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Technical Report

Project Results: Recommendations for EU Policymakers and Enterprises

Executive summary

Big data analysis has become a source of competitive advantage for businesses and even whole economies. Big data is indeed a critical issue for the digital economy, innovation and services that are expected to drive growth and job creation in the EU. Compared to the USA, however, the EU has been slow in the adoption of big data analysis. In particular, performance may be improved by investing in and making use of big customer data to offer goods and services that better meet customer needs, i.e., "big data-driven marketing (BDM)". However, adopting BDM has a steep learning curve due to organizations' lack of understanding regarding the diverse factors required to succeed.

Against this backdrop, the BIDAMARK project aims to assess (1) investment into big data, i.e., how the acquisition and/or internal development of strategic big data –related resources improve firm marketing strategy, and ultimately, firm performance; and (2) utilization of big data, i.e., how the organizational use of customer insights in marketing decision-making helps firms offer goods and services that better meet customer needs, and ultimately, improve firm profitability. To address these issues, a multivariate analysis of a multi-industry sample of 301 US-based firms is implemented.

Three important results were found in relation to big data investment. First, the results show that despite the challenges associated with big data, firm performance increases 11-12% as a result of big data resources, as opposed to previously reported 5-6% increases with prior (pre-big data) IT investment. Second, this study identifies and assesses the relative importance of three critical IT resources: big data-related (1) technology; (2) analytics skills; and (3) organizational resources, all of which are confirmed as necessary and complementary dimensions for superior data-driven performance. Third, this study highlights the critical role of the firm's adopted business strategy in driving big data success: Differentiating firms are far more likely to benefit from big data than cost leadership firms.

Three important results were also found in relation to big data utilization. First, this study highlights the role of information quality (IQ) in predicting big data customer analytics use. In particular, the format (visualization) of customer information is the most critical aspect of IQ. Second, big data customer analytics use, and personalization as its most crucial dimension, is found to be a key predictor of firm performance. Third, the performance impacts of big data customer analytics use are highly contingent on its prevalence within an industry, i.e., competitive advantage can be imitated away by rivals. However, hyper-personalization afforded by big data-driven customer insights makes the firm's customers less vulnerable to competitor moves when strong customer relationships are built.

The results of BIDAMARK can be exploited in guiding big data –related policymaking in public bodies related to society and citizens as consumers, and strategic decision-making in firms investing and utilizing big data for better competitiveness.

1. Background

Big data analysis has become a source of competitive advantage for businesses and even whole economies. Big data is indeed a critical issue for the digital economy, innovation and services that are expected to drive growth and job creation in the EU. Compared to the USA, however, the EU has been slow in the adoption of big data analysis. Fortunately, big data opportunities still exist in many business sectors to improve the competitiveness of European firms. In particular, performance may be improved by investing in and making use of big customer data to offer goods and services that better meet customer needs, i.e., "big data-driven marketing (BDM)".

The marketing function (marketing, sales and customer service) is the top driver of big data initiatives. Big data enables firms to better innovate and optimize any given element with big data-driven predictive models and experiments. Web, text, sentiment, social network, mobile, and sensor-based analytics can be used to analyze multi-structured customer data to build predictive models that outperform those that can be generated using legacy customer relationship management (CRM) and business intelligence (BI) tools. Unlike traditional one-way marketing, firms are thus able to tap into customer opinions, understand customer behavior, and converse with customers. In addition, person-specific, context-specific, and location-specific offerings and communications can be tailored by big data-driven insights. Furthermore, data is available in real-time and at a significantly lower cost to tap into customer needs. Big data-driven marketing organizations thus find it easier, faster, and cheaper to orchestrate and experiment with the marketing mix to set optimal levels.

However, adopting BDM has a steep learning curve due to organizations' lack of understanding regarding the diverse factors irequired to succeed. Various industry reports posit that the main challenges that hinder firms from reaping greater rewards from big data are related to three major categories: Big data –related (1) IT infrastructure; (2) human skills and talent; and (3) organizational structure. 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. McKinsey Global Institute's (2016) report describes how the value potential of big data remains widely uncaptured and unexploited by governments and firms today. According to their analysis, US retailing realized only 30-40% of big data's estimated value whereas the European public administration and US health care sector lagged even further behind with a modest 10-20% being captured.

For the majority of firms, a disconnect exists between the collection of data, and the actual usage of data in decision-making. This utilization gap is often cited as one of big data's greatest challenges. Despite virtually unlimited access to diverse customer data, and advances in sophisticated data management tools, only an estimated 35% of marketing decisions are made based on analytics-driven customer information (CMO Survey 2016).

Against this backdrop, this research project offers guidance to EU policymakers and European firms how to reach the value potential of big data.

2. Objectives and research approach

This research project examines two inter-related phenomena: (1) investment into big data, i.e., how the acquisition and/or internal development of strategic big data –related resources improve firm marketing strategy, and ultimately, firm performance; and (2) utilization of big data, i.e., how the organizational use of customer insights in marketing decision-making helps firms offer goods and services that better meet customer needs, leading to higher firm profitability.

To answer these questions, the research was divided into two separate studies, "Study 1: Investment into big data"[2] and "Study 2: Utilization of big data"[3].

A multi-industry sample of was collected from large (>1000 employees), US-based, B2C manufacturing and service firms who had invested in big data technologies. The survey as sent to executives in 2,497 firms, and 301 responses (12% response rate) were returned. The survey data was then analyzed with structural equation modeling to account for all possible cause-effect relationships simultaneously.

3. Study 1: Investment into big data

Study 1 addresses the urgent need to understand how firms could gain returns from big data investment as part of a successful marketing strategy. To overcome technological, skill-based and organizational challenges, firms need to acquire or develop internally a set of complementary IT resources necessary to utilize big data: (1) big data technology resources; (2) big data analytics skills; and (3) organizational big data resources.

Extant research has not examined how and to what extent big data resources enhance firm marketing capabilities (pricing, product development, channel management, communications, market intelligence, marketing planning and implementation, selling) and, by extension, firm performance. In addition, this research investigates whether these relationships differ as a function of the firm's chosen low-cost versus differentiation business strategy. While some firms focus on a cost leadership advantage by reducing costs across internal processes, other firms pursue a differentiation advantage by employing an external focus to understand their market environment, i.e., customers, competitors and innovations, better than their industry rivals.

The research question, thus, combines these as:

> **How can firms achieve competitive advantages from their big data-engendered marketing capabilities and how does the choice of corporate business strategy affect the business impact of big data investment?**

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[2] Full study available at: https://zenodo.org/record/823660#.WW4lQoiGOUk)
[3] Full study available at: https://zenodo.org/record/823666#.WW4lioiGOUk)

3.1 Results

Three important results were found in Study 1. First, this research shows that investment into big data resources enhances marketing capabilities by 25% on average, which in turn improve firm performance by 11-12%. Importantly, these findings confirm that even if most firms have not yet learned how utilize big data to its fullest potential, the big data-driven advantage is still double in comparison to (pre-big data) business intelligence (BI) and marketing analytics that typically account for 5-6% increases in firm performance, according to prior research.

Second, this study sheds light on the mechanisms through which specific big data-related IT resources, in combination, influence performance. While all three dimensions necessary and distinct domains of strategic big data resources, big data analytics skills is the most important resource in predicting better firm performance, followed by big data-related technology, and organizational resources (data-driven culture and top management support). Importantly, the relative importance of the three resources remained unchanged across firm and industry characteristics, lending support for the generalizability of these findings.

Third, this study highlights the critical role of the firm's adopted business strategy in driving big data success. More specifically, big data resources enhance firm performance by 13% in differentiating firms. In stark contrast, firms competing on the basis of cost leadership achieve only a 3% increase in performance attributable to investment into big data resources. Therefore and contrary to prior belief by industry press that industry characteristics largely determine the value potential of big data, it appears that firms' choice of strategy is more important - differentiating firms are far more likely to benefit from big data than cost leadership firms, regardless of industry sector.

4. Study 2: Utilization of big data

Study 2 examines whether big data customer analytics use –the extent to which customer information derived from big data analytics guides customer-focused marketing decisions - improves customer relationship management (CRM) decision-making, consequently leading to higher performance and competitive advantage. According to the Boston Consulting Group (2016), big data is expected to transform firm CRM strategy in all key areas encompassing marketing effectiveness, pricing and revenue management, segmentation and personalization, customer lifecycle assessment, and customer loyalty and churn analysis.

Despite the potential benefits, the utilization gap remains since only an estimated 35% of marketing decisions are made based on analytics-driven customer insights (CMO Survey 2016). This study identifies information quality (IQ), and big data- and customer-oriented cultures, as the key predictors that either facilitate or inhibit the utilization of big data-driven customer insights in managerial decision-making. In addition, it is unclear whether

the competitive advantage, if any, afforded by big data customer analytics use is sustainable when its use is highly prevalent in the firm's industry, i.e., whether big data customer analytics use is vulnerable to imitation by industry rivals. To address these crucial knowledge gaps, Study 2 addresses three research questions related to big data utilization:

What are the key drivers of big data customer analytics use in firms?

How, and to what extent, does big data customer analytics use influence customer relationship performance, and, ultimately, financial performance?

Is competitive advantage, if any, achieved through big data customer analytics use contingent upon its prevalence within an industry?

4.1 Results

Study 2 also revealed three important results. First, this study highlights the role of information quality (IQ); i.e., the overall quality of big data-driven customer insights as perceived by decision-makers, in enhancing big data customer analytics use in firms. Overall IQ is divided into four dimensions. In the big the data (4V's) context, big data analytics is expected to provide firms with customer insight that is accurate (Volume, from large volumes of data), complete (Variety, from various types of data), timely (Velocity, from real-time parallel processing), and delivered to business decision-makers in understandable format (Visualization). The findings reveal that while all four dimensions represent necessary characteristics of customer insights, the relative importance of Visualization is most critical for decision-makers. In contrast, the completeness of customer insights is the least important dimension. The results also indicate that customer orientation and big data analytics culture are pre-requisites for big data customer analytics use, albeit far less important than the quality of the information itself.

Second, the findings confirm big data customer analytics use as a key predictor of firm performance, and more specifically, that big data customer analytics use primarily influences financial performance indirectly via customer relationship performance (higher customer acquisition, satisfaction, and retention). The results also underscore personalization of the marketing mix as the key dimension of big data customer analytics use.

Third, the performance impacts of big data customer analytics use are highly contingent on the prevalence of big data customer analytics use within an industry. The findings further indicate that big data customer analytics use only leads to superior financial performance directly when big data analytics use is low among industry competitors. When the industry prevalence of big data analytics use is high, firms may still achieve sustainable competitive advantage indirectly through better customer outcomes. Thus, the

results suggest that while some of the competitive advantage afforded by big data can be imitated away by rivals, the hyper-personalization afforded by big data makes the firm's customers less vulnerable to competitor moves, allowing the firm to partially escape the game of competition and imitation.

5. Recommendations for EU policymakers and enterprises

The results of BIDAMARK can be exploited in guiding big data –related policymaking in public bodies related to society and citizens as consumers, and strategic decision-making in firms investing in and utilizing big data for better competitiveness.

This research project has important implications for EU society and firms because becoming a big data-driven economy is inhibited by technological, human and organizational challenges. Firms that acquire or develop big data resources to overcome these challenges can achieve competitive advantages over their rivals. Competitive advantage is realized when appropriate investment into complementary big data assets is transformed into actionable insights, which in turn are utilized to improve core organizational processes in marketing (the focus of this research), manufacturing and operations, and R&D.

The key for policymakers and business managers is to understand what they can do to maximize the likelihood that investments into new big data-related technologies, skills and organizational structures result in the creation of business value though big data-driven decision-making. According to this study's findings, the value potential of big data through efficiency and effectiveness gains improve firms' overall marketing capability by 25%, which in turn increases firm performance by 11-12%. In terms of efficiency, big data helps firms automate and optimize organizational processes to reduce operating costs and save time. In terms of effectiveness, big data enables firms to gain market insights, continuously sense and act on market changes that are critical to execute marketing capabilities successfully, i.e., to provide products and services that better meet consumer needs.

In practice, however, many organizations fail to make full use of big data-driven insights to guide marketing decisions. Public policymakers should thus continue to make a concerted effort to finance, communicate and educate public and private bodies to make big data an organizational priority to encourage further investment into big data technologies, skills and organizational structures.

5.1 Recommendations for EU policymakers

5.1.1 Data scientists are key to big data success

Most importantly, there is a pressing need to develop more data scientist educational programs to meet the increasing demand from EU firms. According to this study's findings, the lack of human talent - people who know how to derive actionable insights

from patterns in large quantities of multistructured data, and how to develop predictive models and algorithms that facilitate corresponding business decisions and organizational processes - is the greatest impediment to big data success. The training programs should include versatile elements to develop people who possess rare combinations of skills in mathematics, programming, business knowledge, interpersonal skills, and customer focus.

5.1.2 Big data technology market creates jobs

There are three important reasons to pursue EU policies that promote big data technology investment within the EU in both public and private sectors. First, the vendor market for big data technologies has grown 40% annually, from $3.2 billion in 2010 to $16.9 billion in 2015 and this growth is expected to continue at a 23% rate over 2015-2019 with annual spending reaching $48.6 billion by 2019 (IDC 2015). The big data technology industry grows at a considerably faster rate than the ICT industry on average, and will thus become an even more important source of employment opportunities in the EU in the near future.

In order to support investment into big data IT infrastructure, policymakers should communicate that even if big data technologies do not always provide firms with a competitive advantage in mature data-driven industries, big data is likely to become at least a necessary pre-requisite for competitive parity and firm survival in global markets. When legacy enterprise systems such as CRM, BI, enterprise resource planning (ERP) and supply chain management (SCM) became more prevalent, they were no longer considered sources of differential performance but rather strategic necessities to manage the firm's massive customer databases and operational processes.

5.1.3 Big data assets improve competitiveness

Second and coupled with complementary human skills, there is likely to be a significant boost to the competitiveness of European firms through efficiency and effectiveness gains that are achievable with big data-enabled organizational processes. Policymakers should consider strategies that would encourage EU firms to make investment decisions into novel, non-relational technologies that are necessary to handle big data, and beyond the capability of current relational databases and legacy systems. Since investment into non-relational IT infrastructure is substantial and makes prior investment into legacy systems partially obsolete, firms need strong incentives to make the step up to state-of-the-art big data technologies.

In particular, EU policymakers are advised to pay special attention to the development of big data visualization technologies. Human decision-makers demand easily understandable and real-time insights to make data-driven business decisions. Developments in big data visualization tools currently lag behind non-relational storage, management, integration and analytics technologies, underlining the need to allocate resources to this domain.

5.1.4 Big data improves EU citizens' quality-of-life, pending privacy issues

Third, citizens as consumers will enjoy higher quality-of-life as a consequence of highly personalized offerings that match their individual preferences. In addition, more efficient marketing processes and optimized omnichannel marketing ensure convenience and easier access to products and services at a lower cost. Big data mobile technologies, for example, bring tailor-made solutions to consumers' mobile devices that combines location data with other psychological and behavioural data to create a unique profile that enables micro-segmentation and the provision of hyper-personalization. However, personal data protection concerns prevail.

As a crucial element in EU's strategy to become a data-driven economy, policymakers should prioritize the legislation issues related to personal data privacy and security, and ideally strive for the standardization of global personal data protection laws. At this point in time, EU enterprises are coping with more stringent personal data legislation than US – based competitors, contributing to partial competitive advantages for the latter. The EU-U.S. Privacy Shield (http://europa.eu/rapid/press-release_IP-16-2461_en.htm), a new framework that protects the fundamental rights of anyone in the EU whose personal data is transferred to the United States as well as bringing legal clarity for businesses relying on transatlantic data transfers, is an important initial step in the right direction not only to protect citizens' personal data but also to improve the competitiveness of EU enterprises.

5.2 Recommendations for EU enterprises

5.2.2 Build a complete strategic big data asset

At the strategic level, we advise EU firms to pay special attention that all aspects of the firm's overall big data asset are sufficient, if not perfectly balanced. Firms should not focus solely on their technological big data infrastructure or on their recruitment of data scientists. Lack of data-driven organizational culture, i.e., shared values and norms that encourage decision-makers to utilize big data-driven insights, can seriously undermine big data's utilization and business value potential that cannot be compensated for by excelling in big data analytics, for example. Top executive leadership and vision are also crucial to ensure that middle management support big data-driven decision-making, especially given that people are not naturally inclined to trust or understand data-based models but rather professional experience and intuition. In addition, since the people who carry out big data analyses are not the same people who use resulting market insights, a big data analytics culture plays a critical role in promoting shared values across different groups to gain organizational buy-in. In sum, firms should to take immediate corrective action if inadequacies in any of the three complementary big data assets – technology, skills, organizational culture - are observed.

5.2.2 Make full use of big data insights

Managers should carefully consider whether the potential of big data investment is being fully utilized in their respective firms. More specifically, EU enterprises should take note

that the customer-sensing advantages of big data insights outweigh the efficiency advantages achieved through the automation and optimization of marketing processes. Firms seeking to differentiate themselves from competition need to understand what their customers want and, by offering new products and services accordingly, will then be poised to reap greater rewards from a big data-driven marketing strategy than will cost-focused firms. That is, big data particularly enhances marketing capabilities by helping them become more adaptive to continuous changes in the market. Differentiating firms can still utilize big data to enhance marketing efficiency to maintain relative cost parity while cost leadership firms, in turn, may not be equally apt to improve marketing effectiveness through a better understanding of customer needs and new product and service innovations. B2C manufacturing firms should note that they may be in a particularly favorable position compared to other data-driven industry sectors. The advent of sensor-based analytics ("The Internet of Things") and the lower adoption of big data may represent greater opportunities in B2C manufacturing than in the retail, e-commerce, finance, and banking sectors.

5.2.3 Align big data with business processes

At the business process level, EU enterprises should ensure that big data initiatives are properly aligned with the firm's marketing processes that include pricing, product development, channel management, communications, market intelligence, marketing planning and implementation, and selling. Managers should always assess the feasibility of big data resources in the context of their application to different marketing activities. To do this, managers should regularly measure the impact of big data projects on different marketing processes in terms of efficiency, effectiveness, and innovativeness by identifying the most appropriate customer, market, and financial performance metrics.

5.2.4 Provide easy-to-understand insights for decision-makers

At the decision-making level, EU firms are advised to pay special attention to the overall quality of insights, and in particular, to the visualization aspect in order to enhance managerial decisions made on the basis of big data analytics. This study suggests that only easily interpretable customer insights are likely to be used by non-technical business decision-makers, regardless how high-quality such information is in substance. The completeness of customer insight is the least important dimension, possibly reflecting the pace at which markets and consumers are changing, favoring less in-depth analyses that provide rapid, moderately accurate and easily understandable results to respond to market changes as soon as possible, preferably in real-time. In real-world managerial decision-making, short estimation periods with reduced information and data volume are more realistic and often sufficient to derive adequately informed decisions.