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The Influence of Big Data Analytic Capabilities on firm performance : Mediating Role of Value Creation and Moderating Role of Data Governance

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ABSTRACT

The 'Era of data" is currently prospering, and companies increasingly investing in big data initiatives to foster innovation and outperform competition. Businesses these days are heavily consuming big data analytics, but they struggle to generate value through big data analytic capabilities. These struggles usually concern data management, lack of qualified technical staff, and mainly data protection. Organizations are trying hard to overcome obstacles and hindrances that stop the efficient consumption of big data capabilities so that organizations can attain competitiveness. To address this gap, this study draws on the resource- based view (RBV) of the firm, intends to investigate. This study is based on preexisting scales. Nature of study is cross-sectional. Data was collected from 450 managers of telecommunication companies and banks. With the help of SPSS and MACRO PROCESS statistical test were conducted and links were tested. Results revealed that all hypotheses were accepted. Along with this discussions, research implications and recommendations are also provided.

Keywords: Big data analytic capabilities, Value creation, Data governance, competitive advantage.

1. INTRODUCTION:

BDA (Big Data Analytics) came out as an emerging industrial and academic trend. It has the potency to recast businesses and deliver business intelligence to corporations and enable them to develop responses based on the challenges and opportunities they encounter in the business environment. The traditional conventions of getting, accessing, and scrutinizing data are no longer pertinent, Falahat et al., (2022). The appropriate consumption of big data analytic capabilities allows businesses to uncover patterns from enormous data volumes and protect them from dismissal, Ansharia (2019). BDAC (Big data analytic capabilities) enable businesses to apprehend and interpret data towards the creation of understandings by effectively directing and making use of talent, technology, and data, Hamzeh (2022). Firms combine intangible, financial, human, and technological resources to deliver value creation. Organizations and brands

are integrating big data into their models, some more flourishingly than others. Specific big data amalgamation and analytics are dramatically modifying the way organizations work. Put together with analytics, big data combination permits businesses to bring data pulled from numerous sources to develop and construct a more refined and cohesive model and comprehend the data satisfactorily, Mikalef (2020). Though businesses may have already commenced utilizing big data combinations, some may be left behind. Research has revealed that data itself cannot forge value for consumers, Wanga (2020). The efforts of the business transform the big data analytic capabilities that direct to value creation covering elongated-data network and the internal sphere of the firm as well. Data democratization capacity is used to create value by incorporating data everywhere in the organization and letting considerable employees enter data territory and comprehend it in time of need without time constraints, Kulkarni (2020).

Value creation also happens when BDAC is utilized to accomplish data contextualization, through which data is interpreted by giving it meaning, Hirschlein (2021). The conversion of data understanding into actions that direct to the recognition of unexplored chances that boost consumer engagement, hence creating value, Hassan (2020). Value creation from big data analytics is contingent on how firms swiftly make use of their BDAC. Further concentrating on creating value from inner data, businesses also require a coordinated approach to create value concomitantly from their information network, where a varied and vibrant knowledge ground evolves into a heterogeneous resource grid that is infrequent, inadequate, and complicated for competitors to replicate, Eliaa (2020).

A business can gain a competitive advantage based on its geographical location, coherent internal mechanism, capabilities, and economies of scale, Mikalef (2020). Businesses also attain differential advantage when their offering is perceived as superior in the market and is distinct from their rivals. Substantial brand identity, superior workforce, advanced processes, patentprotected products, and advanced technology call all lead to differential advantage, Kryscynski (2021). A competitive advantage allows organizations to shape their services and products better than their industry rivals at prices that suit their customer base, Distanont

(2020). These elements sustain comprehensive margins and considerable market percentages. The expansion of a market share by the business through raised productivity and efficiency shows that a business has a competitive advantage over its rivals, Knudsen (2021).The notion of data governance holds significant value for organizations as it interprets the data available to an organization, Janssena (2020). It adds confidence and discernment to data available to the organization through control and a strong business wordbook, therefore revving digital changeover across the company. Without successful data governance, the irregularity of the data in various systems cannot get fixed, Micheli (2020).

Pakistan adopted big data technologies late but is now attempting to exploit the opportunities that BDAC brings. Varied Pakistani organizations are paving their way to success by efficiently discovering hidden patterns, market trends, fluctuations, and consumer preferences. Pakistani banks utilize their BDAC for customer profiling and satisfy individualistic customer needs by monitoring transactional patterns and banking history for the time customers stay associated with the bank. Through this, they design tailored solutions and plans to make the consumer experience worthwhile. However, the Pakistani telecom sector utilizes BDAC to optimize service quality by blending network optimization. This research particularly targeted the banking and telecommunication sector of Pakistan to know how both these sectors create value and gain competitive advantage through the utilization of BDAC. The practicality of the BDAC, competitive advantage, value creation, and data governance is not restricted to any single sector of the country and economically facilitates industries to obtain better outcomes.

2. LITERATURE REVIEW

The literature review is a detailed critique and assessment of previous studies and other information to increase understanding of the subject (Kraus et al., 2022). This chapter has reviewed past research and contains an in-depth review of big data analytic capabilities, firm performance, value creation and data governance. Additionally, the integrated theory and research hypothesis have been discussed to elaborate on the relationship between chosen variables.

2.1. Big Data Analytic Capabilities

Mikalef (2020) defined "BDAC as the capacity of an organization to successfully avail talent and technology to seize, hold and diagnose data, to forge valuable insights". Kumar Jhaa (2020) defined "BDAC as sub-capacities of business intelligence abilities that combines relationships, execution, skills, and infrastructure".

The medley of tangible, intangible, and human knowledge and skills aids the formation and action of big data analytic capabilities. Big data capabilities thrive due to the fundamental resource that is the existence of data. It is evident that velocity, variety, and volume are explanatory attributes of big data, Ghasemaghaei (2021). Yet, it is often noted that data reviewers and IT schemers specifically pay attention to the data quality that they examine. Though typically organizations examine enterprise-centric organized data, the variation and range of data origins that modern organizations power cause the factor of quality and are significantly important. The quality of data is considered a crucial resource and perceived value, reliability, timeliness, format, accuracy, and completeness explain this aspect adequately, Faroukhi (2020).Data-oriented decision-making is critical for the success of organizations in the modern era, and it can be stamped through distinguishing organizational practices. It is repeatedly mentioned that prosperous organizations spread data-oriented insights in their all departments to coherently get benefitted, Ebrahimi (2022). Moreover, data-oriented decisions build organizational capabilities to devise instantaneous predictions and insights to enhance productivity and performance (Anna Visvizi, 2023).

2.2. Firm Performance:

Firm performance is the degree to which a firm has superior performance relative to its competition in areas of environmental performance, financial performance, competitiveness, and corporate reputation, Khan et al., (2020). Competition is not a new phenomenon in business, and it can significantly break or make the organization, Wijaya (2020). The conception of competition can push an organization to evolve and transform itself in their better version. Varied organizational factors combine and jointly aid organization in attaining prominent position in the market. Globalization, resource scarcity, and technological complexity drive an organization's performance and ability to deliver and meet

consumer expectations while also affecting customer value, Alnoor (2023). Organizations operating in dynamic environments must be capable of reinventing, rejuvenating, upgrading, and always identifying to reach competitive standing, Sartor (2023).

2.3. Value Creation

The term "value creation" is typically used in business perspective, however, Hansen (2020) defined it as the generation of beneficial output from incorporated input. Businesses come into being to grab their portion of the profit from the market and external ambiguous business world, Enholm (2022). However, endeavouring to attain this purpose without value creation is like a wrong turn on the road. Whatever value an input generates should have the capability to produce the same superior output consistently, Paschen (2020). The usefulness of the output makes it valuable in the eyes of the end-user, therefore this attribute must not be neglected. Businesses set value creation as their goal to allow them to get benefitted from their existence.

2.4. Data Governance

Data governance is defined as the framework for delegating decision-oriented privileges and responsibilities to be capable of sufficiently managing data as a crucial asset across the company, Mahanti (2021). The principal factor for data governance is believing data is an acquisition of the organization. (Janssena, 2020) related governance with ideal utilization of assets then handled information and data as crucial assets, which propels the significance of the data governance within the company. The presence of a strong data governance mechanism ensures relevance, believability, objectivity, consistency, completeness, timeliness, and accuracy. Interoperability solutions have facilitated the processes of data sharing and collection, Pellison (2020). Fundamentally, data governance practices protect organizations from exposure of sensitive data to intruders or irrelevant personnel. As organizations heavily rely on data analytics to optimize business operations therefore strong policies and standards can ensure appropriate data usage, Manoharan (2023).

2.5. Resource based view (overarching theory):

A resource-based view (RBV) is embraced to comprehend the developed conceptual framework. The theory was originally proposed by Wernerfelt (1984)

but in 1991 it was rectified by Barney (2021). The RBV of the organization has found significant backing in the literature concerning business. Prominent speculation of the theory elucidates our research framework adequately by considering that competitive advantage is a purpose that is fulfilled by making use of a firm's capabilities and resources. Barney was of the view that four characteristics of company resources can lead the business toward competitive advantage which are the inability of replaceability, poor imitability, rarity, and value, Davis (2021). The use of RBV declares that a firm that makes use of its capabilities and resources must satisfy organization, imitability, rarity, and value criteria, Ployhart (2021). BDAC is regarded as rare and valuable, and their appropriate utilization can lead the firm toward a competitive advantage, Barney (2021). A lot of internal functions can also be advanced by employing the BDAC. The theory suggests that the BDAC of the business must not be easy for rivals to copy. Besides that, an organization can never generate value through big data analytic capabilities if they detour the organization factor.

2.6 Research Hypothesis

2.6.1 Big Data Analytic Capabilities and Firm performance

BDAC has become a pillar of progressive business tactics, radically shaping firm performance (competitiveness). By capitalizing on enormous data pools, companies acquire crucial insights into workflow improvements, customer behaviors and market inclinations (Sandrin, 2021). This strengthens companies to make data-driven judgements with versatility and precision, maximizing resource distribution, customer engagement, and product development. The capacity to quickly examine and implement this information plenitude not only improves operational strength but also stimulates firm performance, allowing companies to adjust quickly to unpredictable contexts and keep ahead in a modern and swift-moving landscape (Arias-Pérez et al., 2022).

H1: BDAC has a positive influence on Firm performance.

2.6.2 Big Data Analytic Capabilities and Value Creation

Big data analytic capabilities allow businesses to explore opportunities and become flexible, open, creative, and resilient, Lutfi (2023). The popularity of big

data has become common now and this demonstrates how significant is the appeal that organizations hold towards the pattern of Big Data and tremendous value creation through development and implementation of big data solutions, Matarazzo (2021). Big data solutions can neither be developed nor can be implemented if the firm has scarce or poor BDAC. BDAC allows organizations to effectively manage and examine extensive data concentration gathered in a non-structured and structured way, Azad (2020). The consumption of BDAC aid adequate utilization of analytical techniques and innovative algorithms.

H2: BDAC has a positive influence on value creation.

2.6.3 Value creation and firm performance

Value creation greatly influences firm performance by stimulating customer satisfaction, efficiency, and innovation. When an organization concentrates on value creation, it propels innovation within its offerings, enhancing its performance making it superior in the market and giving companies a competitive edge (Santos-Vijande et al., 2022). This innovation usually results in process refinement and cost efficiencies, improving the firm's productivity and effectiveness. Moreover, value creation guarantees that the needs of customers are adequately satisfied, contributing to elevated customer loyalty and satisfaction (Dewarani & Alversia, 2023). Eventually, these aspects integrate to improve the firm's performance, allowing it to surpass competitors and flourish in fast-paced market environments.

H3: Value creation has a positive influence on competitive advantage.

2.6.4 Value creation mediates the relationship between big data analytic capabilities and firm performance.

BDAC causes value creation for diverse organizational units, the creation of value differentiates the organization from its rivals and gives it a competitive advantage. Value creation acts as a perfect intervening variable between BDAC and Firm performance, as it tends to persuade stakeholders, Mariani (2021) and develop their perception that a particular "entity" is offering distinctive value. Building on the RBV, it is established that BDAC is a unique organizational resource that is valuable, and it causes value creation by making sense of scattered data that

builds potencies of the businesses and crushes their weak aspects which means a business attains competitive advantage.

H4: Value creation significantly mediates the relationship between BDAC and Firm performance.

2.6.5 Data governance moderates the relationship between big data analytics capabilities and value creation.

The production of data in large volume and variety requires effective monitoring, scanning, and filtration to make the obtained insights understandable for varied business units, Ahmad (2023). Not every data that comes through big data analytics is precious to get translated through BDAC. Therefore, through data governance mechanisms data is managed properly and its rights are distributed to relevant authorities so that no intruder can get their hands on crucial organizational assets i.e., data, Petzold (2020). BDAC eliminates data discrepancies and makes it valuable for diverse business units. Without BDAC, an organization cannot transform unstructured, semi-structured, and even structured data into meaningful information, Lozada (2023). Data governance, therefore, strengthens the relationship between big data analytic capabilities and value creation.

H5: Data governance significantly moderates the relationship between BDAC and value creation.

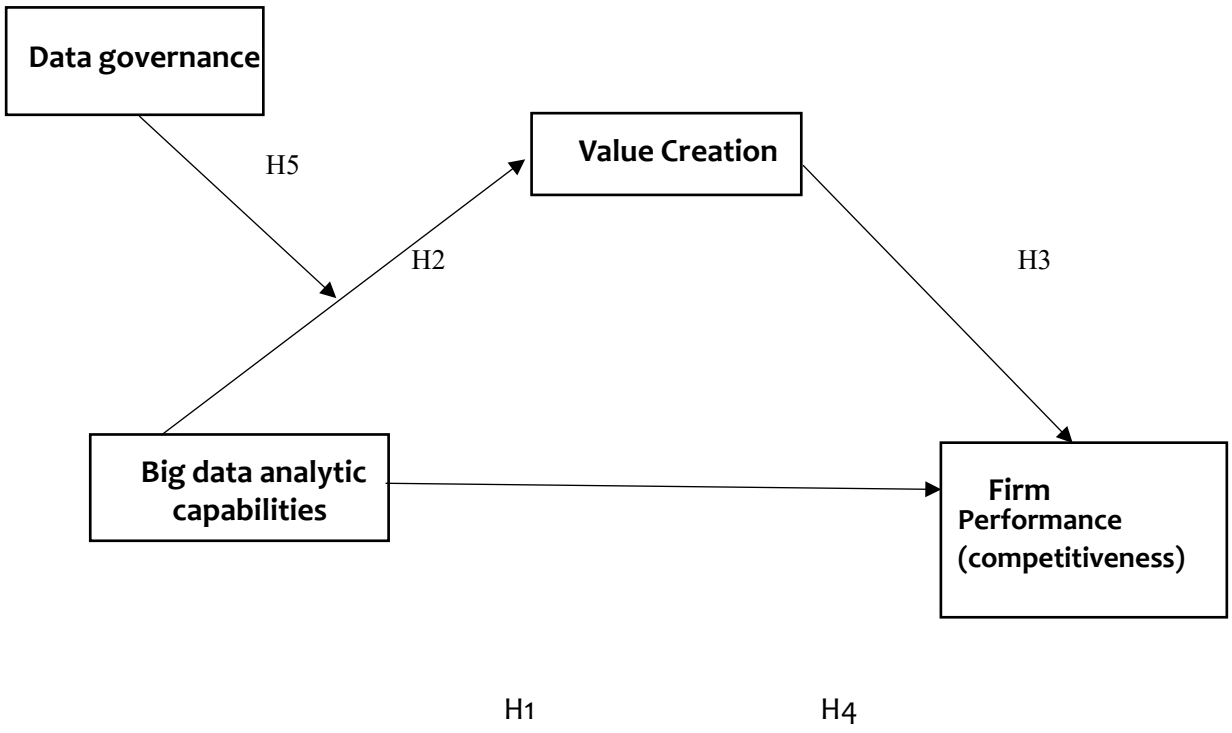


Figure 1: Theoretical framework

3. RESEARCH METHODOLOGY

3.1. Sampling and data collection technique:

The purpose of this research is to examine the role of BDAC in achieving competitive advantage, with the mediating role of value creation and moderating role of data governance. For which mangers of banks and telecom sectors are requested to participate. The reason is we are just collecting data from managers, if we consider only one sector it will be difficult for us to approach population of 450 that why we select two sectors (banks and telecom). The current study used cross-sectional research design. Data has been collected through a survey method. Current study is based on quantitative research method, so questionnaires are the most common approach for data collection. The questioners are distributed personally by meeting managers of telecoms and banks. We also used a cover letter to highlight the significance of our research and ensure confidentiality of data usage.

3.2. Measures:

3 .2.1 Big data analytics capabilities:

To investigate big data analytics capabilities, the study adapted 25 item scale developed by Gupta and George (2016). The scale was measured using 7-point Likert scale ranging from 1=strongly disagree to 7= strongly agree. Sample item includes: "We have access to very large, unstructured, or fast-moving data for analysis"; "We integrate data from multiple sources into a data warehouse for easy access".

3.2.2 Value creation:

To investigate value creation the study adapted 6 item scale developed by Zeng and Khan (2018). The scale was measured using 7-point Likert scale ranging from 1=strongly disagree to 7= agree. Sample item includes: "Our understanding of contextual clues in big data help to gain a holistic view of customers."; "Our data analysis often facilitates innovation processes in the firm".

3.2.3 Firm Performance:

To investigate competitive advantage the study adapted 5 item scale developed by Khan et al., (2020). The scale was measured using 7-point Likert scale ranging from 1=strongly disagree to 7= agree. Sample item includes: We increased capability to introduce innovative products/services ". "We increased accessibility to new markets.

3.2.4 Data governance:

To investigate data governance the study adapted 9 item scale developed by Tallon et al. (2013). The scale was measured using 7-point Likert scale ranging from 1=strongly disagree to 7= agree. Sample item includes: "In our organization, we have identified key IT and non-IT decision makers to have the responsibility regarding data ownership, value analysis, and cost management". "In our organization, we develop communications regarding policy effectiveness and user needs".

4. RESULTS AND ANALYSIS

Data screening:

A questionnaire with 45 items were distributed, and respondents were assured that their responses would be kept confidential. To collect data, 450 questionnaires were distributed among managers working in telecommunication companies and banks of Pakistan. Table 1 illustrates the demographic statistics w.r.t gender, age, education organization for the current study.

4.1 Descriptive Statistics:

Table 4.1: Statistics of respondent's profiles (%, Mean & Standard Deviation)

S No.	Demography	Sub-Classes	Percentage	Mean	Standard Deviation
1	Gender			1.28	.44
		Male	72.2%		
		Female	27.8%		
2	Age Group	20-30	60.9%	1.51	.70
		31-40	26.9 %		
		41-50	12.2%		
3	Educational level	Bachelors	9.3%	2.19	.62
		Masters	64.2%		
		M. Phil	24.2%		
		PHD	2.2%		

4	**Organization**	Banks	82.4%	1.18	.38
		Telecommunications	17.6%		

4.2 Mean, Standard deviation and Correlation Analysis of core variables:

Table 4.2 illustrates the Standard deviations and Means value of all core variables of this study. The means and standard deviation of Big data analytic capabilities and Value creation were (M=5.07, S.D= 1.30) and (M=4.75, S.D=1.38) respectively. DG and FP showed means and standard deviations that were (M= 4.93, S.D=.1.26) and (M=4.83, S.D=1.31) respectively. Table 4.10 also depicts the bivariate correlation value of all core variables of this study. Bivariate Correlation illustrates the association between the variables. In 1988, Cohen described that .10 to .30 correlation value as low and .30 to .50 is medium correlation while correlation value above .50 is considered as high correlation. So table 4.10 shows medium and high correlation .

Table 4.2: Means, Standard deviations and Correlations.

	Mean	**SD**	**BDAC**	**DG**	**VC**	**CA**
BDAC	5.07	1.30	1			
DG	4.93	1.26	.375**	1		
VC	4.75	1.38	.357**	.583**	1	
FP	4.83	1.31	.345**	.449**	.536**	1

Note. N=450; BDAC=Big data analytic capabilities, DG= Data Governance, VC=Value creation, CA=Firm performance. Correlation is significant at the 0.01 level (2-tailed)**

4.3 Mediation Regression Analysis

Preacher and Hayes (2004, 2008) developed a method for mediation testing that is an advanced way for evaluating various hypotheses based on seventy-four models.

Researchers choose and run the model based on their research framework. Hayes and Preacher (2004) developed a macro tool for measuring, testing, or validating indirect effects using the Sobel test. In this study, the same mediation testing procedure is applied. For more valid and authentic tests, the macro procedure used a bootstrapping technique. The results were generated using SPSS 21.

4.4: Big data analytics capabilities on competitive advantage through value creation

Sr. No	Variable	B	SE	T	P
1	Direct effect of big data analytics on competitive advantage	.16	.04	3.7	.00
2	Direct effect of BDAC on value creation	.37	.04	7.9	.00
3	Direct effect of value creation on competitive advantage	.44	.05	-.88	.00
		M	**SE**	**LL95% CI**	**UL 95%**
	Bootstrap results for indirect effects				
1	Mean VC	.16	.02	0.11	.22

The results has shown positive relationship between big data analytics capabilities and competitive advantage, and have the effect of 32% ($\beta = .16$, $R2=.32$ $p < .005$), favorable with proposed hypothesis 1.There is also positive relationship between BDAC and value creation which is also supported by the results, presenting effect of 14% on VC ($\beta = .37$; $R2=.14$,

$p <.005$), favorable with proposed hypothesis 2. There is also positive relationship between value creation and competitive advantage which is also supported by

the results, presenting effect of

VC on CA (β = .44; p <.005), favorable with proposed hypothesis 3. The indirect effect of BDA (B= .16) on CA through VC is statistically significant, with a 95% confidence interval ranging from 0.11 to 0.22. So, Hypothesis 4 is also accepted.

4.5 Moderation Regression Analysis:

The Preacher and Hayes (2004) process technique using a bootstrapping approach was utilized to evaluate the moderation. Age group and education level were the demographic factors that had the greatest influence on the dependent variable, In the moderating study these two demographic factors were controlled. To test the moderation hypotheses, the SPSS 21 macro process was used, in which the independent variable, dependent variable, and moderators were all included individually, and there was no compelling reason to do cantering or create interaction terms; the software does all of this if the correct options were selected in macro.

Table 4.6: The moderating role of Data Governance on big data analytics and value creation:

Sr No	Predictor	B	SE	T	P
1	Constant	5.1	.83	6.1	.00
2	BDAC	-.78	.16	-4.6	.00
3	DG	-.41	.17	-2.4	.00
4	BDAC*DG	.19	.03	5.8	.00

Conditional direct effects of X on Y

Psychological Entitlement	Effect	Boot SE	T	P	LLCI	ULCI
DG -1 SD	.006	.05	.12	.90	-.09	.10
DG M (.00)	.20	.04	4.7	.00	.12	.28
DG +1 SD	.42	.05	7.0	.00	.30	.54

Note: N=450; Unstandardized regression coefficients. Bootstrap sample size=5000; LL = lower Limit; CI = confidence interval; UL = Upper Limit.

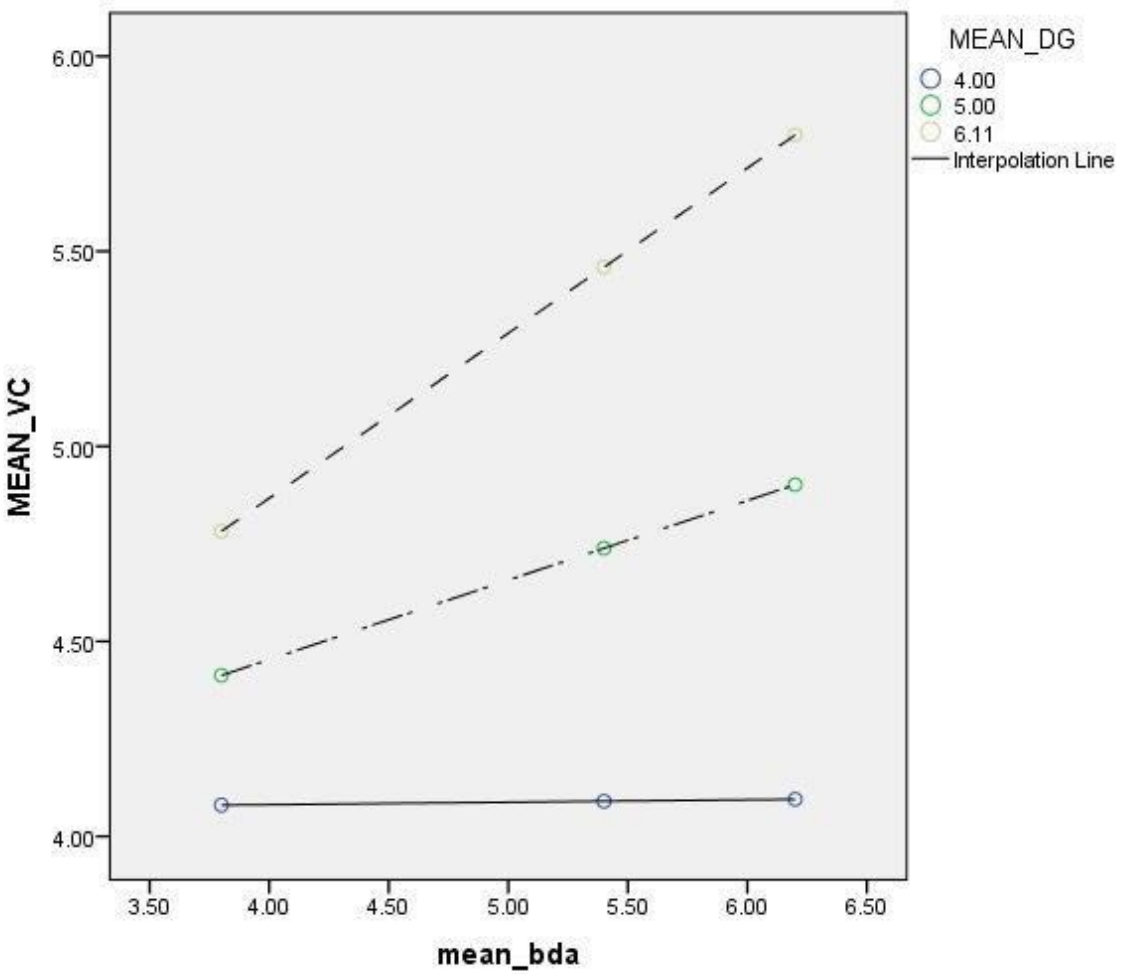
Table4.7 :Results of Simple Slope Tests for Significant Interactions on Value

Interaction	Dependent Variables			
	Value creat ion			
	Moderator Condition			
	High DG		Low DG	
BDAC*DG	*B*	*P value*	*B*	*P value*
creation	6.1	P< .001	4.0	P>.01

IV = BDAC; Mod = DG

Hypothesis 5 posited that the relationship between BDAC and VC is moderated by data governance. According to the data, (β=.19, ΔR2 =.04, p = 0.00). The conditional direct influence was shown to be significant by the two-tailed significance test (Effect =.41, Boot SE =.03, t = 5.8, p =.00). Additionally, the bootstrap results revealed a 95% confidence interval (CI) with non-zero values (.13, .26). As a result, hypothesis 5 is approved.

4.8 Interaction plot:



The interactive effect of big data analytics capabilities and data governance on Value creation

5. Discussion:

Businesses can become operationally efficient, analyse market trends, and learn about the preferences of their target audience within a short period. The whole BDAC conception enables companies to make well-informed and data-driven decisions, facilitating them to obtain actionable insights. Beyond fundamental handling of data, BDAC stimulates innovation by tapping into opportunities, correlations and patterns that might stay concealed if BDAC isn't integrated effectively. Our research makes some advance contributions to literature. Data was merely a byproduct of business processes until the emergence of Big Data analytics capabilities, which transformed it into a strategic asset. Companies are

starting to realize that the enormous volumes of data that are produced every day have inherent value. Value creation acts as a crucial link between Big Data analytics capabilities and competitive advantage. While the analytical power of Big Data is evident, it is the ability to translate insights into tangible value that propels organizations forward. Our findings exhibit that BDAC is a significant predictor of Competitive advantage at work and is also significantly connected to Value creation. This paradigm provides insights into the strategic deployment of analytics capabilities, the transformational function of value creation, the regulatory implications of data governance, and ultimately achieving competitive advantage. As enterprises traverse the challenges of the data-driven era, adopting this theoretical approach may help them optimize their analytical capabilities, encourage innovation, and achieve a strategic advantage in a competitive business climate. the findings of our writing suggest that recognizing big data's disruptive potential, managers use its capabilities to extract important insights from massive and complicated databases. These insights provide a basis for informed decision-making by allowing managers to spot patterns, trends, and correlations that might otherwise go unnoticed. The true core of management efficacy rests not only in the ownership of big data analytics technologies, but also in their strategic use. In this connection, value creation emerges as a critical mediator, operating as a link between raw analytical output and the strategic efforts that drive organizational performance.

6. Conclusion:

The current research explores the revolutionary effect of BDAC (big data analytic capabilities on firms, directed toward their functions in competitive advantage and value creation, and injected data governance as a moderator between BDAC and value creation. Harnessing from a resourcebased view, the research attempts to elucidate the complex interaction among these variables and their joint influence on firms. BDAC enable firms to sufficiently use technology and talent to examine, store and capture data and obtain beneficial insights. However, impotent technology integration, illogical decision-making, talent management problems and antifragile organizational culture hinder the efficacious utilization of BDAC.

BDAC facilitates value creation for firms and customers by supplying data that positively fuel rational decision-making and the formulation of beneficial strategies. As the generated data benefits every unit of the firm and facilitates them to make predictions, forecast and formulate strategies and policies it is asserted that BDAC facilitates firms to create value.

As data holds immense importance for firms it is essential to protect it from intruders and it is regulated by obeying data governance. Data governance mechanisms enable firms to issue rights to relevant individuals filter entire data and extract only relevant information from an extensive data pool so that firms don't experience any kind of discrepancies.

This research is a valuable addition to BDAC literature and has beneficial information for practical field as well.

6.1 Limitations and future directions:

Despite the contributions our study brings to literature, it still has some limitations. The current study investigates only two sectors, that is telecommunications companies and banks.Future research can conduct this study on different sector e.g. software houses or make comparison between two sectors, or may test the same model on a sample of small and medium sized business managers in order to determine if the causes and impact are analogous or different from those in larger companies. This study used a quantitative research approach and cross-sectional research design. Future research can conduct this study by quantitative research approach as well as empirical and can use time lagged research design.

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