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The Strategic JOURNAL of Business & Change MANAGEMENT
ISSN: 2312-9492 www.strategicjournals.com
Vol. 7, Iss. 4, pp 1260 – 1275 November 18, 2020. www.strategicjournals.com, ©Strategic Journals

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Accepted: November 16, 2020

ABSTRACT

This study examined the influence on innovative systems on profitability of listed commercial banks in Kenya. The study examined the influence of crowd funding, artificial intelligence predictive banking system and payment innovations on profitability of listed commercial banks in Kenya. The research adopted explanatory survey research design. The study targeted managers from listed commercial banks headquarters in Nairobi city county, Kenya. Primary data was collected by means of self-administered questionnaires. Data collected from the field was coded, cleaned, tabulated and analyzed using both descriptive and inferential statistics with the aid of specialized Statistical Package for Social Sciences (SPSS) software. The output of analysis was presented using tables to make them reader friendly. Descriptive statistics such as frequencies and percentages as well as measures of central tendency (means) and dispersion (standard deviation) was used. Data was organized into graphs and tables for easy reference. Further, inferential statistics such as regression and correlation analyses was used to determine both the nature and the strength of the relationship between the dependent and independent variables. Both descriptive and inferential statistics showed that all study's independent variables (payment innovations, crowd funding, Artificial intelligence predictive banking) significantly influenced profitability of listed commercial banks in Kenya. The results further revealed that there was significant difference in profitability before and after introduction of bank innovative systems. The study concluded that one, commercial banks that efficiently adopt cost effective electronic payment innovations can enhance their profitability. Two, commercial banks that facilitate their customers access crowd funding platforms can attract a huge customer base and benefit from financial transactions of customers who secure their business transactions using the bank. The study recommended that innovators in commercial banks should adopt secure and cost effective payment innovations systems that can attract and retain a huge customer base; and that innovators in commercial banks should roll out secure and upgraded artificial intelligence predictive banking innovations meant to win customer trust and boost their profitability.

Key Words: *Crowd Funding, Artificial Intelligence, Predictive Banking System, Payment Innovations*

CITATION: Kinoti, M. M., & Otinga, H. N. (2020). Influence of bank innovative systems on profitability of listed commercial banks in Kenya. *The Strategic Journal of Business & Change Management,* 7 (4), 1260 – 1275.

INTRODUCTION

Turbulent profitability of many financial lending institutions has attracted a myriad or researches on the most effective ways of mitigating financial loss, thus, the need for innovations. In this regard, Rosenbusch, Brinckmann and Bausch's (2011) meta-analysis of previous research on the relationship between innovation and firm performance aimed at establishing the direction and strength the relationship. They document a positive relationship between innovation and performance and that investment in process innovation leads to higher firm performance than investment in product innovations.

To minimize costs, attract a larger market share and boost bank profitability in Brazil, private and state owned banks delivered financial services through retail agents including small supermarkets and pharmacies, post offices, and lottery kiosks. These agents are called banking correspondents (Kumar et al., 2006).

The banking sector in Kenya operates is governed by the companies' Act, the Banking Act, the CBK Act and the various prudential guidelines issued by the CBK. The profitabilitys of commercial banks in Kenya have been in a generally turbulent financial trend and these have mainly been attributed to financial management issues and stiff competition from Micro finance institutions (CBK Annual Report, 2018).

More so, the banking industry has been earmarked as a key pillar to the achievement of vision 2030 (a long-term strategy to achieve sustainable growth by year 2030) through increased savings, encouragement of Foreign Direct Investment (FDI), safeguarding the economy from external shocks as well as propelling Kenya to become a leading financial centre in Eastern and Southern Africa. Within the Medium Term Plan (2008-2012) under vision 2030, some of the target areas include development of a safe and innovative payments system that will ensure smooth transfer and settlement of funds between customers and banks as well as between banks (CBK,2018).

Further, the Kenyan banking industry has faced some challenges including: stiff competition from existing microfinance banks and SACCOs as they offer substitute products, offer loaning services at different rates. That is, Microfinance and Savings and Credit Societies (Sacco) institutions are emerging key players in delivery of financial services to both employed and unemployed population. However, it is expected that the banking sector will continue to grow especially in retail banking segment, as major consumer segments remain largely unbanked.

More so, according to the CBK Annual Report (2018) the banking sector has continued to experience significant competition related challenges simultaneously, thus commercial banks need to establish a sustainable innovative strategy into their core business activity in the markets and communities where they operate.

Further in Kenya, the classification of banks into three peer groups since 2010 has been based on the weighted composite index, which comprises total assets, deposits, capital size, number of deposit accounts and loan accounts (CBK 2010). As at December 2013, six banks were classified as large, 15 as medium and 23 as small (CBK, 2013). The six large banks account for 52.39% of the (weighted) market size, medium banks account for 37.95% and the 23 small banks control a paltry 9.66% of the market. Consequently, these statistics provide evidence of high concentration in the banking sector, which is likely to reduce small banks to mere followers and imitators of the financial innovations developed by large banks. The dominance of large banks in terms of total assets and total deposits implies that large banks have sufficient resources to develop banking innovations meant to improve their service delivery (CBK, 2015).

Statement of the problem

Banks innovativeness is meant to boost profitability but evidence from existing literature indicate conflicting relationships between banks innovativeness and banks' profitability, while other researches merely report on bank innovations

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without relating the effectiveness of the purported innovations on bank profitability(Cheng et al., 2017).

For instance, in Kenya, Central Bank of Kenya (2017) indicated that, the number of automated teller machines grew from 166 in 2001 to 2091 in 2010, debit cards increased from 160,000 in 2001 to over 6 million cards in subsequent years while mobile banking transactions increased from 48,000 per annum in 2007 to over 450,000 transactions per annum in 2017. Performance of commercial banks in Kenya also grew impressively between years 2001 to 2010 where profit before tax grew from Kshs 2.7 billion in 2001 to Kshs 74 billion in 2010. During the same period, total income grew from Kshs 61billion to Kshs 178 billion while total assets grew from Kshs 425 billion to over Kshs 1.7 trillion (CBK, 2017); but the banks do not comprehensively report whether banking innovations have had a contributing effect on their growth in total assets.

Further, existing researches on financial innovation have focused on internet and mobile banking innovations without considering other emerging innovations that give banks a competitive edge over their rivals and maintaining a sustainable increase in profitability (Aduda & Kingoo's (2012).

More so, some researchers have revealed conflicting results on the relationship between payment innovations and profitability. For instance Gopalakrishnan (2013) study found a reverse causality between payment innovation and bank profitability and recommended further researches. World Bank (2016) study reported that there was an opportunity for up to 344 million people in developing economies to participate in debt crowd funding, as a form of digital credit, but few banks are aware of the innovation or some lacked the crowd funding innovativeness.

Therefore, lack of adequate empirical evidence on the relationship between emerging banks' innovativeness and bank profitability motivated this study to examine the influence of payment innovations, crowd funding and artificial intelligence predictive banking system on profitability of listed commercial banks in Kenya.

Objectives of the Study

The general objective of the study was to examine influence of bank innovative systems on profitability of listed commercial banks in Kenya. The specific objectives were;

- To determine influence of crowd funding system on profitability of listed commercial banks in Kenya.
- To assess influence of artificial intelligence predictive system on profitability of listed commercial banks in Kenya.
- To examine influence of payment innovation system on profitability of listed commercial banks in Kenya.

The research was guided by the following research hypotheses;

- H_{01}: Crowd funding system does not significantly influence profitability of listed commercial banks in Kenya.
- H_{02}: Artificial intelligence predictive system does not significantly influence profitability of listed commercial banks in Kenya.
- H_{03}: Payment innovation system does not significantly influence profitability of listed commercial banks in Kenya.

LITERATURE REVIEW

Innovation Diffusion theory

This theory proponed by Rogers (1983) asserts that factors which influence the diffusion of an innovation include; relative advantage (the extent to which a technology offers improvements over currently available tools), compatibility (its consistency with social practices and norms among its users), complexity (its ease of use or learning), trialability (the opportunity to try an innovation before committing to use it), and observability (the extent to which the technology's outputs and its gains are clear to see). These elements are not mutually exclusive thus unable to predict either the extent or the rate of innovation diffusion.

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The innovation diffusion theory describe the innovation-decision process within organizations, and is relevant to this study in that it helps in understanding how the characteristics of banking innovation interact to affect its adoption within the banking sector and its consequent on profitability of commercial banks.

Schumpeter theory of innovation

Proponed by Schumpeter (1928), the theorist argued that entrepreneurs, who could be independent inventors or research and development engineers in large corporations, created the opportunity for new profits with their innovations. In turn, groups of imitators attracted by super-profits would start a wave of investment that would erode the profit margin for the innovation. However, before the economy could equilibrate a new innovation or set of innovations, conceptualized by Schumpeter as Kondratiev cycles, would emerge to begin the business cycle over again.

Technology Acceptance Model

Davis (1989) advanced the Technology Acceptance Model which relates the individuals' behavioral intentions and his/her ICT use. From the model, it is suggested that, the actual behavior of a person is determined by his behavioral intention to use, which is in turn influenced by user's attitude toward and perceived usefulness of the technology.

Therefore the Technology Acceptance Model is relevant in this study in the sense that the rolling out of many innovations by commercial banks can be affected by the customers' attitudes of perceived relevance and ease of use of the emerging bank innovations; thus, commercial banks normally use pull and push strategies to enable customers accept new product/service innovations.

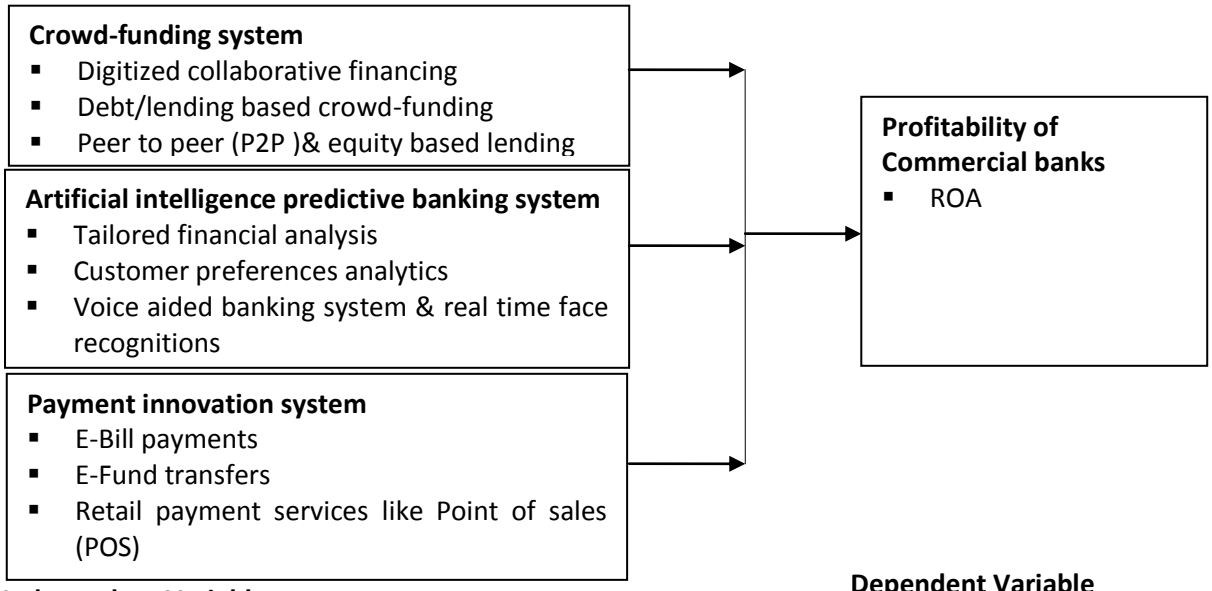

Figure 1: Conceptual framework

Empirical Review

Crowdfunding is a relatively new banking innovation concept and European Commission (2016) studies in its application in EU capital markets reported that some banks were using crowdfunding as open call to the public to raise funds for a specific project. Crowdfunding platforms are websites that enable interaction between fundraisers and the crowd. Financial pledges can be made and collected through the platform.

World Bank (2013) while studying on the crowdfunding's potential for the developing world reported that some banks utilized Crowdfunding as an Internet-enabled way for businesses or other organizations to raise money—typically from about

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US$1,000 to US$1 million—in the form of either donations or investments from multiple individuals facilitated by the banks.

Punamaraju (2018) study found that artificial intelligence systems' assistance in analyzing huge chunks of data, performing calculation and prediction capabilities can aid in developing strategies in financial loaning department for better returns; and in digitalization of branches: the lengthy process of banking can be replaced by complete digitization of documents by developing a comprehensive platform using artificial intelligence

Verma (2017) study in bank innovations found that artificial intelligence can be pivotal in changing in customer engagement within the banking sector. Like a few of the banks in Middle East have used chat boxes for providing their customers a more personalized experience and helps the banks understand their customers better.

Cheng et al. (2017) study on payment innovations found that electronic payment services are provided on an electronic billing platform connected to the bank payment and settlement systems of e-commerce companies and commercial banks. That is, this rose as a way to resolve problems of trust and financial transaction security between buyers and sellers. Thus, it is able to effectively promote the convenience and applicability of traditional cash payments, money transfers, and bank card payments by utilizing innovative payment technology supported by the internet, thus minimizing manual transactions.

Further, DeYoung, Lang and Nolle's (2014) study of 424 community banks comprising the earliest adopters of payment innovations using internet banking in USA explains the implication of financial innovation adoption. The study compares the change in the banks' 1999 – 2001 profitability with that of 5175 community banks using branch-only banking. They found an improvement in the profitability of the early adopters of electronic payments using internet banking among community banks associated with internet banking.

In addition, Hernando and Nieto (2015) study provided a quantitative analysis of the impact of electronic payment innovations and the profitability of 72 banks in Spain. They found that the reduction in transaction costs due to electronic payments leads to an expansion in the banks' profitability.

Gopalakrishnan (2013) study however found a reverse causality between payment innovation and profitability. That is, a reverse or circular relationship between payment innovation and firm performance is evidenced by the higher propensity for better performing firms to innovate and commit their capital to innovation. The relationship between payment innovation and firm performance is therefore two-way, meaning there is a reverse causation between the two. For instance; firms with high turnover, as evidenced by high sales growth shows above-average innovation expenditure in information communication technology in both hardware and software.

METHODOLOGY

This research adopted explanatory survey research design which was used to determine an association between the conceptualized independent and dependent variables as shown in the study's conceptual model. This study targeted manager from 12 listed commercial banks headquarters in Nairobi city County, Kenya. Sampling frame consisted of senior managers of all listed commercial banks whose headquarters were in Nairobi city County, Kenya. Primary data was collected by means of self-administered questionnaires. The questionnaires had structured questions. Data collected from the field was coded, cleaned, tabulated and analyzed using both descriptive and inferential statistics with the aid of specialized Statistical Package for Social Sciences (SPSS) version 24 software. Study conceptualized Regression Model;

$y = \beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+e$

y = profitability of commercial banks

β_0 = Constant

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X_1= crowdfunding

X_2 = Artificial intelligence predictive banking

X_3= payment innovations

$\{\beta_0$-$\beta_3\}$ = Beta coefficients

e = the error term

FINDINGS AND DISCUSSIONS

Descriptive Statistics

The descriptive statistics presented in this section were summated responses on the statements measuring the study's independent variables (crowd funding, Artificial intelligence predictive banking and payment innovations) and dependent variable (profitability) using Likert scale with values ranging from 5 to 1; that is; 5=Strongly Agree, 4=Agree, 3= Uncertain, 2=Disagree and 1= Strongly Disagree. The results were presented in the table form showing frequencies of responses as per each statement and its corresponding percentage score in brackets, means and standard deviations.

Descriptive statistics: Crowd funding and banks' profitability

These were summarized responses on whether crowd funding influence profitability of listed commercial banks in Kenya. The descriptive results were presented in table 1.

Table 1: Descriptive statistics: Crowd Funding System

Statement	5	4	3	2	1	Mean	SDV
The bank operates a crowd funding platform based on sound and enabling legal/regulatory framework	35 (53)	13 (19.7)	11 (16.7)	4 (6.1)	3 (4.5)	4.11	1.17
The bank facilitates a crowd funding platform to connect various investors/funders with bank customers	16 (24.2)	45 (68.2)	1 (1.5)	2 (3)	2 (3)	4.08	0.81
The bank has digitized collaborative financing where willing investors fund business startups for bank customers	12 (18.2)	28 (42.4)	19 (28.8)	3 (4.5)	4 (6.1)	3.62	1.03
The bank's crowdfunding platform facilitates customers in accessing varied capital markets and marketing hubs	10 (15.2)	37 (56.1)	6 (9.1)	7 (10. 6)	6 (9.1)	3.58	1.15
The bank facilitates crowdfunding to enable bank customers raise business starting capital and access diverse marketing hubs	9 (13.6)	44 (66.7)	2 (3)	8 (12. 1)	3 (4.5)	3.73	1.00
The generally, the bank's facilitation of crowdfunding platform has made it raise some capital, increased and retained a higher capital base which has translated to increase in its return on assets	8 (12.1)	46 (69.7)	6 (9.1)	3 (4.5)	3 (4.5)	3.80	.881
Valid list wise=66							
Grand mean =3.87							

From table 1, slight majority of respondents strongly agreed (53.0%) and agreed (19.7%) that the bank operates a crowdfunding platform based on sound and enabling legal/regulatory framework; while 68.2% agreed that the bank facilitates a crowdfunding platform to connect various investors/funders with bank customers, which attracts a large customer base assumed to translate to improved profitability.

Further, 42.4% and 18.2% of respondents agreed and strongly agreed respectively that the bank has digitized collaborative financing where willing investors fund business startups for bank

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customers; and 56.1% agreed that the bank's crowdfunding platform facilitates customers in accessing varied capital markets and marketing hubs; thus transactions from successful customers on crowd funding platform translates to financial benefits to the bank.

Furthermore, most respondents agreed (66.7%) and strongly agreed (13.6%) that the bank facilitates crowdfunding to enable bank customers raise business starting capital and access diverse marketing hubs. Thus, successfully facilitated customers make financial transactions of their business through the facilitating bank, which then increases financial benefits for bank.

Lastly, most respondents agreed (69.7%) that generally, the bank's facilitation of crowdfunding platform has made it raise some capital, increased and retained a higher capital base which has translated to increase in its return on assets. This is also indicated by the grand mean of 3.87 rounded off to 4 which agree on the likert scale of measurement. This is also supported by IOSCO (2014) assertion that crowd-funding as a market-based financing technique can be used to raise funds from large numbers of individuals or legal entities in small amounts, bypassing traditional financial intermediaries, and using mobile phones and online web-based platforms to connect with borrowers who benefit the facilitating bank through financial transactions and attracting a higher customer base.

A paired-samples t-test was conducted to compare profitability of commercial banks before introducing crowd funding and after introducing crowd funding. The results are as shown in Table 2.

Table 2: Profitability Before and After introduction of Crowd Funding

	Mean	N	Std Dev	T	df	Sig
Before Crowd funding	2.7576	66	.68074	-13.948	65	.000
After Crowd funding	4.0758	66	.75060			

There was a significant difference in the performance after introducing crowd funding (M=4.07, SD=0.75) and before introducing crowd funding (M=2.75, SD=0.68); t(65)=-13.948, p = 0.000. These results suggested that crowd funding really does have influence of profitability of commercial bank. Specifically, the results suggested that introduction of crowd funding results to significant increase in profitability of commercial banks.

Descriptive statistics: AI predictive banking and banks' profitability

These are summarized responses on whether Artificial Intelligence predictive banking influences profitability of listed commercial banks in Kenya. The descriptive results are presented in table 3.

Table 3: Descriptive statistics: Artificial intelligence predictive banking

Statement	5	4	3	2	1	Mean	SDV
The bank has adopted artificial intelligence system in a number of bank operations to minimize human error	48 (72.7)	11 (16.7)	1 (1.5)	2 (3)	4 (6.1)	4.47	1.10
The bank has an effective artificial intelligence system to analyze customer preferences and switching intentions	13 (19.7)	28 (42.4)	20 (30.3)	3 (4.5)	2 (3)	3.71	0.94
The bank has voice aided banking system and real time face recognitions to assist customers in decision making and deterring fraud	4 (6.1)	30 (45.5)	25 (37.9)	6 (9.1)	1 (1.5)	3.45	0.81
The installed artificial intelligence aids the bank in analyzing stock markets and helps provides recommendations as per financial goals of	24 (36.4)	25 (37.9)	11 (16.7)	1 (1.5)	5 (7.6)	3.94	1.14

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individual customers.							
5.Artificial intelligence systems' assistance in analyzing huge chunks of data, performing calculations and prediction capabilities helps the bank in investment, loaning and underwriting decisions	28 (42.4)	22 (33.3)	4 (6.1)	7 (10.6)	5 (7.6)	3.92	1.27
6.Generally adoption of customized artificial intelligence system by the bank has really boosted the bank's profitability	31 (47)	14 (21.2)	12 (18.2)	2 (3)	7 (10.6)	3.91	1.321
Valid list wise=66							
Grand mean =3.90							

From table 3, most respondents strongly agreed (72.7%) and agreed (16.7%) that the bank has adopted artificial intelligence system in a number of bank operations to minimize human error; thus reduction in human error saves on losses associated with manual operations. Further, 42.4% and 19.7% of respondents agreed and strongly agreed respectively that the bank has an effective artificial intelligence system to analyze customer preferences and switching intentions; while 45.5% also agreed that the bank has voice aided banking system and real time face recognitions to assist customers in decision making and deterring fraud; thus a reduction in fraud boosts banks' profitability.

Further, 37.9% of the respondents agreed and further 36.4% strongly agreed that the installed artificial intelligence aids the bank in analyzing stock markets and helps provides recommendations as per financial goals of individual customers; while 33.3% and 42.4% agreed and strongly agree respectively that artificial intelligence systems' assistance in analyzing huge chunks of data, performing calculations and prediction capabilities helps the bank in investment, loaning and underwriting decisions.

Lastly, majority respondents agreed (47.0%) and agreed (21.2%) that generally adoption of customized artificial intelligence system by the bank has really boosted the bank's profitability. This is supported by Punamaraju (2018) who indicated that application of artificial intelligence in tailored financial services: can aid in analyzing stock markets and provide recommendations; automation of underwriting process is possible with the use of artificial intelligence services that can use unstructured information in the decision-making process; voice aided banking like language processing using artificial intelligence can reduce human error and improve efficiency of the process.

The study also conducted paired-samples t-test to compare profitability of commercial banks before and after introducing artificial intelligence predictive system. The results are as shown in Table 4.

Table 4: Profitability Before and After introduction of Artificial Intelligence Predictive System

	Mean	N	Std Dev	Mean Difference	T	df	Sig
Before A.I predictive system	2.7273	66	1.07482	-1.15152	-5.553	65	.000
After A.I predictive system	3.8788	66	.88605				

Paired sample test indicated that there was a significant difference in the profitability after introducing artificial intelligence predictive system (M=3.88, SD=0.88) and before introducing artificial intelligence predictive system (M=2.72, SD=1.07); t(65)= -5.553, p = 0.000. These results revealed that artificial intelligence predictive system really does have influence of profitability of commercial bank.

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Particularly, the results suggest that introduction of artificial intelligence predictive system has witnessed improvement in performance.

Descriptive statistics: Payment innovation and banks' profitability

These were summarized responses on whether payment innovations influence profitability of listed commercial banks in Kenya. The descriptive results were presented in table 5.

Table 5: Descriptive statistics; Payment innovation system

Statement	5	4	3	2	1	Mean	SDV
The bank has varied electronic payment services to its customers	32 (48.5)	25 (37.9)	3 (4.5)	4 (6.1)	2 (3)	4.23	1.00
The bank has realized an increase in profitability after adoption of an effective electronic funds transfer system	17 (25.8)	27 (40.9)	8 (12.1)	8 (12.1)	6 (9.1)	3.62	1.25
The electronic billing system really saves on banks transaction costs	24 (36.4)	30 (45.5)	4 (6.1)	6 (9.1)	2 (3)	4.03	1.04
Adoption of an effective electronic bank card payments saves on banks transaction costs and improve bank profitability	17 (25.8)	33 (50)	2 (3)	9 (13.6)	5 (7.6)	3.73	1.21
The bank adopted electronic payments to resolve problems of trust and financial transaction security with its customers	15 (22.7)	30 (45.5)	6 (9.1)	10 (15.2)	5 (7.6)	3.61	1.21
Generally, secure and upgraded electronic payment systems save on transaction costs and boost bank profitability	12 (18.2)	35 (53)	10 (15.2)	4 (6.1)	5 (7.6)	3.68	1.084
Valid list wise=66							
Grand mean =3.82							

From table 5, most respondents strongly agreed (48.5%) and agreed (37.9%) that the bank has varied electronic payment services to its customers; which also supported by 40.9% of respondents who agreed that the bank has realized an increase in profitability after adoption of an effective electronic funds transfer system; implying that banks' electronic payment services to its customers has made banks realize a significant growth in profitability.

More so, 45.5% of respondents agreed that the electronic billing system really saves on banks transaction costs; while half of respondents also agreed that adoption of an effective electronic bank card payments saves on banks transaction costs and improve bank profitability; meaning that introduction of electronic billing system and effective electronic bank card payments saves banking transaction costs and boost the banks' profitability.

Further, 45.5% of respondents agreed and strongly agreed (22.7%) that the bank adopted electronic payments to resolve problems of trust and financial transaction security with its customers; implying that customers that have embraced electronic payment system makes the banks save on manual payment transactions, thus, boost banks' profitability.

Lastly, most respondents agreed (53.0%) and strongly agreed (18.2%) supported by the grand mean = 3.82, 4 = agree) that generally, secure and upgraded electronic payment systems save on transaction costs and boost bank profitability. This is supported by Cheng et al., 2017) assertion that electronic payment innovation rose as a way to resolve problems of trust and financial transaction

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security between buyers and sellers. Thus, it is able to effectively promote the convenience and applicability of traditional cash payments, money transfers, and bank card payments by utilizing innovative payment technology supported by the internet, thus minimizing manual transactions.

The study further conducted paired-samples t-test to compare profitability of commercial banks before and after introducing payment innovation system. The results are as shown in Table 6.

Table 6: Profitability Before and After introduction of payment innovation System

	Mean	N	Std Dev	Mean Difference	T	df	Sig
Before payment innovation system	2.4848	66	.86367	-1.43939	-9.146	65	.000
After payment innovation system	3.9242	66	1.05700				

There was a significant difference in the performance after introducing payment innovation system (M=3.92, SD=1.05) and before introducing payment innovation system (M=2.48, SD=0.86); t(65)=-9.146, p = 0.000. These results suggest that payment innovation system does have influence of profitability of commercial bank. Specifically, the results suggest that introduction of payment innovation system results to significant increase in profitability of commercial banks.

Inferential Statistics

Table 7: Pearson Correlation

		Crowd Funding	A.1	Payment System	Profitability
Crowd Funding	Pearson Correlation	1			
	Sig. (2-tailed)				
	N	66			
Artificial Intelligence Predictive System	Pearson Correlation	.260*	1		
	Sig. (2-tailed)	.035			
	N	66	66		
Payment Innovation System	Pearson Correlation	.400**	.296*	1	
	Sig. (2-tailed)	.001	.016		
	N	66	66	66	
Profitability	Pearson Correlation	.557**	.454**	.607**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	66	66	66	66

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Multiple Regression Analysis

Multiple regression analysis was computed to assess the multivariate influence of the study's independent variables (payment innovations, crowd funding, and artificial intelligence predictive banking) on the dependent variable (profitability of listed commercial banks in Kenya. This was after the compulsory assumptions of multiple regression analyses were checked and met. The multiple regression results were shown in table 8.

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Table 8: Multiple regression results

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.736[a]	.541	.519	.25874	.541	24.388	3	62	.000

ANOVA[b]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	4.898	3	1.633	24.388	.000[b]
	Residual	4.151	62	.067		
	Total	9.049	65			

a. Predictors: (Constant), AI predictive banking, Payment innovations, Crowd funding

b. Dependent Variable: Profitability

Multiple regression analysis in table 8 showed the multiple regression results of the combined influence of the study's independent variables (payment innovations, crowd funding, and artificial intelligence predictive banking). The model's R squared (R^2) is 0.541 which shows that the study explains 54.1% of variation in the profitability of listed commercial banks in Kenya, while other factors not in the conceptualized study model accounts for 45.9 %, hence, it is a good study model.

Furthermore, Analysis of Variance (ANOVA) shows the mean squares and F statistics significant (F = 24.388; significant at *p<.001*), thus confirming the fitness of the model and also implies that the study's independent variables (payment innovations, crowd funding, and artificial intelligence predictive banking) have significant variations in their contributions to profitability of listed commercial banks in Kenya.

Finally, the values of unstandardized regression coefficients with standard errors in parenthesis in table 9 indicated that all the study's independent variables (crowd funding; β = 0.411 (0.118) at *p<0.01,* artificial intelligence predictive banking; β = 0.334 (0.112) at *p<0.01,* payment innovation; β = 0.466 (0.122) at *p<0.01* significantly influenced profitability of listed commercial banks in Kenya (dependent variable).

In this regard, the study's final multiple regression equation is;

$$y= -.535+0.613X_1+0.466X_2+ 0.411X_3 + 0.334X_4$$

Where;

y= profitability of listed commercial banks in Kenya

X_1= crowd funding

X_2= artificial intelligence banking

X_3= payment innovations

Table 9: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	-.535	.496		-1.079	.285
	Crowd funding	.411	.118	.332	3.493	.001
	AI predictive banking	.334	.122	.249	2.729	.008
	Payment innovations	.466	.112	.401	4.166	.000

a. Dependent Variable: Profitability

The Strategic Journal of Business & Change Management. **ISSN** 2312-9492 (Online) 2414-8970 (Print). www.strategicjournals.com

Testing of study hypotheses

Firstly, study hypothesis one (H_{01}) stated that crowd funding system does not significantly influence profitability of listed commercial banks in Kenya. Multiple regression results indicate that crowd funding system significantly influence profitability of listed commercial banks (β = 0.411 (0.118) at *p<0.01*). **Hypothesis one was therefore rejected**. The results indicated that that a single improvement in effective crowd funding systems will lead to 0.411 unit increase in the profitability of listed commercial banks in Kenya.

Secondly, study hypothesis two (H_{02}) stated that artificial intelligence predictive system does not significantly influence profitability of listed commercial banks in Kenya. Multiple regression results indicate that artificial intelligence predictive system significantly influence profitability of listed commercial banks (β = 0.334 (0.122) at *p<0.01*). Hypothesis two was therefore rejected. The results indicated that that a single improvement in effective artificial intelligence predictive systems will lead to 0.334 unit increase in the profitability of listed commercial banks in Kenya.

Thirdly, study hypothesis two (H_{03}) stated that payment innovation system does not significantly influence profitability of listed commercial banks in Kenya. Multiple regression results indicate that payment innovation system significantly influence profitability of listed commercial banks (β = 0.466 (0.112) at *p<0.01*). Hypothesis three was therefore rejected. The results indicated that that a single improvement in effective payment innovations will lead to 0.466 unit increase in the profitability of listed commercial banks in Kenya.

CONCLUSIONS AND RECOMMENDATIONS

The study overall concluded that bank innovative systems influenced profitability of listed commercial banks in Kenya. This implies that increase in bank innovative system would results to improvement in their profitability. Payment innovations had the highest statistically significant influence on profitability of listed commercial banks, Kenya, followed by crowd funding and lastly artificial intelligence predictive banking.

The study concluded that Crowd funding system does significantly influence profitability of listed commercial banks in Kenya. Increase in the utilization of crowd funding system would result to increase in profitability of listed commercial banks. The first null hypothesis was rejected. The listed bank facilitated a crowd funding platform to connect various investors/funders with bank customers. The bank's facilitation of crowdfunding platform has made it raise some capital, increased and retained a higher capital base which has translated to increase in its return on assets

The study concluded that Artificial intelligence predictive system significantly influences profitability of listed commercial banks in Kenya. This indicated, utilization of artificial intelligence predictive system has resulted to minimization of human error, analyze customer preferences and switching intentions as well analyzing huge chunks of data, performing calculations and prediction capabilities helps the bank in investment, loaning and underwriting decisions hence improvement in profitability.

Lastly, the study concluded that payment innovation system significantly influence profitability of listed commercial banks in Kenya. Listed commercial banks in Kenya have adopted various payment innovation systems such as electronic payment services, electronic funds transfer system, electronic billing system, electronic bank card payments among others which has result to cost saving and increase of financial inclusion hence enhanced profitability.

The study recommended that there is need for financial regulators such as Central Bank of Kenya to come up with sound and enabling legal/regulatory framework that would enhance further development of crowd funding. This would allow seamless connection between various investors/funds and listed commercial banks. Similarly, bank management should make

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crowdfunding system to be accessible to all their customers and at same time sensitize availability of crowd funding system.

Further, listed commercial bank management should customize artificial intelligence predictive to specific market niche as this would allow them to analyze the required data that would have impact on their profitability. Further, innovators in commercial banks should roll out secure and upgraded artificial intelligence predictive banking innovations meant to win customer trust.

Finally, bank management should allocate more funds to invest in modern technologies and payment innovation which enhance greater utilization of digital infrastructure. This will boost the banks' efficiency in its operations and lower costs. Moreover, through payment innovations, the bank can widen its range of its products and services resulting into improved sales and overall bank performance.

Areas for further research

First, a similar study can be done on all commercial banks in Kenya using time series analysis so as to compare study findings.

Secondly, a similar study can be done on Micro Finance Banking institutions so as to assess the effectiveness of the adopted banking innovations.

Finally, there is need to introduce bank size as moderating variable so as to establish whether bank size significantly influence the relationship between financial innovation and profitability.

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