Relative Importance of Key Requirements of Business Analytics 3.0. : An Empirical Study

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Abstract— **The main objective of this study is to assess the relative importance of the ten key requirements proposed by Thomas H. Davenport that will help a firm capitalize on business analytics 3.0. Drawing on data collected from 34 experts in the field through an online survey, the study assesses the relative importance of each requirement and proposes a set of new complementary requirements. Finally, implications for business analytics research, theory and practice are discussed.**

Keywords- big data; business analytics; analytics 3.0; requirements; empirical study.

I. INTRODUCTION

Big data analytics (BDA) and related topics have attracted a huge interest from both scholarly and business literatures [1] [2] [3], mainly due to their high operational and strategic potentials. For example, the BDA market that includes sales of related hardware, software and services was estimated to about $18.6 billion in 2013, representing an approximate growth rate of almost 58% over 2012 [4]. The worldwide market of BDA is expected to reach $125 billion in 2015 [5].

Recently, Thomas H. Davenport [1] pointed out that we were moving into the 'Analytics 3.0' era, an era in which 'big data will power consumer products and services'. Even if business analytics 3.0 holds the capability of transforming competition and thus competitive advantage, many managers are still struggling to capture its business value. In order to help a firm capitalize on business analytics (BA) 3.0, Thomas H. Davenport proposed 10 requirements. However, we know from the information technology (IT) innovation history that the acceptance of any given IT innovation within the business ecosystem depends on the change of the perceived benefits or risks related to the said innovation. Therefore, it is critical to assess the importance of the proposed 10 requirements as enablers of competitive advantage though the adoption and use of 'Analytics 3.0'. More specifically, the main objective of this study is to answer the following questions:

- What is the relative importance of the 10 requirements proposed by Thomas H. Davenport [1]?
- Are we missing some important requirements?

The paper is organized as follows. After the introduction in Section 1, we discuss some of the relevant papers for the study, with an emphasis on business analytics requirements, as well as a discussion on the 10 requirements proposed by Thomas H. Davenport [1] in Section 2. In Section 3, we present the methodology used in the study. In Section 4, our results and discussion are presented. Finally, we conclude the study and propose some future research directions in Section 5.

II. LITERATURE REVIEW

IT has been recognized as an important tool for firm optimization for high level competitive advantage achievement and realization. However, we know from the IT innovation history that the acceptance of any given IT innovation within the business ecosystem depends on the change of the perceived benefits or risks related to the said innovation. The Internet is the classic example. Indeed, developed in the early 1970s, Internet acceptance by the business ecosystem only happened in the late 1990s mainly because of the "change in the business perceptions of value based on the advent of fast, reliable and low cost hypertext markup language applications" [6]. Radio frequency identification, another IT innovation that is considered to be at the core of the so called 'Internet of Things' was expected to transform how firms conduct their operations [7]. However, recent studies on the topic showed that the adoption and use of RFID is slower that predicted mainly because of technological, data management, security and privacy, organisational and financing issues [7] [8].

In [9], the author suggests not starting a big data project unless a firm has a clear business objective to achieve with the adoption and use of big data. He further proposes to make sure that any firm that is planning to access internal and external data sources needs to secure this access (e.g., using Application programming interface, pricing in case of external data sources), and develop mechanisms that ensure of the data quality.

According to [10] : "big data isn't just data growth, nor is it a single technology; rather, it's a set of processes and technologies that can crunch through substantial data sets quickly to make complex, often real-time decisions". She argued that big data analytics will require an "infrastructure that spreads storage and compute power over many nodes, in

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order to deliver near-instantaneous results to complex queries".

In [11], the authors suggest that the realization of the high operational and strategic potential of big data in the healthcare context requires: a clear understanding of user needs and requirements of the various stakeholders of healthcare (e.g., patients, clinicians and physicians, healthcare provider, payers, pharmaceutical industry, medical product suppliers and government), followed by the alignment of this objective with big data technologies.

In [12], the author proposes the top 5 requirements that make big data work for all stakeholders involve in an adoption project, namely: (1) the necessity of having a good big data infrastructure, (2) no need to pre-plan, pre-think, or pre-limit your analysis, (3) the ability to analyze the data universe, (4) pre-built analytics to do analysis faster, and (5) easy to use with familiar, excel-like interface.

In [13], a scholar from the firm SAS highlights a seven steps strategy necessary for realizing the full potential of big data : (1) data collection from various data sources that are distributed across multiple nodes (e.g., a grid which processes a subset of data in parallel), (2) process that analyses the data, (3) management of data (e.g. data needs to be understood, defined, annotated, cleansed and audited for security purposes), (4) measure (e.g., measure the rate at which data can be integrated with other customer behaviors or records, and whether the rate of integration or correction is increasing over time). She argued that "business requirements should determine the type of measurement and the ongoing tracking", (5) consume. Here, Dyche [13] argues that we need to make sure that "the resulting use of the data should fit in with the original requirement for the processing", (6) store: for storage, Dyche states that "whether the data is stored for short-term batch processing or longer-term retention, storage solutions should be deliberately addressed", (7) data governance that includes the policies and oversight of data from a business perspective. For Dyche, "data governance applies to each of the six preceding stages of big data delivery. By establishing processes and guiding principles, governance sanctions behaviors around data. And big data needs to be governed according to its intended consumption. Otherwise, the risk is disaffection of constituents, not to mention overinvestment".

In [2], the authors defined BDA as a holistic approach to manage, process and analyze the "5 Vs" data-related dimensions (i.e., volume, variety, velocity, veracity and value) in order to create actionable insights for sustained value delivery, measuring performance and establishing competitive advantages. Therefore, it is critical to look at each requirement related to the BDA "5 Vs" to achieve expected business value.

III. METHODOLOGY

Given the exploratory nature of the adoption and use of big data and analytics for improved decision making and competitive advantage, as well as the scarcity of prior studies on these topics, a web-based survey was used to collect data among big data and analytics experts. The survey was designed using the 10 requirements proposed by Thomas H. Davenport [1]. Each requirement was measured using a seven-point Likert scale with anchors ranging from strongly disagree (1) to strongly agree (7). Also, all respondents were asked to specify any new requirement they believed is very important in achieving the expected business value from big data and analytics. The data collection started on the February 11, 2014 and ended on March 13, 2014. A personalized invitation was sent to 37 big data and analytics experts identified via LinkedIn specialized groups on big data and analytics. Of the 37 invited experts, 35 agreed to participate in the study. After a careful analysis of all responses, we found that 34 questionnaires were correctly filled out and appropriate for further analysis.

IV. RESULTS AND DISCUSSION

TABLE I presents the analysis of respondents by age, gender, and the level of education. From the table, we can see that the vast majority of the respondents are aged more that 50+ (18 (51%)), followed by 10 (29%) who are aged between 34-41 years old. Also, we have 6 respondents (17%) that are aged between 42-49 years. Only 1 respondent is aged between 26-33 years. The same table shows that 86% of respondents are males and 14% are females. Regarding the level of education, 97% of the respondents hold a postgraduate degree (Masters or Ph.D.), and only one respondent (3%) has an undergraduate degree, and thus showing that the panel of experts is clearly dominated by very highly educated people. Finally, the sample is composed of respondents with a range of profile and responsibilities' including: President or CEO (2), Assistant Professor (2), Professors (Marketing, MIS, Operations and Information Systems) (10), Assistant Commissioner (1), Director (e.g., Operations and practice lead, Purchasing) (4), Consultants (2), Associate Professor (4), Partner (1), Doctoral Researcher (1). It should be noted that not all respondents provided their title and responsibilities.

TABLE I. ANALYSIS OF RESPONDENTS BY AGE, GENDER AND EDUCATION

Age	
26-33	1 (3%)
34-41	10 (29%)
42-49	6 (17%)
50+	18 (51%)
Total	35 (100%)
Gender	
Male	30 (86%)
Female	5 (14%)
Total	35 (100%)
Education	
Undergraduate degree	1 (3%)
Postgraduate degree (Master/Ph.D.)	33 (97%)
Total	34 (100%)

TABLE II displays the analysis of respondents by business association. The vast majority of respondents are from the education sector (67%), followed by 9% from the professional, scientific, and technical activities, 6% from both 'Information and communication' and 'Other service activities'. Finally, the 'Administrative and support service

activities', 'Electricity, gas, steam and air conditioning supply', 'Human health and social work activities' and 'Manufacturing' each represent 1% of respondents.

TABLE II. ANALYSIS OF RESPONDENTS BY BUSINESS ASSOCIATION

Administrative and support service activities	1 (3%)
Education	22 (67%)
Electricity, gas, steam and air conditioning supply	1 (3%)
Human health and social work activities	1 (3%)
Information and communication	2 (6%)
Manufacturing	1 (3%)
Professional, scientific and technical activities	3 (9%)
Other service activities	2 (6%)
Total	33 (100%)

TABLE III presents a summary of the important points related to the assessment of the 10 proposed BA requirements.

From the table, we can observe that all respondents, by and large, agree with all proposed requirements by [1]. All the requirements have an average rating higher than 5 and 8 out of 10 of the requirements have an average rating higher than 6. This suggests that the panels not only validate the proposed 10 requirements but also agree with their relative importance in capturing the business value from BA. Based on the rating, the top 4 requirements are as follow: "R1: Multiple types of data often combined" (1st), "R10: New ways of deciding and managing" (2nd), "R2: A new set of data management options" and "R6: Cross-disciplinary data teams" both in the 3rd place.

From the answers of the respondents regarding new important requirements that are missing from Thomas H. Davenport [1], we generated a consolidated list of four (4) high level requirements namely: 1. Corporate culture and capability, 2. Social issues (e.g., ethic, privacy, legal), 3. Analytics tools capability (e.g., data and results presentation, visualization) and 4.Talent management (e.g., training, skills). These are the four important requirements suggested by our panel members (TABLE IV.).

TABLE III. RESPONSES SUMMARY (NUMBER OF RESPONDENTS (%))

Requirements	Strongly Disagree(1)	Moderately Disagree (2)	Slightly Disagree (3)	Undecided (4)	Slightly Agree (5)	Moderately Agree (6)	Strongly Agree (7)	Total	Average rating
R1: Multiple types of data often combined	0 (0%)	0 (0%)	1 (3%)	0 (0%)	4 (12%)	7 (21%)	22 (65%)	34 (100%)	6.44
R2: A new set of data management options	0 (0%)	0 (0%)	1 (3%)	1 (3%)	5 (15%)	12 (35%)	15 (44%)	34 (100%)	6.15
R3: Faster technologies and methods of analysis	0 (0%)	0 (0%)	1 (3%)	1 (3%)	7 (21%)	10 (29%)	15 (44%)	34 (100%)	6.09
R4: Embedded analytics	0 (0%)	1 (3%)	1 (3%)	3 (9%)	4 (12%)	6 (18%)	19 (56%)	34 (100%)	6.06
R5: Data discovery	0 (0%)	0 (0%)	2 (6%)	1 (3%)	5 (15%)	10 (29%)	16 (47%)	34 (100%)	6.09
R6: Cross-disciplinary data teams	0 (0%)	1 (3%)	2 (6%)	1 (3%)	3 (9%)	7 (21%)	20 (59%)	34 (100%)	6.15
R7: Chief analytics officers	1 (3%)	0 (0%)	5 (15%)	4 (12%)	5 (15%)	12 (36%)	7 (21%)	33 (100%)	5.24
R8: Prescriptive analytics	1 (3%)	0 (0%)	0 (0%)	1 (3%)	9 (27%)	7 (21%)	16 (48%)	33 (100%)	6.00
R9: Analytics on an industrial scale	0 (0%)	0 (0%)	3 (9%)	0 (0%)	10 (29%)	12 (35%)	9 (26%)	34 (100%)	5.71
R10: New ways of deciding and managing	0 (0%)	0 (0%)	0 (0%)	3 (9%)	1 (3%)	14 (41%)	16 (47%)	34 (100%)	6.26

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TABLE IV PROPOSED COMPLEMENTARY REQUIREMENTS

1. Corporate culture and capability	1.1. Ability to analyse situations instead of making decisions mostly on positional power 1.2. Ability to distinguish between issues that require qualitative vs. quantitative analysis 1.3. General ability to evaluate and analyse information (e.g., widespread numeracy in corporations) 1.4. Corporate culture must view analytics as a BUSINESS decision instead of a Technology issue 1.5. Corporate should couple data science with business judgment in order to leverage investment in analytics 1.6. Corporate success in deploying analytics should be to answer contemporary business questions with strategic impact
2. Social issues (e.g., ethic, privacy, legal)	2.1. Ethic is an important issue in data gathering and use for big data 2.2. Requirement to consider legal and social ramifications (e.g., privacy and ethic) of new analytic techniques and results when applied to big data (e.g., social media)
3. Analytics tools (e.g., data and results presentation, visualization,)	3.1. Requirement for good analytic tools with improved data and results presentation 3.2. Need to develop integrated analytic frameworks that allow dynamic evolution of problems solutions as problem spaces morph 3.3. Need for effective interchange standard for importing and exporting data 3.4. Advanced analytics means using and providing open data 3.5. Need for the integration of analytics tools with a knowledge management systems and strategy 3.6. Need for the presentation of the results in various formats that are understandable to senior decision-makers who are not numerate 3.6.1. Visualization is not enough, as they are also not comfortable with graphs: verbal, logical 'translations' are needed. 3.6.2. Need for improved analytics visualization tools (e.g., dynamic Visualization) 3.6.2.1. Requirement to have our data and plots constantly updated in real-time 3.7. Need to combine analytics tools with techniques for risk assessment and design of risk responses
4. Talent management (e.g., training, skills)	4.1. Need to define the concept of an "Analytic Scientist" or “Data Scientist” and how to educate him/her 4.2. Need for human skills development to need new challenges created by analytics

Regarding the corporate culture and capability, for example, our respondents believe that corporations should develop their ability to analyse situations rather than making decisions mostly on positional power, distinguish between issues that require qualitative vs. quantitative analysis, and evaluate and analyse information (e.g., widespread numeracy in corporations). Also, corporate culture must view analytics as a business decision instead of a technology issue and should couple data science with business judgment in order to leverage investment in analytics. Furthermore, corporate success in deploying analytics should be to answer contemporary business questions with strategic impact.

Regarding social issues (e.g., ethics, privacy, legal), our respondents believe that firms should start paying attention to these important issues. They estimate that ethics is an important issue in data gathering and use for big data. Also, firms should consider legal and social ramifications (e.g., privacy and ethic) of new analytics techniques and results when applied to big data (e.g., social media).

V. CONCLUSION AND FUTURE RESEARCH DIRECTIONS

In this study, we were interested by the assessment of the 10 requirements proposed by Thomas H. Davenport [1] in order to capture the business value from Analytics 3.0, followed by the exploration and the identification of complementary requirements. First, the study confirms the importance of all the 10 requirements proposed by Thomas H. Davenport [1] in capturing the business value from Analytics 3.0.

Also, a set of four complementary requirements was identified namely: 1. Corporate culture and capability, 2. Social issues, 3. Analytics tools capability and 4. Talent management. These requirements can be used by managers to direct their effort when exploring the potential of analytics 3.0.

While this list of requirements represents a starting point for future studies, the list may not reflect a majority of analytics 3.0 users across industries. In addition, the study only focuses on key requirements of business analytics 3.0. proposed by Thomas H. Davenport [1]. Future research needs conduct a robust literature review to identify an improved list of key requirements of business analytics 3.0. Also, it would be interesting to validate our final list of requirements using a case study or a Delphi study. Also, it will be fascinating to explore the importance of these requirements across various industries, cultures, and countries.

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