwaj 2000). Consistent with this research, we expect we expect that big data resources provide for more efficient and effective marketing capabilities. Therefore:

H1: Big data resources have a positive effect on marketing capabilities.

In contrast with the unexplored relationship between BDR and MC, the impact of MC on firm performance has received substantial support in prior research (Morgan et al. 2009; Vorhies and Morgan 2005). MC is crucial to understand customers and to deliver offerings that match their needs, and is therefore a key driver of firm performance. Marketing capabilities are rare, valuable, non-substitutable, and imperfectly imitable and thus have potential for superior performance and competitive advantage (Vorhies and Morgan 2005). A meta-analytic study found that MC influences superior firm performance more than other core firm capabilities, R&D and operations capabilities, which can be more easily imitated by competitors (Krasnikov and Jayachandran 2008). In sum, we anticipate that MC has a positive influence on firm outcomes (Morgan et al. 2009; Vorhies and Morgan 2005). Therefore:

H2: Marketing capabilities have a positive effect on firm performance.

IT business value studies have shown that the impact of IT resources and capabilities on firm performance is indirect through interactions with complementary non-IT resources and capabilities (Bharadwaj 2000). We expect that MC acts as the mechanism through which BDR is leveraged. Specifically, the first-order effects of IT are as a critical enabler of more efficient and effective organisational processes, which in turn lead to better firm performance (Kohli and Grover 2008; Mithas et al. 2011). Stated differently, the impact of BDR on firm outcomes can be traced back to MC where efficiency and effectiveness gains would not be possible in the absence of BDR (Kohli and Grover 2008). As such, BDR does not affect firm performance directly but rather provides incremental value for MC (Mithas et al. 2011). Consistent with this line of theorizing, we anticipate that BDR influences firm performance indirectly via the mediating effect of MC. Hence:

H3: The positive effect of big data resources on firm performance is mediated by marketing capabilities.

The impact of MC on firm performance may vary as a function of environmental turbulence (Krasnikov and Jayachandran 2008). We therefore include competitive intensity, market turbulence and technological turbulence as control variables (Kohli and Jaworski 1990). We also control for firm/SBU size by means of annual revenue.

METHODOLOGY

We employed a survey study methodology and administered online questionnaires for data collection. Our sampling frame focuses on strategic business units (SBUs) in large (>1000 employees), US-based, B2C manufacturing and service firms who have invested in big data technologies to support marketing decision making. Using a commercial research panel provider, we targeted senior marketing executives in SBUs across a range of B2C industries. The survey was sent to senior marketing executives in 2497 SBUs, and after a rigorous

screening process, 301 usable responses (12% response rate) were received in return. The data was cleared for non-response biases, which included screening for possible differences in variable means between early and late responders with an independent samples t-test (Armstrong and Overton 1977). No significant differences were found among early and late responders.

All of our measures are directly adopted from or based substantially on scales validated by prior studies (Germann et al. 2013; Vorhies and Morgan 2005), and were measured on a 7-point Likert scale. Measures include first-order reflective and first-order formative scales, one second-order formative, first-order formative construct (Big Data Resources), and two second-order reflective, first-order reflective constructs (Marketing Capabilities and Firm Performance). Constructs, measurement types, item descriptions, formative item weights and reflective item loadings are summarized in Appendix 1.

RESULTS

Measurement model validation included reliability and validity analyses for reflective and formative measures, followed by structural model estimation. Partial Least Squares (PLS) structural equation modeling (Smart-PLS 2.0 M3, Ringle et al. 2005) was used with 5000 bootstraps to estimate the significance levels of measures (Hair et al. 2013).

Measurement Model

Reflectively-measured constructs were assessed in terms of item-level reliability (Appendix 1), construct reliability, and convergent and discriminant validity (Table 1) for both 1st and 2nd order measurement models. All item loadings, composite reliability, and average variance extracted (AVE) exceeded acceptable reliability criteria (Hair et al. 2011), and all measures discriminated well (Fornell and Larcker 1981). 1st order and 2nd order formative measures were validated via multicollinearity (VIF values) and construct validity (item weights, loadings, and their significance levels) testing (MacKenzie et al. 2011; Petter et al. 2007). All

VIF values were below 1.5, which is clearly under VIF's recommended threshold (Hair et al. 2013). Formative indicator weights and their significances (Appendix 1) and loadings (>.70) also showed acceptable psychometric properties for structural model assessment.

Since both independent and dependent measures are obtained from the same source, we used CFA and Harman's single-factor test to assess common method bias (Podsakoff et al. 2003). Eight factors had eigenvalues greater than one, and together they accounted for 59% of the total variance; the first factor accounted for 37% of the total variance. We concluded that common method bias is not likely to be a major concern in this study.

| Construct | Mean | SD | CR | AVE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|--|------|------|-----|-----|------|------|------|------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 1 Big Data Resources | 5.41 | .88 | NA | NA | NA | | | | | | | | | | | | | | | | |
| 2 Big Data Technology Resources | 5.28 | 1.03 | NA | NA | 0.88 | NA | | | | | | | | | | | | | | | |
| 3 Big Data Analytics Skills | 5.48 | .98 | NA | NA | 0.92 | 0.69 | NA | | | | | | | | | | | | | | |
| 4 Organisational Big Data Resources | 5.48 | .92 | NA | NA | 0.83 | 0.64 | 0.67 | NA | | | | | | | | | | | | | |
| 5 Marketing Capabilities | 5.30 | .97 | .95 | .93 | 0.61 | 0.53 | 0.55 | 0.50 | 0.96 | | | | | | | | | | | | |
| 6 Pricing | 5.28 | 1.10 | .85 | .65 | 0.50 | 0.46 | 0.42 | 0.40 | 0.86 | 0.81 | | | | | | | | | | | |
| 7 Product Development | 5.35 | 1.07 | .83 | .61 | 0.56 | 0.46 | 0.52 | 0.47 | 0.86 | 0.73 | 0.78 | | | | | | | | | | |
| 8 Channel Management | 5.29 | 1.10 | .83 | .63 | 0.47 | 0.38 | 0.45 | 0.36 | 0.84 | 0.71 | 0.66 | 0.79 | | | | | | | | | |
| 9 Marketing Communication | 5.32 | 1.08 | .82 | .60 | 0.48 | 0.43 | 0.43 | 0.37 | 0.85 | 0.71 | 0.68 | 0.70 | 0.77 | | | | | | | | |
| 10 Market Information Management | 5.37 | 1.09 | .84 | .64 | 0.52 | 0.47 | 0.45 | 0.45 | 0.87 | 0.69 | 0.70 | 0.67 | 0.71 | 0.80 | | | | | | | |
| 11 Selling | 5.33 | 1.13 | .85 | .66 | 0.54 | 0.48 | 0.51 | 0.41 | 0.86 | 0.68 | 0.69 | 0.66 | 0.69 | 0.74 | 0.81 | | | | | | |
| 12 Marketing Planning | 5.25 | 1.09 | .84 | .64 | 0.54 | 0.46 | 0.48 | 0.45 | 0.87 | 0.72 | 0.72 | 0.69 | 0.68 | 0.73 | 0.71 | 0.80 | | | | | |
| 13 Marketing Implementation | 5.18 | 1.15 | .84 | .64 | 0.59 | 0.50 | 0.54 | 0.51 | 0.86 | 0.69 | 0.73 | 0.67 | 0.68 | 0.70 | 0.70 | 0.75 | 0.80 | | | | |
| 14 Firm Performance | 5.25 | .99 | .91 | .95 | 0.60 | 0.55 | 0.52 | 0.49 | 0.82 | 0.73 | 0.69 | 0.68 | 0.71 | 0.71 | 0.72 | 0.73 | 0.70 | 0.97 | | | |
| 15 Customer Satisfaction | 5.29 | 1.09 | .86 | .67 | 0.54 | 0.47 | 0.47 | 0.46 | 0.72 | 0.63 | 0.59 | 0.59 | 0.63 | 0.62 | 0.65 | 0.65 | 0.59 | 0.89 | 0.82 | | |
| 16 Market Effectiveness | 5.26 | 1.09 | .83 | .62 | 0.52 | 0.47 | 0.47 | 0.38 | 0.72 | 0.65 | 0.60 | 0.60 | 0.63 | 0.61 | 0.62 | 0.64 | 0.61 | 0.88 | 0.67 | 0.79 | |
| 17 Profitability | 5.20 | 1.05 | .86 | .60 | 0.57 | 0.53 | 0.48 | 0.47 | 0.78 | 0.69 | 0.66 | 0.65 | 0.65 | 0.68 | 0.69 | 0.68 | 0.68 | 0.94 | 0.75 | 0.74 | 0.82 |
| NA: not applicable for formative construct | | | | | | | | | | | | | | | | | | | | | |
| √AVE in bold | | | | | | | | | | | | | | | | | | | | | |

Table 1. Descriptive Statistics, Measure Validation, and Latent Variable Correlations

Structural Model

We assessed the structural model with explained variances, standardized beta coefficients, and significance levels with 5000 bootstrap iterations (Hair et al. 2013). The results are illustrated in Figure 2. For ease of presentation, the eight 1st order factors of 2nd order marketing capabilities (MC) are excluded from Figure 2. Their loadings (LV correlations) with the underlying construct MC can be found in Table 1 above.

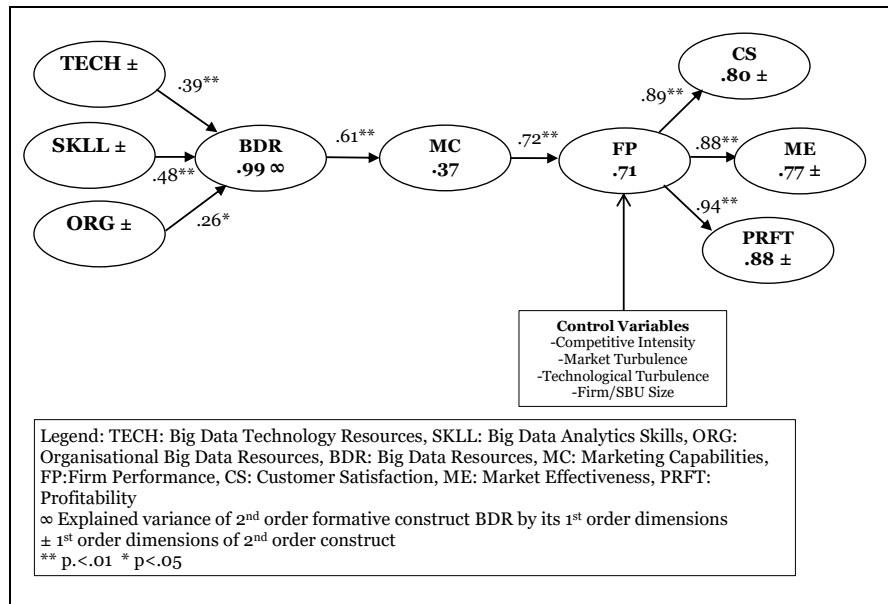


Figure 2. Results

The results reveal that big data resources (BDR) have a significant (.61, $p < .01$) effect on marketing capabilities (MC), explaining 37% of its variance and thus supporting H1. All three dimensions forming BDR make a significant contribution to the underlying second-order construct. Big data analytics skills (SKLL) (.48, $p < .01$) is particularly important contributor to BDR, followed by big data technology resources (.39, $p < .01$) and organisational big data resources (.26, $p < .05$).

As expected, the results show that MC (.72, $p < .01$) is a strong predictor firm performance. H2 is thus supported. Since MC is formally hypothesized (H3) to be a key mediator in the relationship between BDR and FP, we tested for indirect effects separately using the bootstrapping method with 5000 bootstrap resamples (Preacher and Hayes 2008). The results of the mediation hypothesis (Table 2) are interpreted by examining the standardized regression coefficients, and the significance levels, bias-corrected 99% confidence intervals, and standard errors of the indirect effect *ab* (Preacher and Hayes 2008).

| Mediation path | BDR→MC→FP |
|--|---------------|
| a | 0.61** |
| b | 0.69** |
| c | 0.44** |
| c' | 0.09 |
| ab^a | 0.42** |
| SE | 0.04 |
| Bias-C. CI 99% Lower | 0.32 |
| Bias-C. CI 99% Upper | 0.53 |
| R ² | 0.72 |
| Controls | Control→FP |
| Competitive Intensity | -0.01 |
| Market Turbulence | 0.14* |
| Technological Turbulence | 0.05 |
| Firm/SBU Size | -0.04 |
| ** p<.01; * p<.05 | |
| Legend: | |
| Path a: from independent variable to mediator. | |
| Path b: from mediator to dependent variable. | |
| Path c: direct effect. | |
| Path ab: indirect effect. | |
| Path c': direct effect when ab is controlled for | |

Table 2. Mediation Bootstrapping Results

The indirect relationship between BDR and FP (.42, $p<.01$) is highly significant, thus supporting H3. When the indirect effect is controlled for, the direct effect of BDR→FP is insignificant (.09, $p=.07$), indicating that MC fully mediates the impact of BDR on firm performance (Baron and Kenny 1986; Zhao et al. 2010). Finally, control variables had no significant effects on firm performance with the exception of market turbulence (.14, $p<.05$).

DISCUSSION

Research implications

The study makes two important theoretical contributions. Firstly, this study makes a novel theoretical contribution with the parsimonious conceptualisation of big data resources (BDR). The results indicate that BDR is a critical antecedent of marketing capabilities (MC) and firm performance. Consistent with RBV theories, the results suggest that effective BDR requires a set of diverse and complementary big data –related IT resources to exert a joint influence on MC. As informed by qualitative big data literature, the empirical analyses indicate that all three dimensions (big data technology resources, big data analytics skills, organisational big data resources) represent statistically significant, conceptually distinct domains of BDR. However, we found that big data analytics skills are the most critical domain of BDR. The empirical results thus confirm concerns raised by scholars that lack of human talent may be

the greatest impediment to big data success (Davenport and Patil 2012; McAfee and Brynjolfsson 2012).

Second, our study improves understanding of the mechanisms through which (*i.e.*, *how*) and to what extent BDR impacts firm performance. Based on RBV logic and the empirical results, BDR is a valuable, rare, and costly-to-imitate resource (Peteraf 1993) that can be a source of strategic advantage when its value-creating potential is leveraged in marketing processes (Barney and Hesterly 2012; Kohli and Grover 2008). Specifically, the results show that MC fully mediates the relationship between BDR and firm performance. The indirect effect linking BDR with firm performance is substantial (.42, $p < .01$), suggesting that BDR is indeed a source of competitive advantage when leveraged in complementary marketing processes. This study thus lends support recent RBV-based marketing [IS] studies asserting that strategic [IT] resources only have value *potential*, and realizing this value requires alignment with other complementary [IT –enabled] organisational capabilities (Kohli and Grover 2008; Mithas et al. 2011; Morgan et al. 2009).

Managerial Implications

The road to becoming a big data-driven marketing organisation is littered with technological, human and organisational challenges. However, the findings suggest that firms who manage to acquire the appropriate big data resources may achieve competitive advantage over their rivals. We thus advise managers to ensure that all aspects of the firm's overall big data asset are sufficient. Firms should thus not focus solely on their technological big data infrastructure, or on the recruitment of data scientists. An organisational culture that does not encourage big data utilisation may seriously undermine such investments. We urge management to take immediate corrective action if inadequacies in any of these dimensions are observed.

Furthermore, we find that marketing capabilities is the critical link between big data resources and firm performance. Managers should therefore ensure that big data resources are properly aligned with the firm's marketing processes because otherwise they will fail to realise the full benefits from big data investment. Hence, it is imperative that managers evaluate big data resources in the context of their application to support marketing capabilities. To do this, we recommend that managers regularly measure the effectiveness of big data projects on different marketing processes with the appropriate customer, market and financial performance metrics.

Limitations

This study has several limitations, some of which point to opportunities for future research. First, the data in this research was gathered in a cross-sectional format and causal relationships cannot be asserted with complete confidence. Second, we used a single-informant design with self-reported subjective data that may be a source of common method bias, though our tests show that it should be not an issue. Subjective measures have shown a stronger marketing capabilities-firm performance relationship in prior studies (Krasnikov and Jayachandran 2008). Third, the generalizability of results is restricted to large US-based firms/SBUs operating in B2C industries. Finally, this study focused solely on marketing capabilities. Future research may seek to improve understanding about how big data resources influence marketing capabilities when other firm capabilities such as R&D and operational capabilities are controlled for.

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Appendix 1. Measure Descriptions and Item Reliability

| Measure / item | Weight |
|---|---------|
| Big Data Resources (2nd order formative measure) | |
| Big Data Technology Resources | 0.39 ** |
| Big Data analytics skills | 0.48 ** |
| Organisational Big Data Resources | 0.26 * |
| Big Data Technology Resources | |
| Our SBU has a state-of-art Big Data IT infrastructure. | 0.40 ** |
| Our SBU uses Big Data tools to gain a competitive advantage. | 0.41 ** |
| In general, our SBU collects more data than our primary competitors. | 0.51 ** |
| Big Data analytics skills | |
| Our analytics people are very good at identifying and employing the appropriate Big Data analysis tool given the problem at hand. | 0.49 ** |
| Our analytics people have the ability to use many different Big Data analysis tools and techniques. | 0.36 ** |
| Our analytics people can be considered as experts in Big Data analytics. | 0.47 ** |
| Organisational Big Data Resources | |
| If our SBU reduces its Big Data analytics activities, its profits will suffer. | 0.17 * |
| The use of Big Data analytics improves our SBU's ability to satisfy its customers. | 0.37 ** |
| Most people in our SBU are skeptical of Big Data-based results and recommendations. (R) | 0.17 * |
| Our SBU's top management has a favorable attitude towards Big Data analytics. | 0.24 ** |
| Our SBU's annual reports and other publications highlight our use of Big Data analytics as a core competitive advantage. | 0.34 ** |
| Our SBU's top management expects Big Data analyses be used to support important decisions. | 0.28 ** |
| Marketing Capabilities (2nd order reflective measure) | |
| Loading | |
| Pricing | 0.86 ** |
| Product development | 0.86 ** |
| Channel management | 0.84 ** |
| Marketing communication | 0.85 ** |
| Market Information Management | 0.87 ** |
| Selling | 0.86 ** |
| Marketing Planning | 0.87 ** |
| Marketing Implementation | 0.86 ** |
| In the most recent year, relative to your major competitors, how has your SBU performed with respect to: | |
| Pricing | |
| Using pricing skills and systems to respond quickly to market changes. | 0.82 ** |
| Doing an effective job of pricing products/services. | 0.81 ** |
| Monitoring competitors' prices and price changes. | 0.80 ** |
| Product development | |
| Ability to develop new products/services. | 0.80 ** |
| Successfully launching new products/services. | 0.78 ** |
| Ensuring that product/service development efforts are responsive to customer needs. | 0.77 ** |
| Channel management | |
| Strength of relationships with distributors. | 0.80 ** |
| Attracting and retaining the best distributors. | 0.76 ** |
| Adding value to distributors' businesses. | 0.81 ** |
| Marketing communication | |
| Developing and executing advertising programs. | 0.75 ** |
| Brand image management skills and processes. | 0.79 ** |
| Managing corporate image and reputation. | 0.78 ** |
| Market Information Management | |
| Gathering information about customers and competitors. | 0.80 ** |
| Making full use of marketing research information. | 0.79 ** |
| Analyzing our market information. | 0.81 ** |
| Selling | |
| Giving salespeople the training they need to be effective. | 0.84 ** |
| Sales management skills. | 0.79 ** |
| Providing effective sales support to the sales . | 0.81 ** |
| Marketing Planning | |
| Marketing planning skills. | 0.82 ** |
| Marketing management skills and processes. | 0.80 ** |
| Thoroughness of marketing planning processes. | 0.78 ** |
| Marketing Implementation | |
| Organizing to deliver marketing programs effectively. | 0.78 ** |
| Translating marketing strategies into action. | 0.79 ** |
| Executing marketing strategies quickly. | 0.83 ** |
| Firm Performance (2nd order reflective measure) | |
| Loading | |
| Customer Satisfaction | 0.89 ** |
| Market Effectiveness | 0.88 ** |
| Profitability | 0.94 ** |
| In the most recent year, relative to your major competitors, how has your SBU performed with respect to: | |
| Customer Satisfaction | |
| Customer satisfaction | 0.81 ** |
| Delivering value to your customers | 0.81 ** |
| Delivering what your customers want | 0.84 ** |
| Market Effectiveness | |
| Growth in sales revenue | 0.76 ** |
| Acquiring new customers | 0.80 ** |
| Increasing sales to existing customers | 0.80 ** |
| Profitability | |
| Business unit profitability | 0.76 ** |
| Reaching financial goals | 0.78 ** |
| Return on investment (ROI) | 0.76 ** |
| Return on sales (ROS) | 0.78 ** |
| *p<.05 ** p<.01 | |
| α formative item weights in bold | |