VISVESVARAYA TECHNOLOGICAL UNIVERSITY
Belgaum, Karnataka

ST JOSEPH ENGINEERING COLLEGE
MANGALORE

Department of Mechanical Engineering

Seminar on
"Blockchain Technology in Mechanical Engineering**"**

Presented By
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for the academic year 2017-2018

Under the Guidance of **Dr. Binu K G**

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CERTIFICATE

This is to certify that the seminar entitled **"BLOCKCHAIN TECHNOLOGY IN MECHANICAL ENGINEERING"** has been successfully presented by

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a student of VIII semester B.E. for the partial fulfilment of the requirements for the Bachelors Degree in Mechanical Engineering of Visvesvaraya Technological University during the academic year 2017-2018.

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Sl. No.	CRITERIA	Marks allotted	Marks obtained
I	Abstract & Report	15	
II	PPT	5	
III	Oral Presentation	12	
IV	Presentation skills	3	
V	Answering ability	3	
VI	Attendance	3	
VII	Presentation of key findings	3	
VIII	Supportive conclusions	3	
IX	Identification for future research	3	
	Total score	50	

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ABSTRACT

As the name implies, blockchain technology refers to the protocol where data, which may include transaction details, data transfers, names and values, are combined into something called a block. When these blocks are digitally attached to each other with encryption, they are formed into a chain of blocks that contain the information in a sequential order. This linear method of data documentation can be used to have a foolproof ledger, whose content cannot be modified, removed or otherwise altered in any manner.

Such a technology finds application in various fields, those that come under the scope of mechanical engineering being some of them. When the ledger is distributed throughout a large number of incentivised volunteers, the transactions become public knowledge and hence it is very hard to hack into the system or otherwise cheat in any manner. Some of the areas where blockchain technology can be used are manufacturing, contracts, raw material sourcing, supply chains, labour and service transparency.

CONTENTS

1. INTRODUCTION / LITERATURE REVIEW

The world of mechanical engineering includes manufacture, automation, service optimisation, customer satisfaction or user input, optimisation strategies, waste minimisation, construction, mass production and various other fields. A lot of them requiring the collaboration of a large number of people. This also increases the number of middlemen and gaps that are filled by individuals or agencies that accept payment by means of commission. Being such a vast industry this introduces a lot of discrepancies in the system. It also decreases the efficiency, adds to waste production and since there are issues of trust, everything needs to be verified, hence, the whole process of getting anything done is extremely cumbersome.

The above situation is where work and worker is abundant. But we can also, for instance, take cases where there are people that need work done, something that probably requires a specialised skill set, but are not able to find someone that suits their requirements, owing to the scarcity of such workers in their vicinity or network. This does not highlight a scarcity of workers but rather highlights a deficient network infrastructure. Where there are both people that need work done and the people that can get it done, but since there isn't a trustable bridge connecting both the parties, a middleman is introduced, which increases the cost of service or production. All these cots are added up and this adds to the price of the end product and the customer ends up paying more for something that could be avoided if there was only a better infrastructure in place, something that would make the current trust and verification based systems redundant. With the current systems, not only would the customer end up paying more but certain companies that have relatively good products are not able to make it to the market owing to not being able to compete with the large companies that make up a considerable portion of the middlemen's client base. This paves way for monopolies and causes indirectly harms the customers as they don't get the products they otherwise could and also, they end up paying more for a product that could have been much better. The current model of operation, as we can see, is slow moving, not trustworthy, doesn't pave the way for small or individual entities and is an inefficient process overall.

This is where blockchain technology takes the stage. Upon perfection of the technology, problems and hang ups in the supply chain or any such system will be vastly, if not completely reduced. This is owing to some of the properties of blockchain technology or decentralised ledger system that make it extremely useful for operations that include trust to be placed by one party on another or in the verification of a certain product or raw material or anything else that exhibit features that could be used in this technology. If something can be identified by using some or all of its characteristics (Dimension, weight, mass, material, etc.), then it can be

digitally identified and that identity can be used to track it during the entire process. This information can be encrypted and encoded onto something called blocks whose number indicates the sequence in which it was produced. The final piece comes in when this chain of blocks is allowed to be downloaded and saved in multiple voluntary locations called nodes, and this type of distributed information sharing is called decentralised ledger system.

Centralised systems are where one single entity takes care of all the record keeping and management. Distributed systems are those where multiple nodes are in charge of the same record keeping and management but they are, above all, governed by a single entity. And decentralised systems are those where the records are open for voluntary nodes to download. This results in multiple copies of the same ledger in different locations and under the supervision of different entities. All the nodes have the same data with them and what this does is that, since all the nodes are virtually invisible from one another, it secures the data in such a way that no one person can change the data without having his version of the record completely disagreeing with what all the other records have to say. In that manner no one person can change the record by changing his version of the ledger. Also, if a single entity had to hack into, say for example, a centralised system as opposed to a decentralised one, then one could do so by going through the mainframe or whatever the records would be stored in, and alter, delete or otherwise modify it. If one had to do the same with a decentralised system then they would have to do the same multiple number of times, since they would have to make the same changes in a number that is a majority while considering the number of nodes. Depending on the number of nodes, this task might prove to be of very high difficulty owing to the sheer computing power required to accomplish such a task within a given period of time. Hence the system of decentralisation achieves a much larger score at keeping the records or data secure.

Moving further ahead, comes the topic of DAO. Acronym for Decentralised Autonomous Organisation. This concept combines the decentralised nature of blockchain and the concept of smart contracts into an autonomous digital organisation. Which means that, it is not under the care or control of any single entity. It will be a platform for organisations to do business on. Since the DAO is entirely made of code, it will not favour or be partial towards any particular party. It will perform as instructed, while the instructions themselves may be governed by the parties involved that are having business with each other. This nullifies the need for an escrow party that acts as a third party which mediates between the multiple organisations involved, in which case the cost rises as well as complexity, which further increases cost and causes delays and hang ups. With the involvement of a DAO there won't be any issue of trust since the DAO would be based on conditions already agreed upon by all the parties involved. There would be instant payment of funds through cryptocurrencies that are again supported by blockchain technology, and all this entire complex web of transactions would be recorded and stored in various ways, all over in multiple locations.

1.1 How blockchain technology can affect supply chain management? [1]

The number of products being manufactured throughout the world for human consumption is countless. Each one of this product has its own manufacturing cycle, a separate procedure to manufacture anything, with different sources of raw materials, logistic services, labour, catalysts, equipment and various other factors. All these combine to form a complex web of sources, retailers, transporters and suppliers. To add to that complexity is human slack, that regularly produces error in all systems that involve human intervention. It wouldn't be a problem if such an error only affected a certain field only, but owing to the complexity of the mess, a single error would be capable of shutting down an entire production line somewhere. When these errors increase the time delay caused is so much that there is a loss of capital in most situations which extends to a loss of human productivity and maybe even a customer base.

Another issue is something which is indirect. Meaning that in a situation where products or raw materials are purchased without knowing their sources, it can be such that the producers are ideal members of society, or it could be possible that they use uncompensated labour for service or even child labour. Blood diamonds are an example of the situation that is being addressed here. In such cases, the customer or any other entity is unaware of where the capital is going once it has reached the hands of the producers. This calls for a transparent supply chain to build the trust customers have on an organisation.

There are also situations where one is not sure if a certain product is original, or if the life mentioned for it by the supplier is the right one. There are many situations where one needs to verify the quality of the product. If this verification has to be made possible with the use of the current infrastructure, that would be a Herculean task. To do such a thing would be expensive and tedious. Currently there are a lot of certifying organisations that, for a fee, will certify the quality according to their standards. For example ISI, DOT, CE, etcetera. These entities rate them with a certain standard that could then be used to verify the quality of the product. But even then this method of verification has downsides, other than the fact that they are expensive, time consuming and laborious, they can be faked with only a sticker. There is no end-to-end tracking of the product right from where the raw materials are sourced to the point where the customer receives the product.

Through blockchain technology, anyone can add to the records by merely transacting in the platform. Due to the decentralised nature of blockchain, a large group of people in the network can come to a consensus regarding the state of data and rules of the network without the use of a single governing entity. Similarly, an improvement to the state of system can be proposed by

any single user. This will be accepted if there is a valid number of users, depending upon the rules of the network, want the same changes to be made.

Mining is a process where nodes solve cryptographic algorithms in order to validate a new block and add it to the existing chain of blocks. This new block must be accepted by a majority of all the blocks, failing which it will not be considered a valid block. A miner could be tagged if blocks are added that don't agree with the network are repeatedly rejected. This increases the traceability of the system. But for every block mined successfully, the miner will either receive a certain amount of digital credit in cryptocurrencies or they might also gain approval for the completion of an event.

The proposed approach comprises of a decentralized distributed system that uses blockchain(s) to collect, store and manage key product information of each product throughout its life cycle. This creates a secure, shared record of exchange for each product along with specific product information. As a product moves through its life cycle, it is possessed by a variety of actors, for example, producers, suppliers, manufacturers, distributors, retailers and finally the end consumer. Each of these actors play an important part in this system, logging in key information about the product and its current status on to the blockchain network. Each product would have a unique digital profile containing all related information, populated during various life cycle stages.

By using this transparent set of information, anyone in the network can take better decisions regarding the choices that are being made, while purchasing the end product or sourcing the raw materials. The benefit of this would largely extend to multiple sectors, reduce the prices of products, require fewer middlemen or none at all, keep unethical labour out of the system and root out a large number of misgivings and errors. Since each product would have it's unique product ID, it could be traced right back to where it's raw materials were sourced from. This could bring about a lot of benefits that can include better demographic targetting but most importantly reduce the impact on the environment.
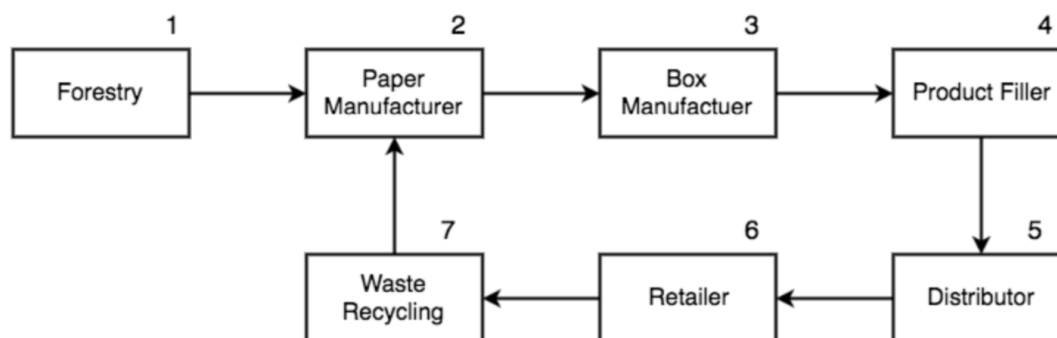
The above block diagram shows the supply chain for a cardboard box. In this case, all the participants, starting form the Forestry sector could document and tag their outputs, which when received by the next sector, it could be taken as input and then sequentially attached to the output they produce. All this data could then be uploaded on the blockchain and verified immediately.

1.2 How blockchain technology can affect logistics management? [2]

Trade has been one of the most important factors if not the most important factor in the making and breaking of economies and organisations around the world for thousands of years now. But it is widely accepted that the current system of transportation has a great deal of inefficiencies and hang ups in the process. Transportation is the most important factor affecting trade. Using transport standards that are not up to the mark will result in delays, loss to capitol and a waste of human resources as a whole. As the world's economies scale up, that number is only expected to increase as we become more dependant on the complex international supply chain for our goods and services. The industry, however, is not prepared for growth, as it currently sits on top of a crumbling infrastructure prone to systematic inefficiencies and rampant fraud. Countless intermediaries rake in fees and drive up the price of shipping. The problem is that the complexity and opaqueness of the process make it difficult to put checks and balances in place. [3]

The FBI estimates that cargo theft causes an annual loss of approximately $30 billion in the U.S. alone. In effect, cargo theft can cost consumers up to 20 percent more for their goods. And though most of the problem areas have been well-documented for decades, the distributed nature of ownership has instilled little accountability in any of the industry's stakeholders. [3]

This is where blockchain comes by promising to deliver a cheaper and more efficient system of maintaining logistics. The freight and logistics industry incorporates a large number of brokers and significant amounts of hidden information across complex supply chains. No single party can access all aspects of the chain. Currently, the freight and logistics industry is heavily controlled by freight brokers, which exist to facilitate transactions of loads from shippers to carriers. Brokers seek out loads, tag on a markup, then sell it to carriers. This not only increases costs for carriers, it also leads to increases in downstream prices that directly affect consumers. The lack of efficiency, transparency and security across the global networks is precisely the problem blockchain technology is designed to solve. Blockchain, if adequately leveraged, will give customers the opportunity to participate in a freer, more transparent global trade, and potentially limit the need for brokers and lower intermediary costs.

One effective way transparency and efficiency can be increased is by leveraging smart contracts. Smart contracts are essentially self-executing contracts that are fulfilled when predefined stipulations are met. This is particularly useful when it comes to increasing the efficiency of shipping escrow by removing or limiting the intermediaries involved, and therefore bypassing the hang ups they post.

Blockchain also can increase the tracking and transparency of the supply chain. Shippers can gain more visibility across their supply chain and communicate important information such as loads, geo-waypoints and basic compliance information with carriers. Once a shipment is confirmed and recorded on the blockchain, it is immutable, meaning no party can dispute the validity of the transaction or fraudulently manipulate the records. Once transactions are logged, smart contracts can then release any payments in escrow instantaneously, limiting the time and costs associated with intermediary processing.

2. RESULTS / ANALYSIS

The following points summarize the benefits of using blockchain technology as compared to conventional methods:

- Users are empowered since they are in control of all their transactions.

- Transparency can be introduced in a system where it is required and privacy can be implemented when privacy is required.

- Process integrity is maintained since one can be sure that transactions will be executed exactly based on the programmed algorithms and not based on the whims of an individual.

- Data recorded in the blockchain is highly consistent, timely and accurate.

- Owing to the decentralised nature of blockchain, it lacks a central point of failure and hence is robust.

- Due to multiple nodes in a network, the transaction is much faster and reliable.

- Transaction costs are lowered by eliminating third parties from the equation.

- By eliminating middlemen, a lot of paperwork, trust issues, need for verification are reduced which reduces time wastage and increases efficiency of work.

- With all the transactions in a network being added to a single ledger, it is not necessary to keep track of multiple ledgers in different locations.

- Individuals can be empowered and since this provides for opportunities in multiple sectors, this can be considered a boost for the economy.

- The number of cases of fraud and cheating will be reduced by a large extent owing to the immutability of a decentralised ledger.

- It allows for the suggestion of modification by a single user.

- It allows for incorporation into bigger systems such as governments, voting processes, educations, health management, etcetera.

- If smart contracts are implemented, then the traditional method of doing work can be eliminated along with its short comings and replaced by a superior system.

The following points summarize the drawbacks of using blockchain technology as compared to conventional methods:

- Redundancy is one of the main drawbacks that come to mind when talking about blockchain technology. When a transaction is verified, it gets verified by a large number of nodes in the system, as compared to a centralised system which needs to verify the data only once before being recorded.

- Request verification needs to take place since every time a request is posted it needs to be verified.

- Resolving challenges such as transaction speed, the verification process and data limit will be crucial in making blockchain widely applicable.

- Owing to the nature of blockchain which requires the participation of each of the nodes in the network, there is a large amount of electricity consumption that is being drawn be the amount of computational power required by all the nodes.

- If smart contracts are used then, they will have to be generated every time in the instance that the work being done is not of a repeatable manner.

- The technology needs to be integrated into the current infrastructure for it to enjoy wide scale adoption.

Some of the relevant negative points that are not exclusive to blockchain technology are:

- There is a lack of knowledge and technical know how amongst the people for them to realise the trust in this system.

- If currencies are involved in this system them it might make way for propagation of illegal entities like terrorism, drug mafia or any other illegal capital laundering or generating business.

- There might be issues of tax evasion and the like by misusing facilities provided by this technology.

3. DISCUSSION

The main applications of this technology that this paper presents involves the simplification of the supply chain sector and also the logistics sector. It is ideal to use blockchain technology in any sector of business where the amount of transactions is high and the number of people or entities involved is so large that conventional digital systems find it hard to keep track of. The main appeal of this system is where individuals are given the power to keep an eye on the transactions and verify the new transactions happening. It is generally necessary to have a method of compensation involving either a certain currency or a digitally backed proof regarding the nature of compensation. This is vital to the working of the network, since this will be the incentive required by the peers to validate transactions on the network. And owing to the network effect, more the number of users in a network, the better it will work out. Also, if the ledgers are distributed among a larger number of people then, it can be considered safer and more secure, since the number of nodes increase, the number of nodes that need to be compromised in order to change the transaction details also increases and this further adds to the immutability of the ledger. It is also possible for a single person or entity to propose a change, in the sense that the change will be accepted if a majority of peers in the network provide consensus for the same. This ensures a from of true democracy where the conditions of the network is adjusted in relation to the conditions the majority sets.

The major plus point blockchain technology provides is its ability to potentially communicate with other ledgers and form a vast network of verified records that are immutable and inter-dependant. What this means is that it is possible to have a network of inter communicating ledgers that are a vast collection of records which can be made accessible to the authorised users. In this sense, a large amount of human relations, structures and even governments can be aided by the use of such indisputable record of documents and presumed conditions that is set by the government. With addition of machine learning algorithms and AI, it is possible to, maybe sometime in the future, make redundant entire governments and institutions as long as it is possible to make a digital ID of anything that is a part of the ledger. If it is possible to make a digital ID out of something then it is possible to incorporate it in a digital format. Thus, it can be accounted for and can be attached to contracts. The one condition necessary for this to successfully happen is that the digital ID for the instrument must be unique. A certain digital ID must be applicable for a single item and cannot mean anything else. The more we use this technology, more the amount of automation can take place in the management and human relations can be made friction free. With the amount of companies adopting or planning to adopt this technology it is almost certain that either this or something like this is going to be a major deal in the future.

4. CONCLUSION

The invention of Blockchain Technology is credited to Satoshi Nakamoto. It first appeared in a paper submitted by him, titled "Bitcoin: A peer-to-peer electronic cash system" in 2008. Needless to say, Bitcoin was the first to ever use this technology. Bitcoin is only meant to be a payment system. But even then it's price has escalated enormously since it's conception. It gives a certain validation that blockchain technology has a vast amount of support amongst it's community. And currently it's potential impact is being compared to the printing press revolution and it is also being called the Internet 2.0 for its ability to further delve into the world of human interaction and organisation.

Even though it might need a lot of modifications and additions to make it efficient, what is most likely is that it will soon start being integrated into our every day lives. As large companies and governments adopt it, it will have wide scale support owing to its democratic nature. Since it also has large scale applications from shipping to voting and in fact anything at all, in the next few years it is extremely likely that we are going to see a world where Blockchain Technology becomes as abundant in usage as the internet itself. Trust chains can be made redundant and a large number of middlemen can be eliminated, bringing about transparency and democracy in the system. The same technology can be used to issue loans and collect debit without the need for a centralised managing entity such as a bank.

Blockchain technology will certainly be an increment to the ascent of technology and make way for a more efficient and democratic world to live in.

5. REFERENCES

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