

## **Design And Develop Framework for Vital Event Record Management Using Blockchain Technology**

Getachew Biratu\*\*<sup>1</sup>, Abraham Teklu<sup>2</sup>, Moti Girmaw<sup>3</sup>

<sup>1</sup>Information Technology, Assosa University, Assosa, Ethiopia

<sup>2</sup>Computer Networking, Assosa University, Assosa, Ethiopia

<sup>3</sup>Information Technology, Assosa University, Assosa, Ethiopia

Corresponding author email: [getachewbiratu15@gmail.com](mailto:getachewbiratu15@gmail.com)

**ABSTRACT:** *Blockchain technology has an emerging and revolutionary technology nowadays, in world. This emerging technology is applied in different studies to resolve problems and challenges like vital event record management. The Vital event record is the continuous, permanent record of the happening and characteristics of the vital event like a birth, marriage, and death events of an individual. The record of the event needs technology that records the event permanently that achieve decentralization and distribution. As the development of digital technology is created a new falsification/copy of vital event record in developing countries. This falsification of the document in the governmental and private organizations is a critical challenge in Ethiopia. To solve such problems and challenges the present vital event record to convert to other digital technology that improves the integrity, availability, and security issues of the vital event record. Therefore, in this thesis, we proposed vital event record management framework using blockchain technology. This research study is used to design science methodology to solve the problems and challenges. To design and develop the framework for vital event record management we used the Hyperledger Fabric blockchain technology. The finding will a fundamental inference for policymakers, researchers, and students in the area.*

**Key Word:** *Blockchain, Vital event record, Hyperledger Fabric, Framework*

### **INTRODUCTION**

Blockchain is a powerful and distributed technology platform for the transaction which require a unified, resilient, transparent, and consensus-based record-keeping system(Gao et al., 2018). The Blockchain is known to be the distributed public ledger for all transactions, eliminating the need for trust between the user and central administrator and the control is distributed among different computer/nodes in a P2P network. Moreover, the blockchain resolved the double-spend problem

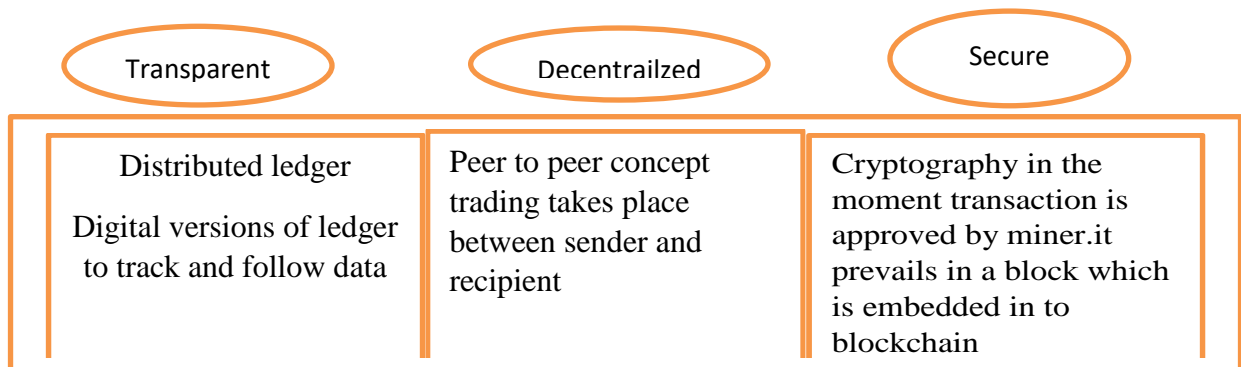
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\* Corresponding Author: Getachew Biratu  
Email: [getachewbiratu15@gmail.com](mailto:getachewbiratu15@gmail.com)

using P2P technology in combination with public/private key cryptography(I. Karamitsos, apadaki, Maria, Al Barghuthi, Nedaa Baker, 2018; I. Karamitsos, Papadaki, & Al Barghuthi, 2018).

Blockchain is different from other computing technologies in many ways, but the pillar ideology is how the transaction is validated, how a new block is added to an existing chain, how the decision is made, and the characters of the data in the blockchain. Valid transaction decisions are made by consensus agreement of most participants in the process(Bessa, 2019).

According to (Casino, 2019)blockchain-enabled applications across various areas such as supply chain, business, healthcare, IoT, privacy, and data management, and we establish key themes, trends, and emerging areas for research. Blockchain technology depends on three major pillars those are consensus, distributed, and trustless and all users running blockchain software are nodes that have identical ledger transactions copy and also have done all transactions will be visible or accessible to all nodes in the network at all times. The basic advantages of blockchain are reducing the intermediate for any types of transaction to record or centrally managing replaces with decentralized, eliminating data duplication, recording or getting multiple certificates for individual, improving transparency of data recording, increasing performance sharing information and reduced recorded cost, keep security and privacy of data of individual information, access the important information at the real-time also increase. To solve such issues, technology-based vital event record management can be used to address security, decentralized, and distribution of vital event records management.



**Figure-1: Basic characteristics of the blockchain (Tijan, 2019)**

According to (Tayyem, 2015) and (P. Lemieux, 2013) the innovation of blockchain technology is credited to a person or group of people under the name of Satoshi Nakamoto. Although this name is linked to the creation of blockchain, a creative invention, not much is known about its real identity about Satoshi Nakamoto.

**2. STATEMENT OF THE PROBLEM**

Vital event registration or certificate issuing is most significant to measure and monitors the influence of sustainable growth and deciding. Ethiopia has one of the low-income countries within the world and has low vital registration like birth, marriage, and death rate. The vital event record exists in a most developing country, including Ethiopia nowadays has not supported by technology, mostly the registration is predicated on paper for issuing certificates and also the ways of record system is different from place to place and mostly recorded by the hospital, church, Kebele based on the request of the individual and Vital event registration agency. The lack of emerging technology in Ethiopia's vital event record falsification and loss of vital event information is the issue and challenge in a most developing country. Most of the vital event records or civil registration in the developing country include our country is based on a paper that vital event is not visible that much computer-based. Due to centralize, manage data at one specific place or organization anyone has accessed more than one certificate when moving from place to place and data or information loss opportunity due to only have managed data at specific organizations. Most population in our country has no idea toward vital event records due to a lack of understanding of its importance.

The absence of a uniform and computerized vital registration in Ethiopia cause to have multiple identities, anonymity, and invisible birth registration, marriage, death cause for inefficiency in strategic planning for good governance. The cause of an unrecorded event is difficult to identify individuals during criminal occur and challenge for the government to address different services like health, education, and so on. The unregistered vital event is difficult to identify the childbirth

record that is the main cause of harmful traditional practices like child marriage and child labor. The other vital event is a case of corruption that one family having twice getting serviced as an individual means wife and husband access service as a single person from one family like land because of the vital event in Ethiopia nowadays is recorded manually and lack of transparency. Even a single person having multiple certificates from different places and getting double service from a single organization and different organization. To solve the problems that raises above decentralized data management has geographic independence, reduces data loss, and increases the accessibility of information or data.

### **Research Questions**

- What is the key component, including designing blockchain in digitizing vital event recording?
- How blockchain technology is design framework for storing digital certificates for a vital events?
- How to implement blockchain technology in the vital event certificate issuing process?

### **3. RELATED WORK**

A blockchain is a distributed database of records or a ledger of transactions and digital events that are shared among all the users connected with it(Rizwan, 2019). The researchers work on the blockchain to record academic information about students using Multichain that stored full information of students with full information about the academic result. The table below shows blockchain-based student academic information and university information are stored on the blockchain with Multichain blockchain.

According to (V. L. Lemieux, 2016) Identity records, like birth certificates, passports, drivers' licenses, and marriage certificates are amongst the most relied upon records the common Canadian will use all over his or her lifetime. Numbers of blockchain startups have proposed solutions to put these records on the blockchain to ensure their integrity. But the identity records are mostly centralized systems or manual that based on the request of individual need and the research proposed blockchain framework for vital event record storing and certificate issuing for an event

listed above. Civil registration systems, land title management systems, and health records systems are computerized with the usage of centralized, decentralized, and cloud database solutions in many countries(Deshapriya, 2017).

Birth is the complete throwing out or separation from its mother of a product of beginning. Marriage is the act of ceremony or process in which the relationship of partners is established by civil, religious, and became recognized by law, according to the rule and regulations of the country (UN, 2018).

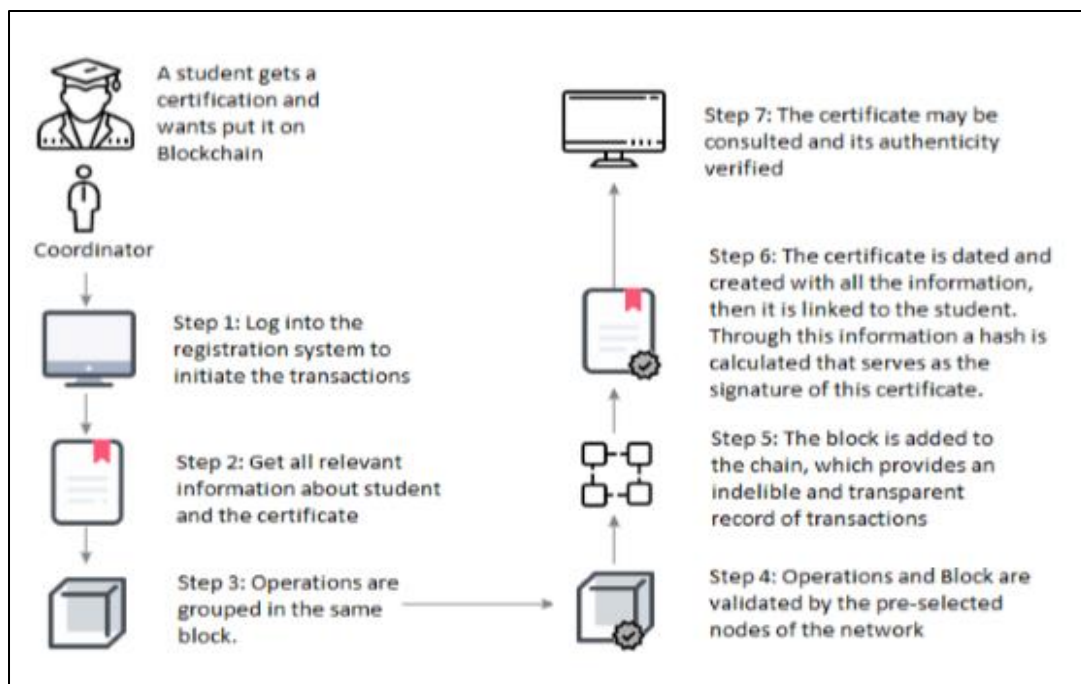
**Table 1: percentage of birth that unrecorded across world regions (UNICEF, 2005)**

Regions	Percentage of birth that is not recorded across the world.
South Asia	63%
Sub- Saharan Africa	55%
Eastern Europe, the Commonwealth of eastern independent states, and Baltic states.	23%
East Asia and Pacific region	19%
The middle east and north Africa.	16%
Latin America and the Caribbean	15%
Industrialized countries	2%

Blockchain as one of the emerging recent technology with its characteristics such as trust, transparency, immutability, self-sovereignty, and provenance offer alternative solutions to different problems in different industries(Lushi, 2018). According to researchers, blockchain could be used by higher education institutions, as from an EU (European Union) study identified, are award of a qualification, licensing and accreditation, management of student records, intellectual property management and payment using the new technology of blockchain.

Blockchain is a distributed database that is naturally resistant to attack and fraud. The blockchain is a peer-to-peer network of information technology that keeps records of Digital asset transactions using distributed ledgers that are free from control by Intermediaries such as banks and governments(Min, 2019). Blockchain is the new decentralized protocol for the recording of transactions and asset ownership.

According to(Bessa, 2019), a blockchain-based Educational Record Repository was implemented to manage and distribute educational assets for academic and industry professionals. According to the researchers, the blockchain is used to store files, documents, and other material related to the academic history of students or professionals. The problem identifies by the researchers is the loss of educational assets due to different reasons. To solve the physical or other problem with loss of educational asset like certificates of diploma the researcher use blockchain to store educational certificates using Hyperledger Composer. A blockchain is designed to be accessed across a peer-to-peer network, each node/peer then communicates with other nodes for block and transaction exchange(Barnes, 2016). Once the node in the network is connected to the peer sends messages to each other without Intimidator. According to the researchers, the purpose of a node within the network is to validate an unconfirmed transaction and recently mined blocks, before a new node can start to do the initial block download.



**Figure 2: “Certificate Register creation in BcER” (Bessa, 2019)**

## 4. METHODOLOGY

The main aim of this chapter was to design the framework based on the problems and evaluate the design artifact. In order to finalize the study we use the following ways.

### 4.1. RESEARCH DESIGN.

To achieve the objective, we selected the design science paradigm to solve the research problem identified by researchers in the proposal phase and design framework for the problem according to the objective and evaluating the design framework. The design framework is evaluated qualitatively based on the possibility of deleting or changing a record in the blockchain, tracking the history of records, accessibility, providing the ability and maintaining the privacy of records.

### 4.2 STUDY SETTING

The study was done in Ethiopia citizens that provide a digital vital event for access information easily and to securely managing the citizen information in distributed and decentralized. Most of the interviews, document reviews and document observation are performed in Assosa VERA

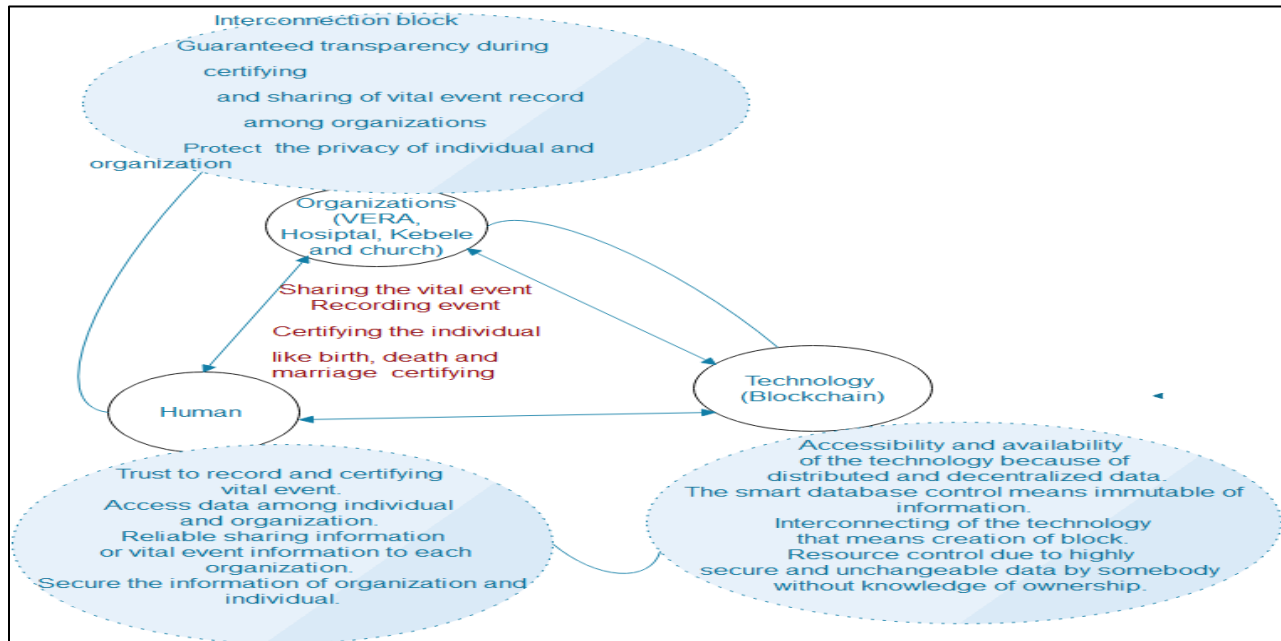
branch to understand the current problem and find the solution for the problem observed during data collection.

### 4.3 STUDY POPULATION

The different population was used for the study this thesis those include the employee in the hospital. Kebele leader and employee in VERA to understand the information flow in the vital event registration and certificate issuing, the problem of current in the study area, and finding a solution for the problem.

### 4.4 CONCEPTUAL FRAMEWORK

The following conceptual framework figure was adopted from the research paper that worked for smart city blockchain-based sharing service that includes three basic actors are an organization, technology, and people.

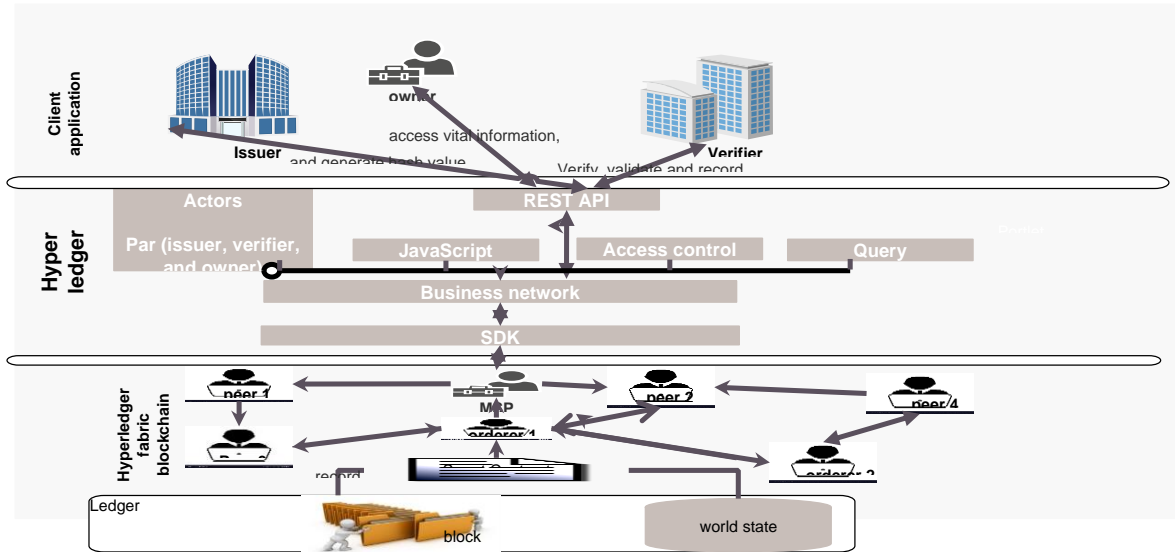


**Figure 3 Conceptual framework for vital event record management**

The vital event record management contains organization, human and technology have interrelation to each other and the three basic factors used in this research work. The organization is the agent who performs vital event records and certificate issued those organizations are VERA,



Hospital, Kebele and church and those organizations perform the record of the vital event according to their own rule.



**Figure 4: The proposed Framework for vital event record management**

#### 4.5 SAMPLING DESIGN

There are two basic varieties of sampling techniques that are used for choosing the sample for the research study those are the probability and non-probability sampling method. The probability sample method isn't used/suitable for qualitative research studies because it is not used for generalization of the result (Mohajan, 2017) and non-probability based on the personal decision of researcher that chance of choosing the sampling element for study. During this study, we used a purposive sampling method for collecting data using a different data collection method from VERA to now the activity of the organization.

**Table 3: population sample size**

<b>Organizations</b>	<b>No. of organizations selected</b>	<b>Name of Organizations selected</b>	<b>No. of respondents (interviewee) selected</b>

VERA	2	Vital event registration agency assosa branch and federal office.	2
Hospital (health org)	2	Assosa general hospital and primary health	2
Worda	2	Assosa worda one and two	4
Kebele	2	Kebele assosa worda 1 and 2	2
Church	2	Two church	2
Expert on the technology	1	From assosa university	3
Total	11		15

**Table 4: summarized feature-based suitability assessment of Blockchain**

Metrics	Public Blockchain	Private Blockchain	Consortium Blockchain
Access	Read/write for anyone	Read/write for a single organization	Read /write for multiple select organization
Transaction speed	Slower	Lighter and faster	Lighter and faster
Efficiency	Low	High	Higher

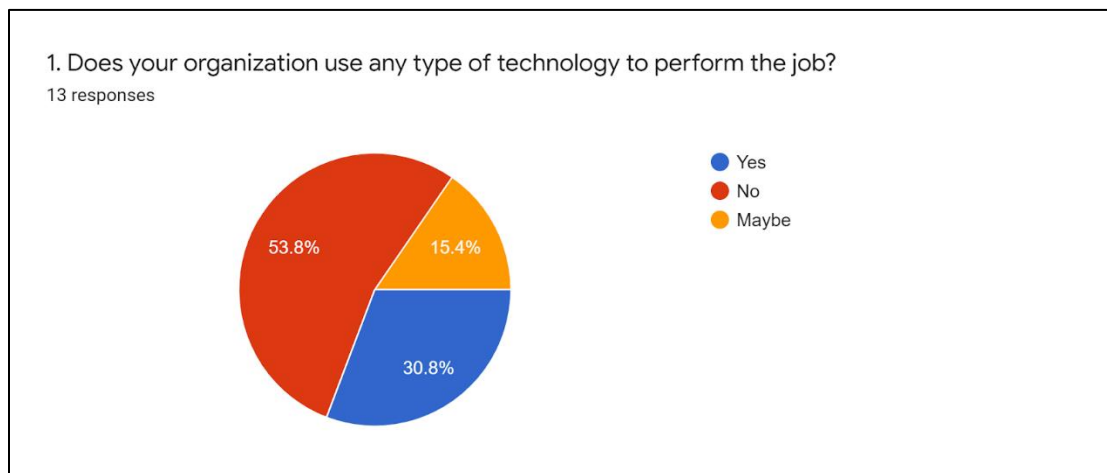
Security	Proof of work, proof of stack and other consensus algorithm	Pre-approved participant and vote multiparty consensus	Pre-approved participant and vote multiparty consensus
Immutability	Nearly impossible to temper	Could be temper	Could be tempered but participants are listed and know
Trust	Less trusted	More trusted	Most trusted
Anonymity	More anonymity	Less anonymity	Batter anonymity than the other
Consensus process	Permission-less and anonymity	Permissioned and know identities	Permissioned and know identities
Network	Decentralized	Partially Decentralized	Partially Decentralized
Asset	Native asset	Any asset	Any asset
Cost	High	Low	Low
Transaction approval frequency	Long (Bitcoin 10 min or more)	Short (100ms)	Short (100ms)
Example	Bitcoin, Ethereum	Ripple, Multichain	Hyperledger

In this study Consortium types of Blockchain are selected to design the proposed framework due to different features and advantages that best for this study over another blockchain category. The following list is the advantage of Consortium types of the blockchain(Abulzahad, 2017).

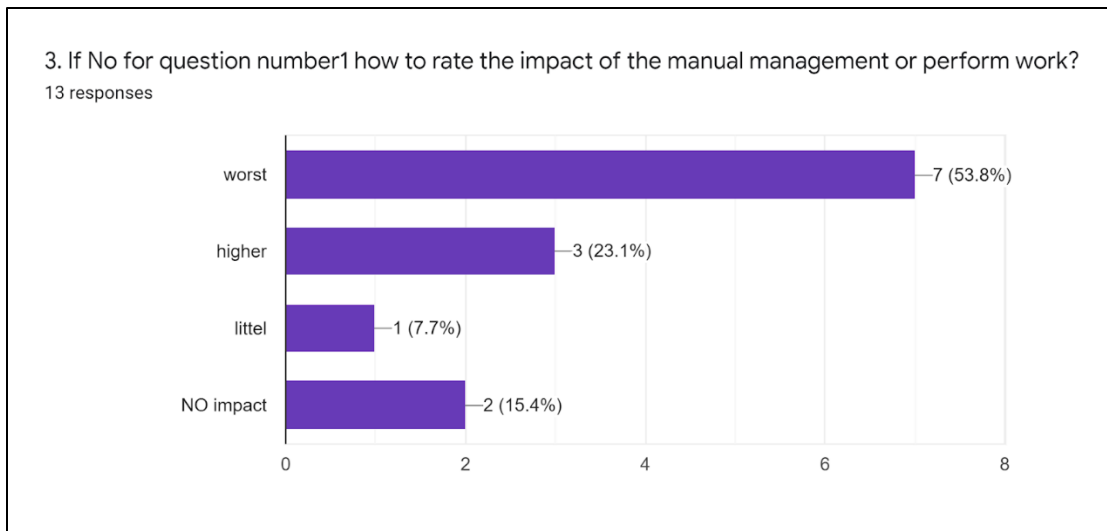
**Table 5: Summarized feature-based suitability assessment of Blockchain technology**

<b>Metrics</b>	<b>Bitcoin</b>	<b>Ethereum</b>	<b>Hyperledger fabrics</b>	<b>Multichain</b>
Purpose	Cryptocurrency	General-purpose	For the industry use case	For creating your blockchain
Popularity	Very high	High	High	Medium
Governance	Public	Ethereum, developer	Linux foundation	N/A
Types of data stored	Cryptocurrency transaction	Cryptocurrency digital asset smart contract	Any digital asset and smart contract	Any digital asset
Block release time	10 minutes	12-15 sec	N/A	configurable
Transaction rate	3.5-7 TPS	5.40TPS	3500TPS	1000TPS
Transaction cost	Must be paid	Must be paid	No fee	Must be paid
Privacy	No	No	Yes	Yes
Open-source	Yes	Yes	Yes	Yes
Blockchain type	Public	Public	consortium	Private
Mode of operation	Permission-less	Permission-less	Permissioned	Permissioned

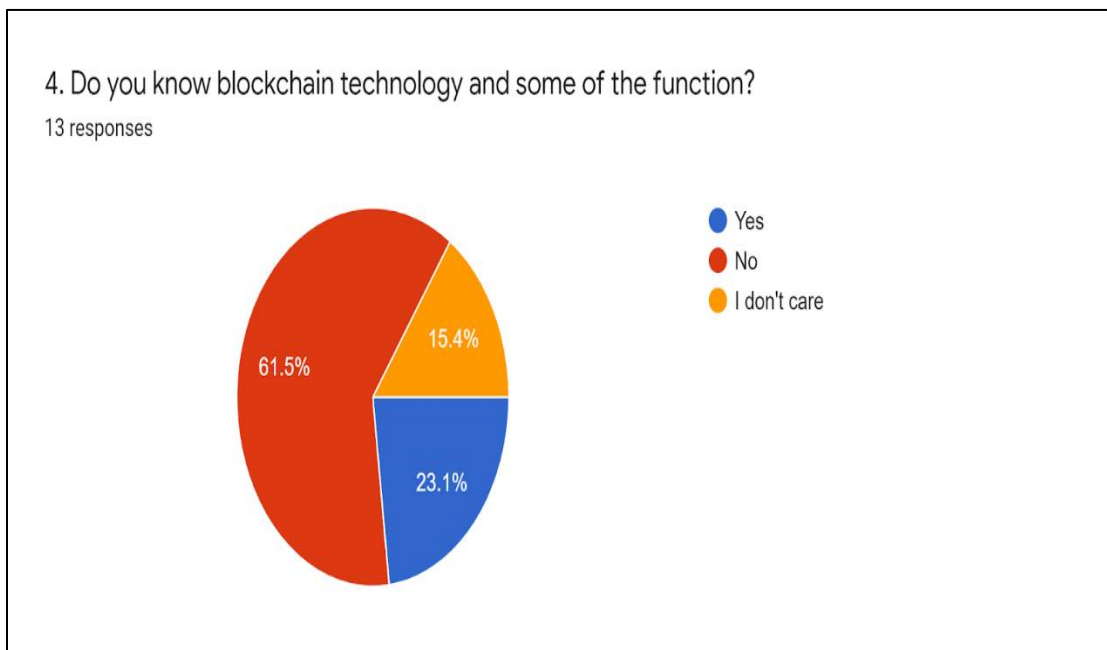
Currency	Bitcoin	Ether	None	N/A
Protocol	POW	POW,POS	pluggable(PBFT)	POW
Scalability	Less scalable	Less scalable	More scalable	Scalable
Power consumption	High	High	Less	Medium
Supported language	C++	Python, go, java and C++	Go, Java and JavaScript	Python, PHP



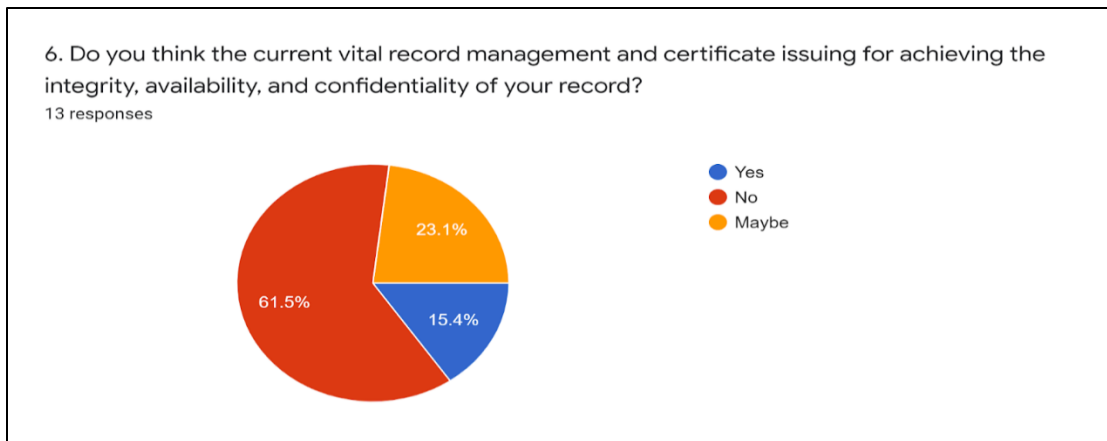
**Figure 6 responses summary of the availability of technology**



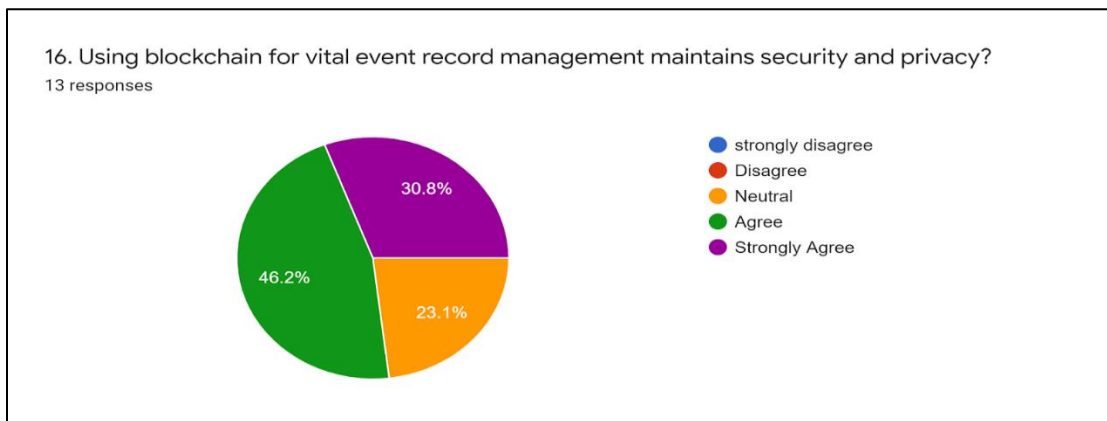
**Figure 7 response summery work with the manual.**



**Figure 8 response summary for know the blockchain technology**



**Figure 9: response summary of the current record management**



**Figure 10: response summary blockchain achieving security issue.**

## 5. RESULT DISCUSSION

The proposed framework with Hyperledger fabric consists of three basic components those are Client Application, Hyperledger composer, and Hyperledger fabric layer, and based the addressed method we get the following results.

### 5.1 APPLICATION PROGRAM INTERFACE.

After Hyperledger composer installed on the Hyperledger Fabric, the other external client cooperates with Hyperledger composer to see the content through the composer rest server that generated a loopback to communicate to the client application.

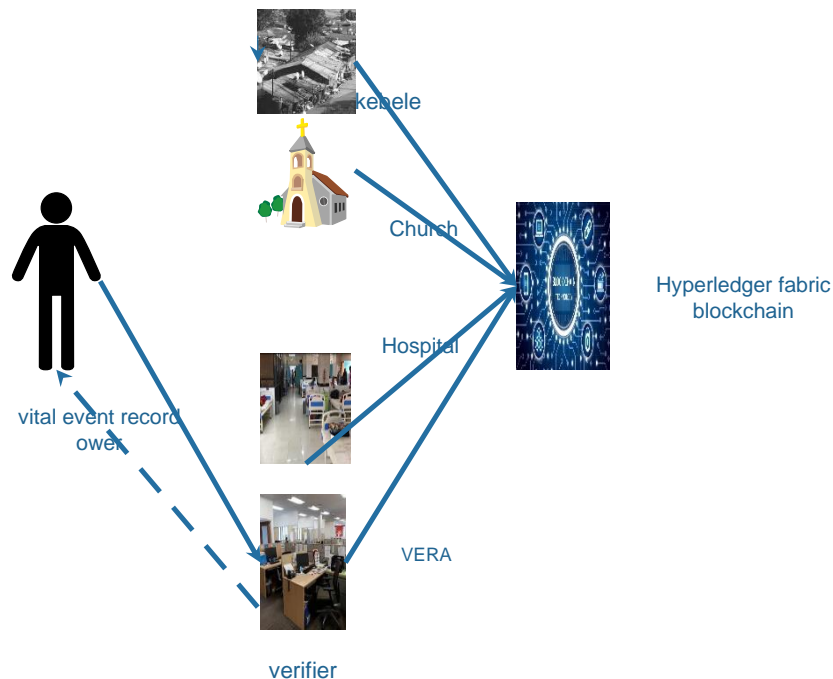
## 5.2 SOFTWARE DEVELOPMENT KIT

SDK stands for software development kit that allows the client application connected to the peer for querying or updating vital event records or the ledger by performing the smart contract.

### 5.2.1 THE MEMBERSHIP SERVICE PROVIDER (MSP).

MSP is the rule that governs the identities of the participant in the network and that ensure the communication several networks are secure and the ledger on the blockchain is properly authenticated. The MSP is used to identify the member of network participant identities who have accepted to the network has access to the network and issue or verified the vital event record (certificate) and from the participant who has no membership that has not issued or verify the event or certificate. The process of vital event record management and certifying the individual.

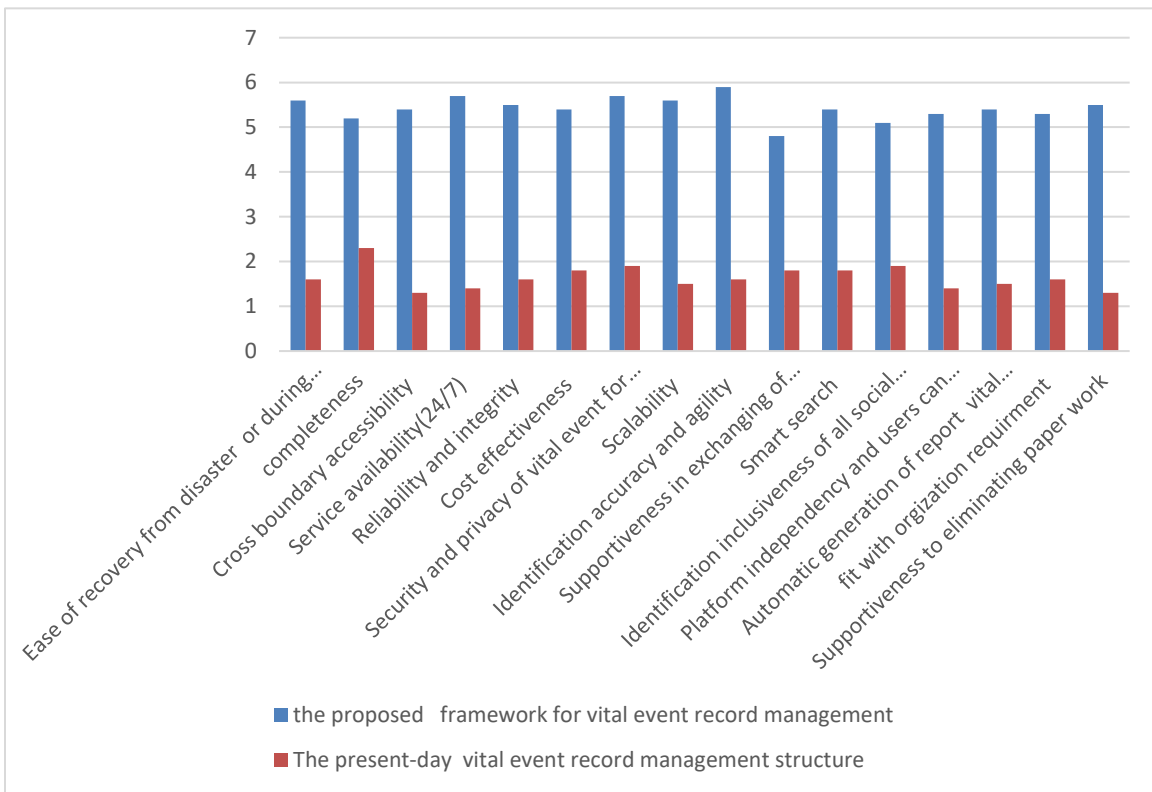
The process of issuing vital event certificates and record management in the proposed framework show as follows in the next figure.



**Figure 11: the process of vital event document certification process**



To validate the proposed framework for vital event records using blockchain through acceptance 12 participants are involved. For this thesis purposive sampling technique to choose the participant in the validation process. During the selection of participants knowledge is considered in the domain are of the studied like blockchain. The participants understand the proposed framework for the vital event before started the validation process. This validation is compared to the traditional vital event record management practice with the new proposed framework based on the acceptance of the user based on a parameter selected by the researcher.



**Figure 12 Validation and Acceptance of the proposed framework for vital event records**

## 6. CONCLUSION

Primarily this thesis work aim was to identify the issue, challenge, and difficulties of the current vital event record management practices and verification process in Ethiopia from the selected organization. The result of the investigation of the organization indicated that there is a lot of issues and challenges in the organization to manage vital event information through existing ways to storing and verifying in Ethiopia in the general and different governmental and non-governmental


organization are surveyed to understand the existing practices of vital event records management like hospitals. The recommendations for future research are full implementation and evolution of the framework in the organization with similar work and evolution of the performance of the blockchain in vital event record management organization.


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**Author Profile:**

	<p><b>Getachew Biratu</b>, Is a former lecturer of Assosa University, with having of Bachelor of Science in Information technology from Ambo University and Masters of Science from Bahrdar University/Bahrdar Institutes of Technology. Getachew participates on different project development specially Desktop and Web based application and deliver Community Service voluntary for Illiterate society in Assosa Town, and His research interest is blockchain, Distributed System, Data Base Management System.</p>
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	<p><b>Abraham Teklu</b>, Lecturer, researcher and project developer In Assosa University, Ethiopia for more than 8 years. He awards in Information Technology from Debre Berhan University and Mater of Science by thesis in Computer network from Jimma University, Jimma Institutes of Technology. Abraham's research interest is MANET, VANET, Underwater wireless sensor network, Network security.</p>
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	<p><b>Moti Girmaw</b> a Lecturer, In Assosa University, Ethiopia for more than 5 years. He awards in Information Technology from Ambo University and Masters of Science in Information Technology from Arba Minch University. Moti research interest is blockchain, Cloud Computing, Data Base management System. He develops Database management tool for Assosa Police Zone that manages employees' data.</p>
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