# CHAPTER 1

# INTRODUCTION

## 1.1    Research Object

International Business Machines Corp. (IBM) is an American multinational company that runs in the information technology sector. IBM was initially established in the State of New York by Charles Ranlett Flint and Thomas J. Watson Sr. on June 16, 1911 under the name of Computing-Tabulating-Recording Co. (C-T-R). Since that day, IBM has been concentrating on the intersection of business insight and technological innovation. In terms of its operations and aims, IBM has always been international in nature. C-T-R finally changed its name to International Business Machines Corp. in 1924. The company creates value for clients by enabling new capabilities to derive competitive advantage through insights and the latest digital technologies (IBM, 2018).



**Figure 1.1 IBM Logo**

*Source:* ibm.com

Headquartered in Armonk, New York, IBM has operated for over ten decades and currently has more than 350,000 employees serving clients that are spread in 170 countries (IBM, n.d.). IBM manufactures and sells computer hardware and software and offers from infrastructure, hosting to consulting services in areas ranging from mainframe computers to nanotechnology (The Guardian, n.d.). They operate through five critical segments which are, Cognitive Solutions, Global Business Services, Technology Services & Cloud Platforms, Systems, and Global Financing (IBM, 2018).

Cognitive Solutions includes a wide range of primarily software capabilities that support IBM's clients to identify actionable new insights and inform decision making for competitive advantage. This business provides a broad range of capabilities from descriptive, predictive, and prescriptive analytics to artificial intelligence by utilizing IBM's research, technology, and industry expertise. Global Business Services provides consulting, application management, and business process services for clients. Meanwhile, Technology Services & Cloud Platforms delivers integrated IT infrastructure and platform services that create business value for clients. The Systems segment provides clients with innovative infrastructure platforms to better fulfill the current requirements of hybrid cloud and enterprise Artificial Intelligence (AI) workloads. Global Financing includes two main businesses: financing, primarily conducted through IBM Credit LLC (IBM Credit), as well as remanufacturing and remarketing. IBM Credit facilitates clients' acquisition of information technology systems, software, and services in the areas where the company has expertise through its financing solutions (IBM, 2018).

IBM is unique for the way it delivers value for clients by providing integrated solutions and products that leverage data, information technology, deep expertise industries, and business process, with trust and security and a broad ecosystem of partners and alliances. It is not a new story of IBM bringing innovative technology to the world. For decades IBM Engineers have developed countless products and services (IBM, 2018). IBM's innovative technology here includes Analytics and AI with its Watson platform helping to embed AI in various fields, Cybersecurity/IBM Security which was built for industry-leading compliance, threat monitoring, and container security, Blockchain which can help to transform supply chain processes as well as bringing trust and transparency to transactions, another innovation technology is Cloud Services where they offer a hybrid cloud solution (IBM, 2019).

Research has always been an important part of IBM. Its research and development operations have delivered many new technologies to IBM's portfolio every year and help clients address their difficult challenges. There are more than 3,000 researches in 12 labs located across six continents. Back in 2018, IBM holds

the record for most patents generated by a business for the 26<sup>th</sup> consecutive year (IBM, 2018).

Blockchain as one of the innovative technologies that IBM works on will be discussed further in this research along with its implementation in supply chain. IBM itself started to join the blockchain hype around 2016 teamed up with other groups of tech and finance giants like Intel, Cisco, the London Stock Exchange Group, JP Morgan, Wells Fargo, etc to create Hyperledger. It is known as an open-source project inspired by Bitcoin with the aim to provide a more secure and reliable way of trading stocks and other assets. IBM was not just intended to use Hyperledger to market products to other companies, but they also planned to put it to work within the company as well. IBM handles million transactions per year and that makes disputes arise over problems like tax rates and missing or incorrect shipments. They were certainly hoping Hyperledger can streamline these disputes by creating a transparent system for verifying who has actually paid for what (Finley, 2016).

## 1.2    Research Background

Many people might have known or heard about blockchain at least once. Aside from the emergence of the internet, blockchain is probably the most hyped technology at the moment, a controversial topic, and yet offering a broad potential to the table. Although blockchain has become a point of discussion, many people have not completely understood the definition of blockchain technology itself. It is more likely to associate blockchain with the transfer of funds because initially, it emerged as the technology behind the well-known cryptocurrencies. However, blockchain is not limited to finance and actually goes far beyond that (Adelore, 2019). All across the world, from small startups to big multinational companies, many have embraced and implemented this technology in various areas within their business (Felicita, 2019). In the simplest terms, blockchain is described as a digital ledger in which data is stored in a distributed network (Dughi, 2018). It is like information is reconciled into a database, but instead of depending on a central server, data is distributed on thousands of servers (Mearian, 2019). The first-ever and most famous blockchain application is Bitcoin, which was introduced by a

person under a pseudonym of Satoshi Nakamoto in 2008 and then officially launched in 2009.

Blockchain draws a lot of attention is because it is decentralized and not owned by any individual (Wright & Filippi, 2015). Every single user has the opportunity to become one of the network's transaction processors (Cipi, 2020). With decentralization, third-party intermediaries become unnecessary because transactions can be done on a peer-to-peer basis (Miles, 2017; Puthal et al., 2018). Besides that, blockchain is immutable (Zheng et al., 2017). No one can tamper the data, once it is stored. Records stored into blockchain is also secured using cryptography (Crosby et al., 2016). Network participants have their own individual keys that are assigned to the transactions they make and act as a personal digital signature (Miles, 2017). Transparency is also provided by blockchain through smart contracts, so anyone can track their data (Nugent et al., 2016). With all those unique features provided by blockchain, people can have easier automated transactions surpassing complex bureaucracy in a secure network.

Banking and cryptocurrencies were the starting point of blockchain technology. More people now believe that blockchain can also transform various areas from business, government, and society beyond financial services (Tapscott & Tapscott, 2016). A survey from PwC in 2018 mentioned several industries that are the most advanced in blockchain development as shown in Figure 1.2. This survey is based on the opinion of global executives in various industries.
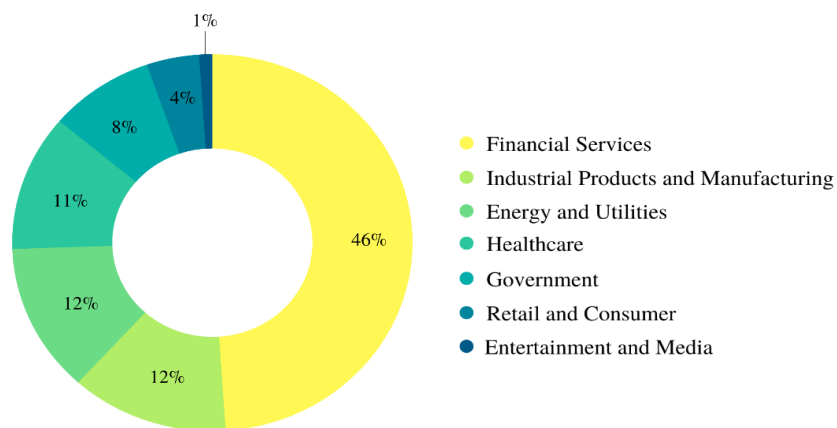


**Figure 1.2 The Most Advanced Industries in Blockchain Development**
*Source:* PwC Global Blockchain Survey (2018)

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Based on the survey, 46% of respondents still believe that financial services will be the current and future's most advanced industries in blockchain development. Moreover, potentials are also seen in other industries like industrial products (12%), energy and utilities (12%), healthcare (11%), government (8%), retail (4%), and entertainment (1%). In terms of manufacturing and retail, blockchain can also be useful to support traceability and transparency of supply chain management (Song et al., 2019). Supply chain has always struggled with the issue of traceability, which requires accurate information of product flow from the origin to end-users (EMURGO Indonesia, 2020).

In the majority of current supply chain implementation, companies apply the centralized system in which information is shared with the entire supply chain network and order decisions are determined by a central authority (Fu et al., 2014). Problems that may arise from the current centralized supply chain include trust issues, such as fraud, corruption, manipulation, and falsification of information. This kind of system also prone to collapse since a single point of malfunction could lead the entire system to crash (Perboli et al., 2018). Real examples of current supply chain issues are like bottlenecks and delays on lower-tier suppliers due to large and complex datasets (Ma, 2020). In addition, Mettler (2016) stated a few problems with the current supply chain in healthcare. There has been a lack of transparency to the latest treatment information among medical stakeholders. Besides that, counterfeit medicines have been a global issue at the moment. Based on an Oceana publication report, US is also struggling with seafood mislabeling issues (Warner et al., 2019).

In contrast with the centralized supply chain, blockchain was designed to prevent any single point of failure, as it allows decentralization (Mauri, 2017). Other benefits blockchain may offer are improved tracking and traceability, automation which leads to efficiency, complexities reduction, improved transparency, secure information sharing, and increase trust (Wang et al., 2019). Therefore, problems like bottlenecks and delays can be solved with automation through smart contracts, medical information become more transparent, and counterfeit products can be traced easily (Ma, 2020).

According to Lapinskaitė and Kuckailytė (2014), supply chain cost covers for about 55% of the total cost of the product. Since supply chain is said to have a big impact on the product cost, then improvement on supply chain can be beneficial to reduce the overall cost. Reducing cost can affect the profitability of the entire supply chain network to increase. Thus, implementing blockchain might be a way to make an improved yet cost-efficient supply chain system. Saberi et al. (2019) explained that blockchain supports transparency, which allows product's real-time tracking for all stakeholders without intermediaries involved. Fewer tiers may eventually result in time and cost reduction, it may also reduce business waste in the supply chain.

Opposed from the idea of disintermediation, Tönnissen and Teuteberg (2020) conducted a research which resulted in no disintermediation upon the majority of logistics blockchain applications they investigated. So, what kind of intermediaries can be eliminated within supply chain? DHL (2018) then reported intermediaries that can be eliminated include insurance, legal, brokerage, and settlement services (DHL, 2018). Therefore, blockchain comes in hand to facilitate and automate business transactions and enable direct relationships between participants (manufacturer, logistic service provider, wholesaler, retailer, dealer, and consumer). The existence of blockchain may allow an opportunity to improve the business process of companies. For instance, shipments can be optimized by providing integration of digital contracts, shared inventory and logistics information, pricing, invoicing, and payment (EY Ireland, 2019). Yusuf et al. (2018) also explained how blockchain could benefit the company's supply chain in terms of product distribution, which is through real-time traceability that can provide visibility on the status of products, its shipments, and verification by all stakeholders within the supply chain. Through visibility, companies can reduce stock they hold as a buffer, encourage more efficient inventory management, and thus lower holding costs. Aside from that, the existence of smart contracts which record agreements between parties with automated contract execution and payment may reduce the use of banks, thereby reducing or even possibly eliminate letter-of-credit fees. Because of accurate data records by blockchain, then companies can

immediately detect any defect, which can result in faster dispute resolution and reduces the amount of money lost due to damaged goods, as well as minimizing pilferage and fraud by invalidating sales of stolen items at retail outlets. Blockchain can also minimize the need for brokers or customs clearance by allowing regulators to digitally trace shipments and other critical information, such as invoices, certificates of origin, and clearance documents. Lastly, an analysis of container usage patterns can detect available space, allowing more efficient container utilization.

To understand more about this blockchain phenomena, it is best to analyze the best practice of a company that has utilized blockchain in its supply chain activities. In this case, IBM is chosen as the research subject because IBM is one of the early adopters of blockchain technology for supply chain purposes since 2016. For being the early adopter, it is assumed that IBM is more matured in implementing blockchain. Moreover, not only adopting the technology, currently IBM also serves blockchain services for other businesses. Later, from IBM's data, it can be concluded whether cost after blockchain implementation is lower than before blockchain implementation.

## 1.3 Problem Formulation

Blockchain implementation is reaching beyond financial services. Nowadays, researchers are also starting to investigate blockchain use cases in different areas, and one of them is supply chain. Blockchain in the supply chain area may help in business processes and cost efficiencies. With the help of peer to peer network, transactions between supply chain participants can be optimized through smart contracts. They can help to reduce complexity in supply chain through automated verification and execution of the multiple business transactions involved (Law, 2017). Moreover, middlemen like insurance, legal, brokerage, and settlement services may be eliminated, thus reducing transaction costs. Blockchain also provides transparency and traceability which ensure equal access to information for all stakeholders and lead to a trustworthy environment

One of the main benefits of blockchain adoption is probably the ability to reduce costs. Kshetri (2018) implied that implementing blockchain within the

company could improve supply chain cost, speed, dependability, risk reduction, sustainability, and flexibility. According to Ko et al. (2018), real-time transparency provided by blockchain may reduce surveillance, remittance verification, and networking costs that eventually can help manufacturing firms to produce at a smaller marginal cost. Furthermore, Fosso Wamba and Guthrie (2019) stated that process innovation and relational innovation that developed along with the implementation of blockchain can bring a major reduction in cost and time. Schmidt and Wagner (2019) also implied that blockchain is possible to minimize search and information costs, (re-)negotiation and agreement cost, and post-contract management costs related to supply chain activities. Moreover, blockchain technology adoption can help company improving the employment of their assets which can help generating sales at a minimum cost (Pan et al., 2020). This cost reduction will eventually lead to increased profitability, thus showing a good performance in terms of finances. Higher profits can help to expand the organization, create more employment, and overall industrial prosperity. Besides that, cost reduction may increase competitive strength in the industry.

Despite all the benefits, some would say that it may take a long time to see the significant impact of cost-savings. Like Kshetri (2018) stated in his research that the benefits of cost reduction are not expected for at least two years or so until the technology is more widely used. In addition to that statement, Gatteschi et al. (2018) stated that not all adoption of blockchain technology can surpass the initial expectations. Some companies are seen to be reluctant because they do not really see the benefits for them and prefer manual processing (Gatteschi et al., 2018; Tönnissen & Teuteberg, 2020).

Many researchers did imply that blockchain can reduce costs. However, some also said that the cost-savings benefits do not live up to the expectations. Therefore, this research is conducted to analyze and prove this cost reduction benefit. Using IBM's financial data, costs of the company before and after blockchain implementation will be compared and investigated using a statistical method, which is paired sample t-test. The result will show whether cost after blockchain is lesser than cost before blockchain implemented.

## 1.4 Research Questions

Based on the problem formulation that has been stated before, thus the research questions suitable for this research will be stated as follows.

1. Are the operating costs after blockchain implementation is significantly lower than the costs before blockchain implementation within the supply chain?

2. If the operating cost after blockchain is significantly lower than before blockchain implemented, how can blockchain reduce supply chain costs?

## 1.5 Research Aims

Based on the previous research questions, the research aims of the study are stated below.

1. To see whether operating costs after blockchain implementation is significantly lower than the operating costs before blockchain within the supply chain

2. To improve comprehension on how blockchain can reduce supply chain costs, thus improving future supply chain application.

## 1.6 Research Benefits

### 1.6.1 Theoretical Aspects

When it is interpreted in a theoretical sense, the results from this paper are expected to deliver utility and benefits as a reference for further research as well as additional information for Academicians and Researchers who do similar research about the implementation of blockchain on the supply chain.

### 1.6.2 Practical Aspects

From the practical aspect, the information and conclusion of this study are expected to give benefits to:

a. Organizations

   Companies can acknowledge the impact of blockchain technology on the supply chain cost. This can lead to companies' awareness of disruptive technology like blockchain, which may be able to help reduce cost and increasing companies' profitability and efficiency or in an unfortunate case, does not have a significant impact on the efficiency of cost.

b. Supply Chain Network

Not only the organization that is going to be analyzed who can get the benefits, but the whole supply chain network may also be impacted positively/negatively upon this implementation of blockchain technology.

## 1.7 Thesis Structure

The thesis structure is used to provide a clear image regarding the research which can help to give information related to the topic and material discussed in each chapter. Additionally, the thesis structure is intended to facilitate the readers in understanding the contents of this study, therefore this thesis structure is arranged as follows.

CHAPTER 1 INTRODUCTION

Chapter 1 provides a general and concise description of the research, which includes research overview, research background, research questions, research aims, and system of writing.

CHAPTER 2 THEORETICAL REVIEW

Chapter 2 summarizes all valid and scientifically-tested theories, published researches regarding the topic or the problem, a set of reasoning used to describe the research problems that finally form a theoretical framework leading to a conclusion which is the research hypothesis.

CHAPTER 3 RESEARCH METHODOLOGY

Chapter 3 emphasizes the approach, method, and technique used to gather and analyze data to answer or explain the research problem. It presents types of research, operational variables, research stages, population and sample, data collection and source, type of data, the technique used for data analysis, and hypothesis testing

CHAPTER 4 RESEARCH RESULTS AND DISCUSSION

Chapter 4 systematically explains the result of the research and discussion related to the problem formulation and research objects, which will be presented in separate subtitles. This chapter contains two parts, the first section presents the result of the research, while the second section presents a discussion or analysis. Each aspect of the discussion should start from the result of data analysis, then

interpreted and followed by concluding the whole research. The written discussion should be compared with previous studies or relevant theories.

CHAPTER 5 CONCLUSION AND SUGGESTION

Chapter 5 contains research findings. The suggestion will be stated as well as a reference for further study regarding this topic to help other researchers.