Novel Blockchain framework for the collection of goods and sales tax in India

Abstract

The Goods and sales tax process in India is going through developmental changes to curb challenges such as compliance, fraudulent activities, and additional operational cost. This paper seeks to identify how blockchain, an immutable and append-only data ledger, can impact the processing of the Indian tax system. A qualitative analysis methodology was chosen for this study with an aim to understand blockchain in depth. Induction approach was adopted for the course of this study. This study presents the results from 5 interviews with industry experts from IT and tax industry. Text mining and a thematic data analysis were combined to investigate the likelihood of the tax industry adopting a disruptive technology that has the potential to affect various stakeholders and replace current t platforms. This study provides an overview about the technological changes of blockchain for the collection of GST and provides a detailed discussion about the operational advantage it brings to the process. This study carries out a detail discussion about challenges faced by blockchain and solution for it. This study further proposes a three phase blockchain adoption framework for processing goods and sales tax in India.

This study focuses on answering below mentioned question with a vision to understand and analyse adaptability of blockchain for goods and sales tax.

1. What are some of the areas of concern in the current Indian goods and sales tax system?
2. What is Blockchain and to understand its features, and its implementation for the goods and sales tax?
3. What impact has blockchain made across industries globally?

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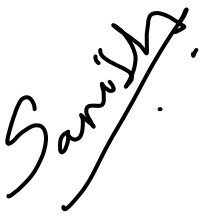

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List of Abbreviations

- *GST* – Goods and sales tax
- *VAT*- Value added tax
- *DLT* – Distributed ledger technology
- *POW* – Proof of work
- *POS* - Proof of stake
- *POA* – Proof of Authority.
- *POC* – Proof of capacity
- *PBFT* – Practical Byzantine fault-tolerant
- *DAG* – Directed acyclic graph
- *DAPPS* – Digital application
- *DPoS* – Delegated proof stake
- *EU* – European union
- *EC* – European commission
- *OCC* - Office of the comptroller of the currency
- *SEC* – Security exchange commission
- *FCA* – Financial conduct authority
- *FATF* - Financial action task force
- *RBI* – Reserve bank of India
- *TPS* – Transaction per second
- *CPCT* – Cost per confirmed transaction
- *GSTIN* – Goods and sales tax invoice
- *TXID* – Transaction ID
- TwH - Terawatt-hour

1 Introduction

The evolution of technology over the years has had a significant effect on our everyday life. Today our smartphones are not just devices used for answering calls but there are various things one can do through different applications. Technology has evolved from generation to generation like from telephones to smartphones from letters to email. Generational technological changes show a progressive technical advancement. (Lawless and Anderson, 1996: 1187.) The invention of the internet has made the life of a person easy, convenient, and free. The same way technological advancements have affected the way businesses are operated around the world, also it has strengthened the trust among organizations involved in the business. As a result, businesses are more focused on delivering value to end-users.

One such technology which has gained immense popularity amongst various experts is Blockchain. Blockchain came into the picture in 2008 when a pseudonym named Satoshi Nakamoto published a white paper online introducing digital currency called Bitcoin and the decentralized technology used for processing transactions called the blockchain. Bitcoin was the first digital currency or cryptocurrency introduced in 2008 and the uniqueness of bitcoin was that it could be transferred from across border securely from one user to another with the need of intermediaries like banks or the need of having a central authority. (Nakamoto. S., 2008.) The problem that bitcoin solved was of establishing trust in a distributed system. More specifically enabling distributed storage of timestamped documents which if manipulated is easily identifiable. Problems related to authenticity; integrity can be solved by digital signatures. A verifiable link is established between parties through digital signature. Having a valid digital signature indeed means that the party has signed the document and it is not altered (Di Pierro, M., 2017.) With bitcoin decentralization of data storing and transfer of value was carried out through its underlying technology called Blockchain. Everyone took notice of this technology as it was one of the most secure ways of transacting and storing data. High advance cryptography makes it impossible to tamper with the data. Blockchain is a peer-to-peer decentralized distributed ledger technology (DLT). Information on the blockchain is validated by a consensus mechanism involving various participants on the blockchain network. Blockchain brings in various possibilities for today's business world and especially the finance sector. Blockchain along with smart contracts has the potential to speed up the current financial system dramatically. Further advancements in the blockchain sector

saw development and adaptation of Smart contracts in it. Smart contracts are like a traditional contract but the terms and agreements in a smart contract are written in codes which then allows the application to self-execute itself when the terms are met. Smart contracts being entirely digital reduces the use of paper which is not the case in the current traditional system. The self-executing feature removes the need for a third-party entity for enforcement. (Deloitte 2017). According to the discussion in the World economic forum, Davos 2018, by the year 2023-2025 many of the countries will be using blockchain technology of collecting taxes.

Addition to the above more than 200 plus distributed ledger technology-based initiation in the public sector have been started by 50 jurisdictions around the world. Blockchain technology is currently being used for identity purposes, personal records for health, medical, financial purpose, and for land registry and asset inventory. Blockchain has the potential to fundamentally change most markets and industries. (OECD 2020.)

1.1 Research rationale

Goods and service tax is imposed when a consumer buys a product, it is a destination based indirect tax imposed on sale, manufacture, and consumption of the product. It is aimed to remove the cascading effect and being single comprehensive tax for all types of goods and services. GST was introduced in April 2017 by the central and state government of India. GST includes tax policy for online trading which was not the case in VAT structure. Although implementation of GST in India has been facing challenges such as less compliance, increase in operational cost, multiple forms and complicated processing also building burden on SME manufacturers. These are some of the major challenges that result in damaging the tax collection eventually. Currently small businesses in India are facing difficulty to file taxes under the current GST structure. Constant efforts are being made by authorities working towards improving and streamlining the process making it more efficient and effective.

Blockchain is a peer-to-peer decentralized distributed ledger technology (DLT). A digital ledger allows storing information in a way that it cannot be changed or compromised. A consensus mechanism is used in blockchain for validating any information. Once the consensus is met between all the participants present in the blockchain the information gets

stored in the system with a unique cryptography combination of letters and numbers. Hence information once stored in the blockchain cannot be tampered. Blockchain demonstrates features like replication, decentralization, timestamping, automation (Khan and salah, 2020) Bitcoin allowed individuals who do not have trust in each other or are geographically located distant from each other can transfer anything of value securely on a blockchain network. Today blockchain is adopted extensively in financial sector for developing blockchain-based applications for their business operations. Introduction of digital applications known as *Dapps* been developed on the blockchain platform which enables users to transact or share any kind information with each other securely another used case of blockchain being adopted for secure identity, electronic voting, also for storing and processing health and medical records. (Deloitte, 2018.) The primary focus of this study was to understand and analyse blockchain and its impact for processing the Goods and sales tax in India.

1.2 Public blockchain:

The first-ever use of this technology was for the highly popular digital currency Bitcoin. The blockchain network used in Bitcoin is an open to participate platform making it a public blockchain. Blockchain in bitcoin was adopted for storing and validating transactions, secure transfer of bitcoins from one entity across border quickly and efficiently. Once a transaction is initiated from the parties a request is then broadcasted on the network for the nodes to validate and authorize that information. Going ahead the nodes on the network will validate the transaction through a consensus mechanism. Consensus mechanism used in Bitcoin is called proof of work (PoW). Proof of work is a cryptic puzzle; where each node or miner solves the puzzle to practice consensus. Whoever solves it first gets rewarded with some freshly mined bitcoins along with some percentage of the transaction fee as a reward for solving the puzzle without the need of a centralized authority for validating an information (Deloitte, 2020). A message is then broadcasted on the network for other nodes to validate and add the block with consensus. Once a new block is added it is then chained to other blocks of transaction forming a chain. The update of the transaction is then sent throughout the distributed ledger and then the transaction is recorded. The blockchain technology used in bitcoin known as public blockchain an open to all blockchain where anyone with computational power can take part as a miner. (S. Nakamoto, 2008.) Although this process did not seem suitable for the major adoption of the technology from a business point of view

reason being the time taken for validating a transaction and adding a new block was 30-60 minutes and would require high computational power with large consumption of energy.

1.3. Permissioned or consortium blockchain (Private)

To make blockchain more suitable for the business operation programmer named Vitalik Buterin and his team introduced an advanced version of the blockchain with smart contracts called Ethereum which enabled building digital applications (DAPS) on their platform enabling automation of payments without the need of an intermediary. Introduction of Ethereum enabled use of blockchain for more than cryptocurrency. This transition of Bitcoin to Ethereum is identified as Blockchain 2.0 (von Haller Gronbaek, M., 2016.) These types of blockchains are known as permissioned blockchain. Unlike Public blockchain permissioned blockchains enabled authorized parties to form a consortium and carry out operations. Permissioned blockchain allows interoperability amongst businesses from similar or different industries to come together and form a consortium. In addition, it allowed developing blockchain based application as required for business operations. In a permissioned blockchain selective stakeholders with certain rights on the network can be added. Figure 2 demonstrates consortium of stakeholders required for tax collection. Government officials can create a consortium blockchain that would involve all the parties required for the operations. E.g., Tax collection will have Tax administration, corporate taxpayers, regulators, and financial institutions (PwC, 2019).

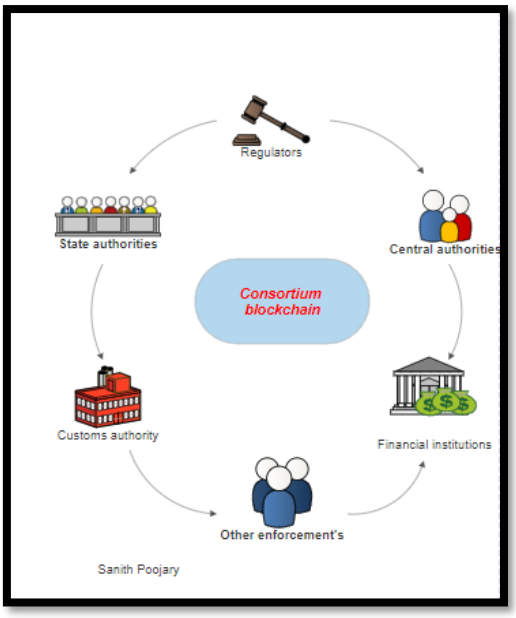


FIGURE 1 CONSORTIUM BLOCKCHAIN

1.4. Features of blockchain:

Consensus – Consensus mechanism is used in blockchain for validating and authorizing an information. This is carried out by the participants on the blockchain network for e.g., miners in Bitcoin. Consensus mechanism allows establishing authentic information without the need of an authority or any kind of trusted intermediary (Bach, L.M., Mihaljevic, B. and Zagar, M., 2018.)

Types of consensuses

- Proof of work (POW)– POW is a consensus mechanism adopted by the bitcoin blockchain network. When any new block of transactions is added on the network, proof of work is practiced by all the miners, to validate and authenticate the transaction this is done by solving a cryptographic puzzle allowing addition of a new block. Miner solving the puzzle first gets rewarded with bitcoins and some percentage of the transaction fees. PoW mechanism is adopted by many other blockchain platforms. In bitcoin to prevent forking the transaction confirmation time after 5 blocks is set to 1 hour. (S Nakamoto, 2018.) Hence practicing PoW mechanism for validating a transaction involves consumption of lot of electricity making it a not so adoptable resource for business organizations.

- Proof of stake (POS)- Is a type of consensus where the participant places a bet on their blocks and participant who holds the block with no fraudulent transaction wins and their block is added to the chain and the one with fraudulent transaction gets punished by deducting the amount of bet from the participant. POS does not consume much electricity and is said to be suitable for blockchains that are not cryptocurrency. (Bodó, B. and Giannopoulou, A., 2019.) Other consensus mechanism related to this study are discussed further in the research.

Hash – Hash is the function used in the blockchain which acts as a digital signature for every block. It is a combination of numbers and letters with every block having a unique combination. Every block in the blockchain consist of 2 hashes, one of the current blocks and the previous block. As represented in figure 1 a block consists of three parts one part stores transaction timestamps, second part stores transaction details and the last part stores hash of the current and previous block. When a new record is created, the last computed hash is broadcasted to interested parties. In a blockchain it's enough for only some parties to store the entire transaction history. Information when required can be requested through hash and any kind of modification the record will also be notified to other parties on the network. To tamper the data on blockchain it will require very high and sophisticated computational power which is practically not economic (Di Pierro, M., 2017.) The hash value in blockchain is created by the mathematically which can take any size of data and gives a specific number as output known as hash. Bitcoin uses SHA 256 hash function in its blockchain (S. Nakamoto, 2018.)

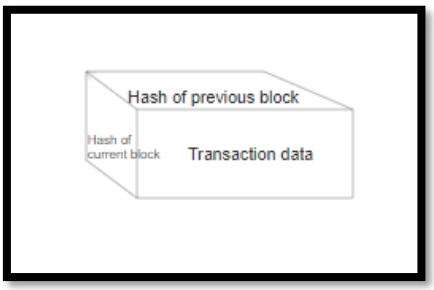


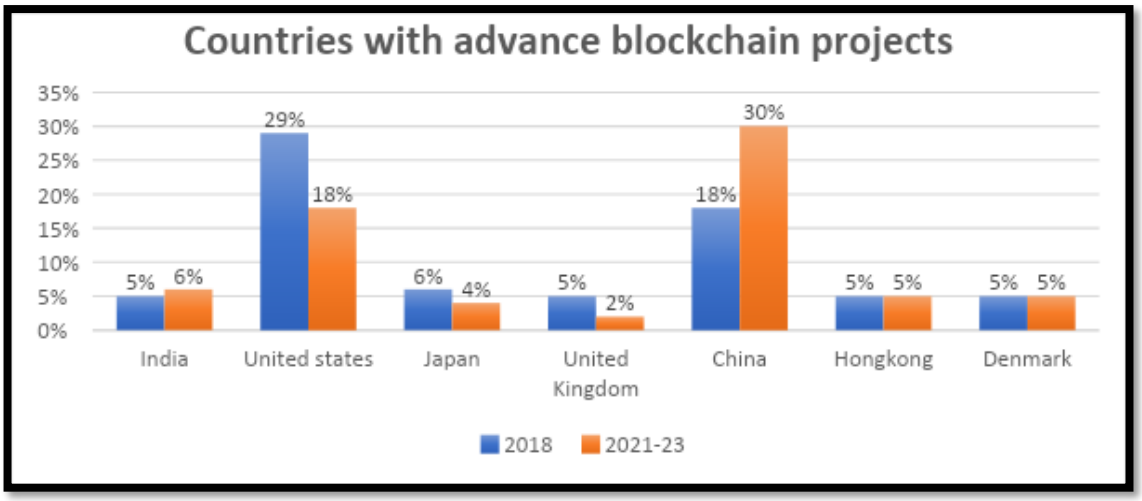
FIGURE 2 REPRESENTATION OF A BLOCK

Smart contracts – Just like regular contracts smart contracts have terms of agreements coded in the form of computer programs. The smart contract is programmed in a way that when the

predefined terms of the agreement are met the contract self-executes. (A. López Vivar, 2020). Self-executing feature of smart contract allows automation of operations like payments and verification of information. Smart contracts are advancing significantly by developing new applications based on smart contracts ranging from supply chain to financial services industries. Due to immutability feature of blockchain, smart contracts on the network also cannot be altered or mutilated. All the information on the network is easily accessible and auditable reducing risk in the process. Introduction of smart contracts ensures efficiency in the administration and operational cost. Blockchain brings transparency to the process ensuring more trust in the system without the requirement of any central authority addition of smart contract enables automating payments ensuring accelerating the entire process *Z. Zheng, S. Xie, H.-N. Dai et al.*

1.5. Global scenario

In recent times many jurisdictions have started using blockchain to carry out different functions around the world. Brazil are one of the early adopters of the digitization of the tax structure by introducing e-invoices. The tax administration has made e-invoices mandatory, and the paper invoice works as a substitute. Implementing e-invoices enabled tracking and tracing of invoices and hence reducing the margin for unlawful activities. This strategy has made the process fast and made documents easily accessible for tax officials (PwC 2019). Estonia is one of the pioneers of blockchain and has around 99% of public services available on the digital platform. Some of the public services being functioned digitally are health care registry, property registry, Business registry, Succession registry (PwC, 2019). Estonia introduced a decentralized public network known as x-road aligned with blockchain that is been used for secured transfer of data throughout the network that includes government officials and regulators. This enables filling for taxes in less than a minute. According to PwC 2019 report, Estonia saves over 1400 years of working time and 2% GDP annually due to its strong digital infrastructure. Regulatory body OECD is also acknowledging the role of technology in the future of tax processing making blockchain an integral part of the future of tax processing.



Source – PwC global blockchain survey 2018

FIGURE 3:DEVELOPMENT IN BLOCKCHAIN PROJECTS IN DIFFERENT COUNTRIES

Figure 3 above demonstrates countries with advanced blockchain technologies. The above comparison is between the years 2018 and 2021-23. China ranking first according to a greater number of blockchain application projects from 18% to 30% in 2021-23, Then the USA with 29% in 2018 and 18% in 2021-23, Hongkong and Denmark with 5% each, and India with an increase in the blockchain projects in 2021-23. As observed in the above figure 3 demonstrates wide adoption and development of blockchain technology globally.

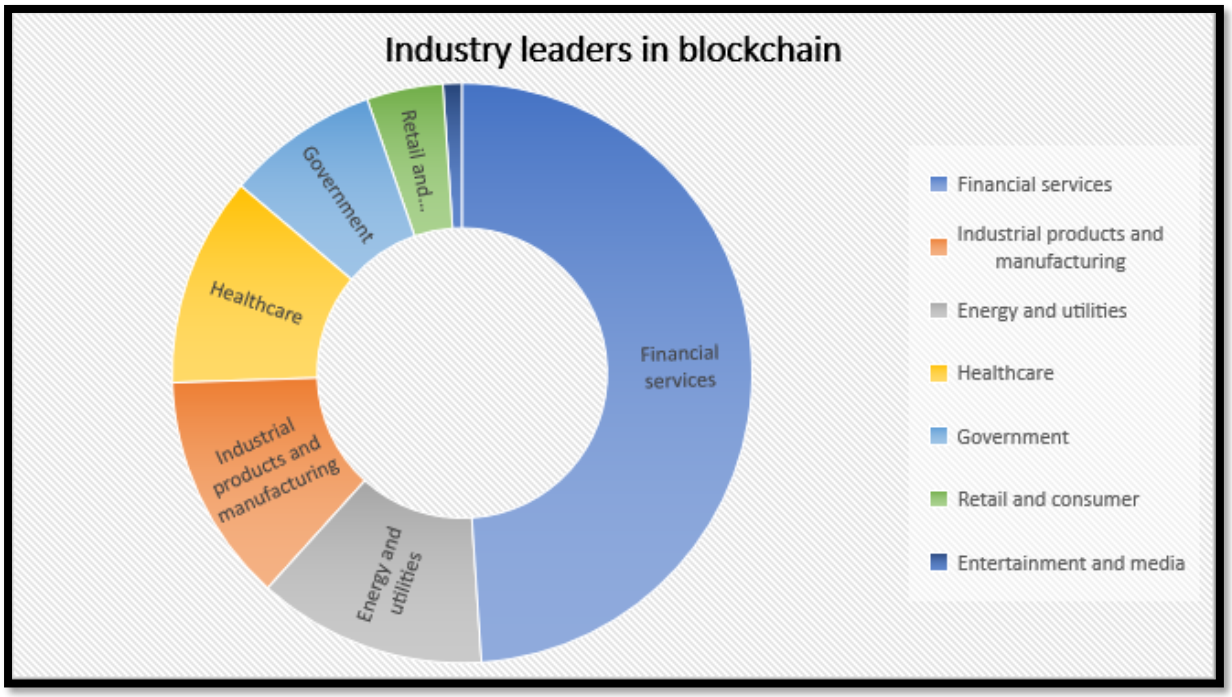
Industry	Countries	Projects
Critical infrastructures	South Korea	Asset management, optimization, etc.
Blockchain city	Malaysia	Cryptocurrency, data management
Asset management	Georgia, Sweden, Switzerland	Land registry, property transactions, etc.
Education	Japan, Malta	Certificate management

Data management	Philippines, Australia	Cloud data management
Medical and healthcare	China, United States, Switzerland, Philippines, Japan, Brazil, etc.	Supply chain, Internet-of-Things, etc.
Financial applications	China, United States, Switzerland, Philippines, Japan, Brazil, India.	Cryptocurrencies, asset management, etc.

Source – ACM digital library

TABLE 1:BLOCKCHAIN PROJECTS GLOBALLY

Figure 4 demonstrates countries currently using blockchain applications for different projects ranging from asset management and optimization to Supply chain and the internet of things. Different countries globally are operating on blockchain in various industries like asset management, education, medical and healthcare, data management, and finance.



Source – PwC global blockchain survey 2018

FIGURE 4: INDUSTRY LEADERS IN BLOCKCHAIN

Figure 4 shows industries that are currently using blockchain technology for carrying out their operations. As you can see financial services are the industry that has the greatest number of blockchain applications followed by Industrial products and manufacturing, healthcare, energy and utilities, and the government sector. The point to be noticed here is there is a fair number of government operations that are being carried out through blockchain applications.

1.6. Significance of the research

India introduced goods and service tax (GST) in the year 2017. GST replaced the traditional value-added tax (VAT) system which was multiple flowing taxes levied by the central and the state government. GST removed the cascading tax effect that was there in the value-added tax system. GST is collected by the state government (SGST) and the central government (CGST). GST is collected through the supply chain right from the supplier to the end consumer. There are different tax slabs for different goods and services from 0-28% (GST council India).

Under the current GST structure time taken from registration-to-filling for a GST is a long process. In addition, filling GST is done by filling three different types of forms and Input tax credit or tax rebate is only processed once the information furnished on all the forms are correct which is the reason for the delay in the process. According to the Times of India 2018, there has been a significant fall in tax collection and decrease tax compliance activity in the past two years. In this research, have identified some challenges of the current GST structure and propose a blockchain-based solution to overcome challenges such as compliance and fraudulent activities and automate the tax collection process.

1.7. Research aim

This research aims to understand the concept of blockchain and to understand the advantages of using blockchain for the collection of goods and sales tax in India. In terms of governance perspective, this research identifies and analyses the areas of concern with regards to the goods and sales tax in India and provides a blockchain-based solution that has the potential to make the tax process more secured, transparent, and fast.

2 Literature review

2.1. Adoption of blockchain for Industrial advancements

The authors Dursun, T., and Ustundag, b. b., [1] suggests an on-chain governance solution around policy-based management and secured decentralized identity to tackle complication in the application of blockchain technology for governance purpose. Blockchain even after being self-initiating technologies needs to have human interventions at some point in time. They identified two main parts that require human intervention in the application of blockchain one is governance, and the other is the management of nodes on the blockchain. This paper focuses on a solution to tackle the easy application of blockchain involving various participants required for a government blockchain. They argue that the policy-based management fits well with the blockchain ecosystem allowing all the stakeholders to participate and share knowledge. The secured decentralized identity approach helps in the decision-making process. Further, suggest a smart contract-based solution that would allow the adoption of other components of governance.

Nanayakkara, S., Rodrigo, M. N. N., Perera, S., Weerasuriya, G. T., Hijazi, A. A. [2] in this paper the authors suggest a solution to choose a suitable blockchain for resolving industry or organizational issues. The focus of this study is mainly on the right approach and techniques that can be used for selecting an appropriate blockchain platform. The authors suggest a four stages process i.e., Identification, selection, evaluation, validation. According to this study, blockchain is currently in the developing stage like the first blockchain was used for building digital currency, blockchain 2.0 for the financial institution and they suggest the upcoming blockchain will not be specific to one industry but for all the industries in the future. Decision-making of the right blockchain platform can be achieved by using techniques Simple multi-attribute technique allows evaluating the system according to architecture, libraries, tools, domain-specific applications, and capability analysis of various platforms.

Zutshi, A. Grilo, A. Nodehi, T. [3] This paper suggests some key value propositions of blockchain and how it can be used in the evolution of digital platforms. The author of this study also argues that some of the value propositions of blockchain can be easily integrated whereas the application of blockchain for business automation and governance is a more complicated approach. The complication of the application of blockchain for business automation is mainly because of the various parties involved in the process though they

suggest that finding a solution to integrate blockchain into business and government will not just help in technological advancement but can change the way operations are carried out currently by automating with a secured manner.

Amenta, C. Sanseverino, E. R. Stagnaro, C. [6] According to this research the author argues the advantages of the application of blockchain for the electricity industry. The author suggests and mentions how organizations in the electricity industry are making use of blockchain technology for automating operations. The author further focuses on the factors that can make it complicated to advancing to this future technology. The authors further argue how blockchain can be applied to the electricity system without disruption of current. Responses from energy regulators were taken into consideration by the author to come up with a monitoring mechanism to support innovation without disturbing the current process.

Garages, M. Treiblmaier H. [7] This paper studies the use of blockchain technology in the food industry. How Blockchain application is used for tracking food throughout the supply chain process is explained in this paper. The authors of this study mentioned how issues such as counterfeiting, dilution, or adulteration can be prevented through blockchain. The application of blockchain in the supply chain of food enables tracking raw materials from the start point of the supply chain to the end consumer. The study further shows how this helps in building consumer trust in the retailer and the product. Also, this brings more transparency to the process.

Zheng, Y. Boh, W. F. [8] The authors of this article developed a theoretical model to identify the core value drivers enabled through blockchain for online communities. In their study, there is a brief analysis of how blockchain has the potential to change the way businesses are carried out around the world. As per the paper, the core value drivers are based upon three concepts verification and tracking mechanism, reputation-value system, and data ownership mechanism. According to their research findings, these are the significant factors that enable a business to enhance the value creation of online communities along with motivating participation and securing contributions.

Browse, S. Limniotis, K. Bendiab, G. Kolokptronis, N. Shiaeles, S. [9] This paper is a study about the application of the blockchain-based solution on IoT applications. How the application of blockchain on IoT can resolve many challenges that are currently seen. One of the major challenges is the security of data and how it can be achieved along enhancing performance with the application of blockchain is mentioned in this study. There is detailed

mention about currently available blockchain solution can be used effectively to overcome current challenges. Architectural study of the technology according to the requirements or business challenges, use of smart contracts to automate the process. According to the findings of the study, the defences currently provided by blockchain are currently not up to the mark and there is still a gap that must be filled with regards to IoT.

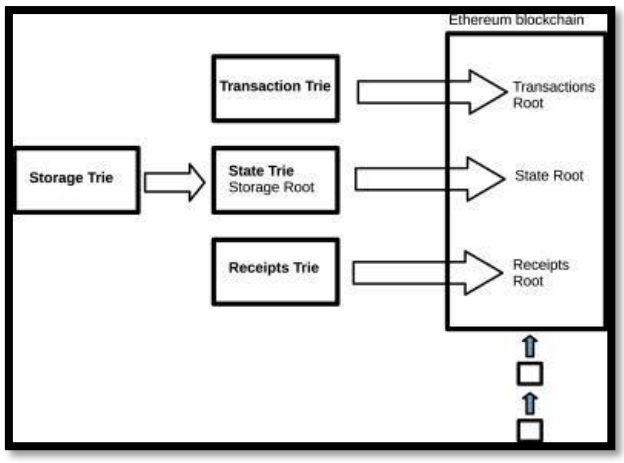
2.2. Operational advancements of blockchain

Liu, X. [15] This study is based on the application of blockchain technology for processing property registration. The author in their study conveys how blockchain can reduce the cost associated with property registration. In this study, the author tries to propose a model based on Ethereum based blockchain technology instead of Bitcoin-based blockchain technology. Further recommendations and reasons are briefly mentioned in the study about the time taking factor about the Bitcoin-based blockchain are what makes it less suitable for the business. At the end of the study, the author shows various challenges faced by the property registration sector can be resolved by bringing more efficiency and speed to the process.

Sanka, I. A. Irfan, M. Huang, I. Cheung Ray, C.C. [5] The authors of this paper study various breakthroughs in blockchain technology. This paper provides a complete study of how blockchain functions including the architecture of the technology. Advantages of blockchain apart from the cryptocurrency industry. They further mention the application and the challenges faced during the application of blockchain. Further the paper mention types of blockchain such as public and enterprise and provide an overview about each. It further talks about the adoption of this technology in various other sectors or industries than cryptocurrencies.

Vivar, A. L. Orozco, A. L. S. Villalba, L. J. G. [10] According to the authors like other software smart contracts also have some vulnerability in the technology and coding which hackers can take advantage of. Many tools are available for analysing such vulnerability, but the complicated nature of smart contracts makes it a difficult task for the developer to study and understand. Hence the author of this article came up with a framework to tackle this situation known as ‘’ ESAF (Ethereum Security Analysis Framework)’’. Using this framework smart contract developer will be able to identify the vulnerabilities in the software

and can be used as a security monitoring tool for target contracts and can be used as a vulnerability analysis tool for other users.



Source: Article: A security framework for Ethereum smart contracts

FIGURE 5:ETHEREUM SECURITY ANALYSIS FRAMEWORK.

Chen,P.W.,Jiang,B.S.,and Wang,C.H.[11] authors of this studied the possibilities of applying blockchain solutions to overcome the traditional financial system. In this study, they explain the vast doors of positive outcomes which can be achieved by blockchain application. They further mention using a blockchain-based payment collection system for customers and merchants who spend and earn digital currency. Their findings show how the blockchain-based solution can also be efficiently used for government financial supervision, easy accessibility for audit purposes of the transaction, and a subsequent increase in the tax collection process.

Junjun Lou, QichaoZhang, Zhuyun Qi, Kai Lei ’[12] The authors of this paper showed how blockchain-based information-centric networking is completely different and fast than the traditional IP network. Characteristics of IP network such as channel security that requires SSL/TLS to ensure data has not eavesdropped during the time of transmission. In their study, they propose a solution based on the advantages of blockchain such as distribution of data between peer-to-peer networks is difficult to tamper with and misused. In their research finding, they propose a solution based on key signature and verification method like partial decentralization.

Authors such as Kshetri, N., and Voas, J. [13] In their book developed an application known as chain tutor for students to understand the concept of blockchain technology. The book can be seen as teaching material for students or for anyone who wants to understand and study the concept of blockchain. The authors built this application with the use of Java. The application consists of various modules helping understand each technical aspect of the blockchain. Plus learn module, blockchain module, nodes, and network module run on the same interface and allows students to verify and validate different information on the blockchain. The article also gives an overview of how blockchain technology can be built in line with the business. The dynamic feature of blockchain and smart contracts and the advantage of data security make it a significant technology for the business world.

Wang, S., Ouyang,L., Yuan,Y., Ni, X.,Han,X.and Wang,F. Y.' [14] The authors of this paper studies about the various possibilities that can be achieved in the financial industries with the use of smart contracts. The self-executing feature in a smart contract makes it a game-changer today. With the use of smart contracts operations can be automated and the payment process can be automated. They mention a detailed structure about how a smart contract automatically verifies, facilitates, and enforce negotiation without the need for a central authority. This paper is an overview of how blockchain and smart contract functions and how there is still so much research about this technology to make efficient use of it. Going ahead in the research the authors propose a framework based on six-level architecture. There is a brief discussion about future possibilities surrounding this technology. At the end of the study, it provides a direction for future research opportunities in the field of blockchains and smart contracts.

S. Singh and N. Singh [16] The author of this paper shows a broader understanding of how blockchain solutions can transform every field of work and are a definite future in the world of cybersecurity. Further in the paper, the authors discuss the functioning and mechanism of Bitcoin, how it functions? How blockchain technology is used to secure the transfer of data? They briefly discuss the consensus mechanism used in blockchain to validate information which can be the solution to many challenges current businesses are facing with regards to their data security. The findings of this paper show operational advantages that can be achieved through blockchain applications in the banking and finance industry.

2.3. Challenges of the current goods and sales tax India

Mehta, P., Mathews, J., Suryamukhi, K., Kumar, K. S., and Babu, C. S. [17] The author of this paper proposes a model to identify tax return defaulters, ones who avoid paying liability. The model is built for commercial tax purposes, which would also help the taxpayers by giving them tax information to be paid and will help in avoiding paying extra taxes. The model suggested by the authors in the paper is to assist the tax officials in identifying the defaulters by showing a prediction if the business entity will pay taxes or not. This model is structured on this basis of the business entities' previous filling details, the value of the organization. This model also uses Benford's MAD first digit law for the sales transaction, this is done to detect any fraud in naturally detecting numbers.

According to the Babu, S. and Jain, P.K. [20]. This article revolves around the application of the goods and service tax regime in the Indian tax structure. This article highlights challenges faced by the tax officials concerning the GST system in India. According to the report, the tax compliance burden has increased after the introduction of GST in the Indian tax system. Filling taxes under the GST system is a time taking process and turns out to be a burden for small and medium businesses. Going ahead the biggest challenge from the official site is the lower tax collection rate with the monthly average GST collection being just above rupees One lakh crore. They further mention Government difficulties and the backlog of work because of the non-compliance from taxpayers.

Babar, K., & Sikarwar, D. [21] In this article the authors highlight the section which the current taxpayer more specifically the small and medium enterprises face is filling for the tax. In the current GST system to file for taxes and to get the input tax credit, the taxpayer must file three different forms GSTR1, GSTR2, GSTR3. GSTR1 is filled when the goods are supplied, GSTR2 when the goods are received. Once both the forms are submitted the officials verify the details and if details in both the form are correct, they process input tax credit. Apart from these two forms, the business must file one more form with details of sales and purchases in the GSTR3 form. Hence becomes a burden for the taxpayer to adhere to this practice and hence there has been a major problem of tax compliance in the current system.

2.4. Blockchain for tax

According to PricewaterhouseCoopers Belastingadviseurs N.V. (2019) [18] report talks about two practical cases of blockchain application for collection of tax. Two cases in the reports are blockchain for VAT processing and blockchain for eco-tourism tax. This article briefly explains how blockchain and smart contracts can be used to enhance the current VAT structure. The first half of this report deals with the corporate tax department. Secured identification, automation of payment and tax collection process through smart contracts, the immutability of data are some advantages highlighted in the study. Also, they suggest a direction for the adoption of blockchain in phases without disrupting the current tax structure. The second half of the report is an example of the application of blockchain for eco-tourism taxes. The article suggests categorizing tourist levy a tax that tourist pays when visiting any place. By doing so and with the application of blockchain this such tax payment, collection can be automated also makes the whole process more transparent for both the parties with secured identity, mitigating intermediaries and saving a lot of time. This article breaks down the whole mechanism of the technology into sections making it easy to understand for the reader. Shows different types of blockchain, the mechanism behind those types. At the end of the article, entities can get a clear picture of which blockchain platform is suitable for their business operations.

Deloitte's (2017) [19] article talks about the concept of blockchain technology and its potential specifically to the tax industry. This paper reads about the invention of blockchain and how experts started seeing many different opportunities that blockchain brings in and can be utilized for business today by making them more efficient. This paper emphasizes how challenges such as the tax gap, tax evasion can be controlled by the application of blockchain. Blockchain application brings in advantages such as data security, secured identity, transparency in the operations, and automate the collection of tax through smart contracts. The automation tax collection process helps in tapping billions worth of tax income for the officials. Also how having all the stakeholders with regards to the tax structure helps in the easy flow of data and makes it more accessible for audit. The current tax structure loses money and time for the reconciliation process which is one of the reasons for the delay in the whole process. Self-executing applications and robotics can automate this process entirely.

Deloitte (2017) [20] This article magnifies the ability of blockchain in shaping the future of the finance industry. Blockchain's capability to record and deliver information securely on a real-time basis makes it a standout technology for the future. They further mention that the financial world has started working towards the application of blockchain for their businesses. The advantages of adopting e-governance are further discussed in the paper. As per the report by the year 2023-2025, most of the tax authorities would start using blockchain technology for collecting taxes.

2.5. Research Gap

As mentioned above there has been a lot of research and analysis done on blockchain technology and its ability to modify the way the finance industry functions by bringing in more transparency, security of information, and stability to the process. By now we have understood that blockchain is not just applicable for cryptocurrency but has a huge potential outside that world too. Earlier research shows us used practical cases of this technology and the interest of government around the globe for this technology. Big four professional services organizations like Deloitte, PwC, E&Y, and KPMG are continuously working on blockchain and its application for the tax process. Coming to the Indian tax system, India has already started away towards processing tax electronically by the introduction of the Good and service tax in 2017. Processing tax electronically gives an advantage of tracking and tracing invoices through GSTN. Although due to rigid tax process and filling up of various forms authorities are facing challenges to prevent compliance issues in the current system along with a low rate of tax collection. Hence there is a huge scope of research with the application of blockchain technology for the Indian tax system. This research intends to highlight how the advantages of blockchain technology can be used to overcome the challenges of tax compliance and tax collection faced by the Indian government.

3. Research Methodology

The research methodology section covers the data collection and data analysis part of the study. According to authors Ørngreen and Levinsen (2017) explains methodology as a systematic study of different methods to achieve combined results within a discipline. According to Snyder (2019) methodology is detail analysis of various methods, rules applied to collect data by the researcher. The guiding research questions for this study is ‘’What is Blockchain and its application for collection for Goods and sales tax in India’’. This chapter will explain different approaches selected from the research onion to collect detailed information from the sources.

3.1 Constructive Paradigm

A constructivist paradigm approach was chosen to understand the concept of this new technology called blockchain and explore the possibility of making efficient use for collecting goods and sales tax in India. Constructivist paradigm approach allows the researcher to understand better people’s understanding about the topic being studied (Guba & Lincoln,1994). A constructivists researchers’ basic idea is to obtain knowledge through researcher and participant interactions. A constructivist researcher uses dialogues and reasoning as the primary methods for investigating the topic. At the end, the researcher tries to integrate the data according to the understanding of the researcher (Rudestam & Newton, 1992). Therefore, in-depth interviews were conducted with 5 professionals consisting of the field of IT, Blockchain and tax. After collecting data, it was studied thoroughly to understand participants responses through their experience and knowledge about the research topic. The approach and methods used for this study were based around the below questions:

1. Analysing blockchain and it features and its implementation for the Goods and sales tax?
2. What are some of the current challenges surrounding blockchain?
3. What are some of the areas of concern in the current Goods and sales tax system?

3.2. Research Philosophy

The first layer of the research onion consists of research philosophy. Research philosophy depends upon the assumptions of the way the researcher views world. It is the researcher point of view what is considered important and relevant information for the study. (Saunders *et al.*, 2012: 128). There are four different approaches namely positivism, realism, interpretivism and pragmatism.

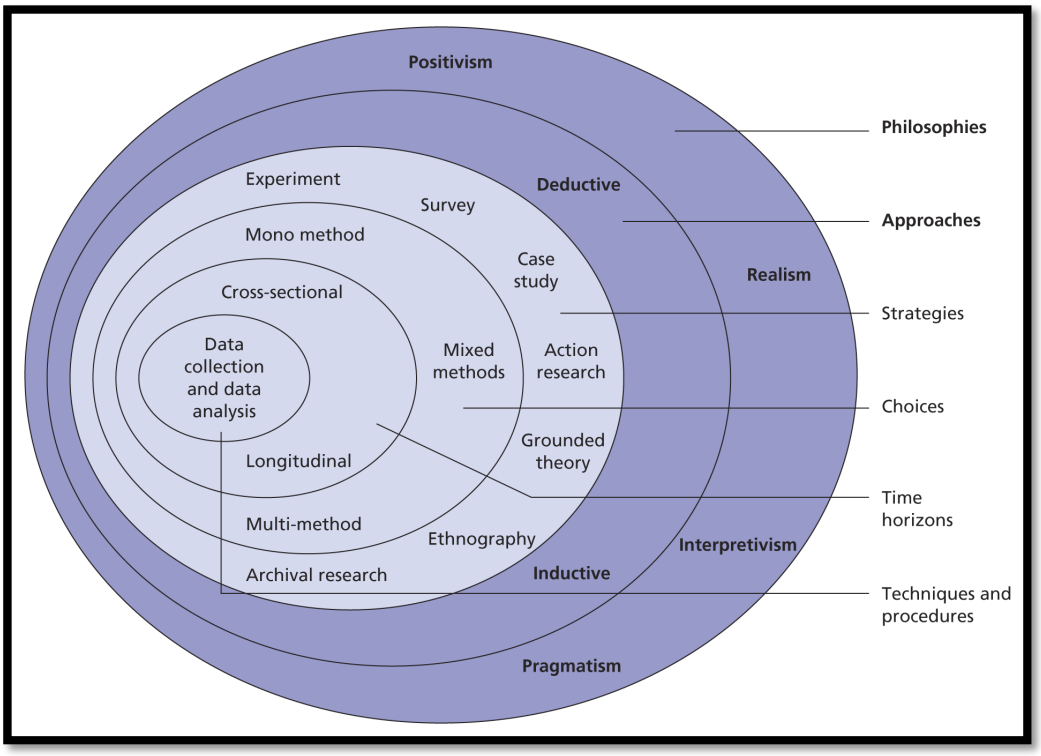


FIGURE 6 RESEARCH ONION

Choosing a particular approach for the study depends upon the research topic, research structure, and the outcome of the study. Understanding concepts of blockchain and tax from the working professionals makes more sense to gather up to date information about the field of study. A more sense making approach is suitable rather than the hypothesis testing approach to thoroughly understand the concept of blockchain. Interpretivism approach was chosen for this study because this approach acknowledges and focuses on the subjective meaning of the social action and is useful in discovering meaning from people's experience. Interpretivism approach is based on the concept that social reality is shaped by human experiences and social contexts and is best studied

by understanding the experiences of the participants. Moreover, this approach is well suited for constructing theories around less researched topics. (Aithal 2017).

3.3. Research approach

Two types of research approaches which are used by researchers while conducting a research are inductive approach and deductive approach. Induction theory is based on understanding the meaning humans attach to events. Blockchain technology is still an evolving technology and so the knowledge about it is limited to few people. Hence Inductive approach was chosen, and which seemed to be more suitable to acquire knowledge from the experience of the participants. Inductive approach emphasizes on gaining knowledge through human experiences. Communicating with professionals and understand the technology through their experiences adds more context to this study making it more concrete (Basias and Pollalis 2018). This study is based upon theoretical concepts based on analysis. Inductive approach gives the opportunity to have a flexible structure and the possibility to learn about unknown areas related to the study (Saunders *et al.*, 2012). Reason for not choosing deductive approach for this study is the necessity to select samples and then generalize the outcome according to it. Deduction is a highly structured approach, and the result is more suited for a generalized topic (Attia and Edge 2017).

3.4. Qualitative research approach

Qualitative research approach was chosen for conducting this research because these methods are useful in discovering meaning people give to events that they experience or have experienced. (Merriam, 1998). Specifically, as mentioned above inductive approach was used to understand how participants make meaning of the phenomena being studied. This approach is well suited and effective for studying small number of participants which in this studies case is 5 which will help identify experience of the participants with the field of study also it uses researchers and participants own experience towards understand the phenomena (Creswell, 2003).

Qualitative research approach used for this study are mentioned further and included purposive sampling, open-ended interviews, systematic data collection and analysis methods. Grounded theory or constant comparative method was used to analyse data thoroughly (Glaser & Strauss, 1957). Data collection methods other than open end interviews, information was also collected from various articles and journals to understand the impact of blockchain technology globally. Data

collected from interviews and other sources was analysed to understand the possibility of application of blockchain for the collection of goods and sales tax in India.

3.5. Research choices

The fourth layer of the research onion helps identify methods of collecting data suitable for the study. It consists of three methods Mono-method, mixed-method, and multi-method. Researchers can choose mono-method strategy if their research can solely be based upon the outcome of either qualitative or quantitative approach. Whereas mixed and multi-methods allow collecting data through both the means but in multi-methods the weightage of one of the methods will be more than the other (Haydon *et al.* 2018). For this study mono method was used. Information was collected only via open ended interviews taking into consideration the phenomena of the study.

3.6. Time horizons

Two types of time horizons considered while researching for the topic were cross-sectional and longitudinal. This method basically identifies the time to be taken to collect and analyse data by the researcher. Longitudinal method can be a good option when the results of the research require researchers to study the participants for a longer period. (Basias and Pollalis 2018). For this study cross-sectional time horizon approach is used because the study was conducted to understand concepts and impact of blockchain technology and possibility of its application for collection of goods and sales tax in India. Understanding about concepts of blockchain and the result of this study is based upon the experiences and knowledge of the participant and the researcher which is done through one-on-one communication between the participant and the researcher.

3.7. Techniques and procedures

The sixth and the final layer for the research onion consists of different data collection techniques and procedures used for the study. Data collection is mainly categorized into two sections primary data and secondary data. Primary data collection consists of first-hand, up-to-date, and authentic data acquired by using qualitative or quantitative methods. Primary data acts as the key value for the research being conducted. Primary data plays and important role in construction of the research (Haydon *et al.* 2018). Primary data is collected through trusted sources and hence hold high

importance in the study. As mentioned earlier methods used collecting primary data for this research were open end interviews with professional pertaining from IT, blockchain and tax industries. (Wang *et al.* 2019). Collecting primary data through interviews helped in understanding professionals' personal experience/opinions. It allowed to ask the participants questions about the current changes in the technology and the impact it will have on organization, government, and people in general. (Kvale, 1995, p. 105).

Interviews for this study were conducted through Microsoft teams, Zoom and emails depending upon the participants convenience. Conducting interview via Zoom and Teams served to be efficient considering the participants busy work schedules. For 2 participants emails were sent with questions and responses were received. Semi structured interview approach was used while conducting interview to get more information regarding the study. Semi structured interviews are tool for gathering enriching data for the study (Lofland, 1971). Having a flexible interview structure allowed both researcher and the participant to discuss the topic in depth. Thorough notes were taken during the interview to ensure key points discussed. Interviews were scheduled for 20 mins considering the work schedule of the participants. Prior emails with PowerPoint presentation (Appendix 4) were sent to the participants with all the information regarding the interview. This approach helped in spending more time in asking questions and obtaining more relevant information for the study.

3.8. Sampling

The goal of the study is to learn about blockchain and its application for collecting GST and the fact that blockchain is still an evolving technology and not many people yet know of this technology. A purposive sampling technique was used to obtain diversification in the data collected. A limited number of participants were selected for this study. Brainstorming was done to select and narrow down on individuals working in IT and tax industry. Participants for the study were selected after a discussion between the researcher and the supervisor for the study. This research has followed the judgment-sampling method under non-probability sampling (*Haydon, et al, 2015*.) 5 individuals with experience and knowledge of blockchain and tax were selected since they would be ''well informed'' about the topic of the study. Participants selected are currently working in IT, Business, tax and Blockchain currently based in India and Republic of Ireland. Participants were contacted via professional networking site Linkedin and emails. Participant's

exposure and suggestion helped the researcher in understanding about blockchain and learning new and emerging changes about the technology.

As mentioned earlier the researcher has followed a semi-structured interview process for this study. Most of the questions were asked as they are mentioned in the paper. Questions were framed starting with ‘’Why’’ and ‘Could you explain some?’’ to get more in-depth information from the participants regarding the topic. Following the semi structured interview helped the researcher in adding additional questions ‘’ Which blockchain is more effective for tax collection process?’’ and ‘’Which consensus mechanism will be more suitable for tax collection process?’’. during the interview. The interview was started with the open-ended question ‘’ what do you know about blockchain?’’ to understand participants familiarity with topic of the subject.

3.8.1 Interview questions

1. How do you think blockchain should be used to streamline and speed up the current tax processing?

2. Why could blockchain be a better solution in comparison to other technologies?

3. How much of an impact blockchain has made on your organization's operations?

4. What are some of the current limitation of the tax system that should be improved? Are there any urgent areas that should be prioritized?

5. Could you explain some of the challenges and solution of blockchain?

Field notes turned out to be one of the important sources of data collection for this study. Field notes were taken during each interview by the researcher. They were then formatted using technique by Bogdan and Biklen (1982). Date, time, and the working title were mentioned on the first page of the field note. Field note proved to be very useful to take down information that the researcher was unknown of. Further topic related to participants experience, researcher hypothesis about the study were discussed and noted down as filed notes by the researcher. Suggestions and recommendations were also taken down in different sections of the field notes which added more credibility to the study. (Mishler, 1985, p. 50).

On the other hand, information related to the topics were collected from various journal, articles, existing research work that has been done and is being done around the blockchain. Secondary data

was collected to understand in detail about the first used case of blockchain in Bitcoin and its evolution over last few years. Secondary data also helped in gaining knowledge about how organization, regulator, and government perception around this technology (Mishra and Alok 2017).

3.9. Role of the researcher

Researcher acts as a primary research instrument while conducting qualitative research. The knowledge the researcher brings to the research for his/her respective background should be treated as his/her bias (Maxwell, 2005). Point to be considered in this context is as qualitative research is more of an interpretive research so the researchers' beliefs, biases can interfere into the analysis of the data. To ensure credibility, validity of the study member checks was performed after the interviews (Lincoln & Guba, 1985). Through the course of interviews, the researcher summarized the information to question on the accuracy of the information. Data collected was thoroughly analysed for the need of the study. In addition, researcher also utilized own previous experience and knowledge as a tax consultant to better analyse the subject. Further resources and faculty supervisor were consulted throughout the course of the study. Recommendations from the advisor and sources lead to constant learning and developing new themes for the study (Maxwell, 2005).

3.10. Ethical Considerations

Data protection 2018 was followed to maintain confidentiality regarding the identity and contact details of the participants of the study. As per Data protection 2018 the details of the participants will not be shared will only be used for academic purpose from the researcher. Data collected from the participants will also solely be used for conducting this study for academic purpose. Prior permission will be taken from the participants before publishing any information online. Interview will consist of question strictly regarding the topic of the study and no personal question will be asked to the participant. Information received from the participant will recorded and presented as mentioned by the participant maintaining the originality of the information. (Khairuldin *et al.* 2020). Please refer to the appendix 4.

3.10.1 Accessibility Issue

One major issue that the researcher experienced while collecting data was the accessibility issue. Due to the Covid pandemic situation, in most of the organization's workload was high as not every manager was working. As a result, the existing participants had to perform several extra activities to ensure operations remain uninterrupted. As a result, the interviews were delayed, and dates were changed repeatedly (Wang *et al.* 2019). Scheduling interviews considering the participants situation and limited accessibility to the participants resulted in delay in completing the interviews within decided time frame.

4. Research results and findings

Content and narrative analysis techniques were used for analysing the information received from the participants. Researcher was able to identify three different topics which allowed understanding and gaining more knowledge about the Blockchain. The three themes are as follows:

- Understanding concept of blockchain and its application for collecting GST in India. (Topic 1)
- Current challenges of blockchain and limitation of GST process in India. (Topic 2)
- Impact of blockchain on organization operations. (Topic 3)

Questions 1 and 2 resulted in framing the concept for topic 1''How do you think blockchain should be used to streamline and speed up the current tax processing?'' '' Why could blockchain be a better solution in comparison to other technologies?'' Questions 3 & 4 '' Could blockchain-based solutions be more complex to adopt in the public sector than in the private sector?'' '' What would be some of your concerns regarding applying blockchain for tax processing?'' formed a basis for understanding the challenges of blockchain and limitations of the current GST processing. Whereas Questions 5 & 6 ''How much of an impact blockchain has made on your organization's operations?'' What are some of the current limitations of the tax system that should be improved? Are there any urgent areas that should be prioritized?'' formed a basis for further understanding the overall impact blockchain is making in various industries globally. All the scenarios are discussed in detail below.

4.1 Topic 1: Understanding concept of blockchain and its application for collecting GST in India.

All 5 participants interviewed for the study had knowledge about blockchain either through work experience or have heard and read about the subject because of the sudden rise in the use of cryptocurrencies. All the 5 participants noted that blockchain can be the possible solution for streamlining the current goods and sales tax process. 'Participant 1', currently working in IT industry specifically blockchain responded to question 1 as '*''It is a known fact that tax calculation is a time taking and complicated process. Application of blockchain seems to hold the possibility to simplify the current tax process. Smart contracts, immutability of data and time stamping can help in achieving more transparency and speeding up the process.''* And question 2 was '*''As I mentioned before blockchain brings in transparency, accessibility and high security is what makes it stand out and promising. It can build the trust between the authorities and the taxpayers and reduce fraudulent activities*.''

Participant 2 currently working on developing blockchain solutions answered the first question as *''all the key value drivers and benefits of blockchain laid out are beneficial with respect to collection of goods and sales tax in India. In addition,''* and question 2 as '' *Traditional tax practices are paper heavy and carry a huge risk of errors. Application of blockchain can streamline the process with high profile data security and payment automation. This is what makes blockchain a promising technology.''*

Whereas participant 3 currently working in the IT industry professional answered question 1 as *'' Blockchain is accessible to entire community. Once taxation is streamlined with block chain it would be fast and automated. No more manually work would be needed to file and compute taxes. Which saves time, gets more transparency, and reduce possibility of error.''* and question 2 as '' *It will reduce inter-dependency. Authorities can have check and reverification of any transaction from beginning of time (since inception of blockchain).''*

Participant 4 response to question 2 was '' *Through blockchain it is possible to form a trust less network where information is secured through advance cryptography and transfer of anything value securely and much quickly than the current technologies.*'' Participant 5 answered the question 1 as "*Decentralized data storing, timestamping and forming trail of records of transaction and automation through smart contracts are features that can remove the loopholes and make them more efficient and streamlined process.*'' And question 2)- as '*'Authorization and validation of data without the presence of an intermediary is what makes*

blockchain more demanding than the current available technologies. Also use cases of blockchain from the world of finance or supply chain shows the positive effect it has on the operations of the organization.'' And Participant 5 answered question 1) as *''Decentralized data storing, timestamping and forming trail of records of transaction and automation through smart contracts are features that can remove the loopholes and make them more efficient and streamlined process.''* And question 2) as *''Authorization and validation of data without the presence of an intermediary is what makes blockchain more demanding than the current available technologies. Also use cases of blockchain from the world of finance or supply chain shows the positive effect it has on the operations of the organization.''*

Participants acknowledged the capability and advantages blockchain brings to the operations of tax processing. Blockchain if planned and executed properly can make the processing of the goods and sales tax more efficient than what it currently is. The current goods and sales tax processing is more dependent on manual work and the complicated structure creates a lot of friction with information going through and from the taxpayer to the authorities and from the authorities to the taxpayer. The current tax system also lacks behind in security of data and involving large amount spent on reconciliation work. All 5 Participants interviewed for the study agreed to the above observation and stated blockchain to be the key driver while processing goods and sales tax by bringing in more transparency, efficiency to the entire system. Decentralized data storage capability brings in advantages like, accessibility of data as and when required, complete detail of history of transactions from the inception till date whilst as compared to traditional data storing technique which involves a huge risk of system breakdown, system hacks and a high risk of losing data.

4.2 Topic 2: Current challenges of blockchain and limitation of GST process in India.

The second topic emerged from study participants response about some of the challenges surrounding blockchain and limitations of the current GST system. Participant 1 response to question no 3) - Could you explain some of the limitations concerning blockchain? is as follows ''*Rules and regulations, governance and forming consortium to process tax will be one of the concerns for the authorities to take into considerations.''* And the response to the question 4) - What are some of the current limitations of the tax system that should be improved? Are there any urgent areas that should be prioritized? Is as follows *''Long and*

time taking process, less transparency more dependency on manual work leading to possibility of errors and loopholes in the process.'' Participant 2 responded to question 3) - Could you explain some of the limitations concerning blockchain? as *''Regulation regarding blockchains, limited knowledge and resources about the technology can. Still in the evolution stage means skill gap and financial investment and planning can also be one of the limitations regarding blockchain.''* And for question 4) - What are some of the current limitations of the tax system that should be improved? As ''*Time taking and complicated process. The current tax system has a lot of parties included in the process which makes the process more complicated and time taking. Traditional tax collection practices are resulting in backlog of work making the entire process of filling tax to collection slow. Multiple forms to file taxes acts as an additional burden on the taxpayer and increases more work for the authorities''.* Participant 3 response for question 3)- was '' *Majority of users would not be willing to give access to their taxation details out publicly, this could be one matter of concern for its adoption. Since blockchain is open for all, this gives access to everything on it to everyone.''* And for question 4) was '' *If automatic tax calculation can be introduced, it will be great. For example - If one has multiple income streams like job, rental income, and a business. And it gets auto calculated at the year end. All one needs to check if their total tax to be paid and details, it will be great. Down the line, once all is on blockchain it will be all connected and simple.''* Participant 4 response for questions 3) ''*Blockchain being a new technology people are less aware. Scalability and governance are some of the areas of concern to be considered during the planning stage. Discussions regarding the members in the consortium and authorization can be some of the areas of concerns according to me.''* And question 4) as ''*Less transparency and trust in the system are some of the areas of concerns that the authorities should take into considerations. Current tax system struggles to prevent fraudulent activities and in return incurs huge amount of losses.''* Participant 5 answered question 3) as *'' Blockchain is a nascent technology and as we talk there are developments going around to make blockchain more scalable and sustainable to make the most of the technology throughout different industries.''* And question 4) as *''More dependency on paperwork is one of the concerns in the current GST system. Paperwork increases the margin for error, loss of data and even tax fraud activities. This is also resulting in the increase in audit cost and takes a lot of time for the reconciliation. As we move into a more digital era it makes more sense to calculate taxes with the use of technology.''*

Response from participants for question 3 helped in understanding participants perception about some of the challenges surrounding blockchain. Participant 1, 2 & 4 response was based upon the forming and architecture side of the blockchain. Three of the before mentioned participants mentioned about rules and regulations about the digital assets, cryptocurrency and blockchain. Blockchain is an evolving technology and has a lot of potential to be solution for some of the business problems, rules & regulations describes authorities take on the technology. Some of the other challenges further mentioned were limited knowledge about the subject and governance of consortium required to form a blockchain network. Participant 3 stated users' disagreement about the information shared on the open blockchain network. Whereas participant 5 response covered about the backlash the technology facing for using more energy and not being sustainable.

4.3 Topic 3: Impact of blockchain on organization operations

In addition, participants response to the last question of the interview enabled researcher to understand the impact blockchain is making in their organizations. This question formed a basis for understanding business point of view towards blockchain. 4 out of 5 participants interviewed for the study said to have witnessed adoption of blockchain technology in their organization's operations. Following are the responses for question 5) How much of an impact blockchain has made on your organization's operations? Participant 1 responded as '' *There have been various developments going on right now in my organization particularly blockchain. My organization are working on developing and coming up with possible blockchain solutions for processing secure identification.''* Participant 2 answered question 5 as *''Currently there have been blockchain projects that my organization is working towards but it's still in the planning stage.''* Participant 4 responded as '' *The organization I am working in currently are investing in various blockchain projects and has adopted blockchain for storing and accessing employee qualification details.''* Participant 5 responded as *'' My organization has not yet started the use of blockchain for its operations. There is high a possibility it will be used in the coming future.''* Whereas Participant 3 responded to the final question of the interview as *''My organization has not adopted blockchain yet.''*

4.4 Summary

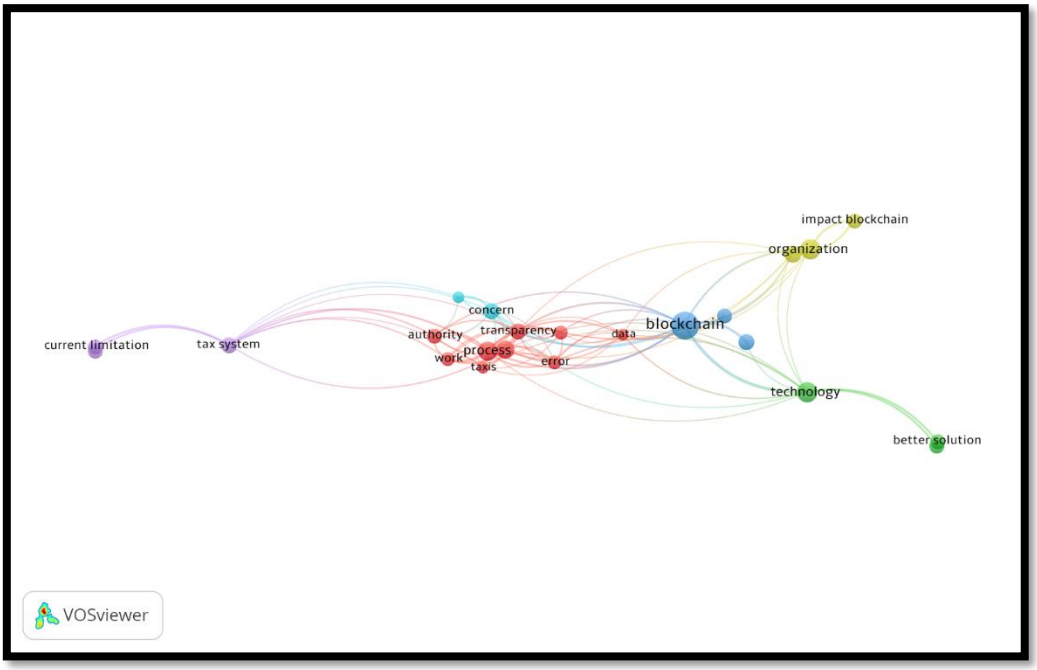


FIGURE 7:VOS'S VIEWER NETWORK VISUALIZATION

VOSviewer is a software tool for constructing and visualizing bibliometric networks. These networks may for instance include journals, researchers, or individual publications, and they can be constructed based on citation, bibliographic coupling, co-citation, or co-authorship relations. VOSviewer also offers text mining functionality that can be used to construct and visualize co-occurrence networks of important terms extracted from a body of scientific literature (Van Eck & Waltman, 2018).

Using text mining techniques, the researcher separated the information received from the participants into four different clusters this would help in understanding the participants anticipation about blockchain and its adoption for collecting goods and sales tax. This technique gives a better understanding of the co-occurrence of the relevance of the words used in the research and in the interviews with the research topic. The four clusters formed after reading the participants response are Red, Blue, Yellow, and green. The below table mentions the 23 terms used in the interviews segregated in clusters and their relevance to each other (Van Eck & Waltman, 2018).

Cluster 1 (Red)	Cluster 2 (Green)	Cluster 3 (Black)	Cluster 4 (Yellow)
Authority	Better solution	Blockchain	Impact of blockchain
Data	Technology	Current tax processing	Application
Error	Comparison	Limitations	Operations
Regulations			
Process			
Taxes			
Time taking			
Transparency			

TABLE 2: CLUSTER GRAPH OF THE INTERVIEW

Cluster 1 highlights terms used in the interviews related to tax specifically collection of goods and sales tax. Cluster 2 the one in green colour here mentions terms used to understand which technology is better as compared to each other. Cluster 3 the one in black in (table 2) mentions terms used in the interview for understanding limitation in the current tax processing and Blockchain and its features including smart contracts. Cluster 4 in yellow colour mentions terms used in the interview to discuss and understand the application of blockchain and its impact on the operations of businesses globally. Cluster graph demonstrates participants knowledge and view about the topic of study by highlighting the words used in the responses. It supports in the analysing of data collected from the participants (Van Eck & Waltman, 2018).

5 Discussion of findings and recommendations

The previous Chapter of this study provided the findings acquired from the interviews. This chapter will provide an in-detail discussion about the findings and proposes a recommendation for adopting blockchain for the collection of goods and sales tax in India. As mentioned previously in the research blockchain is currently being used and developed for carrying out various activities ranging from finance, health, travel, entertainment furthermore it also being used by governments and regulators for carrying out public services like Estonia is doing. As mentioned by most of the participant's application of blockchain brings in more transparency and makes it more efficient with high security of data. The findings of this research also show that the tax collection system is currently in a decisive phase in adopting technology for tax collection purposes. Currently in India and many of the country's taxes are collected using the old and traditional methods. These methods are more suited for the traditional businesses. Now businesses are technology-driven and collecting taxes through traditional methods makes the processes complicated and leaves room for error.

As established earlier in the study the Indian government loses billions of USD every year in tax losses eventually affecting the economy of the country. This study has identified four major issues in the current GST system making it more inefficient for today's time.

5.1. Multiple forms for filling GST

The current GST collection process consists of filling of multiple forms from the taxpayers to start the process. Multiple forms for filing taxes increases complication for both the parties involved. Participants 2 and 4 mentioned in their responses about the multiple forms making the process even more complicated. From a tax-payers point of view, GSTR 1 form is to be filled after the sales being made, GSTR 2 form for purchases, and GSTR 3 for filing taxes with the information provided in GSTR 1 and 2. Also making the reconciliation more time taking and complex. Moreover, the current tax process is still heavily dependent on manual processing of activities such as verification and authorization of information. Processing validation and authorization of data through human resources are more vulnerable to errors and results in slow processing of taxes. Participant 14 stated 'Authorization and validation of data without the presence of an intermediary is what makes blockchain more demanding than the currently available technologies. Also, use cases of blockchain from the world of finance

or supply chain show the positive effect it has on the operations of the organization.'' Data in the current GST process moves from authorities to payers and payers to authorities causing a lot of friction in the processing and resulting in taking more time for the entire process to get completed.

5.2. Auditing

Participant 5 stated that more dependency on paperwork is one of the concerns in the current GST system. Paperwork increases the margin for error, loss of data, and even give rise to tax fraud activities. This results in increasing audit costs and making reconciliation a costly affair. As we move into a more digital era it makes more sense to calculate taxes with the use of technology. Participants 2 also stated Traditional tax collection practices are resulting in a backlog of work making the entire process of filling to collection slow. Multiple forms to file taxes act as an additional burden on the taxpayer and increases more work for the authorities. The current GST system consists of 3 types of auditing, turnover-based audit, general audit, special audit. Turnover audits are carried out by CA or CWA hired by the taxpayer, General audits are carried out by an authorized person and the special audits are carried out by CA and CWA hired by the GST commissioners. Incomplete records, missing data controls in audit, and unreconciled books of GST books of accounts. Unavailable and incomplete transaction results in delaying the entire process. Lack of information for auditing results in a backlog of work making the auditing processes expensive for the authorities.

5.3. Compliance issues

Two major causes for the rise in non-tax compliance are tax evasion or fraudulent activities and less transparency in the process. Tax authorities across countries are making efforts to make the tax processing more compliant. According to a report from CBEC, only 64 percent of taxpayers filed GSTR3 B in the year 2018. The reason for the lower compliance rate is deemed less awareness amongst taxpayers and complicated processing mechanism of the goods and sales tax in India. The current GST system efforts to start processing GST tax online through GSTIN can be acquired has not proven to be successful because of various technical difficulties. Less awareness about the new way and limited technical knowledge is one of the factors for the rise in compliance problems. Participant 3 briefly mentioned the

compliance difficulties faced by the authorities when asked about some limitations of the current GST system. Moreover, the current infrastructure of the GST process is complex resulting in less transparency in tax processing. Zero transparency hampers the trust relationship between the taxpayer and the tax authority eventually affecting the entire process. Participation of multiple parties and complications of the process creates loopholes in the system which gives rise to fraudulent and tax evasion activities. Dependency on paper processing makes it difficult for the authorities to track and trace the piece of information required.

5.4. Payments

The presence of multiple middlemen in the system, various procedures, and manual validation and authorization affects the payments for both parties involved. In the current GST system, an input tax credit is processed when the authority receives GSTR 2 from the supplier and GSTR 1 from the manufacturer. After validating information from both the forms manually if the information is correct the ITC is processed which can take longer than the desired time. This becomes a burden for businesses due to the non-availability of funds at the required time. Similarly, tax collection gets delayed because of the manual process of validating information. Information moving from taxpayers to authority and vice versa creates a lot of friction in the system. Missing information, delayed information increases the backlog of work eventually making the entire process slow and behind time (Dr. R. Vasanthagopal2011).

5.5. Blockchain solutions for the above issues

Blockchain is an open-ended decentralized data storing technology. Data once entered and stored in the blockchain cannot be changed or manipulated. Data in a blockchain is stored in different blocks that are chained to each other. Because each block in the blockchain network is chained to the previous block makes accessing data simpler and faster. E.g., any information once entered by the taxpayer, if validated by the nodes gets added to the network this piece of information stays on the blockchain and can be used by or referred by the authorities when needed. Another advantage of using blockchain is that information can be transferred throughout the blockchain securely and can be done on a real-time basis.

Participant 4 response throws more light on this topic ‘’ Blockchain is an open-ended decentralized data storing technology. Data once entered and stored in the blockchain cannot be changed or manipulated. Data in a blockchain is stored in different that are linked to each other. Because each block in the blockchain network is linked to the previous block makes accessing data simpler and faster.’’ As described in the study above the current GST system requires the taxpayers to fill two forms while requesting for ITC and the third form for filing taxes. Blockchain features such as immutability, data security, data storage, and transfer facility help in acquiring data present in the system. (Rashideh, W., 2020). Processing GST with blockchain will diminish the margin for duplicity of information. This means that once the information entered by the taxpayer gets updated on the blockchain there is no need for the individual to enter that information again and authorities can access the information when required without requesting the information from the taxpayer again. On the blockchain, only one tax form with required information is needed the validation and authorization part is done by the smart contracts and concerned entities are notified according to the result of the validation.*Alkhodre,etal*.

5.5.1. Data Reliability

Data reliability since data on the blockchain cannot be altered until and unless from the consensus of more than 51% of the nodes in the network i.e., technically impossible, makes the data more reliable and trusted. Once this comfort of data reliability is achieved the auditors can be in a position where the risk of fake information completely vanishes and makes it easier for the auditors to process. Apart from inaccuracy of the data, another problem that the auditors face in the current GST system is incomplete information provided to the auditors. It takes plenty of time for the auditors and authorities to gather and request information from the taxpayers on time resulting in a backlog of work and delay in the entire tax processing. Information on the blockchain is updated on a near-to-real-time basis, Once the information updated by a taxpayer is incomplete or faulty this can be verified by the nodes and if any additional information is required can be sent to the concerned party without delays. On blockchain the authorities do not have to track any outstanding information from the taxpayers this can be done completely through the systems (Deloitte 2017.) This makes the whole auditing process more cost and time efficient.

5.5.2. Better tax compliance

Blockchain can significantly modernize the whole tax collection process. Blockchain enables automation through smart contracts this increases efficiency in tax payments and refunds. It can complement the current GST system without disrupting it. Moreover, it can help in reducing fraud by making the process of GST collection more transparent. It reduces the imbalance nature of the communication carried between the authorities and the taxpayers. Blockchain can reduce fragmentation of the compliance processes at the country level. A single audit file system can be achieved through blockchain this will help the auditors in receiving information in a single file containing all the information related to the business. Blockchain brings in more transparency in the system which enhances to build of a stronger relationship between both parties. Resulting in a better complaint taxing process. Also, the tracking and tracing, timestamping of information mitigate the possibilities for the rise of any fraudulent activities. As described by participant 2 when asked about blockchains impact on tax processing '' *'All the key value drivers and benefits of blockchain laid out are beneficial concerning the collection of goods and sales tax in India. In addition, blockchain reduces reconciliation activity by marginalizing the complexity of the structure overall cutting down compliance cost.''*

According to Campbell Harvey, (Professor of Finance at Duke University's Fuqua School of Business interview to FERF, 2018) mentions Real-time transaction recording is the primary benefit of blockchain. The current financial systems work on reporting numbers based on past during annual, semi-annual, and quarterly basis. Blockchain allows the possibility of creating and maintaining a ledger with data being sent to it directly from the business lines. This data can be monitored and can be sent to the external auditors for validation in real-time. According to (David L. Yermack, FERF 2018.) calls ''blockchain is a self-auditing, technology''. Blockchain and shared ledger technology reduce the need for financial record keeping it allows to store these records in a block format that cannot be compromised. Any minute change to the data can be identified by the participants in the network making the whole process immutable and secured.

5.5.3. Automating payments

Blockchain also allows automating the payments process without the need for a centralized authorities administration. Once predefined conditions of the contracts are met the smart contract self-executes itself and payments are processed without authorization or the presence of a centralized authority. As stated by participant 5 ‘‘Decentralized data storing, timestamping and forming a trail of records of transaction and automation through smart contracts are features that can remove the loopholes and make them more efficient and streamlined process.’’ E.g., The tax authority sends a catalogue with all the tax information to the taxpayer on the blockchain network. The taxpayer verifies all the details and once the taxpayer confirms the details the payment between both parties will be automatically triggered through predefined rules on the smart contract. Deployment of smart contracts on a blockchain network not only automates the payments but also reduces the risk of the system's failures through malicious activities. Further, it cuts down the administration and service cost and eventually increasing the efficiency of the whole process.

Through the course of the interview participants also pointed out some of the challenges surrounding blockchains such as scalability issues, governance and consortium, and regulations. Participant 5 stated ‘’ *Blockchain is a nascent technology and as we talk developments are going around to make blockchain more scalable and sustainable to make the most of the technology throughout different industries*.’’ It’s been over a decade since the first use case of blockchain in 2008, Bitcoin. Nakamoto’s paper proposed a platform to transfer a digital currency across borders without the need for a central authority. As per the whitepaper, it would take 10 mins for a block of the transaction to be verified and validate and save the transaction on the blockchain. This seemed to be a major challenge for businesses and developers to make blockchain more scalable as per business requirements. Also stated by participant 4‘’ Blockchain is a new technology people are less aware. Scalability and governance are some of the areas of concern to be considered during the planning stage. Discussions regarding the members in the consortium and authorization can be some of the areas of concerns according to me.’’

5.6. Approaches to scalability solutions

For processing GST on a blockchain network it would require high scalability for the entire process to work efficiently. The total size and number of the transaction to be processed for GST purposes will be higher and so further chapters are approaches that can be considered for a highly scalable GST network. There are various scalability solutions currently being developed they are divided into two layers -Layer 1 and Layer 2. Layer 1 solutions are concerned with the technical part i.e., on-chain solutions and layer 2 as non-on-chain solutions. Refer to appendix 2 for an entire list of Layer 1 and Layer 2 solutions. Below topics is a discussion about selected solutions suitable for our topic of study application of blockchain for processing goods and sales tax *Q. Zhou et al*

5.6.1. Block data

With the popularity of bitcoin over the years one challenge it faced was scalability. *Kyle Corman et al.* mentions metrics to measure the scalability of the bitcoin blockchain. Metrics proposed are *maximum throughput, Bootstrap, and CPCT (cost per confirmed transaction).* In the bitcoin blockchain's case, the transaction throughput pulls more attention. Bitcoin's transaction throughput time is 7 TPS which is very low as compared to 4000 TPS of visa (Q. Zhou et al.: Solutions to Scalability of Blockchain: Survey). In the blockchain, transaction throughput is more because of the size of the blocks. A block size on a bitcoin's blockchain network is 1MB and the gap between an old block and forming of a new block is 10 minutes. Theoretically speaking increasing the block size increases the storage size which will raise the transaction throughput but also causes increases in propagation time and can lead to forking threats. Overall, these factors have a strong impact on the user experience (Q. Zhou et al.: Solutions to Scalability of Blockchain: Survey). An increase in demand and limited block size increases the latency on the network causing a delay in the confirmation. In such situation nodes tend to try validating blocks with more transaction fees. Point to be noted here leaders and developers should plan about the size of the block, propagation time at an earlier stage depending on the requirement of the businesses. To counter these challenges various compression and sharing techniques are being adopted to make it more adaptable to more users.

5.6.2. Consensus

Another factor that affects the scalability of blockchain is the consensus mechanism used to validate a transaction in the blockchain network. The nodes on the bitcoin network use the POW mechanism to validate and upload a block. It takes 10 mins for a block to be added to bitcoin (Satoshi, 2008.) And it requires high computational power which consumes a large amount of energy making it a not so suitable option for business purposes. In figure () shows the energy consumption of bitcoin as compared to some of the countries. A single bitcoin carbon footprint caused by a single transaction is 843.65 KgCO2 which is equivalent to the carbon footprint of 1,869,814 visas and 140,608 hours of YouTube watching (Digiconomist, 2021.) Proof work is an efficient mechanism to maintain security, but it is not sustainable. Appendix 1 mentions a complete list of consensus mechanisms currently being adopted.

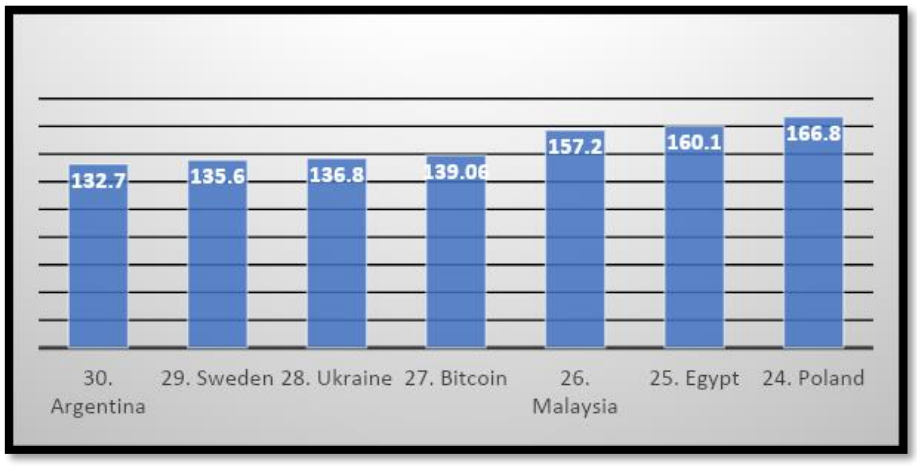


FIGURE 8:ENERGY CONSUMPTION BY COUNTRY AND BITCOIN

5.6.3. Active solutions to increase transaction throughput

As seen above block size plays a vital role in the scalability of the transaction. Block compression is one of the solutions for the issue and reducing storage overhead. Various compression techniques are developed and tested to increase the overall throughput of a transaction in the blockchain. Two such block compression techniques introduced by BIP152 which are relevant to our study and application for GST collection are C*ompact block relay* and *Txilm*. The primary objective of all these techniques is to reduce the redundant data of the

block which is already stored in the *Mempool* of receivers. Mempool is a cryptocurrency node used for storing information on an unconfirmed transaction (Binance, 2021.)

The compact block relay technique was introduced in BIP152 which altered the data structure of the block. How a compact block relay work is, it contains the header of the block and the transaction ID (TXID) which it uses to match with the transaction available to the receiver. *Q. Zhou et al., an* Important Part of the compact block relay mechanism are the *CPC block* messages which are dealt with by another node. After receiving the message, the node will compare the transaction with TXID after calculating the TXID of the transaction. After this process, if all the unknown transactions are available to the node, then that block can be reconstructed. If not, the need will need to send one more message to request more information.

Txilm is another mechanism proposed in BIP152 in which these transactions are compressed in each block to increase scalability and reduce bandwidth on the network. Txilm uses the hash of the block to represent it and helps in achieving greater transaction compression results. Although there is a threat of collision attack because of the use of the short hash. So, what Txilm does is optimizes the protocol by applying sorted transactions based on their TXID's to reduce the probability of the collision attack. The result of this protocol shows up to 80% data reduction improving the throughput and scalability of the blockchain network. For the collection of GST, the authorities thus need to understand user requirements overall scalability of the process and hence use Tilm techniques to achieve and maintain scalability of the network *Q. Zhou et al.*

5.6.4. Different consensus mechanisms to increase scalability

As observed in the above chapter to achieve consensus amongst the nodes to validate and update a block on the network requires very high computational powers and uses a lot of energy making Bitcoin and not so sustainable technology. Different consensus mechanism has been developed after the first use case of blockchain dating back in 2008 to attain more scalability and make blockchain more sustainable *Q. Zhou et al.*

5.6.4.1. Proof of Work (POW)

PoW is the first consensus mechanism used in Bitcoin for validating and adding a new block on the network. In PoW, participants called miners to solve a computational task to create a new block of transactions on the network. The miner who cracks the puzzle first broadcasts a message on the blockchain network for other miners to verify the block. Once the block is verified by all the other miners it gets added to the network and the miner gets rewarded with tokens. The computational power is used for getting the answer to confirm the legitimacy of the work gone behind. The higher the computational power higher the probability of solving the cryptographic puzzle (S. Nakamoto., 2008) In Bitcoin, the transaction confirmation time after 6 blocks have been mined is set to one hour which makes it vulnerable to forking threats. Also, the mining of bitcoins uses a high amount of energy which is also why this consensus mechanism is not preferred for business purposes (Deloitte, 2018).

Different studies were dedicated to making the PoW mechanism more efficient. Bitcoin-NG was introduced this mechanism uses Nakamoto consensus it uses PoW mechanism to appoint a leader node who then is responsible for validating and adding micro-blocks on the network Q. Zhou *et al.* This method helped in achieving low transaction cost by reducing transaction confirmation time and improved scalability. The other two mechanisms developed based on the PoW mechanism are GHOST and SPECTRE Q. Zhou *et al.*

5.6.4.2. Proof of stake (PoS) and Delegated proof of stake (DPoS)

PoS was developed to avoid the computational overhead of PoW. Unlike PoW which requires high computational power, PoS requires nodes to elect a leader based upon the amount of currency owned by the node. PoS requires less computational power and is more energy efficient as compared to PoW. As there is no computational task required in PoS makes examining the security of the PoS mechanism is a challenging task. Various other alternatives were developed based on the idea of PoS like Ouroboros, Ouroboros Praos, and Snowhite (R. Oliynykov, 2017.)

DPoS on the other hand is completely different from the consensus protocol of PoS. DPoS mechanism is used for solving the problem of scalability in Bitshare and EOS (Bitshare, 2019.) The Algorithm in the DPoS mechanism is divided into two stages, first stage is staked voting, nodes holding tokens can vote for the potential block validator. In the end, 21 nodes with the most votes are selected to add future blocks. The entire idea behind the DPoS

protocol is to select 21 nodes amongst the range of nodes with the highest tokens who then can provide high computational required for adding a block without the need of usage of the extra computational power of other nodes. In DPoS protocol a block to be added is broadcasted on the network and if more than 15 nodes form a consensus the block is then added to the network. The voting of the block producing node is simultaneously performed through the network and if a selected block producing node does add a new block to the system in 24 hours that block is replaced by a spare block and in the future, the chance of the default node will lower because of the failure of producing a new block. A block is generated by one node every three seconds and takes seconds to confirm a transaction. Compare to other consensus mechanisms EOS achieves million-level TPS. In EOS more than % of the tokens are occupied by 10 addresses and 1% of nodes on the network occupy 86% of the tokens on the network. This technique is more suitable for permissioned blockchain especially blockchain solutions used for governance or regulation purpose.

5.6.4.3. Practical Byzantine Fault Tolerance (PBFT)

One another consensus mechanism used for achieving high scalability is PBFT. PBFT mechanism focuses on curbing the consistency issues caused by unreliable nodes on the blockchain network. In PBFT a primary server is selected to broadcast client messages. PBFT work is a three-stage protocol. First prepare the message, Prepare, and confirm stage. Once the primary server receives the client request it is then broadcasted in an ordered sequence to other servers. Each server chooses to either accept or reject the prepared message broadcasted by the primary server in the pre-prepared stage. The server broadcasts a prepared message after receiving successful confirmation from other servers. A commit message is broadcasted, and confirmation is received from the other servers confirming the client request Q. Zhou *et al.* PBFT requires more communication overheads although it reduces the computational task required for PoW. Some of the used cases of PBFT mechanism are Tendermint (Tendermint, 2016.) and Elastico (Elastico, 2016.)

Some of the other solutions to the scalability challenges of blockchain are Sharding which is derived from the technique used to divide the data of a large database whereas in Sharding a blockchain network is split into smaller networks which allow different shard networks to process transactions simultaneously. (Directed acyclic graph) DAG works on the idea where a block act as a vertex and is connected to some previous blocks. DAG is different from the

traditional blockchain as it allows multiple blocks to be connected to a previous block allowing more transactions to be added to the system.

5.7. Layer 2 off-chain solutions

Layer 2 consists of solutions related to Payment channels, Sidechain, off-chain computation, and the cross-chain. Payment channel techniques are a secondary payment channel on the network allowing solving a high volume of transaction problems on the main blockchain channel. Payment channel solutions like lighting networks have been adopted by Bitcoin and Raiden network (Raiden network, 2019). Another solution to make blockchain more efficient is Sidechain solutions, Sidechain enables assets in a blockchain network to be transferred from one blockchain network to another preventing fraudulent attacks on the asset. Q. Zhou *et al.* some of the used cases of Sidechain solutions are Pegged-Sidechain (Pegged-Sidechain, 2019.), Plasma (Plasma, 2019.) and liquidity network (Liquidity network, 2019.) Whereas Off-chain computation solutions are based on making the functioning of smart contracts more efficient and scalable. A couple of such solutions are Truebit (J. Teutsch and C. Reitwieÿner, 2019.) and Arbitrum (Arbitrum: Scalable, 2018.)

5.7.1. Regulatory requirement

Participants 1 and 2 responses briefly mention the regulatory challenges currently surrounding blockchain and challenges regarding a consortium of governance on the blockchain network. Blockchain technology has made a huge impact on the financial industries around the world. Though the regulation around the technology is not very clear and can hamper the mass adoption of this technology (J. S. Cermeno, 2016.) Like other technologies blockchain technology brings a lot of advantages to the process but there are also challenges to be addressed for mass adoption of the technology. Currently, there is no common regulation in place for blockchain technology. Regulations specific to cryptocurrencies regulators are focused on the legality of their use, considering them from a taxable source and avoiding the usage of cryptocurrencies for illicit purposes.

Regulators, financial institutions, and government bodies are working on regulating cryptocurrency considering the scope of the underlying technology. European Parliament and

the European Commission have a neutral take regarding digital currencies. Both the policymakers have created a task force to study and analyse the potential of blockchain technology not just for business purposes but for governance use also. The European Commission has occupied a DLT workstream in the financial technology task force. As of 2020 European commission introduced the Market in crypto-asset regulation (MICA) intending to promote the adoption of blockchain throughout the EU whilst protecting consumers' interest and integrity of cryptocurrencies. (Council of the EU, 2020.) United states policy-making bodies have a positive position by including initiatives like Resolution calling for national technology innovation policy including digital currencies and blockchain. Also, by developing new study groups entirely focused on Bitcoin and blockchains. In addition, financial authorities like OCC (Office of the comptroller of the currency.), Security exchange commission (SEC), Federal reserve USA and Financial conduct authority UK (FCA) have a positive take on cryptocurrency and blockchain technology. Sandbox initiative is an initiative by FCA that brings the business professionals, regulators, and blockchain developers together to test and develop innovative blockchain solutions. The European Commission has also introduced the sandbox initiative in the year 2020. (Council of the EU, 2020.) International financial institutions like the financial action task force (FATF) and financial stability boards take have been neutral to negative and have previously commented on the illicit use of digital currencies. In contrast, the International monetary fund (IMF) and World Bank have a positive view and showed their interests in the publication of multiple reports on cryptocurrencies and blockchain. (BBVA research, 2020.)

The Indian government also saw a surge in the demand for cryptocurrency and the advancement of blockchain technology in the Fintech market. In the year 2013, the Reserve bank of RBI (Reserve bank of India.) submitted a report in 2019 recommending a ban on private cryptocurrencies in India. There has been developed around the regulation about digital currencies and blockchains in India. The Indian government is considering the introduction of a new bill that will completely focus on cryptocurrency and the technology behind its blockchain. This bill is known as ‘’Cryptocurrency and Regulation of official digital currency. The intend of this bill is to promote the underlying technology of cryptocurrency blockchain and to develop an official digital currency that will be issued by RBI. As of March 2021, Government of India has asked all the companies to disclose their investments in cryptocurrencies this move has been accepted by the companies as a growing opportunity for digital currency and adoption of the blockchain (The legal 500, 2021.)

6 Recommendations

Blockchain technology is a disruptor for operational work for many industries. Blockchain is currently being adopted in various industries ranging from decentralized finance, the health sector, and Supply chain. Adopting blockchain has been proven to give operational advantages such as easy accessibility to data, security of data, and automating payments. Smart contracts application in blockchain allows cutting down of operational cost impacting and making the entire process more efficient. Leaders and regulatory authorities around the world understand the importance of regulating the use of cryptocurrency whilst keeping in my mind the scope of blockchain. As previously established in the study the current GST system in India is considering technological changes with the introduction of GSTIN to the system. Despite the introduction of GSTIN, the authorities are still facing challenges regarding compliance, duration of the entire process, and losses in tax collection due to fraudulent activities. One of the limitation of this research is it was conducted to study blockchain from a business perspective and does not cover the technical part of the blockchain. This study illustrates that the challenges faced by the current GST system are equivalent to the technological advantages blockchain brings allowing more efficiency and transparency to the system (Zhang, Y., 2019.) Through the course of this, we study various features of blockchain and current used examples around the world in different industries. This study recommends authorities consider the adoption of blockchain as a possible solution to achieve more transparency, security and making the overall process more efficient.

This study proposes a framework for the application of blockchain for collecting GST in India. Appendix 5-7 represents three phase framework proposed in the study.

The tax collection process involves confidential information about the taxpayers which makes data security more crucial. Adopting a **permissioned blockchain** is more suitable for processing GST considering involvement of stakeholders as participants of the consortium. Through a permissioned blockchain, authorities can choose stakeholders required in forming the consortium. Processing tax on the blockchain would require high scalability and so block size and block compression options should be considered while planning the architecture. According to the findings and research, this study proposes **DPoS** as a more suitable and scalable consensus mechanism for processing GST. The reason being it prevents computational workload and is currently a highly scalable solution with maximum TPS (Zhang, S., and Lee, J.H., 2020.) Disrupting the entire tax system is not practical and thus

application of blockchain should be done in phases. The first phase of blockchain should be adopted for information sharing about taxes between stakeholders. Forming a strong information exchange channel is very important especially in tax processing as these factors the overall tax processing time. Once the network is established for information exchange and storage the second phase should be executed which focuses on the implementation of smart contracts for processing payments. Agreements or rules to be included in smart contracts should be thoroughly discussed between stakeholders. Smart contracts will automate settlements, returns, Input tax credit without the need for central authorities' intervention this should be done in the second phase. In the third phase once the blockchain is established the authorities can introduce their **tax token or digital currency** for tax which can be used for rewarding the nodes and as a high compliance reward for the taxpayers. This can be developed by the consortium of authorities, regulators, and financial institutions to analyse and develop more blockchain solutions in the future.

6.1. Role of the authorities

1. The authority's role in the adoption of blockchain is important considering their involvement in planning the entire blockchain architecture. Authorities should team up with developers and regulators to work on developing a successful blockchain solution.
2. Analysing and selecting appropriate stakeholders. It is very important to plan about the parties to be involved in the tax collection process. Forming of consortium and governance of consortium which includes voting rights of participants, data access authorization, roles and responsibilities of participants and nodes should be thoroughly examined by the authorities.
3. Blockchain is a nascent technology with limited knowledge authorities should work towards promoting blockchain courses in colleges and universities and develop platforms for developers to work together in forming an efficient blockchain solution.
4. Authorities should consider the interoperability of blockchain while the planning stage. Interoperability of blockchain network makes information from one blockchain be transferred to another blockchain network. This can be made use in the future while adopting blockchain for Direct tax purposes.

6.2. Limitations to the research

Time and resources were limited for this study. The researcher did not encounter many issues to obtain and analyse secondary data, obtaining primary data was a problem for this study. Limitation regarding the sample size has been mentioned before in the study this can be attributed to the ongoing pandemic and busy work schedule of professionals. The researcher found It difficult to contact people in person and hence had to depend on electronics modes to contact potential participants. This limited the sample size of the study and potentially reduced the ability to gather more information allowing more depth in the study. However, this study can help future research to explore current and future technological, environmental, and organizational approaches to blockchain solutions in more detail as these aspects are not thoroughly understood (Clohessy, Treiblmaier, Acton, & Rogers, 2020.)

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APPENDIX 1

Sr no.	Types of consensuses	Blockchain application
1.	Proof of work	Bitcoin, Bitcoin NG, GHOST, SPECTRE
2.	Proof of stake	Ethereum, Ethereum casper
3.	Delegated proof of stake	Bitshare and EOS
4.	Practical Byzantine fault tolerant	Tendermint and Elastico
5.	Hybrid consensus (PBFT+POW)	Byzcoin and Solidus
6.	Proof of authority	VeChain
7.	Proof capacity	Burstcoin

TABLE 3: DIFFERENT CONSENSUS AND THEIR USED EXAMPLES

APPENDIX 2

Layers	Solutions	Applications
Layer 1	Jidar, Bitcoin cash, CUB	Blockdata
	Bitcoin-NG, Snow White	Consensus
	Ominledger, Elastico	Sharding
	Dagcoin, Spectrum	DAG
Layer 2	Pegged sidechain, Plasma	Side-Chain
	Sprites, Raiden network	Payment channel
	Arbitrum, Truebit	Off-chain Computation
	Polkadot, Cosmos	Cross-chain

TABLE 4:EXAMPLES OF SCALABILITY SOLUTIONS

Appendix 3

Participants	Country	Industry	Job-title
Participant 1	Republic of Ireland	Information technology, Blockchain	Senior - Manager
Participant 2	India	Tax	Senior - Manager
Participant 3	Republic of Ireland	Information technology	Developer
Participant 4	India	Information technology	Business analyst
Participant 5	Republic of Ireland	Fintech	Analyst

TABLE 5:SUMMARY DETAILS FOR ALL THE 5 PARTICIPANTS

Appendix 4

Participant Consent Form template

Blockchain and its impact on application of goods and sales tax

Consent to take part in research

- I…… voluntarily agree to participate in this research study.
- I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
- I understand that I can withdraw permission to use data from my interview within two weeks after the interview, in which case the material will be deleted.
- I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.
- I understand that participation involves…[outline briefly in simple terms what participation in your research will involve].
- I understand that I will not benefit directly from participating in this research.
- I agree to my interview being audio-recorded.
- I understand that all information I provide for this study will be treated confidentially.
- I understand that in any report on the results of this research my identity will remain anonymous.
- This will be done by changing my name and disguising any details of my interview which may reveal my identity or the identity of people I speak about.
- I understand that disguised extracts from my interview may be quoted in…[list all forum in which you plan to use the data from the interview: dissertation, conference presentation, published papers etc.].
- I understand that if I inform the researcher that myself or someone else is at risk of harm, they may have to report this to the relevant authorities - they will discuss this with me first but may be required to report with or without my permission.
- I understand that signed consent forms and original audio recordings will be retained in [specify location, security arrangements and who has access to data] until [specific relevant period – for students this will be until the exam board confirms the results of their dissertation].

- I understand that a transcript of my interview in which all identifying information has been removed will be retained for [specific relevant period – for students this will be two years from the date of the exam board].
- I understand that under freedom of information legalization I am entitled to access the information I have provided at any time while it is in storage as specified above.
- I understand that I am free to contact any of the people involved in the research to seek further clarification and information.

Names, degrees, affiliations, and contact details of researchers (and academic supervisors when relevant).

Signature of research participant

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Signature of participant Date

Signature of researcher

I believe the participant is giving informed consent to participate in this study

Signature of researcher Date

Appendix 5

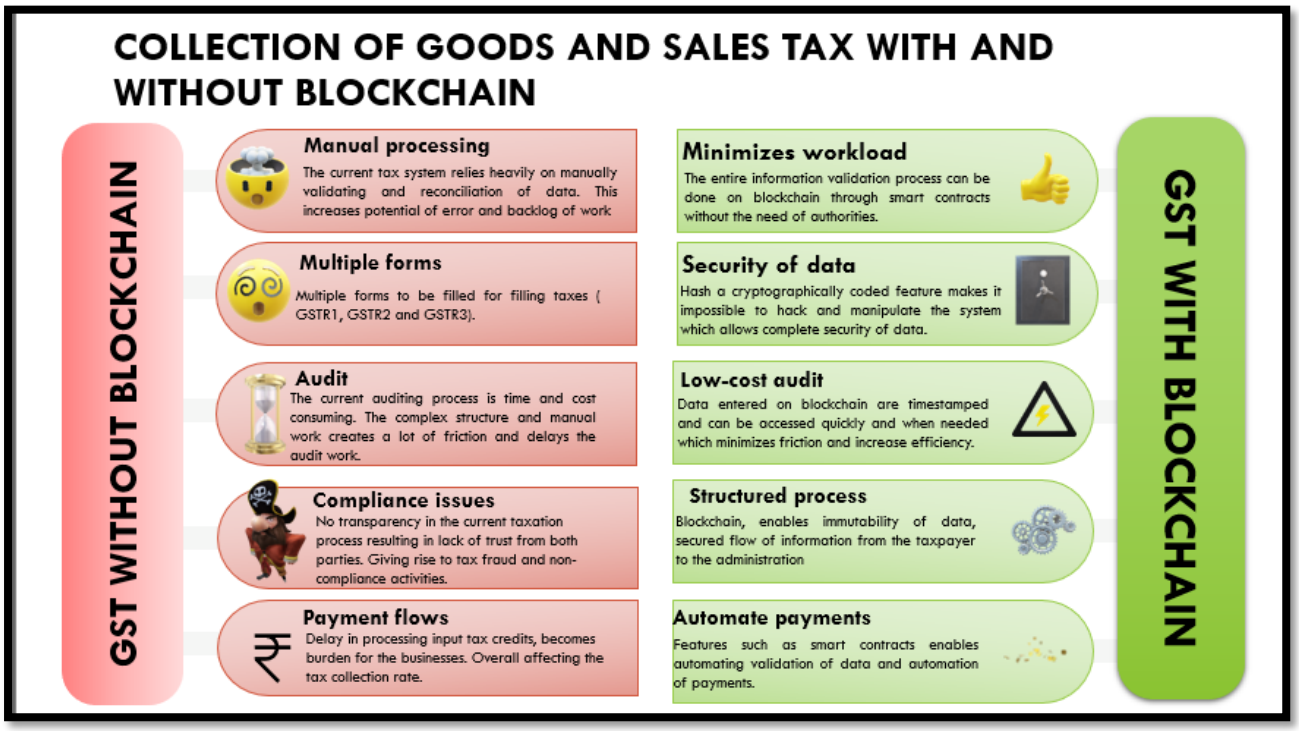

TABLE 6 GST WITH AND WITHOUT BLOCKCHAIN

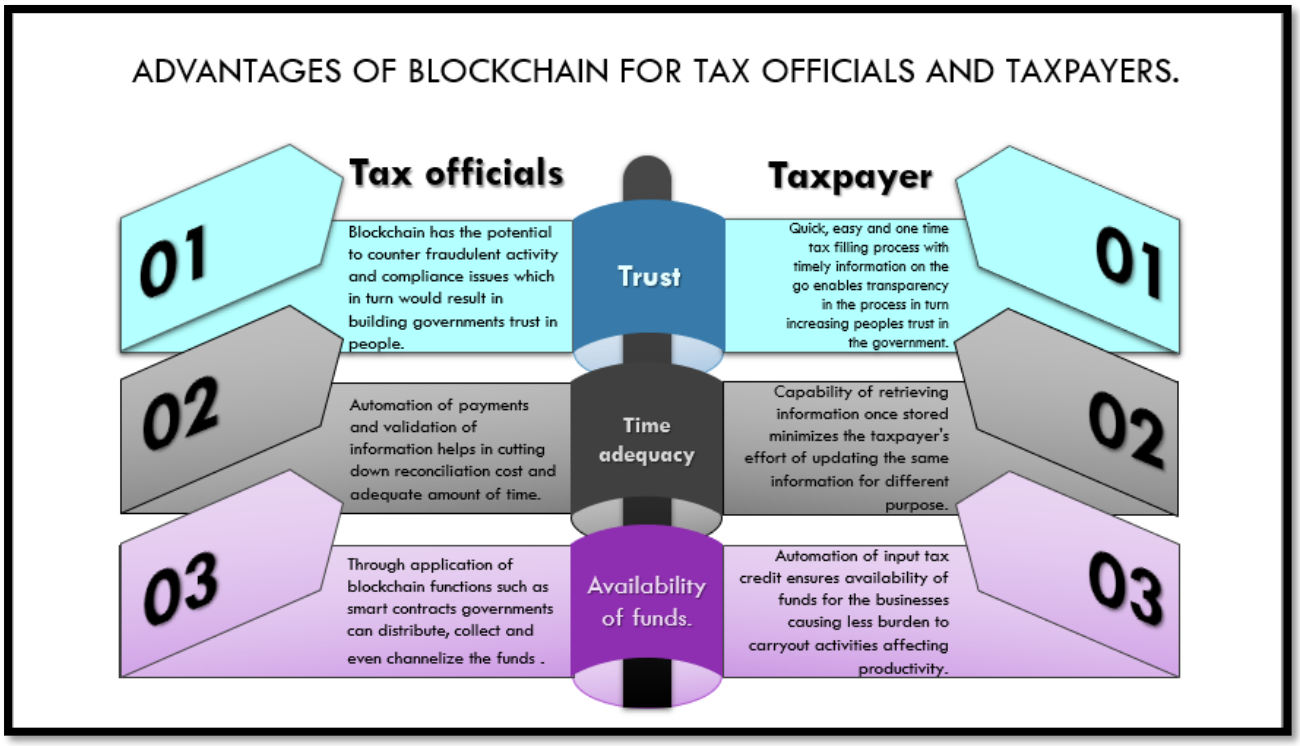

TABLE 7 ADVANTAGES FOR AUTHORITIES AND TAXPAYERS

Appendix 6

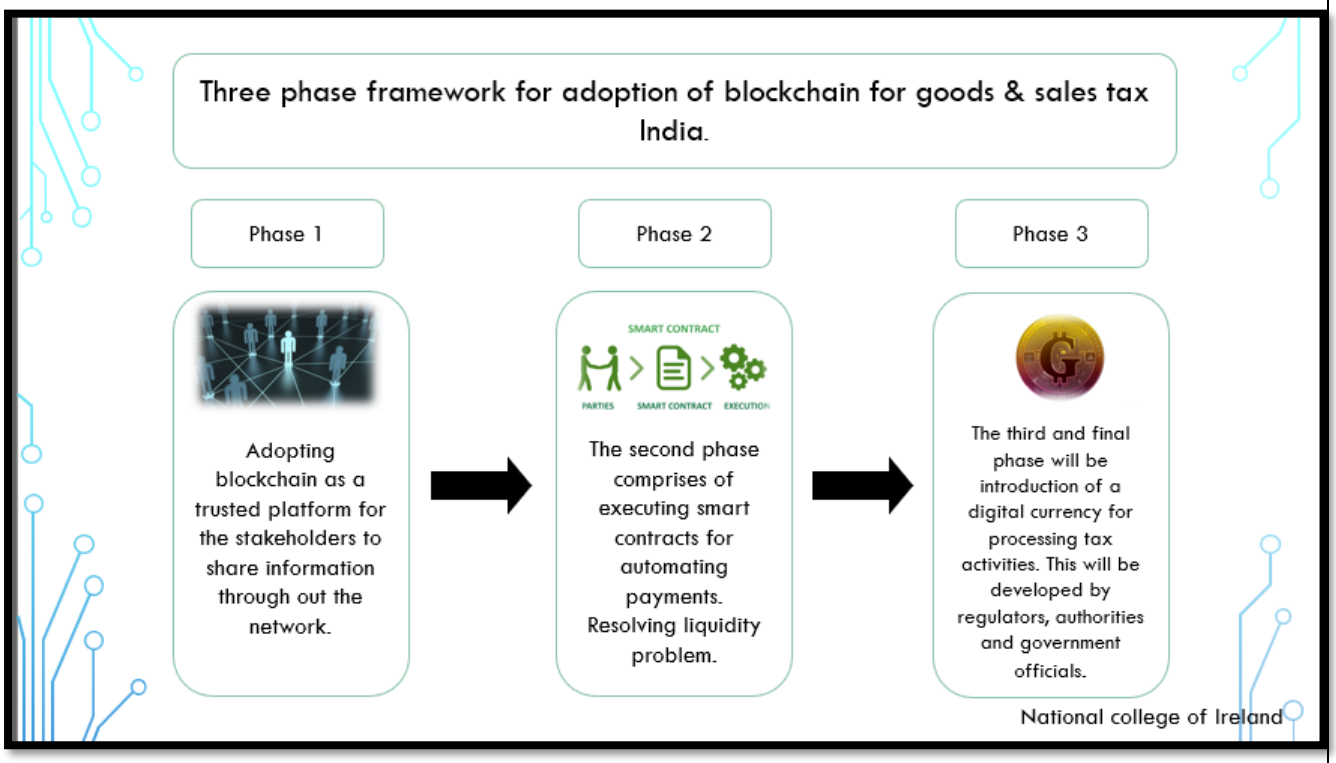

TABLE 8 THREE PHASE FRAMEWORK