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THE BLOCKCHAIN ERA: QUANTITATIVE RESEARCH ON IMPLEMENTING BLOCKCHAIN IN THE TAXATION SYSTEM

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Abstract

Blockchain, as a decentralized system, offers numerous benefits such as data security, financial services, and smart contracts. In my case, I use blockchain to receive taxes, store transaction records, eliminate third-party involvement, and simplify auditing for Pakistani citizens. This technology does not alter any accounting or auditing principles but enhances auditing capabilities. It collects taxes, tracks transactions, and secures all records, reducing the risk of data leakage and corruption. The second technology we use is Google Cloud Platform, which helps us manage our data, conduct big data analysis, use machine learning for prediction, and transfer real-time data. Our main objective is to ensure the security and proper use of our data.

Keywords: Blockchain, Google Cloud Platform, Taxation, Tax Payer, Tax Authority, Hyper ledger Fabric

1. INTRODUCTION

Collecting taxes, securing them, and saving them from corruption is the most challenging job. [1]In Pakistan, only 1% of the population pays taxes which is quite disappointing. Currently, Pakistan collects 11.4% of its GDP in taxes which is expected at 50% of the current estimated collection rate. This year, 2022, Pakistan collected $ 458 billion in July. It is still unknown how much corruption is found in this processing. In Pakistan, there are two major agencies, the NAB and the FIA, that are working against money laundering cases, corruption, economic terrorism, financial crimes, and financial mismanagement because of problems like political instability, undefined taxation policies, and poor economic development. That’s why Pakistan ranks 140 out of 180 in the corruption nation index, according to the 2021 Corruption Perception Index report. The World Bank supported revenue authorities at the federal level and in Pakistan's two most populous provinces, Sindh and Punjab, by engaging in comprehensive domestic resource

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mobilization efforts that emphasized conventional and environmental taxes, customs, and administration reforms, as per the World Bank [2]. The engagement, which is still ongoing, has yielded concrete outcomes, including a notable increase in Pakistan's tax-to-GDP ratio, which rose steadily from 9.5% (FY11) to 12.5% (FY17). When the time comes for accountability and auditing most of the time agencies have no record of the tax and the details of their transaction. Because of corruption, the tax collection system is ineffective. People on the inside of an organization commit corruption. Because there are many people involved in the system who are controlling things based on their desires. That is the main reason for introducing technology that is a string in all conditions, can't be controlled by anyone, is easy to predict, aids in analysis, requires less manpower, is fast and accurate, aids in decision making, tracks all transactions, secures the data, is free of human error, and finally provides a trustworthy environment. All these features are combined into one shape, which is the Blockchain.

The Block Chain is a technology [3], which is a decentralized and distributed system. It is managed by peer-to-peer computer networks, with no third-party involvement, and works as a public ledger that store transaction between two parties. It provides multiple features like decentralized, persistence, Anonymity, and Audibility. Today, Block Chain works in private, public, Hyper-ledger Fabric and hybrid versions that supported complex software. We used Hyper-ledger Fabric Block Chain because it is fully decentralized as compared to the Private Block Chain. A Public Block Chain is very good in security but it starts lacking comes to speed and efficiency if many users join the network, however, Hyper-ledger Fabric Block Chain is too fastest it would take 100x seconds which is an insane speed of transactions. When we discuss the scalability of the Hyper-ledger Fabric Block Chain, we can't face any kind of issues. Because the network wouldn't allow anyone to join the network without any validation and authentication. They go through extremely secure procedures, all the procedure is maintained and controlled differently. There is zero percent of attacks, low cost of the transactions, no risk of criminal activity, and low energy used. With the help of Block Chain, we can make Smart Contract, facilitates financial services (no double sending, Zero frauds), and Big Data Analytics (BDA). Big Data Analytics is the key feature of our research. We deal with large amounts of data, audit all little information related to taxes like who sent and received the tax, where the money has been utilized, optimized the operation, and help to take decisions in future business goals based on the historical data. Google Cloud Platform is providing these features [4] like Big Data Analytics, ML (Machines Learning), and DP (Deep Learning).

The use of deep learning in combating cyberattacks [5] involves analyzing patterns in internet traffic to train a model. This technology holds great potential in detecting intrusions and preventing future threats. In the event of a suspicious transaction or illegal activity being detected, deep learning can alert users, and the blockchain can freeze all accounts until users grant permission to reactivate the system. This provides a high level of security. Additionally, deep learning plays a crucial role in predicting outcomes and indicating where investment is needed in the tax agency. The remaining sections of the paper are as follows: Abstract, Introduction, Keywords, Literature Review, Methodology, Model, Conclusion, Future work, and References.

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2. LITERATURE REVIEW

Daniel Mago Vistro et al., 2021 [6] in this research, introduced the taxation management system to keep the records secure and maintain them. They presented the tax inspector and officer with a high-level framework. Taxpayers continue to deposit the tax into the bank. They introduced the interplanetary file system, which provides a hypermedia protocol that makes the web efficient and secure. The key point of their research is DAPP (Decentralized Application) which is more secure than other simple applications. But they did not confirm who was going to use DAPP. They mentioned that the taxpayer pays the tax in the bank, and the web is used by the tax officer and inspector; then who is using the DAPP? Which is quite confusing as to how things work. Du Xiaoping et al., 2021 [7] proposed an intelligent settlement platform based on cloud computing and blockchain. The purpose of this research is to determine how to digitalize the invoice, order, and receiving. The platform encompasses the complete business tax system, suppliers, an e-commerce platform, an ERP, a material supply system, and real-time data sharing, and eliminates paper-based e-invoices submitted by both the issuer and recipient. VAT Special combines blockchain and cloud computing to generate e-invoices, ensure authenticity, provide electronic signatures for material acceptance, and automate payments. The cloud computing-based e-invoice network architecture built on blockchain technology has two types of nodes. In the blockchain network, the tax authority assumes the role of the first node, whereas the e-invoice service provider is designated as the second node. In addition to this, third-party platforms such as BESTWONDER or Aision are utilized by the tax authority to facilitate the connection between the drawer and drawee and link them to the blockchain, thereby playing a significant role. The tax authority acts as the controller and manager of the consensus mechanism in the blockchain algorithm. They have the power to grant and revoke access to various nodes. They establish distinct operations, enforce contract conditions, and assign varying permissions to each node. All nodes and participants must abide by their rules and standards. The e-invoice service provider's blockchain links the Tax Authorities, Drawee, and Drawer, facilitating the sharing of all invoicing-related information among all participants. It solved the anti-counterfeiting problems. The e-invoice provider settlement consists of three types of nodes. The first node in the network is responsible for managing the settlement blockchain and granting access to other nodes. The second node represents the supplier or the "drawer" and the third node represents the "drawee. All these nodes are interconnected with the national tax system. After the e-invoice passes the necessary security checks, the invoice verification results are automatically transmitted to the national tax system through ECP 2.0 by the ERP system. Furthermore, the VAT deductions mentioned in the invoice are automatically entered. Subsequently, the payment results are returned to the ERP system. This entire electronic business process is swift, networked, and intelligent, and considerably reduces the payment collection cycle, which is why suppliers view it as a crucial aspect. The best working environment is one with a convenient user experience and operation. A. Ivasbcbenko and G. Sudak [8] discussed the basic lessons of blockchain technology and how it can be used. In light of the current economic and political situation in Ukraine regarding its tax system, the research paper sheds light on the possibility of employing blockchain as a solution to

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streamline the Ukrainian tax system, which would benefit both the government and taxpayers. The primary emphasis of this research was on the utilization of blockchain technology in taxation. Some instances of controls include tamper detection, compensation, and data structure, all of which promote security. Strategic delivery (transparency), transfer pricing flexibility, and smart operations conventions. The authors ranked the states according to the official use of electronic invoicing. It is permissible, unacceptable, enforceable, and illegal. It has been described as a property of blockchain technology. Ability to reorganize accounting, automates payments and transfers, and record transactions Property protection. This paper focuses on blockchain-based VAT collection and refunds that can provide such benefits. The system can be opened immediately after the transaction is completed. No duplication and no cheating in current transnational surveys; increased confidence in digital signatures Successful use cases of blockchain in the public sector were considered test cases. In Innisfil (Canada), there is a program where residents can pay taxes in cryptocurrency. The Georgia Office of Public Records may make use of blockchain technology. Citizens with digital credentials for their assets are backed by published cryptographic evidence. Bitcoin Blockchain; Exonum Blockchain can be thought of as a bridge between the backend and the front. Frontend for the end system and users, where smart contracts verify all transactions. Then you'd have perpetual access to the blockchain. The authors identified the potential benefits of using blockchain in taxation to reach this conclusion. Blockchain in Tax Administration enables simpler, more efficient, and effective tax operations by lowering transaction costs and increasing flexibility. Ahmad Alkhodre et al.'s [9] proposed research (2019) aligns with the needs of Saudi Arabia, which, as part of its "Saudi Vision 2030," is investing in blockchain technology Blockchain technology is being widely adopted across the globe due to its numerous advantages and applications. This research endorses the adoption of blockchain for implementing the value-added tax (VAT) in Saudi Arabia. The author proposes a solution that merges VAT, the supply chain, and interfaces into the Hyper-ledger framework, thereby offering blockchain-based solutions that have the potential to yield billions of dollars in revenue. The ultimate goal is to enhance communication and collaboration between supply chain management, public and private organizations, service providers, and businesses of all sizes. The architecture of this solution is based on Hyper-ledger Fabric, which operates as a network of servers with command nodes, certificate authorities (CAS), and peers. In the VAT collection system cluster in Saudi Arabia, all components, including the consensus mechanism managed by the certificate authority, are controlled. Peer nodes facilitate the connection of servers that implement supply chain management to the cluster. This research evaluates different approaches to VAT collection utilizing blockchain and suggests potential solutions that can improve VAT collection efficiency and effectiveness through blockchain technology. The author has successfully executed a proof-of-concept implementation of Hyper-ledger with the aid of a composer that promotes a well-organized architecture and streamlined blockchain transaction processing. Further research should focus on replicating this architecture on other blockchain models, as the current implementation has limitations and only works with the Bitcoin architecture. This could lead to more significant advancements, such as heightened efficiency, confidentiality, security, and performance. The work of Huimn Niu

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et al. (2022) [10] aimed to establish a blockchain-based tax collection and administration system that provides secure authentication for taxpayers while safeguarding their privacy. The system provides conditional privacy protection, meaning that certificate authorities can track non-compliant taxpayers and reveal their identities if needed. To bolster security measures, a self-authenticating public key system was adopted, replacing the certificate-based system. This implementation enhanced registry efficiency and mitigate security threats by reducing reliance on certificate authorities. Derya Yaman [11] proposed The structure of a blockchain is made up of dispersed blocks of information that are secured using hash algorithms, which allow for the monitoring of data. The digitization of payment methods, goods, and services has led to the emergence of cryptocurrencies such as Bitcoin. Although it was initially created for Bitcoin trading, the capabilities of blockchain go beyond cryptocurrencies and are continuously evolving. The primary objective of this research is to investigate the potential of blockchain technology in taxation. In this study, the use of blockchain in taxation has been examined for several countries, including Turkey. There is a global effort underway to simplify tax systems, minimize administrative burdens, reduce costs for tax collection, and reduce tax shortfalls through legal and administrative research. As a result, the adoption of blockchain technology is poised to bring about transformation in the world's tax regimes due to its transparency. The value-added tax (VAT) is levied during the production and distribution stages to boost domestic revenue. A VAT mismatch, which can be attributed to fraud, financial problems, and bankruptcies, creates a discrepancy between estimated and actual VAT collection. VAT constitutes a major source of revenue for most countries, and substantial losses occur every year due to inadequate tax collection, fraud, evasion, and mismatches. The tax system is becoming progressively more intricate, and novel interpretations are necessary to promote transparency and decrease the tax deficit. Tax authorities are increasingly investing in digital data integration and analysis systems to enhance tax collection and prevent fraud. The invoice plays a pivotal role in VAT, and a blockchain-based tax system would mandate the inclusion of a digital fingerprint generated via the VAT blockchain consensus process on each VAT invoice. This would enable the monitoring of the complete commercial chain, both forwards and backward, for cross-border transactions. With a hand-held scanner connected to an authorized tax inspection program, the entire commercial chain for a valid item can be promptly accessed. All nodes must have immediate access to standard invoice-level information for both parties, such as name, address, VAT ID, item price, and associated volumes. AI operators trained in the relevant industry can use blockchain to perform risk analysis at all nodes, making it a recommended solution by experts for customs use. Blockchain technology can trace the development of materials and items across borders and can be secured in a Digital Invoice Customs Exchange (DICE) blockchain for business transactions. However, due to the reluctance of governments to share their databases, the use of a centralized ledger may still be necessary. Jurisdictions may perform confidential AI risk analysis with their data and may not allow the target legal system to access it while conducting its analysis. The level of confidence in the consensus among these jurisdictions mostly depends on their taxpayers, and sometimes, the threshold may need to be raised to attain an acceptable level of certainty. In 2018, the **European Parliament** released a report

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providing recommendations on combating cross-border VAT fraud, including the utilization of blockchain to discover cross-border transaction data and the exploration of a secure digital currency for VAT payments. Scholars at **Boston University Law School** proposed the adoption of a VAT Coin as a means of paying taxes for the **Gulf Cooperation Council** (GCC) countries, such as Saudi Arabia, Kuwait, the United Arab Emirates, Qatar, Bahrain, and Oman. VAT Coin is a private cryptocurrency managed by the state, designed to be used solely for VAT payments, and unlike Bitcoin, is not speculative. Transactions using VAT Coin are recorded in a distributed ledger, and each jurisdiction has government nodes for verification. The VAT Coin blockchain would be implemented throughout the GCC, with new valid transactions added every 10 minutes. The GCC proposal requires VAT payments to be made and received only in VAT Coin, which is non-convertible except by the government. VAT Coin inputs and outputs will be verified and added to the blockchain in real-time, with daily VAT Coin account balancing and a smart contract for refunds in cases where the VAT balance is negative. Orly Sulami Mazur [12] conducted research stating that blockchain technology, along with smart contracts, is predicted by experts to revolutionize business operations by removing intermediaries, increasing transparency and trust, and improving access to shared information. As a result, there has been a rise in the development of blockchain solutions for different markets, ranging from real estate to healthcare. This article examines the potential influence of blockchain technology on tax administration. The tax system currently encounters obstacles, including a significant tax gap, costly administrative and compliance requirements, and operational inadequacies. The author proposes two novel blockchain applications in tax administration: an information return platform and a digital invoice platform, which could digitize and automate specific tax procedures, enhance compliance and enforcement, and minimize inefficiencies. The author also stresses the importance of government action in supporting the use of blockchain technology in tax administration and provides steps for policymakers to take in promoting its use. To modernize the tax administration system, this article advocates a proactive approach to comprehending the advantages, restrictions, and implications of blockchain technology. However, the article also discusses the suggestion for the government to implement blockchain. Although the emergence of blockchain is apparent, the blockchain industry and policymakers must overcome several hurdles before blockchain's transformative impact on the tax sector can be achieved. This article strongly suggests that governments get involved in the growth of blockchain and other innovative technologies. Governments must take a proactive approach for two main reasons. Firstly, if blockchain reaches its full potential and the government has taken part in its development, tax agencies could see substantial advancements in their information access, automation of various tax processes, and an overall boost in the efficiency and effectiveness of tax administration. This method also allows policymakers to guarantee that the technology evolves responsibly, allowing governments, particularly tax authorities, to study and understand the impact that technology can have on tax administration, placing them in the best position to take advantage of these advancements.

Secondly, if blockchain becomes widespread, but the government fails to keep up with the technology, the information limitations that the government currently faces may

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become magnified. This is because more revenue sources will become entrenched in technology that is not accessible to the government, likely leading to a larger tax gap. Even if blockchain technology does not become widespread, exploring its use in the tax space is still a beneficial endeavor. This provides a chance for government agencies and policymakers to assess the potential role of technology in modernizing the tax administration system and updating its outdated technology infrastructure. The suggestions outlined in this Article would still benefit the tax administration system even if a different technology is adopted. To make the most of blockchain technology's potential, this article provides normative recommendations for policymakers to support its development. These steps will help the government be ready to take advantage of blockchain technology when the opportunity arises. Filip Fatz, et al. [13] describes the challenges in the tax process. The law mandates that companies comply with tax regulations, and noncompliance can lead to serious consequences, such as fines and criminal charges. To enhance tax compliance for businesses and improve the efficiency of tax agencies, experts recommend distributed ledger technology. This paper proposes the use of distributed ledger technology to enable effective information sharing between companies, tax authorities, and auditors. We suggest utilizing tax process models as a basis for smart contract rule implementation and overcoming barriers to adopting distributed ledger technology (DLT) in practical scenarios. Furthermore, we offer insights into the decentralized enforcement of compliance. The adoption of DLT has gained attention as a means of enhancing tax compliance for companies and tax agencies [14, 15, 16, and 17]. The use of DLT enables businesses to securely and transparently record tax-related transactions and makes tax information readily available due to its decentralized structure and data replication. The authors suggest a DLT-based tax information system that allows for the exchange and validation of tax-related information. The system would utilize smart contracts to execute process logic and enforce tax regulations, while also storing documents created or modified during the process in an immutable manner. This would make it easier for auditors to track past business transactions. There are challenges to implementing DLT in taxation, including organizational and technical obstacles that hinder its widespread adoption. While DLT is effective at validating information within the ledger, it does not have the mechanisms to ensure that the information provided corresponds to real-world business practices. Smart contracts can be built on tax process models, but process modeling languages like BPMN lack concepts specific to DLT. The implementation of a DLT-based information system must balance the conflicting goals of transparency and confidentiality. Increased tax transparency benefits the public and tax administration, but businesses are concerned about the disclosure of sensitive information. Additionally [18], DLT's decentralized nature weakens its ability to ensure confidentiality. Recent progress in zero-knowledge-proof techniques may offer a solution to this challenge. These proofs enable the verification of confidential data properties without disclosing the data itself. For instance, a business could demonstrate that the tax rate on an invoice document is either 7% or 19% without disclosing the precise rate. Dr. Rana Tahir Naveed and colleagues (19) implemented the Online Tax System (OTS) in Pakistan, which has garnered significant attention from developed nations. However, Pakistan, being a developing country, has not been

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successful in adopting the OTS, primarily due to low-quality tax services. This study aims to investigate how Tax Service Quality (TSQ) affects the OTS and explore the role of Information Communication Technology (ICT) in addressing this issue. A cross-sectional design and quantitative method were used, and data were collected from taxpayers who use the OTS through a 5-point Likert scale questionnaire, utilizing convenience sampling. Smart PLS 3 was used to analyze the data. The findings suggest that ICT has a positive association with OTS, and that informativeness, reliability, and responsiveness are connected to ICT. The study introduces ICT as a mediating variable to enhance the OTS, which is its contribution to the literature. This could be beneficial for tax authorities to improve tax collection levels. The success of the Online Tax System (OTS) is dependent on Tax Service Quality (TSQ), as revealed by the study. Without good TSQ, taxpayers may not be motivated to use OTS for tax payments. Information Communication Technology (ICT) plays a vital role in connecting good TSQ and OTS to provide quality tax services. Informativeness, reliability, and responsiveness are essential elements of good TSQ that could be enhanced by ICT in favor of OTS. Therefore, introducing high-quality OTS with the help of ICT in Pakistan could improve the tax collection rate. It is recommended that tax authorities in Pakistan enhance TSQ by introducing ICT. Future research could incorporate various other measures of service quality, and "perceived ease of use" could be a moderator in the current study's framework. We will discuss this study in our Methodology as a previous work.

3. METHODOLOGY

3.0.1 Previous Work

The Online Tax System [19] is based on the advance of information technology (IT) which brought excessive attention to the Online Tax System (OTS), which has had a positive impact on the tax administration system worldwide. OTS has increased tax collection rates in various countries, which has had a positive effect on their economies by increasing income generation and tax compliance. OTS is considered a convenient, time-saving, and cost-effective system for tax administrators and taxpayers. However, in Pakistan, the current situation of OTS is unfavorable for the economy. In 2012, Pakistan had one of the worst tax collection rates globally, and its GDP-to-tax ratio remains very low. The inadequate performance of OTS is attributed to the low tax collection rate. TSQ is a significant element of OTS, crucial for not only taxpayers but also administrators and tax authorities. According to Warrington, Abgrab, and Caldwell [20], research on service quality should consider the perspectives of both the provider and the receiver. Therefore, the quality of online tax services is essential for both taxpayers and tax authorities to maintain the smooth operation of the system.

3.1 Research Design

The study employed a cross-sectional research design and a quantitative research approach, which is a suitable technique for testing hypotheses, as suggested by Shuttle worth [21]. The data were exclusively collected from taxpayers who were using OTS.

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Theoretical Framework

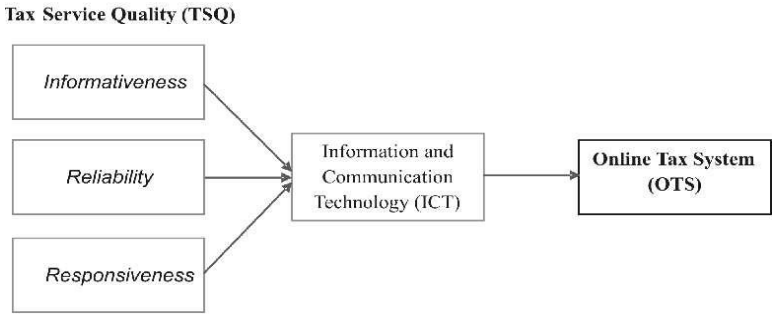

Figure 1: Online Tax System

Figure no. 1 showed how TSQ is a crucial factor in motivating taxpayers to use OTS instead of visiting tax authorities in person. Improving TSQ by enhancing in formativeness, reliability, and responsiveness from tax authorities can help solve these issues. Moreover, the role of information and communication technology (ICT) is critical in linking TSQ and OTS, given that OTS relies on information technology. With electronic payment systems, taxpayers can conveniently pay their taxes, benefiting from features like security, ease of use, acceptability, efficiency, and privacy. This increases customer satisfaction, which in turn fosters commitment and motivation to pay taxes [22-31]), while also meeting the tax authorities' needs for efficient tax collection. Thus, ICT plays a mediating role between TSQ and OTS.

3.2 Proposed Solution for the Taxation System

This research is consisting of the two technologies.

1. Google Cloud Platform
2. Hyper-ledger Fabric

3.2.1 Google Cloud Platform (GCP)

Beginning in 1998 [32], the year Google search was introduced. Google has built one of the world's biggest and most potent IT infrastructures. Today, billions of users use this infrastructure to access services like Gmail, YouTube, Google Photos, and Maps. Google launched the Google Cloud Platform in 2008 after deciding to make its network and IT infrastructure available to commercial customers. This decision involved turning an infrastructure that had originally been designed for consumer applications into a public service.

3.2.2 Why did we choose GCP [33]?

- GCP provides different services like machine learning, big data, storage, analytics, and backend services for mobile and web applications.
- It is economical and universal.
- It supports open source.
- It has a security focus.

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In our case [34], we are concentrated on Big Data and analytics. Google's cutting-edge technologies for batch and real-time data processing, including Google Cloud Dataflow and Google Cloud Dataproc, can give you some really useful insights. Or instance, Big Query is a completely managed data warehouse that enables you to process enormous amounts of data at breakneck speeds. Google claims that its users view technologies like Big Query as "almost magical" since they enable tasks that once required hours to complete to be completed in a matter of minutes. It is easy to integrate into the Hyper-ledger Fabric Blockchain which is our main purpose to use this service.

3.3 Hyper-ledger Fabric Blockchain

The ability to create a peer-to-peer system with captivating features [35] of the fabric. Members of the network cooperate, but because some commercial data must stay secret, they frequently retain different ties within their networks. For instance, a buyer might collaborate with other vendors to sell the same good. The buyer's and each seller's specific transactional relationship ought to be kept separate and unreported to the other sellers. If you need total isolation of transactions, The Hyper-ledger Fabric platform offers the feature of "channels" to aid in maintaining data privacy, with the option to share the hash values of transactions as proof on the ledger. The "private data" feature allows for sharing among a specific group of members or an organization on the Hyper-ledger Fabric network. Fabric is designed with security and scalability in mind, allowing for private transactions and confidential contracts, as opposed to a public, permissionless system. This customizable design makes it suitable for a range of industries, promoting trust, accountability, and transparency in business. As a platform created specifically for enterprise use, Hyper-ledger Fabric offers a flexible and adaptable architecture, capable of supporting a variety of industry use cases and providing a high-performance consensus mechanism that protects anonymity. In comparison, while Ethereum 2.0 implementations hold potential, they are primarily aimed at public networks and their new architecture has yet to be fully implemented. On the other hand, Hyper-ledger Fabric has already reached version 2.0. There are a few key features of the Hyper-ledger Fabric below.

- Architecture restricted to authorized participants
- Modular design
- Interchangeable consensus mechanism
- Open contract model that allows for implementing various solution models (account, UTXO, structured/unstructured data)
- Quick finalization with low latency
- Flexible data privacy options (channel isolation or private data sharing)
- Smart contract support in multiple languages (Go, Java, JavaScript)
- Compatible with Ethereum Virtual Machine (EVM) and Solidity
- Built for ongoing operations and supports upgrades and asymmetric versioning
- Governed and versioned smart contracts
- Endorsement process for consensus among necessary parties
- Query-able data including JSON and key-based queries

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3.3.1 Why did we choose Hyper-ledger Fabric?

Comparison among Block Chains [36]

Table 1: Applying Criteria Catalog

	Bitcoin	**Hyper-ledger Fabric**	**Ethereum**
Scope	Public	Private	Public
Number of Verifiers	~ 9962	Configurable	~ 8829
Consensus Protocol	PoW	Kafka / Raft	PoW
Use case	Crypto Currency	Multi-purpose	Crypto Currency / multi-purpose
Functionality	-	-	-
Accuracy	05	04	05
Serviceability	04	04	05
Potency	01 (4.6 TPS)	05 (20000 TPS)	03 (15 TPS)
Maintain-ability	02	05	03
Flexibility	04	03	04
Modifiability	02	05	03
Security	03	05	03
Maintenance capability	05	04	04
Consistency	05	04	04
Maturity level	04	04	04

Table no.1 provides a sample application of the criteria catalog. The authors evaluate the three most commonly used blockchain implementations, which are Bitcoin, Hyper-ledger Fabric, and Ethereum, against a set of requirements. The importance of the requirements may differ based on the use case, so the authors do not assign any weights. However, they illustrate how use cases can influence weighting by presenting a scenario where blockchain is used to digitize bills of lading, where confidentiality is a priority, making the scope attribute more important.

The sample criteria can be classified into qualitative and quantitative. Qualitative criteria, such as Bitcoin being a public blockchain with a Proof-of-Work consensus protocol, are easily understood. However, quantitative criteria, such as efficiency measured in transactions per second, require additional research, prototyping, and expertise. The authors note that a public blockchain may not be appropriate for electronic bills of lading applications due to confidentiality considerations. Other factors, such as the blockchain framework's support for smart contracts, can also impact the suitability for a specific use case. The criteria catalog employs a nominal scale to demonstrate the criteria and their attributes, while the functionality criterion is excluded since it requires a more thorough analysis. The sample criteria are rated on a scale of 1 to 5, with 5 representing the highest rating and 1 the lowest. The authors' focus, however, is on identifying the criteria.

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3.4 Implementation of Taxation System

3.4.1 Tax Payer

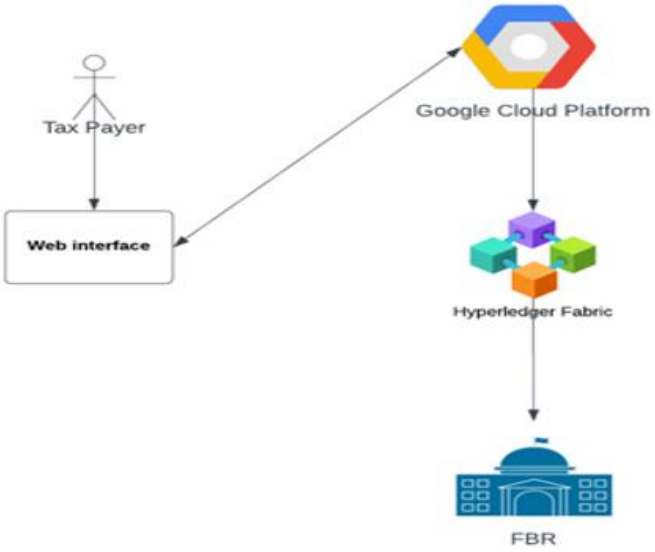

Figure 2: Network Diagram for the Tax Payer based on the Block Chain technology

Tax Payer (TP) interacts with the web Interface after assigning the account by the Tax Authority (FBR in our case). On the TP interface, you can view all kinds of taxes. There are two main classifications of taxes: first is direct and second is indirect [37]. Direct taxes are imposed directly by the government on individuals or companies, who are unable to pass the tax onto others. Examples of direct taxes include capital gains tax, income tax, property tax, transfer tax, and entitlement tax. Indirect taxes, on the other hand, are imposed by the government on businesses that produce or sell goods or services, which then pass on the tax to the government. The government initially receives the tax payment, and then it is transferred to the consumers through multiple intermediaries. Indirect taxes are harder to evade than direct taxes because they are already included in the price of goods and services. Some examples of indirect taxes include VAT, sales tax, customs tax, service tax, and securities transaction tax. TP selects the tax and pays the tax through a different financial platform like mini banking or online Baking using Visa etc. Taxpaying procedures depend on the Tax Authority. All the transactions are passed through the blockchain and sent the tax amount to the relevant Tax Department. No one can edit the record and delete it. TP just views and pays.

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3.4.2 Tax Authority (FBR) Tasks

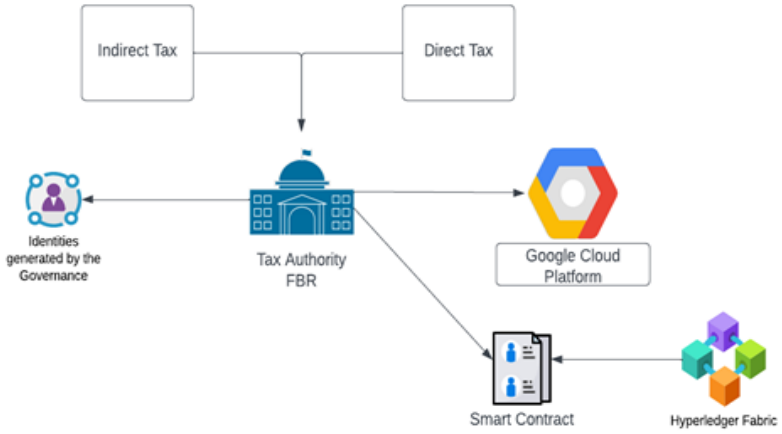

Figure 3: Tax Authority Jobs

Tax Authority (TA) is creating the jobs, assigns the jobs and accomplishes the goals. They have some duties for the TA like.

i. Set the criteria for tax
ii. Generating the Tax Payer ID
iii. Store all their Assets Record
iv. Manage the Google Cloud Platform,
v. Set the rules for the Blockchain (Smart Contract).

- **Criteria Tax**

  In our case, FBR (Federal Board of Revenue) passes all the acts/ordinances/ rules to reach the objectives. Tell the system if this person has that much amount that means He or She is eligible for the Tax and how much.

- **Generating ID**

  TA authenticates the Tax Payer and then gives the Authority to their web interface. This ID is only assigned by the TA. If TP forgets or misses the id and password. TA helps the TP and guides them.

- **Store their Assets Record**

  If **Tax Payer (TP)** is new in the Taxation System **Tax Authority (TA)** guides and helps them.

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- **Manage the Google Cloud Platform (GCP) TA using the**

  GCP to inform the TP about the Tax, view all received tax, use Analytics on Big Data and use their own need, to perform the inspection.
- **Smart Contract**

  Smart contracts provide a self-executing [38] agreement between a taxpayer and the tax authority. The terms of the agreement are defined in code and distributed across a decentralized blockchain network, resulting in transparent and irreversible transactions controlled by the code. With smart contracts, trusted transactions can be made between anonymous and decentralized parties without the need for a centralized authority or external enforcement mechanism. The tax authority sets the unalterable rules for the blockchain, while smart contracts ensure that all information is secure and confidential.

3.5 Block Diagram of Taxation system

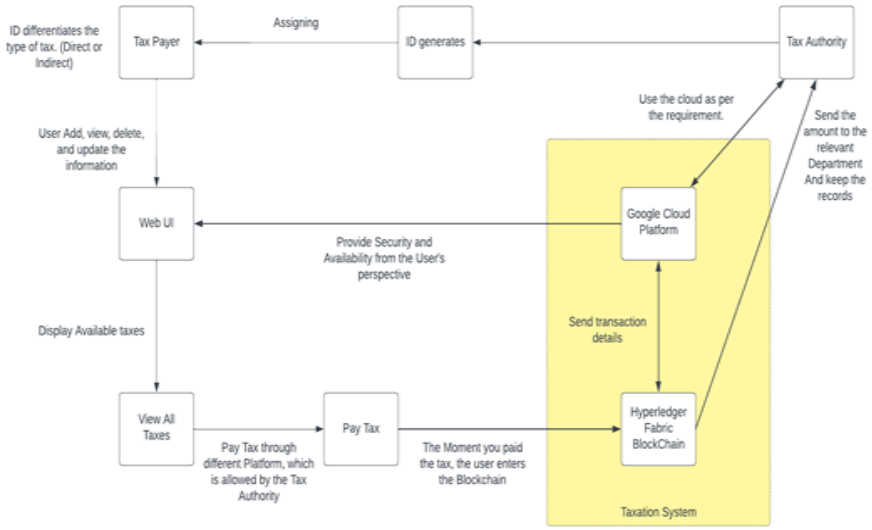

Figure 4: Block Diagram of the Taxation System

In figure 4, the Taxation System is fully defined with the flow of data and operations. The tax authority starts the system by assigning IDs to taxpayers after they are authenticated and authorized (access is granted based on their needs, such as read-only or read-write). New taxpayers add their information to the system while existing ones already have it stored. They can view, add, delete, or update their information using a web interface. Taxpayers choose the available tax to pay and the platform for payment, which is provided by the tax authority. The payment is recorded on the Hyper-ledger Fabric Blockchain, which updates the Google Cloud about the receipt of the amount and transfers it to the relevant department of the tax authority. The Google Cloud Platform is used for big data analytics and predictions. The blockchain keeps a record of any transactions if the tax authority decides to transfer the amount to another department or organization.

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3.6 The properties of Block Chain and Google Cloud Platform that relate to security and privacy

We discuss privacy related to the transaction and security of the system [39]. These problems occur in the existing Taxation System and we resolve them with the Hyper-ledger Fabric Block Chain.

3.6.1 The uniformity of the ledger among institutions.

During reconciliation, clearing, and liquidation processes, maintaining a consistent ledger among financial institutions can be difficult. Variations in architecture and business processes between institutions, as well as the use of manual processes, can lead to high transaction fees for clients and internal business operations. Moreover, this approach increases the likelihood of inconsistencies and errors between the ledgers maintained by different financial institutions. Hyper-ledger fabric works automatically after the deployment. Transaction fees are very low due to the Smart Contract.

3.6.2 The consistency and accuracy of transactions

Online investment and asset management transactions involve multiple intermediaries who manage different types of assets such as equity, bonds, notes, direct, and indirect tax. This approach results in higher transaction costs and increases the risk of intentional falsification or forgery of certificates. As a result, ensuring the integrity of transactions and preventing tampering is crucial for the system to function properly. All the transactions go through the Blockchain and Google Cloud Platform manage all the records. The things working its own after defining their duties.

3.6.3 The accessibility of the system and data

Continuous access to transaction data from any location is a fundamental requirement for users of online systems. Availability is critical at both the system and transaction levels. The system should remain operational during a network attack, and at the transaction level, authorized users should be able to access transaction data without encountering issues such as unavailability, inconsistencies, or corruption. Google Cloud and Blockchain make sure to provide the system availability. When you view something the GCP provides real-time access and blockchain available for all kinds of transactions. There are no chances of the legging in the system because they are working together but independently. Both technologies are lowly coupled.

3.6.4 Avoidance spending a digital currency more than once

Preventing double-spending, which refers to spending a digital currency more than once, is a significant obstacle in decentralized digital currency trading. In centralized environments, a dependable third party verifies the possibility of double-spending. However, in decentralized networks, robust security mechanisms and countermeasures are necessary to prevent double-spending in transactions.

3.6.5 Privacy of transactions

In online financial transactions, users typically desire limited disclosure of their account information and transaction details in the trading system. Such minimal disclosure

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comprises several requirements: (1) prevention of unauthorized access to users' transaction information; (2) prohibition of disclosure of any user's information by system administrators or network participants to third parties without the user's consent; (3) consistent and secure storage and access to user data, even under unexpected failures or malicious cyber-attacks. Confidentiality is also a crucial aspect in many non-financial scenarios.

3.6.6 Protection of User Identity Anonymity

Sharing user data among financial institutions can be challenging and may result in repeated user authentication, which can be costly and inefficient. This can also pose a risk of identity disclosure by intermediaries. Moreover, in certain scenarios, one or both parties involved in a transaction may be hesitant to disclose their true identity to the other party. The anonymity of users' identities can be a concern in such cases.

3.6.7 Transaction unlinkability

In addition to preserving anonymity, users must ensure the unlinkability of their transactions. If all transactions can be linked, it can enable adversaries to deduce sensitive information about the user, including their transaction history, frequency, and account balance. Attackers can use statistical data about transactions and accounts along with other background knowledge to confidently guess the user's real identity. Our system uses encrypted data transfer, making it impossible to hack any information from it.

4. RESULTS & DISCUSSION

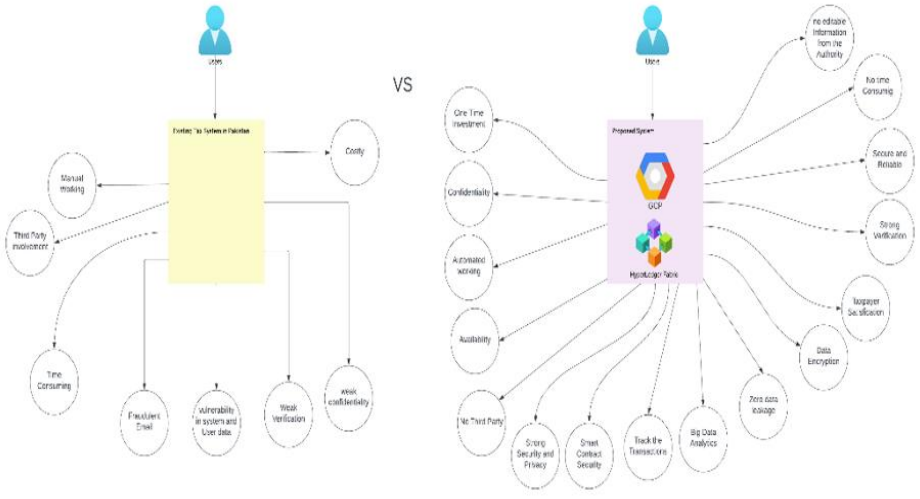

Figure 5: Comparison between Existing and Our System [39]

In figure 5, on one hand, there is the current tax system in Pakistan which has certain characteristics. On the other hand, our proposed tax system offers additional features and functionalities that address the shortcomings and limitations of the existing system. Our system addresses the gaps in functionality and introduces new features.

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4.1 Outcomes

Existed System:

- Manual Working
- Third-Party Involvement
- Time-Consuming
- Fraudulent Email
- Vulnerability in System and User Data
- Weak Verification
- Weak Confidentiality
- Costly

Our System:

- One Time Investment
- Confidentiality
- Automated Working
- Availability
- No Third Party
- Strong Security and Privacy
- Smart Contract
- Track Transaction
- Big Data Analytics
- Zero Data Leakage
- Data Encryption
- Taxpayer Satisfaction
- Strong Verification
- Secure and Reliable
- No Time Consuming
- Not editable from the Authority

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5. CONCLUSION

This research paper proposes using the Hyper-ledger Fabric blockchain and Google Cloud Platform to improve the tax collection system in Pakistan. The blockchain would keep records of taxpayer transactions and track the amount of taxes paid, while the GCP would control the system and analyze data for predictions. The taxpayer would log into the system using an ID provided by the Tax Authority (TA) and view tax details, pay taxes, and send payments via the blockchain. The TA would receive the payments and set rules. The implementation of blockchain technology would improve the effectiveness and efficiency of the government's tax system, reduce risk, maintain data confidentiality, increase tax revenue, and provide taxpayer identity security. This system helps to improve Security from both ends (Taxpayer and Authority).

Future Works

With this system, Blockchain and Google Cloud Platform system for efficient, secure, and transparent tax collection. It also suggests the potential for using this system in other areas such as the e-challan system. The benefits of reduced human interaction and real-time processing are clearly stated.

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