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Strengthening the Islamic Banking Services Through Blockchain Technology: ANP- Stei Approach

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Abstract

The purpose of the study is to explore the rank-wise contribution of blockchain technology with its four components, i.e. Security, Transparency, Efficiency and Immutability, along with ten nodes, i.e audit trial, real-time, traceability, reliable, peer-to-peer, cost, fast, time, permanent and decentralized in strengthening the Islamic Banking services in Pakistan. The Analytical Network Process (ANP) technique has been applied for data collection and expert opinion from Bankers, academia and blockchain technology Practitioners. The data was analyzed on Super Decision software. The study reveals that blockchain adoption in Pakistani Islamic Banking enhances financial services through its ten nodes' security, transparency, efficiency, and immutability. This technology effortlessly facilitates processes, enhances accessibility, and validates blockchain's pivotal role in Islamic banking product offerings.

Keywords - Pakistan, Islamic finance, Blockchain Technology, Security, transparency, efficiency, immutability.

1. Introduction

The latest innovations in Financial Technology (Fin-Tech) services, such as money transfer services, mobile payments, crowdfunding, trading platforms and automated portfolio managers, have entirely revolutionized the startup business. Using the crowdfunding application, you can easily collect funds from and transfer them to people from all around the globe, even from those individuals you have never. Fintech services have played an imperative role in changing consumer expectations and behavior, including access to data anywhere and anytime, even for SMEs. This development has made consumers cherish high expectations (Muzdalifa et al., 2018; Yudaruddin, 2023). In this digital era, the Fintech services industry is gaining popularity and being used as a revolutionary technology. Digital payment Apps are ranked as the most advanced applications in the Fin-Tech industry. This App can potentially attract governments and individuals to benefit from its financial services. The digital economy's potential has achieved massive and significant growth in Pakistan (Lau, 2023; Wibowo & Krisnadi, 2016).

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Fin-Tech services have emerged as an innovative form of business that exploits technology, power and digital devices in order to make financial transactions more convenient. In Pakistan, Fin-Tech services are ranked as the latest form of business that provides clients hassle-free and smooth transaction procedures. . In Pakistan, Fin-Tech services penetrate nearly every sector, including startup payments, personal finance, lending, retail investment, remittances, crowdfunding, and financial research. However, some individuals think that this is a new phenomenon named as a disruptive innovation in the field of financial services(Yudaruddin, 2023).The historical data of the State Bank of Pakistan (SBP) revealed a substantial year-to-year growth in deposits: by 7.1% in December 2022, achieving Rs. 22.467 trillion as compared to December 2021 when deposits were at Rs. 20.972 trillion. This significant growth in deposits has been observed due to Fin-Tech innovation. Fin-Tech ecosystem, in Pakistan, has witnessed a fostering upsurge graph, since past decade, motivated by high-bandwidth diffusion of 3G/4G striking 34%, and mobile phone penetration attaining more than 77%. With a young population, where 64 percent folks are under 30 years of age, Fin-Techs has played a vital role in introducing a new era of digital financial services in the country. Today, an estimated 269 Fin-tech companies are operating in Pakistan, focusing on mobile banking, digital payments, and lending procedures for under-served segments. The sector is projected to cross \$36 billion by 2025, creating approximately four million new jobs in the country's economy (The News 2023, September 02).

There are two key motives behind the emergence of Fi-Tech institutions: primarily, the worldwide financial crisis, in 2008, evidently observed deficiency in traditional banking which, consequently, triggered this crisis; secondarily, the evolvement of novel technologies that support funds mobility, friendly usage, rapidity and low-cost financial services ((Anikina et al., 2016; Wu et al., 2023). A cross-country research, conducted in Canada, Australia, Singapore, USA, UK and Hong Kong, on survey of 10, 131 individuals, regarding the usage of Fin-Tech services shows that 15.5% from all responded use non-banking services and it is expected that the existing figure will rapidly increase in future. The 25% of the respondents expressed that they used non-banking services in their life regularly, and, as a normal routine life, they used 2 to 3 non-banking products. This research reflects that banking services clients are also potential user of Fin-Tech (Hanafizadeh & Amin, 2023; Saksonova & Kuzmina-Merlino, 2017)

The technological structures and business models of banking companies are established on this technology in order to improve efficacy; for instance, inaugural of new branches is expensive and this new trend will provide an alternative to this issue; then, it will help the banks curtail the burden of their human resources. Besides, banks have tough rivalries with other banks, in terms of services offered or on profit margins. From the above example, if any bank hesitates to adopt Fin-Tech, it will definitely lose its clients, specifically the ones in forthcoming segments. Therefore, concrete action is required to be taken by banks' managements in order to safeguard the survival of banks in this contemporary era of Fin-Tech (Campanella et al., 2023; Chishti & Barberis, 2016).

Considering the innovation and revaluation of Fin-Tech in services industry and conventional banking, it is presumed that it will help Islamic banking to approach its widest range of clients and to uphold the sharia compliance as well as ethics of Islamic banking. In next step, it will assist Islamic banking users with wide range of applications, such as downloading apps for carrying out online and real-time banking transactions, particularly later in the segmentation of financing. This system may lead to other online transactions initiated by bank clients, and to enhance the market share of Islamic banks in prevailing financial markets. The key impact of Fin-Tech is providing cost-efficient facility to its users and fostering the service process in acquiescing funding products at Islamic banking services (Mohd Haridan et al., 2023).

The main barrier in adopting Islamic Fin-Tech is scarcity of trained HR personnel and the explicit policies of the Govt. To create the accurate ecosystem for the growth of Islamic Fin-Tech, within the country, the Govt. should devise some realistic regulations, and the academic institutions should contribute with appropriate research as and well-equipped manpower (Mohd Haridan et al., 2023). The achievement of Islamic Fin-Tech may be accredited to the ranges of financial services wherein Fin-Tech can be linked; for instance, the services offered can be allied with blockchains technology, cryptocurrency, cross-border payment and other areas (Rabbani et al., 2020; Saxena & Kumar, 2023).

The Blockchains technology was allowed in Pakistan by the State Bank of Pakistan (SBP) through a contract mutually signed by Pakistan Banks Association (PBA) and the SBP for the implementation of Blockchains technology based on Knows Your Customer (KYC). Telenor Microfinance Bank was a premier in implementing the Blockchain technology in Pakistan, but when compared to the other states like European region and Malaysia, the usage of this abrupt technology has already gained popularity in Islamic banking and finance. The Data extracted from Dinar Standard-2018, relating to Islamic Fin-Tech Report, reveals that as per the report, about 70% Islamic Fin-Tech institutions internationally are focusing on facilitating the business and their clients in funding through equity crowd funding (ECF) and peer-to-peer (P2P) lending. In this modern era, some Malaysian and Nigerian Banks have launched Investment Account Platform which is purely Islamic crowd funding platform for SMEs (Fund, 2020).

Therefore, this paper is aimed at discussing further as to how the blockchains Islamic Fin-Tech can strengthen Islamic banking services in Pakistan. The Study has been designed to provide an overview of the Islamic Fin-tech which will be supportive in creating wider Islamic financial services, making them safer, more transparent, and more flexible. Fin-tech in Islamic financial services must focus on continuing and creating an ever increasing Islamic financial market and providing evidence of its existence. It must make sure not only having products that have their own characteristics compared to conventional ones, but also the provision of services using Fin-tech to consumers so as to further strengthen facilities that prioritize digitization through blockchain technology.

The banking industry has evolved from banking 1.0, rooted in tradition, to banking 4.0, characterized by advanced technologies like artificial intelligence and blockchains technology. Innovations like ATMs, launched in banking 2.0 by Barclays in 1960, marked a shift, in this regard. Banking 4.0, from 2017 to onwards, leverages blockchain technology for cost effectiveness, faster data processing, untampered data storage, and fastest connectivity, ensuring banks to remain competitive (Biswas et al., 2020). Blockchain-based financial inclusion, with lower operating costs, has driven a rapid transformation in banking services. Commercial licensing for electronic money institutes (EMIs) has surged, tripling the number to 40.8 million (Noreen et al., 2023). The Banks have heavily invested in blockchain technology and innovative financial inclusion solutions to meet the rising demand for financial products. This investment resulted in a 7.6% quarterly growth rate, driven by an additional 7.6 million banking users (Hassan, 2021). The banking sector, including major players like JPMorgan Chase, CitiBank, Wells Fargo, Barclays Bank Plc, and Capital One, has experienced increased revenue generation through the adoption of Blockchain Technology. However, hurdles exist in its widespread adoption, primarily stemming from consumer knowledge gaps. While previous research has touched on this issue generally, more in-depth studies are required to assess Blockchain technological competence. This research narrows its focus to Blockchain Technology knowledge rather than basic technology skills, such as internet and computer

proficiency, as explored in prior studies (Rahman et al., 2021). In the contemporary banking sector, there is a pressing need to update consumer perceptions of financial technologies, particularly regarding the role of Blockchain technology. To align with the Islamic banking industry, it is crucial to delve into consumers' specific knowledge about Blockchain. This exploratory research, from the consumer's standpoint, aims to shed light on their awareness, perception, trust, and norms concerning this transformation. The insights gained from this study will inform the policymakers in the Islamic banking sector about the strategic blockchains adoption plans for work.

2. Literature Review

2.1 Islamic Financial Technology (Fin-Tech)

Before 2016, the term Islamic Fin-Tech was typically used for crowdfunding platform in Islamic Finance sector. Multiple excellent achievements were documented in 2016, like Islamic Account Platform and Islamic Robo-advisor. Besides, Islamic Fin-Tech introduced or launched Islamic Fin-Tech Hub, Islamic Fin-Tech Alliance and peer-to-peer financing facility (Rabbani et al., 2023; Rahmayati, 2021). Similarly, a lot of Fin-Tech applications were introduced in Islamic world like launching of Goolive which is a digital platform with a goal to synergize agriculture; moreover, its whole potency is linked with the objective to yield top grade agricultural crops which are healthy, safe and halal as per shariah compliance. Goolive is zealous to educate individuals' specifically the young generation associated with diverse educational backdrop, to create understanding and the feeling of pride in the Muslim for its superiority in maritime and agricultural fields. This P2P financing company is quite new with the least human power employment (Barbier, 2023; Firmansyah & Anwar, 2019). Similarly, the Natural Shariah Fin-Tech technology gained popularity in startup for financing to the SMEs, with focusing on the quicker and faster growth of Shariah segments. As an aggregator of Islamic Fin-Tech, Alami promotes SMEs sector to avail financing services from Islamic Banking. The company set its goal to provide financing to SMEs sector up to Rs 100 billion at the end of 2018 (Firmansyah & Anwar, 2019; Hasyim et al., 2023). Like Almi and Natural Financing, the hitch-assist Qasir is also an application for free cash which assists a merchant in recording his sale revenue, monitoring stock, managing products and overseeing the sales report. This app is available on both platforms: mobile and Web application. In early 2018, Qasir feature provided facility to its users to connect through their mobile phones to financial institution to avail financing (Firmansyah & Anwar, 2019; Ramadhan et al., 2023)

Initially, the Islamic Fin-Tech was just used as a tool for lending and borrowing money through the use of information technology, in Indonesia. Gradually, Indonesian Islamic banks expanded Fin-Tech scope beyond just borrowing. The reason behind this was that Indonesian banks set their vision for financial innovation which will be safe, efficient, reliable and smooth and will help in economic growth. It further develops the customers' confidence by providing innovative financial services. By warping up the above benefits of Islamic Fin-Tech, it is concluded that it can play an imperative role in encouraging Indonesian Finance Services. Currently, the Islamic Fin-Tech is offering several functions which are not listed amongst online financial services. The results of research studies, conducted by Fin-Tech Association, revealed that Fin-Tech in Indonesia is quite dominated by the companies' payment i.e. 44%: financing 15%, aggregators 15%, crowdfunding 8%, corporate and personal finance planner 10% and others 8% (Baidhowi, 2018).

The Islamic Fin-Tech holds massive potential due to its new development and mostly untapped products. The digital revolution has creased the customer's expectation and demands from

financial services providers which are unique, more convenient, and cost effective and the most efficient. According to Global Islamic Fin-Tech Report 2022, it has been estimated that the size of Islamic Fin-Tech increased from \$ 79 billion to \$ 179 billion by 2026, at a CAGR of 17.9%. This report reflects substantial opportunities for Islamic Fin-Tech. The factors, such as Keen awareness about Islamic Fintech stakeholders, inspiration from top ranked executives of the financial institutions, and an attractive regulatory regulation within key Islamic Financial marketplace may play significant role in driving FinTech revolution in Islamic Banking and Finance (Aderemi & Ishak, 2023; Rahmayati, 2021)

The FinTech is a financial service so innovative that it is permissible in Islam due to having vast benefits for the betterment and problem solving of the community. The existence of Fin-Tech is considered as the key creation for easier, efficient as well as faster services providers in the field of Islamic Finance. Moreover, sooner or later, with the blessing of God, potential as well as the prosperity of natural resources, Pakistan has the opportunity to lead the world as a prominent vindicator in halal food industry that will uphold the halal food, halal tourism and halal fashion to attain an Islamic Economy globally. The Fin-Tech implementation in Islamic Banking and other Finance institutions will make it possible and easier for the business players, particularly for micro SMEs, to approach the offered Shariah Compliance banking services and to apply for relentless financing without any physical connection to bank branches (Rahmayati, 2021).

Islamic Financial Institutions are quite reliant in fulfilling the community financing needs; therefore, necessitating a top level of trust is easy. Accordingly, Islamic Banking and Financial sector must avail the benefits of this latest financial technology for faster financing process. This technology has a capacity to fulfill the customers' expectations regarding services and this factor will definitely impact on user-demand for innovation. High expectations, particularly with regard to convenience, speed, lower prices, and ease of use of financial services, have been fostered by the availability of internet access and the capability of internet network users to transact in real time (Rahmayati, 2021).

2.2 Background of Block Chain Technology

Blockchain technology originates from the digital data concept which has a quality to secure data safely and transmit it with low risk of manipulation and hacking, due to decentralized nature (Padmavathi & Rajagopalan, 2023). Traditionally, in various aspects of our life, encompassed by the digital environment, are controlled by an authority, inevitably, we must trust the controlling entity. For instance, we need to trust on banks' control for various types of financial transactions like money transfer, money depositing, banker's cheques, etc. While banks are subjected to strict regulations, intrinsic risk persists in entrusting financial transactions to centralized entities. Instead, direct P2P transactions involve lack of validation and security guarantees, posing even high risk while exchanging process between individuals. Blockchain Technology offers a promising solution to this critical issue. In a blockchain technology, data exchanges and transactions undergo system validation before becoming a part of an immutable ledger comprised of interconnected data blocks. This ledger is not centralizing, rather it is decentralized, scattered across a network of nodes. To alter any data, changes must be made across multiple chains, which is extremely challenging and computationally intensive. Moreover, every user can independently verify the authenticity and integrity of data, at any time. This intrinsic transparency and security makes data stored on the blockchain highly resistant to forgery and tempering (Tan & Saraniemi, 2023). The Blockchain ensures data security by requiring changes to be made across multiple chains of blocks, making imitation impossible, Blockchain users can individualistically confirm data reliability. This decentralized/ distributed system validates transactions permanently

immutable in a distributed ledger. Shifting existing data in one chain requires changes in others. Users have incessant access to verify data, enhancing blockchains' anti-forgery capabilities (Wu et al., 2023). Financial Reports of De La Torre and Torralba, published in 2017, highlighted key technologies shaping the future, including artificial intelligence, IoT, blockchain, and 3D/4D printing. These technologies were poised to revolutionize various sectors and to enhance capital investment. Notably, blockchain and IoT were central to Fin-tech, a startup-driven sector disrupting financial services, including mobile payments, money transfers, loans, fundraising, and asset management (Govindan et al., 2023; Kumari & Devi, 2023; Rjoub et al., 2023). The Blockchain offers benefits such as decentralized peer-to-peer networks, secure cryptographic connected blocks, adaptable digital technology applications, and supreme transparency with traceable transactions visible to all users (Chong, 2021; Mutamimah & Kartika, 2023; Rabbani et al., 2020). Al Rajhi Bank, a global leader in Islamic banking, successfully conducted a cross-border money transfer using Ripple's blockchain tech. They aim to expand blockchain solutions to serve both retail and corporate customers, enhancing money transfer services. With over 200 money transfer centers in Saudi Arabia, the bank's blockchain integration aligns with the nation's prominent role in remittances (Elhag & Alshehri, 2023; Hariguna et al., 2023; Rahmayati, 2021).

In essence, the Blockchain technology holds immense potential to revolutionize the Islamic Banking Industry in Pakistan by addressing its complexity and unorganized, and excessive intermediaries. It can serve as a consolidation platform, streamlining operations and enhancing efficiency in these services sector. Indeed, as argued in the study of (Kshetri, 2021), developing countries, like Pakistan can avail a lot of benefits from the imperious features of blockchain technology, it has the capacity to promote disintermediation and decentralization in various sectors, such as Islamic banking, including governance and business, while ensuring adherence to sustainability standards. In the case of the Moroccan strawberry supply chain, blockchain can introduce potential enhancements and innovations (Boutkhoul et al., 2021). This paper aims to access the hurdles and potential advantages associated with the integration of blockchain technology, especially within the context of Islamic Banking in Pakistan. As awareness about sustainability rises, there is a growing need for robust compliance. Consequently, the adoption of blockchain technology is seen as a necessary step to ensure real-world implementation of sustainable practices (Boutkhoul et al., 2021). However, it's worth noting that blockchains implementation in Islamic Banking, in this context, is still at its early stages (Zhao et al., 2019). Therefore, addressing the barriers that influence blockchain adoption in Pakistani Islamic Banking is urgently needed. Currently, it is evident from the available literature review that no study has investigated the blockchain –adoption-barriers in Islamic Banking by applying the ANP decision-making framework, particularly in the Pakistani context. This paper makes contributions in this direction.

3. Research Methodology

This study applied Analytical Network Process, a mathematical theory established by Saaty, in the year 1996, as an advanced version of analytical hierarchy process which allows the variable to work systematically with the feedback and dependency that can capture the effect of both quantitative and qualitative variables simultaneously by applying scale distribution (Saaty, 2005). The analytical Network Process (ANP) allows scholars to study the complex interrelationship between the decision levels and their attributes. This approach substitutes hierarchies for networks in which the relationship among various levels are not revealed as lower or high, dominated or being dominated, indirectly or directly (Wang et al., 2010). The ANP network process is built on clusters including criteria and sub-criteria, generally known as nodes.

The ANP assumes relatively four maxims ((Saaty & Vargas, 2006):

- i. A priority or weight, represented as an absolute number in the closed interval $[0,1]$, quantifies relative dominance.
- ii. The reciprocal axiom states that if we have a paired comparison PC (EA, EB) between Elements A and B, regarding a certain property, in relation to Element C, where it represents how many times more the element A possesses the property than B the PC (EB, EA), then, should be equal to the reciprocal of PC (EA, EB), denoted as $1/PC (EA, EB)$. For example, if A is four times larger than B, then B is considered one-fourth of the size of A. This axiom ensures consistency in comparative assessments.
- iii. Homogeneity is the principle behind the Saaty 1–9 evaluation scale, where the upper limit of 9 is set to ensure the stability of the eigenvector when assessing relative priorities. This scale aligns with the need to maintain consistency and to limit comparisons to a small number of elements, preserving the reliability of the decision-making process.
- iv. The assumption of a dependence—condition implies that the system can be broken down into interconnected parts or components

3.1 Analytical Network Process Selection

This study applied the Analytical Network Process (ANP) technique to delve into the key factors effecting the implementation of blockchain technology in Islamic Banking. This approach provides a structured decision-making framework that eliminates the need for making assumptions about the independence of variables across different levels. Moreover, it elegantly captures the intricate relationships among variables, within the same level, facilitating a comprehensive analysis. ANP empowers decision-makers with a nuanced understanding of the determinants, enabling strategic choices in the dynamic landscape of Islamic Banking's blockchain integration (Ascarya & Achsani, 2006; Nazarian-Jashnabadi et al., 2023). Identifying blockchain technology application to Islamic banking determinants informs about the government's strategies for promoting Blockchain technology by addressing specific barriers and tailoring intervention accordingly; therefore, increasing Islamic banking access for all. (Saaty & Vargas, 2006) opined that ANP approach avoids common econometric issues such as multi-collinearity, and aligns with traditional complex indicator methods, which aim to select diverse indicator across several procedures (Shikhteymour et al., 2023).

The ANP approach primarily enables the decision makers, through expert opinion, specifically in the situations when quantitative measures alone are inadequate to address the complex issues within banking industry. Many studies have acknowledged the importance of coalescing qualitative and quantitative approaches to tackle the multifaceted challenges effectively. For instance, Wanke et al., (2016) applied two-stage TOPSIS and neural network approach to predict the efficiency of Islamic banks, integrating multi-criteria decision-making (MCDM) methods. ANP played a vital role as an analytical tool within the MCDM framework. A research study conducted by Rusydiana & Devi, (2013) wherein ANP was applied in order to assess challenges encountered by Bait-ul-Maal Tamwil in Indonesia.

Besides, researchers concluded that available literature on blockchain technology relies on parametric statistical techniques, often using primary or secondary data, and raised concerns about its accuracy in decision making. This school of thought argued that parametric approaches are constrained in capturing the complexities of the subject. In contrast, Analytic Network Process (ANP), an expert-based methodology, was emphasized as a valuable alternative. ANP was praised for its ability to comprehensively analyse complex issues and provide more impartial decision-

making, offering a promising approach for addressing the multifaceted challenges in the realm of blockchain technology. Rezaei et al., (2012) argued that expert based academic research provides a significant alternative methodology to attain more objective finding.

3.2 Data and Data Collection Method

The ANP approach used primary data collected through multi-step process, including literature review and focused group discussion for model decomposition, pair-wise questionnaire for model quantification, and synthesis and analysis. Initial variables were derived from financial inclusion literature to construct the ANP framework, which was then validated through focus group discussion (FGD). The FGD involved ten highly knowledgeable experts in Islamic Banking in Pakistan, representing three distinct expert groups, including Pakistani practitioners, academia and regulators.

Respondents for this study are selected from the group of academia, practitioners and scholars having specific qualification and relevant experience as per the criteria given below:

- The expert having rich experience in the Islamic Banking industry in Pakistan and directly dealing with the blockchain technology implementation.
- The expert who is well equipped having in-depth knowledge and deep understanding of the theory and practice of Islamic Banking in connection with blockchain technology.
- Experts from academic and regulatory backgrounds who demonstrated prolific research activity in Islamic Banking, particularly in the realm of blockchain technology, by consistently publishing their findings and actively participating in both local and international conferences to disseminate their research.

Consequently, this research selected 12 experts from four diverse clusters i.e. IT professionals, bankers, Blockchain Users, and from academics to respond to a simplified ANP pair-wise comparison questionnaire, as shown in Table 1, illustrating the expert respondent profiles as below:

Table-1 (ANP Respondent Profile).

No.	Name	Institutions	Designation
Expert respondents of focus group discussion (FGD)			
1	Mr. G.A.	University of Sindh	PhD Scholar
2	Mr. A.H.K	Banki Islami	Auditor
3	Mr. D.N.S.	Free Lancer (Blockchain User)	BCT Practitioner
4	Mr. N.K	Free Lancer (Blockchain User)	BCT Practitioner
5	Mr. B.K	National Bank of Pakistan	Vice president
6	Ms. K.S.	Muhammad Ali Jinnah University	PhD Scholar
7	Ms. S.N.S.	Federal Urdu University	Lecturer
8	Mr.S.A.K	Lasani Flour Mills (BCT User)	Finance Officer
9	Dr. A.A.M,	Federal Urdu University	Asstt. Professor.
10	Dr. A.R.	National University of Modern Languages	Asstt. Professor.
Expert respondent of ANP pair-wise comparison Questionnaire			
1	Mr. B.K	National Bank of Pakistan	President
2	Dr. T.M R	Free Lancer (BCT)	BCT Practitioner
3	Mr. M.A.Khan	Free Lancer (BCT)	BCT Practitioner
4	Mr. A.W.Khan	PSM	C.I.A
5	Mr. R.K.	PSM	Finance Officer
6	Mr. S.K.	Bank Dubi Islami	O. Manager
7	Mr. A.Khan	Al Barka Bank	B. Manager
8	Mr. Y.Khan	Bank Islami	B. Manger
9	Mr. H.A.	HBL (Islamic Banking)	O. Manager
10	Ms. Mariya	HBL	O. Manager
11	Ms. Nosheen	Bank Islami	B. Manger
12	Ms. Nighat	Meezan Bank	O. Manager

3.3 Research step in ANP Process

For this study, we applied three steps of ANP, particularly construction and model qualification, and result analysis. These three ANP steps are demonstrated in Figure-1

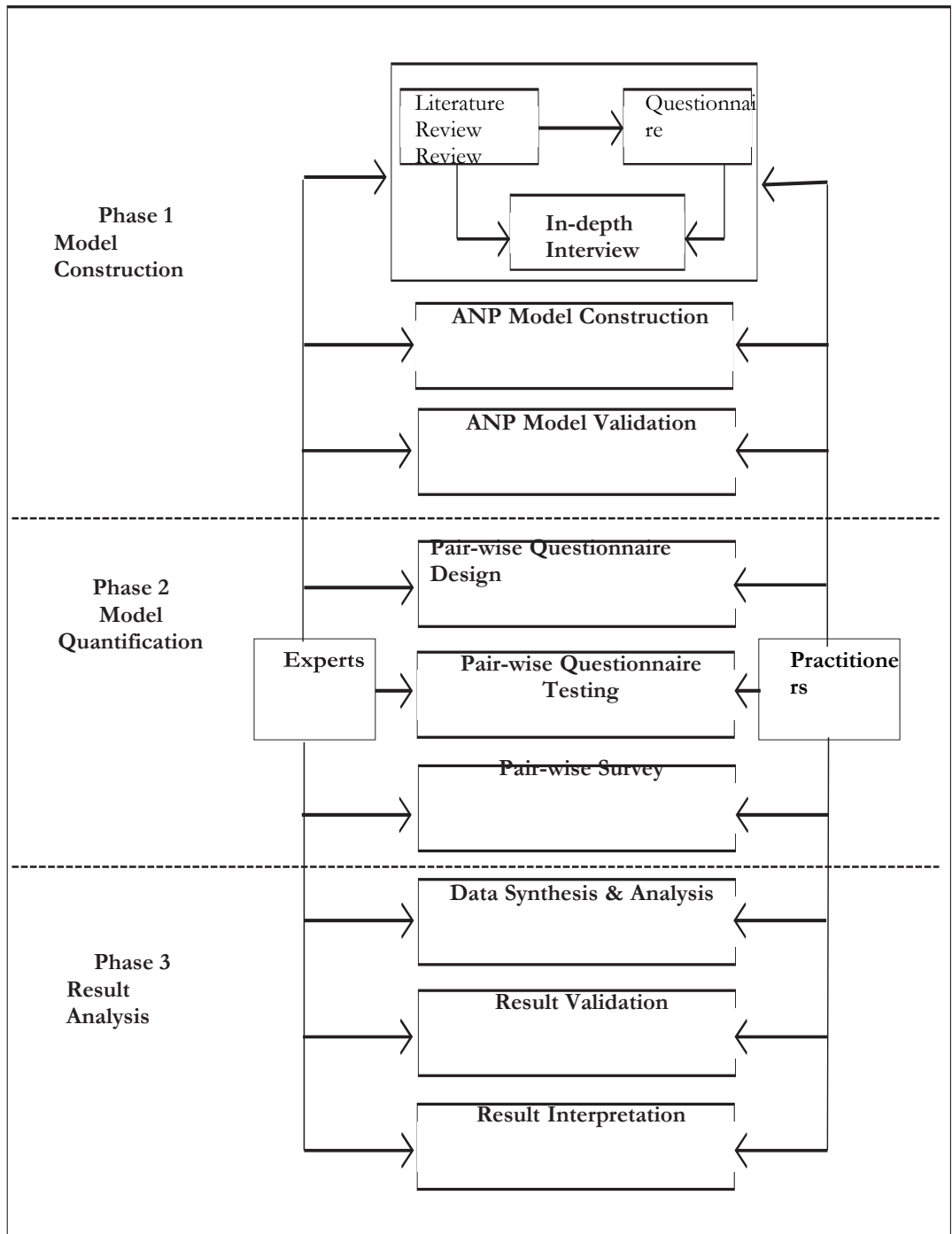
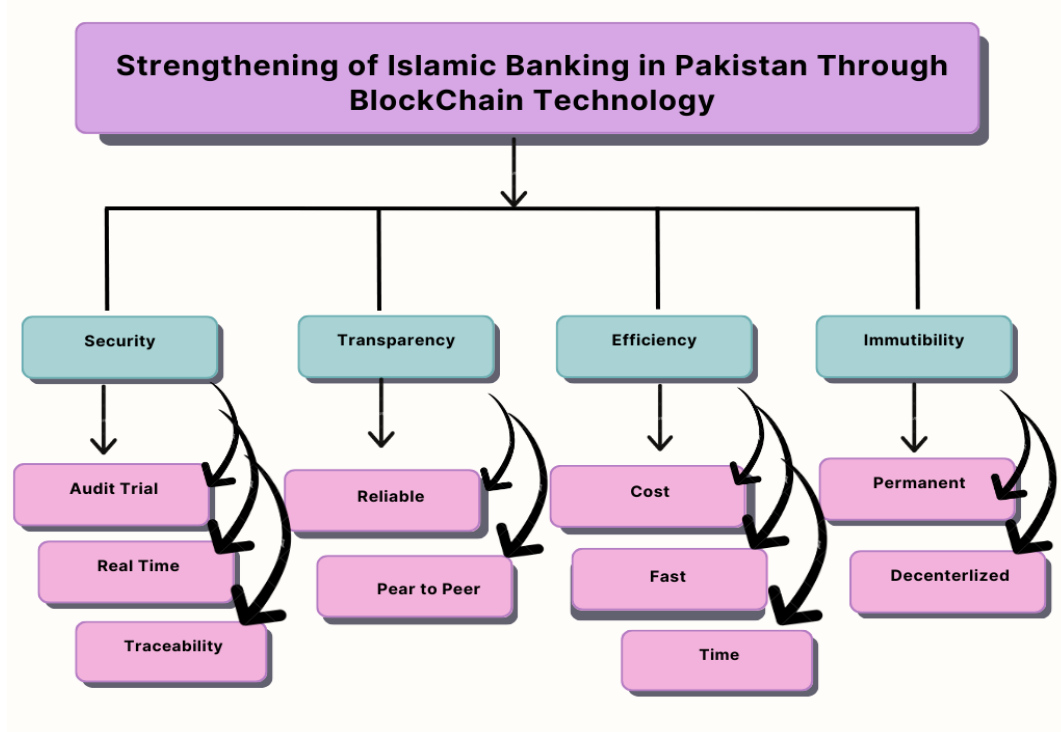


Figure-1.

Source: Acarya (2013).

3.3.1 ANP Model Construction

Model construction is the initial phase wherein focus group discussion (FGD) was done with ten experts having diverse background. Based on expert insight congregated from the FGD, the scholars developed an Analytical Network Process framework (ANP) for assessing the determinant of blockchain technology implementation on Islamic banking. These determinants include Security, transparency, efficiency, and immutability. In order to validate the ANP framework, the appropriate knowledgeable expert among respondent reviewed and acknowledged it. The Figre-2 illustrates the finalized ANP framework which is reflected below:



The ANP network determinants which play vital role for the implementation of blockchain technology in Islamic banking have been constructed on the bases of these determinants which is reflected at Figure-3

$$R = \frac{1}{m} \sum_{j=1}^m \frac{1}{n} \sum_{i=1}^n r_{ij}$$

When the mean from total

$$R = \frac{1}{m} \sum_{j=1}^m \frac{1}{n} \sum_{i=1}^n r_{ij}$$

The sum of deviation quadratic (S) is calculated by the following formula:

$$S = \sum_{i=1}^n \left(\frac{1}{m} \sum_{j=1}^m r_{ij} - \bar{R} \right)^2$$

and then, Kendall's W is defined as:

$$W = \frac{12S}{m^2(n^3 - n)}$$

3.3.2 Model Quantification

The ANP Phase - 2 involves quantifying and measuring of network. Pair-wise questionnaires were computed using "Super Decisions Software" within the established ANP framework. This phase ensures questionnaire consistency and tolerable responses, allowing modifications if needed. ANP utilizes super matrix calculations to derive eigenvector results, based on reciprocal theory using a one-to-nine fundamental scale.

3.3.3 Result Analysis

The table-1 reflects unweight super-matrix results; values reflecting in this table represent eigenvectors used for pairwise comparisons between criteria, ascertaining their interdependence as for as for evaluating alternatives against these criteria. These play a significant role in multi-criteria decision-making, assisting in prioritizing and selecting the most suitable options. Whereas the Table-2 shows the results of weighted super-matrix where each value is obtained by dividing the original values by the sum of its column, ensuring each column sums to one (1) till obtaining the stochastic value. We keep multiplying this table until all rows have the same values in each column, emphasizing important factors. This helps in complex decision-making, prioritizing key criteria for making the best choice and till the super-matrix limit table is obtained. The final table-3 represents the final results of Super-matrix limit, the results reflect that transparency plays key role in strengthening the Islamic Banking while implementing the BCT securing high priority from the selected objectives. Table-4 summarized all the results in rank wise position wherein the transparency contribution is 38%, immutability and efficiency contribute equally i.e as 22% whereas security contribution is at least 18%.

Table- 5 shows the node wise contribution to main objectives; the reliable node contributes 80% while peer to peer contributes 20% in the object of transparency. Similarly permanent node contributes 25% and decentralized one contributes 75% in the object of immutability. The node cost contributes 11%, fast 56% and time 32% in the object of efficiency. The node audit trial shows 37%, real time 30% and traceability 33% in the object of security.

Table-1 Un-weighted Super Matrix.

Goal	O-1	O-2	O-3	O-4	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	A-9	A-10
Goal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Efficiency (O-1)	0.22	0	0	0	1	0	1	0	1	0	0	0	0	1
Immutability (O-2)	0.222	0	0	0	0	0	1	0	0	1	0	0	0	0
Security (O-3)	0.174	0	0	0	0	1	0	0	0	0	1	0	0	1
Transparency (O-4)	0.384	0	0	0	0	0	0	0	1	0	0	1	0	0
Audit Trial (A-1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cost (A-2)	0	0.11	0	0	0	0	0	0	0	0	0	0	0	0
Decentralized (A-3)	0	0	0.3	0	0	0	0	0	0	0	0	0	0	0
Fast (A-4)	0	0.57	0	0	0	0	0	0	0	0	0	0	0	0
Peer to Peer (A-5)	0	0	0	0	0.8	0	0	0	0	0	0	0	0	0
Permanent (A-6)	0	0	0.7	0	0	0	0	0	0	0	0	0	0	0
Real Time (A-7)	0	0	0	0.33	0	0	0	0	0	0	0	0	0	0
Reliable (A-8)	0	0	0	0	0.2	0	0	0	0	0	0	0	0	0
Time (A-9)	0	0.32	0	0	0	0	0	0	0	0	0	0	0	0
Traceability (A-10)	0	0	0	0.33	0	0	0	0	0	0	0	0	0	0

Table-2 Weighted Super Matrix.

	Goal	O-1	O-2	O-3	O-4	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	A-9	A-10
Goal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Efficiency (O-1)	0.22	0	0	0	0	0	1	0	1	0	0	0	0	1	0
Immutability (O-2)	0.22	0	0	0	0	0	0	1	0	0	1	0	0	0	0
Security (O-3)	0.18	0	0	0	0	1	0	0	0	0	0	1	0	0	1
Transparency (O-4)	0.38	0	0	0	0	0	0	0	0	1	0	0	1	0	0
Audit Trial (A-1)	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0
Cost (A-2)	0	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0
Decentralized (A-3)	0	0	0.13	0	0	0	0	0	0	0	0	0	0	0	0
Fast (A-4)	0	0.28	0	0	0	0	0	0	0	0	0	0	0	0	0
Peer to Peer (A-5)	0	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0
Permanent (A-6)	0	0	0.38	0	0	0	0	0	0	0	0	0	0	0	0
Real Time (A-7)	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0
Reliable (A-8)	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0
Time (A-9)	0	0.16	0	0	0	0	0	0	0	0	0	0	0	0	0
Traceability (A-10)	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0

Table-3 Limit Super Matrix.

	Goal	O-1	O-2	O-3	O-4	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	A-9	A-10
Goal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Efficiency (O-1)	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Immutability (O-2)	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Security (O-3)	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Transparency (O-4)	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Audit Trial (A-1)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cost (A-2)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Decentralized (A-3)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fast (A-4)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Peer to Peer (A-5)	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Permanent (A-6)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Real Time (A-7)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Reliable (A-8)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Time (A-9)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Traceability (A-10)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Table-4 Rank Wise Contribution of Objective in Strengthening the Main Goal.

S.No.	Name of Object	Rate of Contribution
1	Transparency	38%
2	Immutability	22%
3	Efficiency	22%
4	Security	18%

Table-5 Node Wise Contribution of Each Objective.

S. No.	Name of Objective	Name of Nodes	Contribution
1	Transparency	Reliable	80%
		Peer to Peer	20%
2	Immutability	Permanent	25%
		Decentralized	75%
		Cost	11%
3	Efficiency	Fast	56%
		Time	32%
		Audit Trial	37%
4	Security	Real Time	30%
		Traceability	33%

4. Conclusion

For decision support, regarding the object selection of strengthening Islamic Banking through blockchain technology in Pakistan has completely been designed in the form of data management system, process modeling as well as user interface subsystem. Our study results support the implementation of BCT in strengthening the Islamic Banking in Pakistan. Further research can be conducted to explore alternative approaches within the same domain, or a combination of methods, such as employing fuzzy models and group decision support systems (GDSS) for enhanced assessment and decision-making capabilities. This could lead to more comprehensive and effective solutions in the field of Islamic Banking and Finance while implementing this disruptive technology i.e. Blockchain.

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