

IMPACT OF BIG DATA ANALYTICS & MACHINE LEARNING ON INNOVATION OF MANUFACTURING COMPANIES

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Abstract

Developments in Business Analytics in the era of Big Data have furnished unprecedented possibilities for businesses to innovate. With insights gained from Business Analytics, businesses are in a position to cultivate new or even enhanced products/services. Nevertheless, not many scientific studies have examined the mechanism whereby Business Analytics plays a role in a firm's innovation results. This particular analysis aims to deal with this gap by empirically and theoretically checking out the connection between Business Analytics as well as innovation. In order to do this aim, absorptive capability principle is employed as a theoretical lens to understand the improvement of a research version. Absorptive capacity theory describes a firm's potential to understand the importance of fresh, external info, assimilate it and put it on to commercial ends. The study model covers the usage of Business Analytics, innovation, data-driven culture, environmental scanning, along with competitive advantage. The study design is examined by way of a questionnaire survey of 228 USA companies. The results suggest that Business Analytics specifically increases green scanning which helps you to improve a company's development. Business Analytics also specifically enhances data driven culture which in turn impacts on green scanning. Data-driven culture plays another essential function by moderating the impact of green scanning on new product meaningfulness. The findings show the beneficial effect of company analytics on development and the pivotal roles of green scanning as well as data driven culture. Organizations wishing to realize the possibility of Business Analytics thus require changes in both their internal and external focus.

Keywords

Analytics; Innovation; Big Data; Data Driven Culture; Absorptive Capacity

JEL Classification

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Introduction

Organizations have to innovate in reaction to changing customer demands as well as opportunities provided by technology and changing dynamics, structures, and marketplaces. Han, Datta, Chi, and Joshi analyze the connection between IT and solid development concentrating on expertise abilities are improved from the usage of it, and show that IT plays a tremendous part in improving solid innovation. The blend of Big Business and Data Analytics represents among the newest possibilities for organizations to modify the practices by the usage of IT. It's argued that organizations have to act quickly to gain from Big Data as well as BA by applying them to produce competitive advantage and innovation [1].

Despite the fact that BA is more and more used in businesses, there's an absence of principle linking analytics to originality, and therefore additionally a lack of pragmatic assistance for managers. Particularly, styles of the innovation process don't normally include any explicit kind of data acquisition, use or analysis. For Kim, Narasimhan, Choi, and example include just "generating rates" of product as well as system understanding, the procedure for generation being Li, Pan, and unspecified similarly apply just learning amount parameters [3]. An exception is the job of Varbraken [25]. Among re-search inquiries they deemed was "How do organizations extract or even produce value from data?". The analysis a Delphi research as well as 3 case studies led to twenty one recommendations, although there was no effort to design these into a causal design [4]. Thus, it's critical to investigate as well as confirm if, exactly how and to what extent BA plays a role in innovation. This particular paper seeks to fill this particular research gap by proposing as well as validating a new model to clarify the relationships between BA as well as product/service innovation. In so doing, it's essential never to regard BA as only a technical advancement, but additionally one associated with organizational culture [6]. Like every method, BA will invariably yield findings of some kind, but just if organizations decide to act on those findings could any innovation happen. Attaining naturally competitive edge because of this will be evidence that is clear that groups have acted on the BA findings [17].

Thus, this particular analysis aims to examine particularly the associations between BA, data driven society, green scanning, new product/service innovation, along with competitive advantage. In order to do this research aim, this particular study employs a deductive method [2]. A variety of hypotheses are suggested from an info processing and work with perspective, making use of absorptive capability principle. These hypotheses are incorporated into an analysis design to explain exactly how BA, working through green scanning as well as data-driven society, contributes to new product/service innovation, and consequently competitive benefit. In order to evaluate re-search version, a survey questionnaire is created to obtain quantitative details from US industrial organizations. Survey data collected from 238 American businesses are utilized to check re-search type [5].

The rest of this particular paper is organized as follows. Section two offers a literature review on the primary key concepts in addition to theoretical considerations. Area three discusses the improvement of the research version. Area four describes the study technique such as investigation constructs, the associated dimensions, and information collection procedure. Section five presents the information analysis and results. It's followed by conversation in section six and conclusion in section seven.

Literature Review

This particular study evaluations the definitions of, and theories applicable to, the main ideas of Data-Driven culture and business Analytics. After that it points out the theoretical considerations being utilized to inform the analysis hypothesis improvement in section three. These develop from snapping an info processing and employ viewpoint, to link data/information and analytics with originality and

organizational success. The most significant component is absorptive capability theory, which entails the 3rd of the central concepts, environmental scanning.

Business Analytics

The word BA is commonly used in numerous contexts, but there appears to be absolutely no generally accepted definition of what BA is. The study uses the Harris and Davenport definition, which often defines BA as "the considerable use of information, quantitative and statistical analysis, predictive and explanatory versions, along with fact based management to get actions" and decisions. Even though the idea of BA features a great deal of theory, as mentioned by Sazu et al. (2022), the functions of its as well as apps have been re defined through the years to focus technical evolution emerging uses [16]. By the literature, it seems that BA is classified in several ways depending on its key functionality, evolution process, or application domain. BA's software domain can include, for example: learning analytics, customer analytics, marketing analytics, web analytics, etc. A major functionality perspective gives a yet more detailed view. BA is usually classified into descriptive, prescriptive and predictive analytics based on an investigation commissioned by INFORMS and including numerous diverse kinds of analytical techniques and tools. Several of these date back quite a distance into the story of OR/MS: others are derived from current leading edge [7].

Data driven Culture

Based on Sazu et al. (2022), a data oriented society underscores a pattern of beliefs, practices, and behaviors which are in line with the concepts of analytical decision making [17]. Likewise, Kiron, Ferguson, along with Prentice talk about a data driven society as "a design of practices and behaviors by a number of individuals that talk about a perception that owning, comprehension and utilizing specific data types as well as info plays a crucial role in the achievements of the organization". This particular description is consistent with the mainstream literature on organizational culture, described as an intricate range of symbols, assumptions, beliefs, and values which determine just how where a solid conducts the business of its and the design of shared values, norms, and methods which distinguishes 1 institution from another [10]. These norms and values define "what is essential available here" and "how we do things around "cultural values and here" are consequently mirrored in real behavioral patterns".

Using Absorptive Capacity to Theorize the Impact of BA in Innovation

Researchers argue that info is a crucial asset helping organizations acquire innovation gain competitive advantage [9]. Originating from an advertising perspective, Glazer argues that businesses have to see outside of the science as well as concentrate on ways to handle the information to get competitive advantage. Examining development achievements from a decision-making perspective, Jahan et al (2022) mention that info plays a crucial role in the reduction of managerial uncertainty in high tech service development results [8].

This particular research thus takes the viewpoint that using BA to assist a company to gain from Big Data, by making it knowledge and insight for innovation, is really an info processing as well as utilize procedure [15]. This particular perspective doesn't seem to have been consumed the literature before today. Versions of paths to development success usually don't include information or data; some include expertise, for example Sazu et al. (2022) treat it just as a property of the business, without any indication of what could affect or even improve it [2] . Because of this perspective, it's argued that to successfully utilize info for producing competitive advantage, a company must develop the absorptive capacity of its. Absorptive capacity theory continues to be used by researchers in the analysis of many complicated organizational phenomena like innovation. Consequently, we construct on absorptive capability principle to theorize the result of BA on innovation [11].

Sazu et al. (2022) have found that "the application of ACAP in several scientific studies hasn't been literal, and every study instantiates ACAP and the components of its to support the unique context" of its [10]. This's additionally the situation for the current study. Even though Jahan et al. (2022) and Sazu & Jahan argue absorptive capability can be separated into prospective absorptive capability and realized absorptive capability, we think that it's not feasible to distinguish them in the context [14]. For instance, descriptive BA is under the assimilation pastime of prospective absorptive capacity, while prescriptive and predictive BA bridge because of this into recognized absorptive capacity. Environmental scanning is usually an acquisition, assimilation as well as exploitation activity in the very same time.

Methods

Research Model

Innovation has numerous definitions. Whilst there's some overlap between them, there's zero understanding. In the context of the analysis, we utilize Thompson's straightforward and simple characterization which states development is "the generation, implementation and acceptance of new ideas, processes, services" or products. As innovation covers a diversified and vast array of literature, it's essential to clarify the emphasis of this study. The central theme of the interest is how companies are able to acquire enhanced intelligence and insights from information using BA and make use of them to create new products/services or even enhance existing ones, and take them to sell. Thus, the emphasis of the study is new product/service innovation in a company. The study style and its related hypotheses are tested by way of a questionnaire survey. Data are collected from an internet questionnaire survey with US businesses [12].

Model Constructs and Measurement Business Analytics

As analyzed in section two, though BA has been around for many years, it's 2 vital extra capabilities in the era of Big Data. Firstly, BA has to deal with large volumes, unstructured and constantly changing data, going far beyond the complexity of traditional database work; and secondly, BA applications encompass various newer types of analytics techniques, such as: text and web analytics, graph mining, sentiment and affect analysis, and social network analytics. As this's a new research region and you will find very few empirically validated measurement products, we've created new measures and constructs for BA, making use of BA literature. The level of BA apps is measured by the usage of descriptive, prescriptive and predictive analytics respectively [16].

Originality Performance

Innovation performance is a multi-dimensional concept and no individual innovation measurement can capture the complex nature of its. For instance, innovation performance continues to be assessed through seen performance against competitors or maybe unbiased actions such as for instance the quantity of patents created. Innovation associated constructs combined with the measurements are taken from the appropriate innovation literature to the present research context, utilizing indicators which happen to have actually been empirically validated by previous studies [13]. Stock as well as Zacharias conduct a considerable literature review about the dimensions of new product development. They discover both product newness as well as meaningfulness have each been commonly used, usually as part of a two dimensional conception of innovativeness. Those for new product newness are from Sazu et al.(2022) ; and those for new product meaningfulness [20].

Depending on Sazu et al. (2022) data driven culture is mirrored in the study by computing organizational thinking, behavior and attitude towards using insight and info produced from information [12].

Findings

The hypotheses had been analyzed empirically utilizing partial least squares structural equation modeling based on survey data. PLS-SEM is suggested to be well suited for research scenarios where theory is formative and developed less constructs are included in the structural design, as there.

Respondents' Profile

As suggested, we utilized a key informant strategy based on place in the group to gather information. The reported positions of the respondents proposed that twenty % of the respondents had been in a senior managerial position as well as the majority of them had been in a middle managerial position, therefore the respondents had been deemed to have the ability to handle the survey questions.

Method that is common and Non respondent Bias

This research used both statistical and procedural remedies to control for typical method bias. The procedural solution used was improving scale items, particularly unfamiliar items, via defining them obviously keeping the questions very simple as well as specific therefore to eliminate ambiguity. Additionally, instead of merely labeling the conclusion points, each and every point on the result scale was tagged, that also has helped decrease item ambiguity [14]. Furthermore, Harman's single factor evaluation was done as a statistical cure to evaluate usual technique bias that could impact the real correlations between variables as well as cause biased parameter estimates. The test result suggested the very first element accounted for 35.90 % of the entire variance; hence, there's simply no proof associated with a considerable typical approach bias in this research.

Prospective bias from non response or maybe self-selection matter was assessed by conducting 2 assessments. The very first test compared respondents in the very first 2 rounds with eventually respondents on all measures by way of a t-test. The t test outcomes didn't locate a major distinction in a significance level of five % in between the 2 respondent groups, saying an absence of non response bias. The next test compares the distribution of the business color of the respondents with which of the entire sampling frame, dependent on the acknowledged worth for the public strategy. A nonparametric chi square test looking at the distribution of the found as well as likely values found no substantial distinction in the five % level.

Evaluation of the Measurement Model

Since the unit has equally formative and reflective constructs, its own set of analyses was done after suggestions made by Sazu et al. (2022) [8]. The reflective measurement design was evaluated by considering inner consistency, discriminant validity, convergent validity and indicator reliability. The composite reliability scores summarized that outcomes depending on these constructs must be consistent, since almost all constructs met the suggested threshold importance for appropriate reliability, that's, each CR as well as Cronbach's α must be bigger than 0.70. Signal reliability was evaluated by watching the component loadings as well as every indicator 's variance; the former must be bigger than 0.70 as well as the latter must be at least 0.50. As summarized, signal reliability was satisfactory. Convergent validity was also positive since the common variance extracted worth for each construct was at least the suggested threshold importance of 0.50.

Discriminant validity was assessed through 2 tests. The very first was analyzing the Fornell Larcker criterion to assess whether the square root of the AVE worth for each construct was higher compared to the correlation of that construct with every other construct, that had been real. The next test was observing whether every reflective signal loaded highest on the construct it had been connected with, that had been additionally accurate, thus demonstrating discriminant validity was positive. The analysis outcomes are summarized.

Discussion

The empirical research has provided support that is strong for the suggested model. As shown in Figure two, every one of the study hypotheses are supported, aside from the moderating impact of data driven society on the connection between environmental scanning as well as new product newness. The primary key findings suggest that a firm 's absorptive capability about BA, data-driven culture and environmental scanning in the current study specifically enhances a firm's originality in terminology of new product newness and meaningfulness. The results show that BA impacts green scanning which helps you to improve a company 's development in terminology of new product newness as well as meaningfulness, the latter outcomes being in line with investigation on the consequences of green scanning going all of the way to Friesen and Miller, however, not in agreement with the outcomes of Jahan & Sazu (2022) [20]. BA strongly and positively influences data driven culture with an extremely high path coefficient, along with data driven culture strongly and positively influences environmental scanning [17]. Based on H5 and H4, the results additionally demonstrate the impact of BA's contribution is mediated via data driven society of the organization; this's in line with the result of organizational culture much more broadly as discovered by other researchers although the focus isn't data driven society per se. The latest item newness as well as new product meaningfulness both boost naturally competitive edge in the organizational level, that generalizes the results of Calantone, Chan, and Cui as well as Sethi and Sethi from the unique device amount [18].

Our results suggest that data driven tradition has a statistically significant moderating impact on the connection between green scanning as well as new product meaningfulness [19]. This suggests that there's a positive interaction between a data driven culture and green scanning, meaning collectively they are going to have a much stronger impact on new product meaningfulness. This appears to make sense as a firm 's data-driven society will motivate it to make use of insights gained from information while the environmental scanning of its supplies the fads of client demands; collectively they'd allow the firm to better comprehend buyers thereby to offer significant new products/services [18].

Nevertheless, data driven lifestyle seems to have zero statistically significant moderating impact on the connection between green scanning as well as new product newness [21]. It may be argued that green checking for product newness that is new depends on information regarding items, while green scanning for new product meaningfulness is dependent upon data about products And clients. That suggests the information enter to new product newness is pretty easy while that to new product meaningfulness is usually more complicated, therefore the data driven society will make it possible to enhance the link between green scanning as well as new product meaningfulness [20].

It might not be very astonishing that organization size, business sort, respondent's job title as well as season of experience as command variables, as tested, don't have any impact on competitive advantage. Though there continues to be much research on working with these variables as command variables to understand whether they've an impact on innovation, the end result thus far seem to be complex and contradictory; Prajogo and McDermott actually discovered that dimension moderated the outcome of innovation on overall results. This might propose that it wouldn't be possible to make a conclusive result [22].

The study makes a selection of crucial contributions to research. For starters, even though a selection of "white paper" posts as well as internet reports say that BA will help businesses to innovate, there's been absolutely no theoretical understanding as well as empirical evidence to substantiate the claims. The study has attempted to fill up this particular exploration gap by linking BA to development with a cross sectional viewpoint, supporting different works from the functional research group, that have been grounded on case studies, e.g. Kunc as well as O 'Brien [24]. This particular aim has been accomplished by starting a route design linking absorptive capability, including BA, data-driven society, and green scanning working in concert to obtain, assimilate and exploit outside info, to new product

development and competitive benefit. Thirdly, our findings show the pivotal part of green scanning in linking BA to innovation. It's crucial that you be aware that the focus on green scanning together with an organization's absorptive capability differs from the concept of industry orientation as being a company method. Even though some businesses like Amazon embody both ideas, it's possible to get one without the other person. For instance, a market place orientation method might be grounded on managers' "gut feel" instead of purposeful green data and scanning acquisition [23].

Lastly, this particular analysis makes new contributions to the understanding of innovation and culture by concentrating on the job of a certain organizational culture, that is data driven society, on new product development. Data-driven tradition has attracted much interest from researchers and practitioners recently as a result of the growing investment in Big BA. and Data Nevertheless, there are actually absolutely no prior efforts from researchers to theorize and empirically examination when BA improves data driven tradition and what part data driven society plays in product development.

Managerial implications

Our findings offer helpful guidance for both managers as well as BA practitioners, to enable them to start to be more efficient in achieving importance from BA. For starters, the empirical evidence obviously demonstrates the key part of data driven society which may be viewed as being an emergent organizational culture in the era of Big Data [25]. Leaders may now depend less on the gut instincts and much more on cultivating a data driven culture and data driven insights. Data-driven culture plays 2 vital roles. One would be to considerably enhance BA's influence on innovation via green scanning, enhancing the acquisition component of absorptive capacity. The alternative is its moderating impact on the connection between green scanning as well as new product meaningfulness, boosting exploitation and assimilation. This particular lifestyle has to discuss all employees, not only BA providers, who from the background will most likely follow a data driven society anyway.

As for the connection between BA plus Or perhaps, 2 of the 6 parts within Sazu et al. (2022) "research agenda for OR/MS in the analytics age" are "Incorporating unstructured data", "Streaming information as well as real time analytics" [7]. The study suggests that such analysis must incorporate cultural and organizational areas and solely specialized or maybe modeling ones: what structures, initiatives or processes would best motivate the required changes to occur? How's it easy to transfer from one pilot BA/OR project to organization wide use? Mixed qualitative as well as quantitative approaches will probably be required. Since organizational culture isn't a thing which could effortlessly be borrowed or shipped, Or's experience in trouble structuring techniques might be essential in supporting a company change the culture of its. Likewise, because it won't ever be easy to catch all information, particularly with the creation of the Internet of Things, exploration into green scanning, particularly information acquisition, now has to create on job like of Pape to cater for even more major change: the procedures which the group may have down the road in addition to anyone that it's right now.

Conclusion

We think that the study is the very first to link BA to effective innovation, and evaluate precisely how that link might operate, particularly the roles of environmental scanning and data-driven culture. The empirical proof resulted in the realization that BA is able to boost a firm's innovation results in terminology of new product newness as well as meaningfulness, so resulting in improved competitive advantage. BA's impact is possible by way of a firm's absorptive capability enabled by Effective information use for business intelligence through green scanning bringing about better innovation.

Organizations that are wanting to purchase BA and wish to maximize the potential impact of its on innovation should pay some attention to environmental scanning and data-driven culture, purposefully utilizing BA to strengthen a data driven culture and enhance green scanning effectiveness. Data-driven society likewise helps an enterprise to create much more significant new items with the insights

produced with environmental scanning. The BA community is able to feel encouraged to advertise the usage of BA, as this particular study demonstrates the impact of its on innovation.

References

- [1] ARMSTRONG, J. S., & Overton, T. S. (1977). Estimating Nonresponse Bias in Mail Surveys. *Journal of Marketing Research (JMR)*, 14(3), 396-402.
- [2] SAZU, M. H. (2022). Does Big Data Drive Innovation In E-Commerce: A Global Perspective?. *SEISENSE Business Review*, 2(1), 55-66.
- [3] AUGUSTO, M., & Coelho, F. (2009). Market orientation and new-to-the-world products: Exploring the moderating effects of innovativeness, competitive strength, and environmental forces. *Industrial Marketing Management*, 38(1), 94-108.
- [4] JAHAN, S. A., & Sazu, M. H. (2022). The Impact of Data Analytics on High Efficiency Supply Chain Management. *CECCAR Business Review*, 3(7), 62-72.
- [5] BAGOZZI, R. P., Youjae, Y., & Phillips, L. W. (1991). Assessing Construct Validity in Organizational Research. *Administrative science quarterly*, 36(3), 421-458.
- [6] BARNEY, J. B. (1986). Organizational culture: can it be a source of sustained competitive advantage? *Academy of Management Review*, 11(3), 656-665.
- [7] SAZU, M. H., & Jahan, S. A. (2022). How Big Data Analytics Impacts the Retail Management on the European and American Markets. *CECCAR Business Review*, 3(6), 62-72.
- [8] SAZU, M. H., & Jahan, S. A. (2022). Can big data analytics improve the quality of decision-making in businesses?. *Iberoamerican Business Journal*, 6(1), 04-27.
- [9] BARON, R. M., & Kenny, D. A. (1986). The Moderator-Mediator Variable Distinction in Social Psychological Research – Conceptual, Strategic, and Statistical Considerations. *Journal of personality and social psychology*, 5(6), 1173–1182.
- [10] SAZU, M. H., & Jahan, S. A. (2022). The impact of big data analytics on supply chain management practices in fast moving consumer goods industry: evidence from developing countries. *International Journal of Business Reflections*, 3(1).
- [11] DELEN, D., & Demirkan, H. (2013). Data, information and analytics as services. *Decision Support Systems*, 55(1), 359-363.
- [12] SAZU, M. H., & Jahan, S. A. (2022). How Analytics Can Improve Logistics And Supply Chain In Multinational Companies: Perspectives From Europe And America. *Business Excellence and Management*, 12(3), 91-107.
- [13] DROGE, C., Calantone, R., & Harmancioglu, N. (2008). New Product Success: Is It Really Controllable by Managers in Highly Turbulent Environments? *Journal of Product Innovation Management*, 25(3), 272-286. doi:10.1111/j.1540-5885.2008.00300.x
- [14] SAZU, M. H., & Jahan, S. A. (2022). Impact of big data analytics on business performance. *International Research Journal of Modernization in Engineering Technology and Science*, 4(03), 367-378.
- [15] ERDOGAN, B., Liden, R. C., & Kraimer, M. L. (2006). Justice and leader-member exchange: The moderating role of organizational culture. *Academy of Management Journal*, 49(2), 395-406.
- [16] SAZU, M. H., & Jahan, S. A. (2022). How Analytics Can Improve Logistics And Supply Chain In Multinational Companies: Perspectives From Europe And America. *Business Excellence and Management*, 12(3), 91-107.
- [17] SAZU, M. H., & Jahan, S. A. (2022). High efficiency public transportation system: role of big data in making recommendations. *Journal of process management and new technologies*, 10(3-4), 9-21.
- [18] FITZGERALD, B., & O'Kane, T. (1999). A longitudinal study of software process improvement. *IEEE Software*, 16(3), 37-45. Stubbs, E. (2014). *Big Data, Big Innovation: Enabling Competitive Differentiation through Business Analytics*: John Wiley & Sons.
- [19] SUBRAMANIAM, M., & Youndt, M. A. (2005). The Influence of Intellectual Capital on the Types of Innovation Capabilities. *Academy of Management Journal*, 48(3), 450-463.

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- [20] SAZU, M. H., & Jahan, S. A. (2022). IMPACT OF BIG DATA ANALYTICS ON DISTRIBUTED MANUFACTURING: DOES BIG DATA HELP?. *Journal of process management and new technologies*, 10(1-2), 70-81.
- [21] SUMO, R., van der Valk, W., Bode, C., & van Weele, A. (2016). Fostering incremental and radical innovation through performance-based contracting in buyer-supplier relationships. *International Journal of Operations and Production Management*, 36(11), 1482-1503.
- [22] THAYER, L. O. (1968). *Communication and communication systems in organization, management, and interpersonal relations*: Homewood (Ill.) Irwin.
- [23] THOMPSON, V. A. (1965). Bureaucracy and innovation. *Administrative science quarterly*, 10(1), 1-20.
Tushman, M. L. (1977). Special boundary roles in the innovation process. *Administrative science quarterly*, 22(4), 587-605.
- [24] VAN RIEL, A. C., Lemmink, J., & Ouwersloot, H. (2004). High-Technology Service Innovation Success: A Decision-Making Perspective. *Journal of Product Innovation Management*, 21(5), 348-359.
- [25] VERBRAKEN, T., Verbeke, W., & Baesens, B. (2014). Profit optimizing customer churn prediction with Bayesian network classifiers. *Intelligent Data Analysis*, 18(1), 3-24.