

Impact of use of big data in decision making in banking sector of Saudi Arabia

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Abstract

The revolution in the form of big data analytics enforced in several spheres of the banking industry has facilitated numerous banking operations. It not only saves cost and time of the institution but also helps in developing a deep understanding of the banks with customers, detection of frauds and risk management. In Saudi Arabia, growth in investment banking has facilitated development of the financial sector and has increased the number of business transactions. The growth in ubiquitous data in different forms developed the need to adopt big data analytics.

In light of this aforementioned information, the current study aimed to understand the impact of big data analytics in decision making in the banking sector of Riyadh in Saudi Arabia. For this, the researcher studied 5 commercial banks and included a survey method with ten management/ higher level authority per bank via a close ended questionnaire. It was found that big data techniques assists in targeted marketing which in turn helps in better decision making in the banking sector.

Key Words:

Big data, data mining, banking, regression, decision-making, risk, challenges

1. Introduction

a) About big data and its use in different departments of organisation

Most of the traditionally driven organizations use transactional data to make the business decisions. However this traditional data bases are not well structured and formatted so that they could be used to interpret the data (Arruda & H. Madhavji, 2017). With the advent of internet, business organizations faced a challenge to assess nontraditional and less structured data for making business decisions. This huge and complex data volume was available in the form of web blogs, social media responses, email, chats and photographs which was very important for effective decision making (Alam, Sajid, Talib, & Niaz, 2014). Big data analytics can derive insights from such huge data in turn serving many departments of the organization including production, sales, management, marketing, R&D (research and development), and finance. Experts in the data analytics technology are not able to analyze and manage this complex data in an efficient way.

This developed a need to invent some effective tools that can collect, store and analyze huge data volumes for a variety of information sets. The evolvement of new techniques led to the development of big data analytics to capture insights from both structured and unstructured data in terms of volume, velocity and variety (Kubina, Varmus, & Kubinova, 2015).

b) Big data in decision making

Although, the revolution of big data analytics assisted all the sectors of the economy, it particularly benefited the banking sector who failed to utilize useful information from their own data bases. The data driven banking sector uses wide set of big data analytic techniques to facilitate its operations. The banking sector has emerged one of the dominant customers of big data services all over the world. The banking sector have huge volume data available from multiple sources including consumer transactions, advertisement records, inventory management, customer preferences, sales and financial transactions (Amakobe, 2015). The insights derived through big data analytics is used to support the decision making process in the banks. These insights assist the banks in effective decision making process. Effective decisions not only improve customer satisfaction but also generate competitive intelligence through optimal pricing and creation of new models (IBM Institute for Business Value, 2013).

c) Banking sector of Saudi Arabia

In the past decade, Saudi Arabia has experienced an increase in the number of business and financial transactions thereby leading to the development and growth of the banking industry. The banking sector in Saudi Arabia has emerged as one the world's largest and fastest banking markets comprising of 24 commercial banks of which 12 are domestic banks and 11 foreign banks (Solaiman, Kadar, Wanke, & Azad, 2017). The deregulation of banking sector and merger of some banks in the country included ease of new banking regulations and increased the concentration of banking structure. Also, the country has experienced an increase in the variation and sophistication of banking services with the growth of

ubiquitous data in variety of forms. Many factors affect the adoption of big data services but technological factors such as technology integration, IT infrastructure and resources of technology play a significant role (Kremer, 2017). These technological factors are the biggest obstacle in adoption of big data analytics in Saudi Arabia. Lack of system integration and weak IT infrastructure has negatively affected the adoption of big data mining. In addition to this, banks in Saudi Arabia is struggling to deal with any unstructured data from social media channels such as Facebook, Twitter, and YouTube which can be a useful resource for promotion and interaction between banks and customers. Further, lack of proper management and training to employees prevent adoption of big data analytics in the banking industry(Almoqren& Altayar, 2016). However, in the past few years the banks in Saudi Arabia have realized the importance of big data mining in acquiring new knowledge and delivering efficiency. The banks have started adopting business intelligence (BI) systems and integration tools that supports optimal management of resources and information. The banks are adopting intelligent strategies in planning decision management to achieve efficiency in banking operations(IDC, 2017).

2. Aim of the Study

The main aim of the study is to understand the impact of using big data in decision making in the banking sector in Saudi Arabia.

3. Literature Review

a) Importance of Big Data today

Banks operate within the domain of money and business which is concerned of multiple activities including deposits, loans, Investments in capital markets, disposal and so on(Hassani, Huang, & Silva, 2018). Hence, effective functioning of the banking system is crucial for achieving economic growth in long run. Traditionally, the data maintained in books or computers did not facilitated functions to analyze the amount of risk associated with the bank's productivity and progress(Oracle, 2015).

The new techniques developed in the form of big data analytics have solved all these problems. The techniques adopted in big data analytics save time as well as cost(Srivastava &Gopalkrishnan, 2015). The hadoop clusters which are generally used for storing large volume of banking data. The cost of one terabyte of storage in hadoop cluster is about \$2000(Roy, 2016).This cost is 800 times less than the amount that was used in storage of traditional data bases. In addition to this, the Macy's merchandise price optimization technique is widely used

to save time in the banking industry. This technique enables calculation of huge data sets in seconds or minutes which earlier took several hours of calculation(Forest, Evelyn, Rose, & Berenzon, 2014).

Further, the big data analytics helps to realize several benefits from high frequency trading (HIT) in the banking sector(Srivastava & Gopalkrishnan, 2015). The use of algorithms facilitated fast calculation and big computing systems has improved the performance of HIT in the banking industry. The algorithmic trading or algo-trading automates the trading procedure using pre-trade analysis and trading signal generation suggest about the buy and sell transactions and finally the trade consummation. This is facilitated through alpha model that predicts the performance of the financial instruments used in trade. This is followed by the functioning of transaction cost model that explores the cost associated with the trading of various financial instruments(Alam et al., 2014). Finally, the trade execution model carries out the trade making decisions with several barriers on transaction cost and duration of the trade. Therefore, big data analytics play a major role in assessing the profitability of the banks.

b) Role of Big Data in decision making

The big data analytics offer multiple features that facilitate increased productivity and improved services in the banking sector(Srivastava & Gopalkrishnan, 2015). This leads to increased profitability and delivers high rate of efficiency in the banking operations. Big data offers various solutions in the form of sentimental analysis, colossal system, expert system and decision support system. The banks need to identify the targeted customers and get their opinion from them at regular intervals regarding marketing, sales and banking services. Deriving useful information through the customer's feedback can be facilitated through sentiment analysis.The colossal system in big data analytics allows to perform multiple tasks. It interprets a range of information entered into the system and provides only the required information. It rectifies various issues within the system before they have any impact on the customers(HK, 2017).

The big data analytics techniques also protect the security and offers risk management. It provides security to the entire system and prevents any unauthorized transactions. It offers a variety of improved features in terms of risk management, fraud detection, customer segmentation, credit scoring, text mining, bank marketing and monitoring the behavior of the clients(Ram, Zhang, & Koronios, 2016). The banks use a variety of techniques including expert systems, decision support system, data mining and knowledge discovery in daily management(Björkman, Franco, & Caesarius, 2017). The current century has witnessed that big data analytics is a huge step in the development of banking sector. Although

the bank adopts various analytical techniques, DM(Data Mining) techniques are widely adopted in the banking industry that includes association rule mining, cluster analytics, decision trees, neural networks , support vector machines , logistic regression and naïve bayes(Hassani et al., 2018).

The data mining applications are widely used for security and fraud detection. The huge transactions record are monitored at regular intervals to strengthen the security of the banks and for noticing any unusual behavior that indicates towards any kind of fraud and money laundering activity(Oracle, 2015). Experts have developed several approaches for fraud detection such as the hybrid approach which is used for credit card fraud detection by combining the fuzzy clustering and Neutral Network (NN) techniques that are 93 % accurate along with the generation of the data set .In addition to this, development of new techniques such as automated fraud detection system (FDS) is used for automatic fraud detection. Further, Luhn's and Hunt's algorithms are used for developing a novel system of credit card fraud detection(IBM Institute for Business Value, 2013).

Apart from fraud detection, the data mining applications are widely used for risk management and investment banking to enable access of credit scoring and credit granting forming an important part of risk management. Some of the popular used models include the Support Vector Machine (SVM) classifier used for credit scoring and Multilayer Perceptron Neutral Network model which is used by employing back propagation algorithm(Hassani et al., 2018). In addition to this, the credit risk evaluation approach is used with the help of external evaluation and sliding window testing. Further, hybrid model has also developed other approaches such as EDGAR to detect the credit scoring(HK, 2017).

Further, data mining techniques are used for marketing by banks, building relationship with the customer and providing enhanced reporting to them. It can be used segmenting of customers and for creating their profile. This helps the banks to identify the potential risk associated with customers, develop a sense of understanding with the customers and understanding their behavior that helps them to improve satisfaction and strategic service design(Oracle, 2015). The enhanced reporting enables the customers to get the required information from the availability of huge sets of data and information. The customer development and customization can be achieved through various approaches (Amakobe, 2015). Amongst these, artificial Neutral Network approach and K mean clustering is used for driving the profits of the banks. New two stem systems are also being proposed that will combine the Neutral Network ensemble and the Particle Swarm Optimization for optimizing the initial weight of each Neutral Network in the framework. Further, new set of targeting market

model have been developed for commercial banks for facilitating personal loans and managing the data transactions (Björkman et al., 2017). Lastly, two step hybrid systems have been developed to achieve an increase in profit ratio by delivering accurate results(Srivastava & Gopalkrishnan, 2015).

c) Empirical Review

The study of Amakobe (2015) highlighted the big data is the key to unlock the market potential. It can assist banks in managing the cost of compliance as well as the risk of noncompliance. However, the banking sector is still lagging behind in using the analytical techniques. The banks need to implement analytical techniques to measure, manage and analyze the market performance. In addition to this, highlighting the obstacles to apply big data, the study of Hassani et al (2018) stated that banks have adopted data mining applications for fraud detection and risk management. However, the process of imparting training is costly, time consuming and complex which creates a difficulty in terms of quality management. Further, the study conducted by Almoqren & Altayar(2016) highlighted that banks in Saudi Arabia are facing multiple challenges in the form of weak infrastructure, lack of proper management and training. Therefore, it can be said the banking sector all over the world is driven by data sensors, computation devices and variety of big data services which are considered to be of great value. But, few countries like Saudi Arabia are facing multiple challenges to implement new technology have failed to adopt Big data analytics in the banking industry.

Adoption of big data analytics can offer variety of solutions in the form of fraud detection, risk management, monitoring the behavior of customers and understanding their needs. Through this, banks can develop effective decision making framework which can deliver high level of efficiency. This study highlights the impact of adopting big data analytics in decision making in the banking sector of Saudi Arabia.

4. Research Methodology

The researcher gathered quantitative data using primary research approach involving a survey analysis methodology. The data was collected from 5 large scale commercial banks based in Riyadh via a close ended questionnaire circulated among ten management / higher level authority from each bank. All of these banks are currently using big data to influence day to day business operations.

5. Data analysis and interpretations

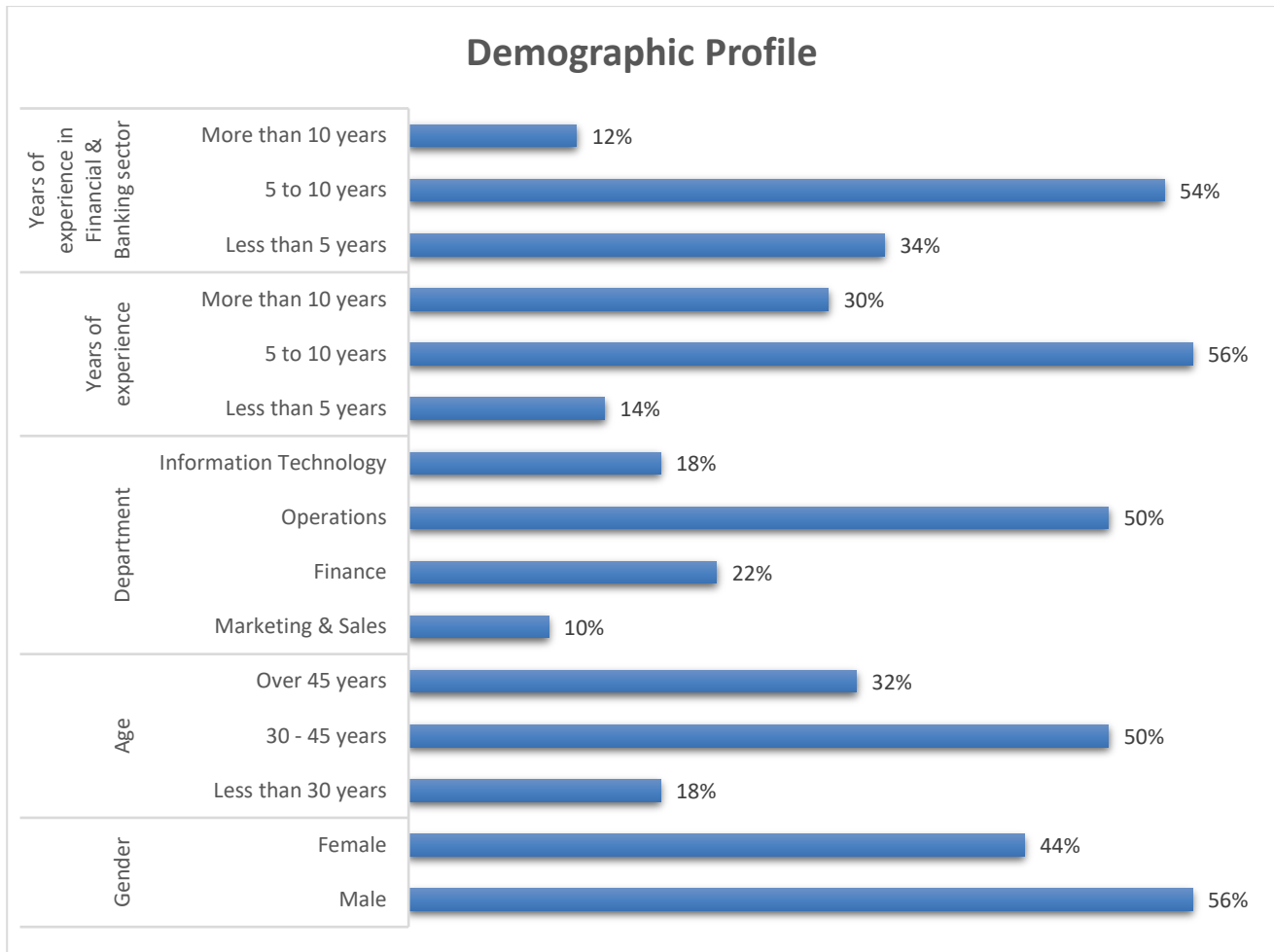
In this section, the researcher conducted data analysis to analyze the results gathered from the respondents perennial to the aim of the study i.e. to understand the positive impact of big data use in decision making in banking sector. Data analysis has been performed on the primary data collected from 50 respondents working across 5 different banking institutions in Saudi Arabia. Primarily a descriptive analysis has been performed including the demographic profile and general background

of the respondents. Thereafter inferential analysis was done using correlation, ANOVA and regression analysis.

a) Descriptive Analysis

To understand the demographic details of the respondents, the categorical variables have been subjected for descriptive analysis and plotted in a bar chart for the better visualization of the analysis.

1.5.a.1 Demographic Profile

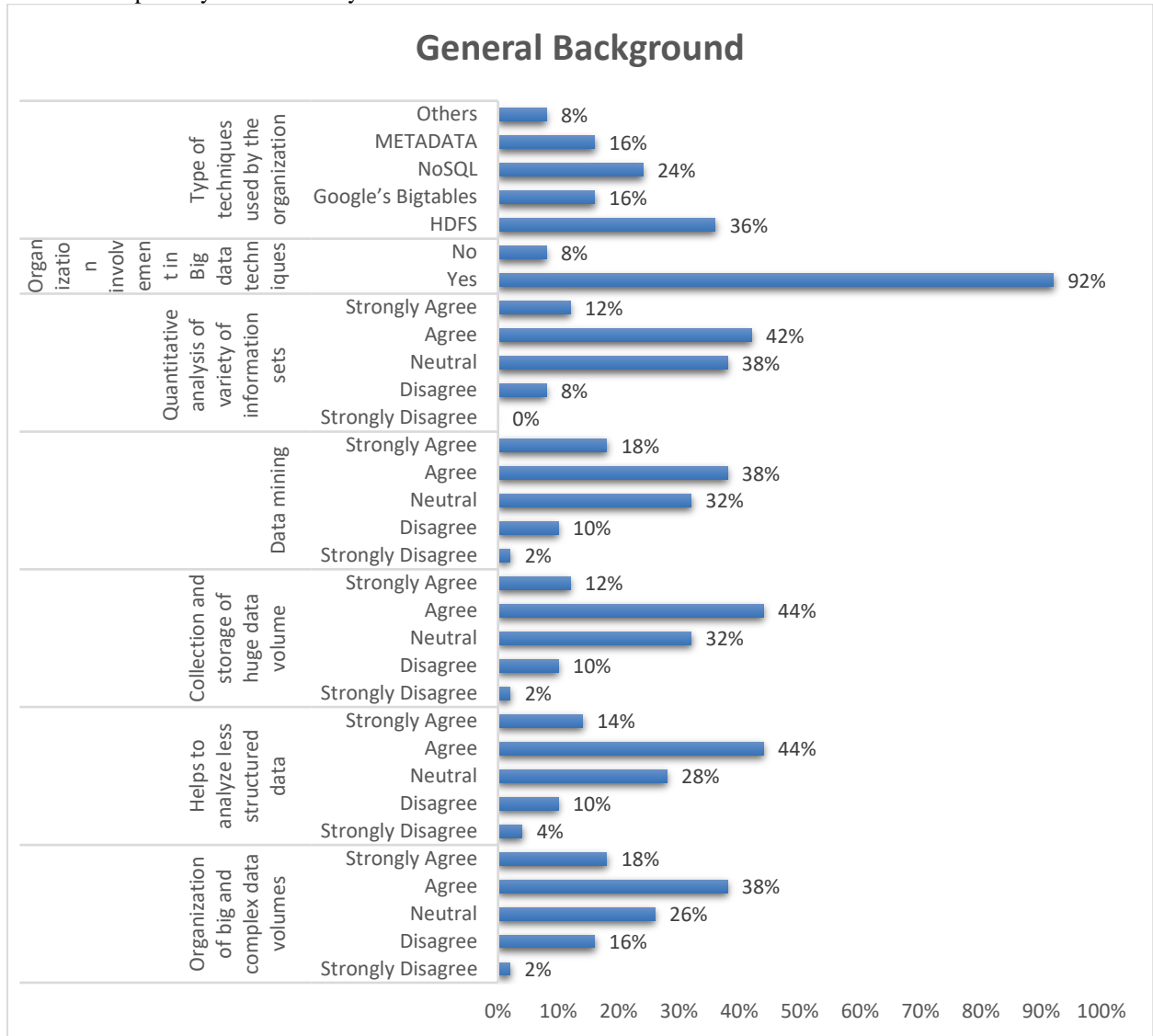


The above figure shows the descriptive analysis for demographic profile of the respondents. From the graph it is clearly evident that the majority of the respondents were males i.e. more than 50% of the respondents. Then 50% of the respondents were from the age group of 30 - 45 years and 32% of the respondents were from the age group of over 45 years. Over 80% of the respondents were having more than 5 years of total work experience, in that 30% of them have more than 10 years of total work experience. With respect to experience in banking and finance sector,

more than 60% of the respondents were having more than 5 years of work experience. In that majorly 54% of respondents were having 5- 10 years of relevant experience. In addition to that, respondents are working across different functions and majority of them are working in Finance and Operation wings, which are the core functions of a banking institutions. A majority of 50% respondents work in operations department and 22% of them work in finance department.

From overall analysis on the demographic profile of the respondents, as majority of respondents belong to 30 plus age categories and were having strong work experience background, it's clearly evident that respondents are well qualified for the primary research study.

1.5.a.2 General Background



Next the respondents were investigated about general information in relation to the application of big data. First, the respondents were addressed on their perception of big data. Exactly 56% of respondents either agree or strongly agree that Big Data techniques helps to organize big and complex data. Around 60% of respondents agreed that it helps in analyzing less structured data, maintaining and storing huge volume of data, and in data mining process without any difficulty. Around 55% of respondents agreed that it is very helpful in performing variety of quantitative analysis on different set of data.

Next, the respondents were asked whether their organization implements any big data techniques. Over 90% responded that they are working in an organization, where Big Data techniques are involved in a humongous way. Following this the respondents were also asked as to what big data techniques are used in their organization. 36% responded that Hadoop Distributed File System is the widely used techniques and another 24% responded that NoSQL is the widely used techniques in their respective organization.

From the overall analysis of perception of respondents on Big Data use, it is clearly evident that majority of the respondents are having positive perception about the big data use in banking sector.

6. Inferential Analysis

To understand the effect of big data use in decision making in banking sector, the researcher has undertaken correlation and regression analysis. For the analysis, “decision making in banking sector (Big.Imp)” is response variable or dependent variable and several factors consisting of both the advantages of and challenges of big data use in banking sector are independent variables. Therefore the proposed hypotheses are:

HA: There is no positive impact of using big data in decision making in banking sector with respect to its benefits.

HB: There is no positive impact of using Big Data application in decision making in banking sector with respect to the challenges faced in its implementation.

a) Use of big data in decision making in banking sector

1.6.a.1 Correlation Test

Table 1: Correlation

		Identify Risk	Monitor capital Inflows	Investor's Behaviour	Improve data statistics	Targeted marketing/Improve Customer making	Fraud Detection	Governance & Compliance	CMS	Customer Retention
Positive impact of Big Data use	Pearson Correlation	0.56**	0.64**	0.56**	0.59**	0.69**	0.67**	0.61**	0.65**	0.69**
	Sig. (2-tailed)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	N	50	50	50	50	50	50	50	50	50

The Pearson correlation used to understand the relationship between the big data benefits and its application in decision making in banking sector is quite high and positive, being significant at $p < 0.05$. Out of all the independent variables representing the advantages of big data use in banking sector, ‘Targeted marketing’ and ‘Customer retention’ (0.69***) respectively depicts the highest correlation with its application in decision making in banking sector. This means that the banking institutions are able to make better decisions in banking sector as the use of big data encapsulates potential customers and keeps them intact to the services provided by banks.

The study of Ahmed Khidir, (2018) discussed with big data, predictive analytics and the unprecedented amount of data available from mobile devices, banks can tailor their digital banking experience on an individual level, and

deliver a personalized level of service to their customers via online, mobile and tablet banking. Banks use analytics to tailor the digital banking customer experience based on the user’s personality and online behavior patterns. Thus big data technology could help banking institutions to engage customers efficiently and effectively to provide better banking experience.

1.6.a.2 Regression Analysis

HA: There is no positive impact of using big data in decision making in banking sector with respect to its benefits.

Table 2: ANNOVA

ANOVA ^a						
	Model	Df	Sum Sq	Mean Sq	F value	Sig
1	Regression	8	30.04	30.04	77.174	0.000
	Residual	46	16.6054	0.3610		
	Total	54	46.6454	46.6454		

The ANNOVA table shows that null hypothesis i.e. there is no impact of using big data in decision making in banking sector is rejected since the F value is significant at $p < 0.05$. In addition the F- value is high (77.174) and so the probability for accepting alternative hypothesis results is quite high and hence the null hypothesis is rejected.

Table 3: Model Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.6239	.6531	.5854	.2006

Further, R square (0.6531) and adjusted R square (0.5854) values are higher than the standardized value of 0.5. So, this indicates that around 60 % variation is contributed by the independent variables in the dependent variable.

Table 4: Regression Analysis

Coefficients:				
	Estimate	Std. Error	t value	Sig
(Intercept)	0.17194	0.48231	-0.356	0.7233
Identify Risk	0.21427	0.20573	1.041	0.3038
Monitor capital Inflows	0.03985	0.24074	0.166	0.8693
Investor's Behaviour	0.11445	0.13802	0.829	0.4118
Improve data statistics	0.11535	0.21713	0.531	0.5981
Targeted marketing /Improve Customer making	0.33688	0.12125	2.778	0.0082**
Fraud Detection	0.21566	0.23223	0.929	0.3585
Governance & Compliance	0.0000	0.0000	0.0000	0.0000
CMS	0.03230	0.16370	0.197	0.8446
Customer Retention	0.0107	0.3508	0.097	0.9139

The coefficient regression table above shows that among all the significant variables, ‘Targeted marketing’ is the most significant factor that contributes to the positive impact of big data use in decision making in banking sector since it shares the highest coefficient (0.33688), significant at $p < 0.05$. This means that big data techniques aided in targeted marketing for specific segments of customers and their details are dug out from the huge volume of market data. Thus there is a better decision making process in banking sector in consideration to such technology.

The study of Vladimir Fedak, (2018) identified that adoption of the Big Data analytics and imbuing it into the existing banking sector workflows is one of the key

elements of surviving and prevailing in the rapidly evolving business environment of the digital millennium. In the last 10 years, the banks invested heavily into modernizing their offers and providing digital access to their services. In fields such as customer spending patterns, transaction channel identification, customer segmentation and profiling and product cross-selling, using big data could do analysis on real time basis and make business decisions accordingly.

b) Challenges of Big Data application in decision making in banking sector

1.6.b.1 Correlation Analysis

Table 2: Correlation

		Privacy Invasion	Financial Exposure	True Insight	Spending lots of money	Spending lots of time	Authority	Lack of Tech.	Real time data	Change Management	Balance btw method & results	Lack of human resources
Challenges of Big Data use	Pearson Correlation	0.69** *	0.56** *	0.40**	0.06	0.13	0.69** *	0.61** *	0.40** *	-0.22	-0.11	0.61** *
	Sig. (2-tailed)	0.0000	0.0000	0.0036	0.6781	0.3640	0.0000	0.0000	0.0000	0.1197	0.4645	0.0000
	N	50	50	50	50	50	50	50	50	50	50	50

A Pearson correlation was used to understand the relationship between the impact of using of big data and challenges of big data application in the banking sector. The correlation results in the above table and graph indicates that there is quite high correlation among some variables, being significant at $p < 0.05$. From correlation test performed, it is understood that 4 factors such as ‘Spending lots of money’, ‘Spending lots of time’, ‘Change Management’ and ‘Balance btw method & results’ are not having any kind of correlation with the dependent variable or objective function, since their Pearson Correlation value is greater than the α -value. Therefore the researcher could conclude that spending lot of money and time for gaining insights from the market data is never a risk or challenging factor for a banking institution. Out of all significant factors, ‘Privacy Invasion’ (0.69***) depicts strong correlation with its challenges of application of big data in decision making in banking sector.

The study of (Ethan Millar, 2017) mentioned that though the data logged by big data systems is anonymous at the high level, if the bank wishes, they can track behavior patterns of each individual customer. It is advantageous in detecting illegal activities, but is a serious security threat to the customer if it falls into wrong hands. Several concerns have already been raised with the concerned authorities about monitoring the use of big data. Even though big data has positive impact for its application in

decision making in banking sector, it has some negative effect as well, especially security threat to the customer.

1.6.b.2 Regression analysis on Big Data challenges in Banking Sector

HB: There is no positive impact of using Big Data application in decision making in banking sector with respect to the challenges faced in its implementation.

Table 6: ANNOVA

ANOVA ^a						
	Model	Df	Sum Sq	Mean Sq	F value	sig
2	Regression	4	26.504	26.504	61.175	0.000
	Residual	47	19.496	0.433		
	Total	51	46	26.937		

The ANOVA table shows that null hypothesis has to be rejected i.e. there is a correlation between the variables considered for challenges of Big Data use in banking sector, since the F value is significant at $p < 0.05$. In addition the F- value is high (61.175) and so the probability for accepting alternative hypothesis results is quite high and hence the null hypothesis is rejected.

Table 5: Model Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
2	0.6582	0.6531	0.5385	.2295

Further, R square (0.6531) and adjusted R square (0.5385) values are higher than the standardized value of 0.5. So, this indicates that around 60 % variation is contributed by the independent variables in the dependent variable.

Table 6: Regression Analysis

Coefficients:				
	Estimate	Std. Error	t value	sig
(Intercept)	0.755760	1.021009	0.740	0.463391
Privacy Invasion	0.463931	0.118279	3.922	0.000327***
Financial Exposure	0.395118	0.226918	1.741	0.089142.
True Insight	-0.283123	0.235185	-1.204	0.235558
Spending lots of money	0.068439	0.129759	0.527	0.600736
Spending lots of time	0.074745	0.138059	0.541	0.591161
Authority	0.0000	0.0000	0.0000	0.0000
Lack of Tech	0.160656	0.155847	1.031	0.308652
Real time data	0.0000	0.0000	0.0000	0.0000
Change Management	-0.046438	0.148279	-0.313	0.755732
Balance btw method & results	0.003383	0.107177	0.032	0.974973
Lack of human resources	0.0000	0.0000	0.0000	0.0000

The coefficient regression table above shows that among all the significant variables, 'Privacy Invasion' is the one which has significant negative impact in big data application in decision making in banking sectorsince it shares the highest coefficient (0.33688), significant at $p < 0.05$. Privacy invasion of seeking confidential information of customers by someone for illegitimate or illegal activities is a very important factor to be considered while implementing big data technology in banks. Hence one could say that though it has some positive impact on its application in banking sector for better decision making, it has some negative effect as well.

The study of Mousumi Ghosh, (2014) viewed that big data comes with many challenges. It presents a number of challenges relating to its complexity. How Banks can understand and use Big Data when it comes in an unstructured format, such as text or video or how they can capture the most important data as it happens and deliver that to the right people in real-time or how they can store and analyze it given its size and our computational capacity. And there are numerous other challenges, from privacy and security to access and deployment.

7. Results of the hypothesis

	Results
HA: There is no positive impact of using big data in decision making in banking sector with respect to its benefits.	Rejected
HB: There is no positive impact of using Big Data application in decision making in banking sector with respect to the challenges faced in its implementation.	Rejected

8. Conclusion

The fast advancing big data technology has started to make a huge impact in data driven industry and has started to pick up its pace in banking and financial sector. Big data technology has now become an essential element to survive and to keep live in this competitive business environment. Saudi Arabia is seen to integrate such technologies rapidly to their organizations since the deregulation of banking sector and merger of some banks in the country including the ease of new banking regulations experienced an increase in the variation and sophistication of banking services with the growth of ubiquitous data in variety of forms. In fact the organizational structure in Saudi Arabian banks is centralized and that resulted in long time for project approval. To this, the banks changed their work technology by adopting big data techniques and tools.

The findings of the study indicate that the use of big data poses both advantages and disadvantages to the decision making in banking and financial sector. Although targeted marketing using big data technology makes the segmentation and profiling of customers easier for the bank for making critical decisions in the business, there arises concern for privacy and security issues. Thus Saudi Arabian banks have though integrated such techniques but require key steps to turn them beneficial and successful. One of the key values of banking industry is 'Customer-Centric' mind-set in order to provide better banking experience for the customer. So the banking sector should identify robust and user friendly big data technology, in order to make the customer segmentation processing and product development decisions efficient and easier. Also while implementing big data technology or integrating big data, banking organizations should ensure that there is a robust security firewall in order to prevent theft of confidential customer data into wrong hands.

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