Blockchain technology and the building industry

Blockchain is a type of database that holds a permanent, transparent record of transactions or inputs in chronological order. It works differently from other databases, and there is presently investigation into its use for solving real-world problems. BRANZ commissioned research to find out how the unique features of blockchain could support the building industry. Although this upcoming technology could have future benefits, it is at an early stage in development and may be some time before it is more widely available. Despite this, the research recommends blockchain should be watched closely by the building sector for future developments and opportunities.

Blockchain is a type of database that stores information. It was invented to create the public ledger of transactions for the cryptocurrency bitcoin and was based on earlier research in the 1990s to create a system where documents' timestamps could not be tampered with.

Blockchain (also known as distributed ledger technology) has received international attention and investment in recent years because it works differently from other databases. This means it could change how agreements and transactions are carried out in the future.

What makes blockchain different from other databases

Databases are designed to store large amounts of information that can be accessed and used simultaneously by many people in different locations. Large databases are generally owned by a single business or organisation that has control over managing the database and the information in it - for example, the local council or a bank. Users then access the information through their computer or device from a central location.

Blockchain is different.

- The information/transactions on a blockchain system are not managed or stored in one central place. Data is stored across the network of computers of everyone using the blockchain. These computers are called nodes.
- Every node has its own copy of the blockchain. New information is added after being validated by computer algorithms that reach a consensus using the computing power across the network. Updates are then distributed to all nodes (Figure 1).
- The information in a blockchain is stored differently than other databases - in blocks that each have a secure code to identify them (a hash). When a record is updated, it is stored in a new block with its own secure code. This new block is also chained to the

old block (hence a blockchain), meaning it carries a reference to the secure code of the previous block. Each block of information has a timestamp and they are stored in chronological order.

This means that identical copies of the information are stored in many places, so it is less vulnerable to system outages or failures. Such systems are also more resistant to hacking or cyberattacks.

A blockchain is completely transparent to its users. No one person, group or organisation owns or has control of the information. An overview of all the information is visible to all users of a blockchain.

Blockchain also keeps a record of every change and addition to the information. Transactions can be traced back to their source and are extremely difficult to tamper with, so it maintains a secure and auditable record.

There are presently three types of blockchain system that have different characteristics: public, private and consortium:

- In a public blockchain network, anyone can read and write to the blockchain without authorisation. These are vulnerable to malicious use that undermines the system integrity.
- Private blockchain networks limit participation to certain users or organisations.
- Consortium blockchain networks have a different approach to reaching consensus for new data coming in, limiting decisions about consensus to a group of pre-approved nodes on the network.

Forms of blockchain in the construction industry will likely be consortium-based.

Blockchain applications in the building industry

At the time of writing, blockchain has been surrounded by a certain amount of hype. This led many to believe that the new technology in blockchain could solve many business problems. While blockchain is not a quick fix or panacea/cure-all, the present hype is prompting important conversations about data sharing and transparency.

Blockchain has mostly been used as a ledger to record financial or token transactions, but other types of information can also be stored on it. BRANZ commissioned two independent research projects to consider applications for blockchain in the building sector (from the University of Auckland and GS1 New Zealand - see More information below).

Smart contracts

A smart contract is a digital agreement stored on a blockchain. It holds a set of instructions that are automatically carried out when certain conditions are met - for example, automatically transferring payments or assets when completed milestones are confirmed. This sort of contract has been researched for other industries, but research for its use in the construction sector is limited.

The unalterable data captured by smart contracts on a blockchain system could allow:

- performance monitoring of suppliers over the short and long term
- improved transparency and trust because the information can be seen by all parties using the blockchain
- identification of bottlenecks during a project
- semi-automation of existing contracting processes

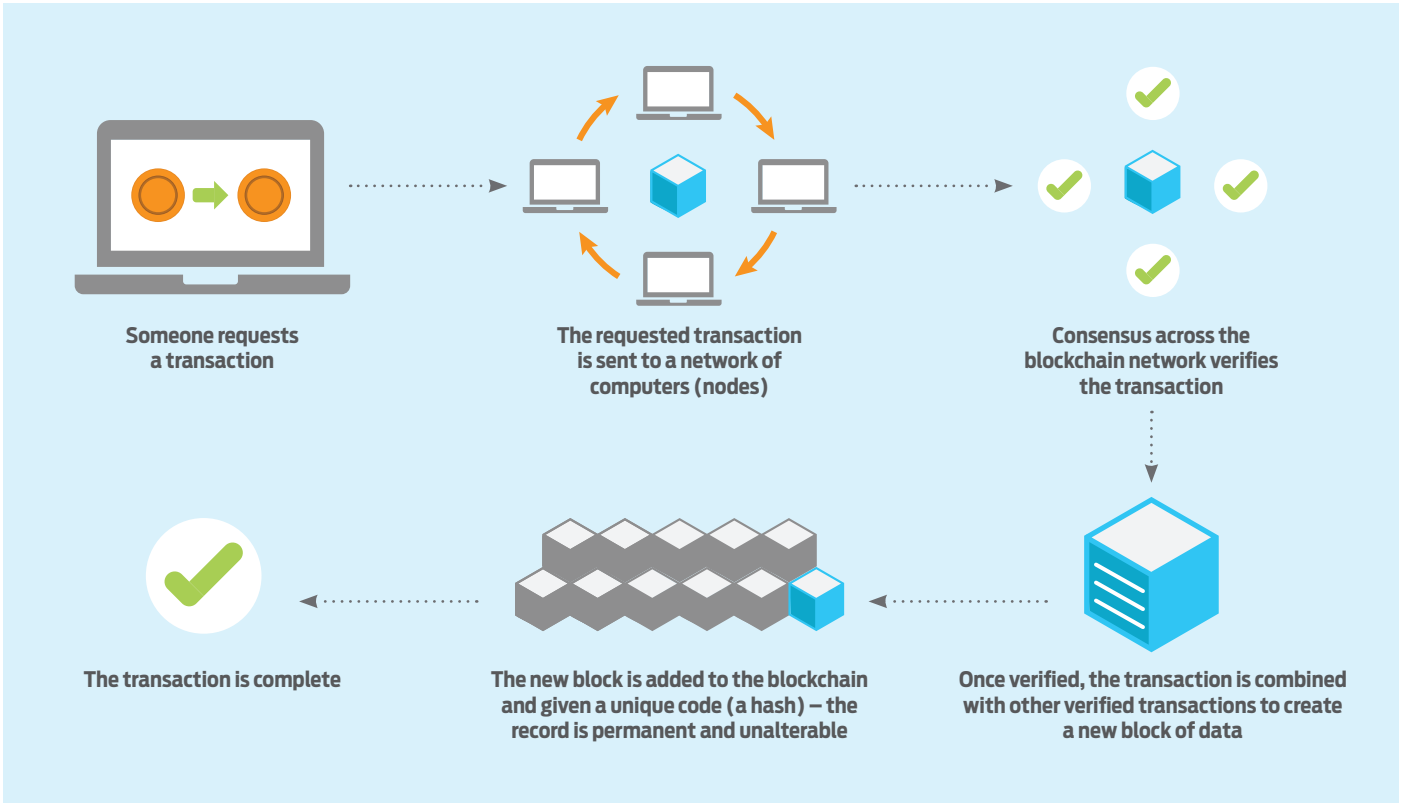

Figure 1. How transactions are validated and added into a blockchain system.

- a permanent record to assist dispute resolution
- faster payments for suppliers.

Smart contracts could be used for traditional procurement of services and materials and for other types of agreement such as alliancing, joint ventures and private-public partnerships.

Product assurance and compliance

In theory, blockchain could provide greater supply chain quality assurance and also security for certification information. However, a key hurdle for using blockchain (and other technologies) in this way in New Zealand is the lack of minimum product identification standards and requirements for accurate product assurance information disclosure.

A standardised set of agreed product information would be crucial for improving information and accountability for building products and methods. Resolving this issue first would support data exchange across the sector.

Token economies within the building sector

Blockchain has enabled the creation of new currencies such as bitcoin. The ability to create coins or tokens has resulted in a new form of token economy where new types of tokens are created and traded. The World Economic Forum identified that blockchain technology has the potential to support circular economies and to finance projects for environmental change.

The research considered whether a token could be created to develop a new type of economy that incentivises waste reduction in construction in New Zealand by facilitating trade in waste. There is presently an emerging trend in off-site prefabrication and assembly that generates higher-quality reusable waste, as well as the existing and growing reduce, reuse and recycle market.

Achieving this would require:

- incentives to value waste and to extract value from it
- addressing existing challenges of scaling business up in this market (currently an artisanal, niche market)
- applying supply chain material management to waste materials as well as new, unused materials.

Things to note about blockchain

The blockchain technology is relatively new and evolving, so it is still being actively researched and developed for various uses. Many blockchain projects are at the pilot phase (including some projects in New Zealand). There are challenges in scaling up the technology to work operationally, and it may be some time before this capability is more widely available. For example, both bitcoin and Ethereum, two leading blockchain networks, experienced slow transaction speeds due to a substantial increase in users on their networks (7 and 20 transactions per second respectively - unacceptably low for most business applications).

As the technology is new, there is still a need for the various advocates of blockchain to agree on the international standards that ensure that different blockchain systems can operate with one another in a standard way (interoperability). Laws and regulations would also be needed based on agreed rules for blockchain. This is further complicated in that there is already considerable variation in data availability, formatting and completeness of technical information available on similar building products in New Zealand and across the world.

Blockchain is not better than traditional databases. The data structure means you can only add data. Data cannot be removed. Traditional databases often still perform better, - for example, the number of transactions that can be handled per minute. Blockchain has limited data storage capacity and is best used for certain types of data, such as ledger transactions and confirmations (in the case of smart contracts).

Blockchain technology is not a stand-alone solution for resolving business challenges and is likely to work as one part of a much larger network using multiple technologies. These are early days, and the path for how blockchain will become adopted into everyday working practices is not yet clear.

Incorporating blockchain into the systems that support the building sector would need leadership, champions, collaboration between the major industry players and setting up preapproved nodes on a network. At the time of writing, this sort of initiative does not exist in New Zealand.

Other technologies, existing and in development, may end up offering greater advantages than the blockchain approach. However, blockchain should still be watched closely by the building sector in coming years for future developments and opportunities.

More information

BRANZ external report ER42 *Applying blockchain to product compliance and assurance in the construction industry*

BRANZ external report ER62 *Chip of the new block(chain): blockchain and the construction sector*