Original Article

The Potential of Blockchain Technology for Occupational Safety and Health Management System

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ABSTRACT: *Industries in Malaysia are entering a period of major disruption caused by new technologies such as Artificial Intelligent, Robotics, Blockchain, Nanotechnology as well as Building Information Modelling (BIM) and the Internet of Things (IoT). In this fourth industrial revolution where information is generated and exchanged at a rapid and huge scale, its reliability is of paramount importance. The success of Occupational Safety & Health Management System (OSHMS) is highly dependent on the reliability of the information gathered and used, where a large number of intermediaries authenticate the information to establish trust between the stakeholders. Blockchain technology is able to do verification by virtue of secured distributed storage brings about a paradigm shift in the way we establish trust. This paper gives an overview of the potential use of Blockchain technology for Occupational Safety & Health Management System. The discussions focused on the benefits and challenges of implementing the Blockchain technology in OSHMS. The conclusion is drawn based on the strength in the characteristics provided by the Blockchain technology itself.*

Keywords – *Blockchain, Industry 4.0, Information System, Occupational Safety & Health Management System (OSHMS)*

1.0 INTRODUCTION

Industries in Malaysia are entering a period of major disruption caused by new technologies such as Artificial Intelligent, Robotics, Blockchain, Nanotechnology as well as Building Information Modelling (BIM) and the Internet of Things (IoT). In this fourth industrial revolution where information is generated and exchanged at a rapid and huge scale, its reliability is of paramount importance. The World Economic Forum (WEF) has highlighted that this revolution will have various impact on businesses, governments and individuals in driving the competitiveness and improving the quality of life of people (MiGHT, 2018). It also reported that a lot of initiatives have been taken by the government to adopt the Internet of Things and Artificial Technologies to prepare for the inevitable fourth industrial revolution. For example, an integration of information and communication technology (ICT) and smart policies for implementing smart cities vision. Both governments and private organizations need to collaborate for the future plan and have an insight into any changes that can occur all over the world.

In order to elevate the competitiveness of the country, Malaysia is looking at digital technologies and the way to interact with each other by increasing interest in this new technologies. Blockchain technology has been identified as a new enabler for the country in the private and public setting. In addition, it benefits the industries by offering trusted recordkeeping, shared trusted processes, improve discoverability and reduce costs and complexity. This paper discusses about blockchain technology which have several characteristics that could potentially be applied in the Occupational Safety and Health Management System (OSHMS).

2.0 BLOCKCHAIN TECHNOLOGY

Blockchain began to emerge in the public as one of the underlying technologies for the first cryptocurrency created as a counter model to the centralised authority (MiGHT, 2018). Technically, blockchain is a form of distributed ledger that stores information across multiple systems securely to empower any peer-to-peer transactions by creating intermediaries of trust. Blockchain is one of the most recent technology that is able to do verification by virtue of secured distributed storage that brings about a paradigm shift in the way we establish trust. Blockchain can be designed for different purposes such as automotive, financial services, healthcare and many others. Access to the blockchain platform is determined by the design of the platform whether it is a public or permissioned blockchain whereby the latter sets a specific requirement for participants to access. The important characteristics of blockchain architecture are as follows:

2.1 The blockchain platform

The core application of blockchain is a transaction database modelled as a secure ledger that is shared by all nodes or users of the blockchain system which acts as a highly transparent ledger. Transactions generally consist of a recipient address, a sender address, and a value (Pluralsight, 2017). A transaction changes the state of the agreed-correct blockchain that all nodes independently hold their own copy of the blockchain. New transactions are distributed throughout the network and independently verified and processes by each node. The movement of data within any blockchain architecture is established. Transactions contain one or more inputs and outputs. An input always references a previous transaction's output which allows for an uninterrupted, verifiable stream of values amongst addresses. The integrity and chronological order of the transactions are enforced by strong cryptographic rules.

2.2 Nodes in the blockchain

A blockchain system consists of a number of nodes and each node has a local copy of a ledger that belong to different users. As part of the network, the function of nodes is different which refer to their business intention. The nodes communicate with each other in order to gain agreement on the contents of the ledger and they do not require a central authority to coordinate and validate transactions (Technolab, 2018). As a trusted third party, all nodes maintains a fully replicated copy of a database in the blockchain system.

2.3 Network protocol

In blockchain technology, consensus protocols are one of the key elements and revolutionary features of the technology. These protocols create an irrefutable system of agreement between various devices across a distributed network, whilst preventing exploitation of the system (LISK, 2018). Consensus rules are considered for validating block and transaction within the network. The main requirement to achieve a consensus is an undisputed acceptance between nodes on the network. Consensus protocols are designed to be difficult to replicate by being extremely costly to carry out as a result of time, the requirement of computing resources required and the holdings of a particular cryptocurrency (LISK, 2018). The consensus method varies based on the validation of the block and forms of consensus. The effectiveness and efficiency of blockchain to function and exist relies on the consensus protocol. As a result, the information that is being stored is authentic and precise.

2.4 Transaction and Block

Both transactions and blocks are two types of blockchain implementation records. Transaction comprise the actual business data to be deposited in the blockchain while blocks record the sequence of transactions in the blockchain. Subsequently, the transaction is generated and pressed into the blockchain node network. This will be captured by a miner node to check and determine that the transaction is legitimate and served into a cryptographic hash function as represented to generate a unique string of digits and vitally combine them with other transactions. The generated hash is then stored with other metadata into a block. The block becomes the basis for running the hash function again to create a subdivision block.

3.0 BLOCKCHAIN CHARACTERISTICS

There are four fundamental characteristics of blockchain (Pattison, 2017) that causes it to be distinct and more transformative. The key characteristics is illustrated in Fig. 1 and explain as follows:

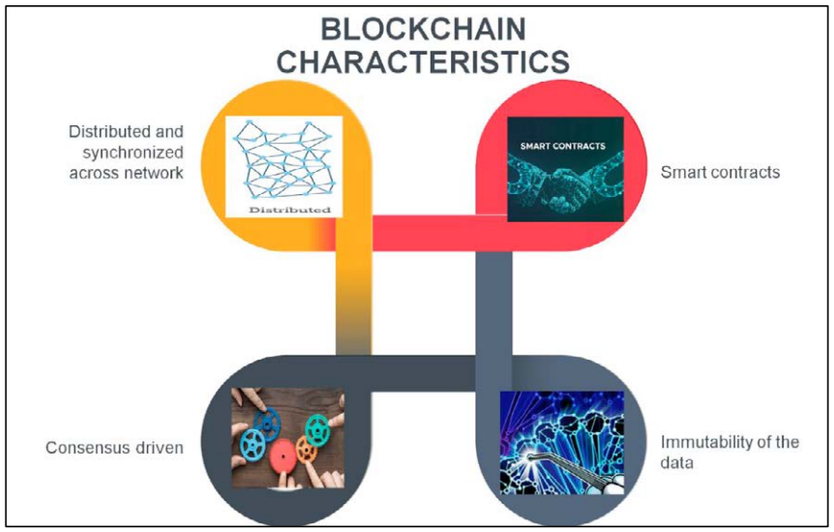

Figure 1 The Key Characteristics of Blockchain

3.1 Distributed and synchronized across networks

Blockchain is designed to be distributed and synchronized across networks which creates an ideal business network for multi-organizations. It also encourages organizations to share data.

3.2 Smart contracts

A smart contract is a software program that adds layers of information onto digital transactions being executed on a blockchain that allows for more complex transactions. In other words, it is an agreement between parties involved in a transaction that holds each party responsible for their role.

3.3 Consensus driven

Consensus is a process which needs an agreement between all relevant parties to validate any transaction before the execution of transaction. This will help to preserve erroneous or potentially fraudulent transactions out of the database.

3.4 Immutability of the data

Once a transaction is endorsed by relevant participants, it can never be changed and serves as a final record of transaction. If a user wants to change the chain, an effort is needed which is computationally hard and expensive. This secures the blockchain and establishes trust independent of a central authority which gives the idea of provenance of data.

Therefore, based on the key characteristics of the blockchain technology, these are the four main characteristics that are able to provide organizations with a high degree of trust in the data and the business network. The level of trust is very crucial for long term business applications specifically in Occupational Safety and Health Management System (OSHMS).

4.0 OCCUPATIONAL SAFETY AND HEALTH MANAGEMENT SYSTEM

Occupational Safety and Health Management System (OSHMS) is a coordinated and systematic approach to manage health and safety risk. The OSHMS consist of five main elements which are policy, organizing, planning and implementation, evaluation as well as action for improvement (ILO, 2011) as shown in Fig. 2. These elements are interrelate and interact with each other to establish and implement Occupational Safety and Health (OSH) policy and objectives for achieving organization's goals.

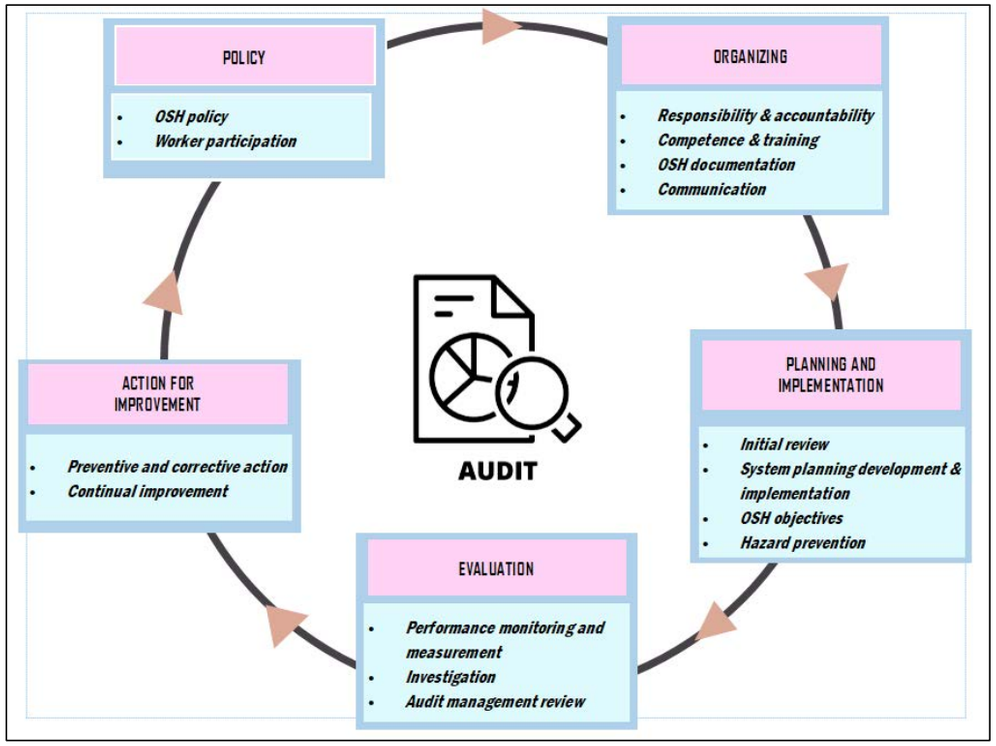

Figure 2 The OSHMS Continual Improvement Cycle (ILO, 2011)

The management systems' approach brings a number of important advantages to the implementation of OSH such as integrating and harmonizing OSH requirement, providing a logical framework for tracking action and monitoring, establishing an environment conducive in the working area and provide an auditable baseline for performance evaluation. A systems' approach also adjusts the overall safety and health programme over time which improves increasingly in decision making on hazard control and risk reduction. On the other hand, there are few limitations in the OSHMS which potentially lead to some serious problems and needs to be avoided for ensuring the effectiveness of the system.

The effectiveness of the OSHMS is depend on the size of the organization that requires to set up the system. Traditionally, organizations have documented and recorded transactions in ledgers kept under lock and key. Those ledgers are typically isolated to protect their accuracy and sanctity. Upon conducting business, each organization maintains its own separate record to independently verify information. This process has an impact on the performance of the OSHMS among organizations. By considering reliability, traceability and transparency of all data and information, a digital distributed transaction ledger is highly recommended and it should be included in the OSHMS for mitigating current organizational limitations.

5.0 THE POTENTIAL OF BLOCKCHAIN TECHNOLOGY FOR OCCUPATIONAL SAFETY AND HEALTH MANAGEMENT SYSTEM

Blockchain technology has potential to mitigate current organizational limitations in implementing an effective OSHMS. Based on the key characteristics of blockchain technology, several benefits such as reliability, data security, accuracy and cost savings can be accumulated in the OSHMS. There is one essential element that is still challenging in the OSHMS which relates to trust. Everyone trusts the old system with its inherent faults and may even be deeply vested in mitigating those faults. As a secured and trusted digital ledger, blockchain technology will store all data over democratised network and all information are secured using cryptography with identical copies maintained on multiple computer systems controlled by different blocks. Hence, any mistakes are easily verifiable. Only pertinent information is shared while the rest remains encrypted and inaccessible. As a result, immutable information makes the blockchain a tool of disintermediation. The same or greater level of trust must be demonstrated and maintained in any new system in order to be adopted and lead to commercial success. In addition, any information available in the organization will be increased and opens up the prospect for moving to lead based measures such as exposure to critical risks.

6.0 CONCLUSION

The success of Occupational Safety & Health Management System (OSHMS) is highly dependent on the reliability of the information gathered and used, where a large number of intermediaries that authenticate the information to establish trust between the stakeholders. Blockchain technology is able to execute verification by virtue of secured distributed storage. This brings about a paradigm shift in the way we establish trust and this technology is recommended to be included in the OSHMS to mitigate current organizational limitations on data management.

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