

# The Impact of **BLOCKCHAIN** on the South Bay Economy

**CSUDH**

CALIFORNIA STATE UNIVERSITY, DOMINGUEZ HILLS



A WORKFORCE  
DEVELOPMENT BOARD

**SOUTH BAY  
ECONOMICS  
INSTITUTE**

CALIFORNIA STATE UNIVERSITY, DOMINGUEZ HILLS

*Innovative and Forward-Thinking Economics  
Research and Teaching*

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# Executive Summary

**B**lockchain and distributed ledger technology (DLT) have the potential to transform the modern workplace. Originally developed to support the Bitcoin digital currency, Blockchain distributes digital information across networks of computers and servers, and updates information so that standardization is maintained across all links of the chain. In other words, Blockchain is like the “Google Docs” equivalent of a Microsoft Word document, except that in Blockchain data is replicated across computers simultaneously rather than being stored in a centralized location.

As a result, Blockchain can be both transparent and not corrupted by a single user. This means that Blockchain has the potential to contribute significantly to numerous areas of business and government activity, including online finance and e-commerce, contracting and title registration, accounting, supply-chain management, cyber-security and anti-money laundering, file storage and data management, intellectual property rights protection, and the Internet of Things. Indeed, a World Economic Forum report recently predicted that 10 percent of global GDP would be stored on Blockchain technology by 2027.

This study is a path-breaking examination of the potential impact of Blockchain on the Los Angeles South Bay economy and workforce.<sup>1</sup> This study aims to inform South Bay businesses, policy makers and government officials about the latest trends in Blockchain technology and emerging companies in the field, as well as the latest research into the issue. The issue has gained traction at the federal level of government (see, e.g. Congressional Blockchain Caucus, 2017) and needs to be focused on at the regional level so that regions such as the South

Bay can support and facilitate this emerging industry where appropriate. This study identifies the occupations and sectors that are likely to be significantly impacted by Blockchain technology, and links these to statistics on the current South Bay economy and workforce. Moreover, this study examines the requirements for workforce training in this new area, as well as the new and revised courses that regional community and technical colleges and universities can provide to address this issue.

The research team conducted 34 interviews with industry sector experts, and 19 interviews with experts in Blockchain or closely-related technology. Responses from industry experts highlighted the potential for Blockchain investment to develop their workplaces, whether through increasing operational efficiency, reducing transaction costs, or creating new opportunities for growth. Responses from Blockchain experts provided more detailed insights into the potential development and spread of the technology as well as likely challenges to implementation. These responses were combined with review of reputable literature on Blockchain and analysis of South Bay occupation and industry data.

## Findings Summary

### ***How big will Blockchain become? To what extent will it impact the global and regional economy?***

The future of Blockchain is uncertain. There is great potential for the technology to be applied in numerous ways across numerous industries, and as such is experiencing substantial interest and investment across numerous economic sectors. The global market for Blockchain is estimated at \$708 million in 2017, and is projected to grow to \$60.7 billion in 2024 (Wintergreen, 2018). Numerous major corporations in the technology

space such as IBM, Microsoft, Oracle, Facebook, and Overstock have invested significantly in Blockchain technology research and development, while management consultants such as Accenture, KPMG, and Deloitte have invested in implementation-related research. However, the technology largely remains in the early development stages, with large numbers of start-ups worldwide developing and testing innovations. How quickly Blockchain spreads globally will be influenced by the dynamics and regulation

<sup>1</sup> The South Bay is a region of Los Angeles County that includes the cities of Avalon, Carson, El Segundo, Gardena, Hawthorne, Hermosa Beach, Inglewood, Lawndale, Lomita, Portions of the City of Los Angeles (Harbor City/Harbor Gateway, San Pedro and Wilmington), Manhattan Beach, Palos Verdes Estates, Ranch Palos Verdes, Redondo Beach, Rolling Hills, Rolling Hills Estates and Torrance.



of Initial Coin Offerings (ICO) and cryptocurrencies, the ability to overcome interoperability and labor market issues, and the level of growth in the world economy. The success of Blockchain in the South Bay will hinge on the region's ability to attract and retain developer talent, local organization willingness to invest in and implement the technology, and to connect with Southern California institutions to create a more unified stance when in competition with U.S. regions such as the Bay Area and New York.

### ***What other sectors will be using this technology?***

Blockchain has a broad range of potential applications, including data and identity management, accounting, contract and title registration, online finance and e-commerce, cybersecurity, and anti-money laundering. These can all be applied across the majority of industry sectors, similar to the way in which the Internet has become an omnipresent feature of modern economic life. The financial and insurance industries have already implemented Blockchain elements around cryptocurrencies and smart contracts, manufacturing and trade sectors have begun to explore the potential for Blockchain to improve supply chain management and production, while government agencies and real estate enterprises are considering the potential for applications around data and identity management, cybersecurity, and smart contracting.

### ***What new careers can be expected to emerge from this? What types of jobs will be available?***

Blockchain is both a disruptive and an "augmenting" technology, (Disparte, 2018). As a disrupter, Blockchain hence has the potential to create substantial opportunity while also displacing current occupations or organization roles. As an augmenting technology, Blockchain builds upon and enhances current systems, requiring the developers and managers to collaborate on solutions that account for the complexities of workplace processes. There is currently substantial demand for workers with experience and knowledge of Blockchain, especially in the areas of software development, finance and accounting, and strategic development. There is also significant opportunity for entrepreneurs to enter this space and contribute to the development of

innovative software and technologies, as well as enterprise solutions designed around the needs and legacy technology of specific organizations. These innovations may push some occupations out of the workplace in particular sectors. Managerial, administrator, and ground-level operator occupations would experience both benefits and costs when Blockchain is implemented: Blockchain could streamline operations and increase effectiveness, yet also replace functions, workers, and possibly create implementation issues. Blockchain could also displace or increase competition for numerous occupations, especially those currently involved in the verification of contracts and supply chain operations, trade brokerage, data management and processing, and accounting systems management.

### ***How many jobs will this produce in the South Bay?***

Blockchain has the potential to create jobs within the South Bay, both within the information technology sector and within the organizations implementing the technology. There is substantial opportunity for Blockchain to be established as a hub within the South Bay, especially when considering broad applications across numerous industry sectors. The Southern California region is unique nationally due to its economic dynamism and diversity, as well as the number of educational establishments and lifestyle. If the South Bay can build upon the success of the Silicon Beach phenomenon, and a Blockchain hub can emerge in the region, there is significant potential for the technology to spread across the wide range of industry sectors present in the South Bay. These levels of implementation would create jobs for the companies developing the technology, and would create new opportunities in the implementing organizations, to manage the technology and to take advantage of the efficiency gains.

***Blockchain is a disruptive technology, and hence has the potential to create substantial opportunity while also displacing current occupations or organization roles.***

***Is the South Bay ready? If not, what should local businesses, policymakers, government officials, and educators be doing to better prepare for these changes?***

The South Bay is in a prime position to take advantage of Blockchain technology. The South Bay is already part of the “Silicon Beach” area, an international hub for startups and science and technological innovation, and this phenomenon is set to spread further throughout the South Bay region.

The South Bay can improve its support for Blockchain implementation in terms of attracting innovative businesses, supporting investment by local organizations, facilitating communication and collaboration between organizations, and promoting workforce development and the attraction of talent. The South Bay is well-placed to benefit from the innovation hub that has developed in the “Silicon Beach” area. The implementation of a high-speed broadband internet system in the South Bay, similar to that employed in the City of Santa Monica – one of the attractions for IT firms in that region – could boost the appeal of the South Bay for Blockchain entrepreneurs.

Smart-Net is a regional broadband project being developed by the South Bay Workforce Investment Board and the South Bay Cities Council of Governments. Smart-Net will connect 15 cities in the South Bay to a fiber-optic network offering capacity and speeds much faster than what is currently available in many areas. The project aims to ensure the South Bay region has the Broadband infrastructure needed to stay globally competitive and to facilitate Smart-City services. Providing world-class broadband speed and ca-

capacity to the South Bay is also important for business retention and consequently saving jobs (SBWIB, 2019).

Local businesses are already investing in Blockchain to identify both enterprise and innovation solutions. South Bay governments can further support these efforts by connecting innovative entrepreneurs with more established firms, and by informing both of the opportunities for IT solutions in this space. There is a developing network of Blockchain developers and experts in the broader Los Angeles region that can inform and support South Bay organizations.

Talented entrepreneurs and developers need to be nurtured and attracted to the region. The South Bay is a desirable location in terms of lifestyle, yet housing costs and transportation issues are notable concerns for many employees in the region. South Bay organizations and governments must promote innovative solutions to these opportunities, including telework programs, housing developments in local cities, and improved transportation infrastructure. Educational institutions can also play an important role in nurturing the development of the local workforce and students.

Government policy makers can also promote the use of Blockchain and related cryptocurrencies for their own organizations. Blockchain can significantly improve government operations, data and identity management, cyber-security, and citizen interactions. Furthermore there is the potential for government agencies across the state of California to use cryptocurrencies for accounts and in tax collection. **This would allow the nascent cannabis industry easier access to banking systems and facilitate tax collection.**

**There is substantial opportunity for those in executive, managerial or operations positions to develop their careers through experience and knowledge of delivering, using, and evaluating Blockchain systems**



***To what extent do we need to prepare students and workers for the impact of Blockchain technology? What career pathways should be developed at the South Bay Workforce Investment Board and local colleges and universities?***

The broad scope of industries potentially impacted by Blockchain highlights the need for students from most disciplines and workers in most occupations and industry sectors to be aware of the ways in which this new technology will be implemented into workplace systems.

There is substantial opportunity for those in executive, managerial or operations positions to develop their careers through experience and knowledge of delivering, using, and evaluating Blockchain systems. It is important to note that if Blockchain is implemented to its potential, some of these positions will be renegotiated or eliminated, highlighting the need for individuals to anticipate such market changes. There is also a significant opportunity for software developers to find employment in this area. As such, there is a need for local educational institutions to provide courses and certificates on Blockchain, focusing on the following:

- Increasing knowledge about the basic functions of Blockchain.

- Providing those in a broad range of occupations (including managers, administrators, data analysts, sales representatives, etc) and industries with an understanding of the practical implementation of Blockchain and the ways in which it might reshape the workplace and organizational structures.

Exploring Blockchain from different perspectives, including legal, ethical, security, and entrepreneurial.

- Providing Blockchain software development training classes with a computer science perspective that highlight the interactions between entrepreneurs, managers, and operators within organizations.

***What additional resources will be needed in the region to stay competitive?***

The South Bay region has the opportunity to play a central role in the development of a Blockchain hub in the Los Angeles region. The region's government agencies and educational institutions can partner with both innovative IT firms and organizations implementing Blockchain to find solutions to workforce development problems.



**The South Bay region has the opportunity to play a central role in the development of a Blockchain hub in the Los Angeles region.**







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# Blockchain Opportunities & Solutions

Originally developed as the system behind cryptocurrencies, Blockchain technology has the potential to revolutionize computing and business processes across a number of industries. Blockchain, as a decentralized DLT, allows for a cryptographic trail of digitally marked transactions to be recorded, maintained, and validated by multiple parties. **Blockchain is a continuously growing list of records, called blocks, which are linked and secured using cryptography.** Each block typically contains a cryptographic hash of the previous block, a timestamp and transaction data (Narayanan, Bonneau, Felten, Miller, & Goldfeder, 2016).

While this system was developed with digital currencies in mind, it quickly became clear that it has a number of attributes that can be applied outside of the cryptocurrency markets. By addressing the fundamental flaws in a specific industry's technology, start-ups are anticipating that Blockchain can transform cybersecurity.

**Blockchain is a continuously growing list of records, called blocks, which are linked and secured using cryptography.**

Organizations are exploring other ways to keep their data secure such as smart contracts, proof of stake, and Blockchain scaling. (Gupta, 2017). Different industries can

implement Blockchain-based systems to streamline operations, improve regulatory compliance, reduce risk between corresponding parties, remove third party intermediaries, provide transparency in cash flow acquisition, and reduce the risk of fraud (World Economic Forum, 2016). According to Magdalena Ramada, senior economist at Willis Towers Watson, Blockchain and its DLT is gaining popularity as people realize its value as a mechanism for executing transactions without the oversight of a third party or central bank (Konish, 2018).

There is significant interest and investment in Blockchain, both in the IT sector and across numerous additional industries. A recent PWC survey of companies suggests that 46% of respondents see Financial services as the leading industry for applications, followed by Industrial products and manufacturing (12%), Energy and utilities (12%), Healthcare (11%), and Government (11%). Major corporations such as IBM, Microsoft, Oracle, Facebook, and Overstock have invested significantly in Blockchain technology research and development. For example, IBM is reported to have over 1,500 employees working on Blockchain. This current popularity is due to recent notable events, yet can also be explained by important economic principles behind the technology – such as the ability to reduce transaction costs, equalize information asymmetry, improve trust, and incorporate efficiencies and economies of scale into decentralized systems. This section will explore the importance of both these events and economic principles.



## Events

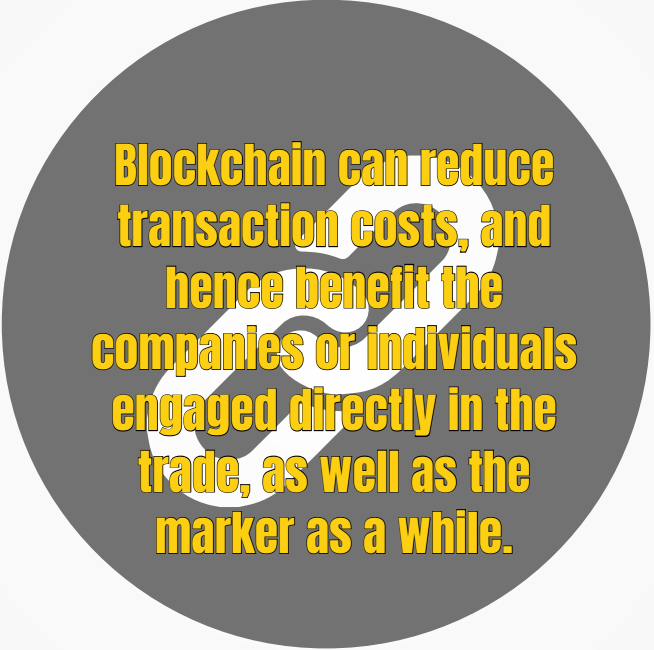
The popularity of ICOs and cryptocurrencies is critical. The wide reach and implementation of cryptocurrencies and the ability for companies and entrepreneurs worldwide to increase the ease of investment through ICOs – which are unregulated, have fewer barriers to entry, and hence are less costly – has spilled over into interest in the Blockchain technology that supports cryptocurrencies. It is notable that both government and industry, at the Federal and State levels (Long, 2019), are discussing regulation of cryptocurrencies and ICOs in the US. On the one hand, there is the concern that regulators will overreach or add substantially to the costs of start-up investments. On the other hand, the lack of regulation and support from governments can lead to businesses investing in regions with more protections and security.

In the last 5 years, cyber-attacks have been prominent in the news cycle; with the Target breach of 2013 a significant example (Julian, 2014). These events have pressured companies to use smarter technology and tactics that will keep them a step ahead of the malicious actors. This is beneficial for their clients and promotes the longevity of their brand. Preventing and responding to incidents have taken multiple forms in cybersecurity. Blockchain has provided one set of cybersecurity solutions in the areas of data and identity management, contracts, and supply chain management (Barzilay, 2017). While Blockchain and cryptocurrencies provide additional security due to their immutable and distribute nature, there is always the incentive to infiltrate or corrupt systems. Moreover, there have been numerous reports over the past year of cryptocurrency fraud cases.

## Economic Principles

### *Information Asymmetry*

Blockchain has the potential to solve a significant problem for any market, that of information asymmetry. When the buyer and seller in a marketplace have significantly different levels of information, there are incentives to cheat, which creates a lack of trust between those transacting. A notable example from the literature is the market for used cars, in which there is incentive for information to be withheld by the seller, such as concealed damages or mechanical issues (Akerloff, 1970). The buyer may also experience some barrier to accessing the information, such as insufficient knowledge of car mechanics or market prices. As a result, buyers are less likely to enter the market, dampening demand for products and leaving the potential traders – not to mention all the others who benefit from such transactions – less well off. These conditions create the opportunity for new actors to enter the marketplace, such as intermediaries like Kelley Blue Book or branded used-car traders. Information asymmetries can also provide justification for government interventions to require that information is revealed to the public through an independent body. The downside for these government interventions is that they add cost to the transaction. In sum, information asymmetries add costs and inefficiencies to the marketplace.



**Blockchain can reduce transaction costs, and hence benefit the companies or individuals engaged directly in the trade, as well as the market as a whole.**

Blockchain has the potential to solve some of these information asymmetry problems by providing immutable and transparent information to all market actors. In theory at least, Blockchain technology could provide a trustworthy and easily accessible register of used-car characteristics that both the buyer and seller could see. This would reduce the uncertainty for buyers and by implication their transaction costs. This same principle could also apply to property information records, contracts, and supply chain management. In each of these areas, Blockchain can reduce transaction costs, and hence benefit the companies or individuals engaged directly in the trade, as well as the market as a whole. One example here is the large medical industry in the South Bay, and if Blockchain is found to be a viable tool for data storage and applications, it could save the South Bay's medical industry thousands of dollars annually (Cabot Technology Solution, April 2018). Another is the innovative partnership between Lyft and Solve. Care using Blockchain to improve medical care (Nunn, 2019). Blockchain could also revolutionize the way the industry operates by providing trusted and incorruptible data to patient and doctor alike.

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## ***Decentralization and Economies of Scale***

Another set of economic principles that helps to explain the appeal of Blockchain is the tension between economies of scale and decentralization. As first highlighted in Ronald Coase's *Nature of the Firm* (1937), individuals group into firms in order to gain the benefits of economies of scale, improved information, and lower risks within an organization. Yet such collaboration comes with costs, including bureaucratic systems, inefficient management structures, and the limitation of innovation and risk-taking. In other words, there are benefits and costs to large, centralized firms on the one hand, and decentralized networks of individuals on the other. In recent years technological innovations have enabled companies and individuals to benefit from combining the best elements of both centralized and decentralized systems. This is most apparent in the gig economy, whereby companies

providing the technology to connect buyers and sellers in the areas of rideshares, vacation rentals, or electric scooters, to facilitate individual transactions that would have previously been impractical. In each of these cases, the market is being improved by the balance of decentralized service providers – rideshare drivers, home-owners, or scooter mechanics and operators – and a centralized software application that improves information and lowers transaction costs (Tasca, 2018).

Blockchain has the potential to provide centralizing forces that are similar in effect to economies of scale, while taking advantage of the benefits of decentralization. Supply chain management provides an interesting example of these forces. Due to the global nature of supply chains, with productive activities linked across industry sectors and nations, supply chains are often decentralized in nature. While there are good reasons for this condition, including the unique practices and regulations of each industry and nation, this condition creates numerous layers of transaction costs. Blockchain can facilitate the management of supply chains by providing standardized and transparent contracts, improving the speed of information flows through the system, and facilitating the ability of corporations and regulators to track and manage productive processes. Each of these elements reduces transaction costs, facilitates partnerships and collaborations between firms worldwide, and ultimately connects producers and consumers. As such, the market can take advantage of the benefits of both centralized information systems and economies of scale and decentralized innovation, flexibility, and knowledge of local markets and regulations.



## ***Technological Change***

Technological change is a key element of macro-economic growth; after every major technological innovation, significant economic development follows. Blockchain is in an interesting position currently because it is still largely in the proof-of-concept stage, yet has substantial potential to be transformative across many industry sectors and occupations. If the potential of Blockchain is realized it will provide yet another example of how technological change can enhance economic growth.

Such disruption creates winners and losers. The winners are likely to be those first adopters who invest in the technology, as either innovating IT start-ups, or organizations implementing enterprise solutions. Similarly, regions and institutions that invest early in Blockchain by supporting innovators, facilitating investors, and educating workers, can reap the rewards of the technological change. In this respect, **South Bay governments and educational institutions have the potential to become a first adopter and first investor in this space and hence benefit while other regions lag behind.**

**Blockchain has the potential to provide centralizing forces that are similar in effect to economies of scale, while taking advantage of the benefits of decentralization.**

**South Bay governments and educational institutions have the potential to become a first adopter and first investor in this space and hence benefit while other regions lag behind.**

## ***Risk and Uncertainty vs Opportunity***

As with any uncertain new technology, there is significant uncertainty that limits the level of investment and creates market distortions. However, this uncertainty also creates opportunity for new market entrants. Blockchain is currently in the early stages of development, and is both inefficient computationally and clunky to use. Moreover, while there are many ideas about how Blockchain might be implemented across different sectors of the economy, these ideas need to be developed and delivered in ways that are practical and meaningful to customers. This development and delivery is uncertain and costly, leading to hesitancy among decision makers.

## The consequences of risk and uncertainty around Blockchain are apparent on a number of levels.

**First**, in order for Blockchain to be implemented broadly, there need to be sufficient numbers innovators and entrepreneurs and a level of competition between them. These individuals and start-ups entering the marketplace face the risk of investing their time and money in the ideas that can create technological change, but with uncertain outcomes and payoffs to them. Such risks are always present for entrepreneurs, yet are heightened given the unproven nature of Blockchain technology.

**Second**, and in a similar vein, organizational executives face uncertainty around investing in Blockchain at this early stage of development. The benefits of these enterprise solutions could be transformative to such organizations, but decision makers need to balance the risks and rewards of adopting the technology early at a possibly cheaper level – and gaining an advantage over competitors – as opposed to waiting for other firms to take the risk and learn from others' mistakes, despite possibly losing out to competitors.

**Third**, there is a risk for individual workers and students with respect to investing time and money in training, either around Blockchain in general, or specifically around software development, as the outcomes are uncertain. Currently, there are not enough workers and students with the sufficient levels of training to contribute to the emerging Blockchain industry. This creates labor market distortions, with the demand for labor outweighing the supply, creating artificially inflated wages, and hence further-stymieing investment levels. Technology journalist Molly Zuckerman recently commented on a tweet that showed a graph of the rising number of job postings for Blockchain developers, a line that kept going up regardless of the price of Bitcoin. Zuckerman thinks that Blockchain development will

become a key type of new career, as crypto-enthusiasts like Jimmy Song have already taken note of. There does appear to be an interest in training in this field: “[P]eople are desperate to get into this field, because it’s the direction the technology is going” (Ye Han, 2018).

One noteworthy element here is that many Blockchain developers have been working out of a desire to contribute to society, are unattached to any organization, and do not receive any monetary compensation for their developments. As such, it will be interesting to see how Blockchain developers will turn this work into a regular paying job at a big technology company (M. Zuckerman, Personal communication, April 20, 2018).

**“[P]eople are desperate to get into this field, because it’s the direction the technology is going” (Ye Han, 2018).**



## Blockchain professionals are lacking in the South Bay,

and most South Bay companies have not yet developed business plans to support Blockchain. While those companies advance with this new technology, smaller companies, and companies in the South Bay, may miss out on emerging opportunities due to their lack of knowledge and resources. For example, the South Bay has many medical and medical insurance facilities not currently using Blockchain management because of many political factors dealing with the security of personal information, and the fear of change (Slabodkin, February 2018). Since the technology is so new, some experts wonder if Blockchain is the answer to their data security problems, or if it is an over-exaggerated claim. South Bay businesses, both large and small organizations, may be afraid of or overwhelmed with change from conventional data management systems to Blockchain technology (Slabodkin, February 2018).

**Local educational institutions can play a key role in preparing students and workers for a career in the Blockchain field.** Small businesses need the workforce that are ready to meet the demands of the ever-changing dynamics of Blockchain, especially professionals with specific knowledge of Blockchain utility and construction. Educational institutions can also highlight the potential job opportunities for a knowledgeable workforce to build applications to run on the network. The technology is often open-source and is waiting for innovative thinkers to become application developers and programmers. In sum, instructors and degree programs will be needed to advance and legitimize the technology.

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**Local educational institutions can play a key role in preparing students and workers for a career in the Blockchain field.**

# Blockchain Applications

While there is substantial potential for growth and disruption from this relatively new technology, there has only been limited exploration of how Blockchain will impact specific economic sectors, and there have been no studies on how it will impact workforce development concerns broadly, nor specific economic regions. The impact of Blockchain has been studied in general at UC Berkeley (Blockchain at Berkeley, 2017), in terms of global supply chains at UC Irvine (2017), with respect to alternative finance at the University of Cambridge (Hileman and Rauchs, 2017a; 2017b), and in terms of human resources and the public sector at Deloitte (Killmeyer, White, and Chew, 2017; Brown and Smit, 2017).

This section identifies and examines the themes observed across those discussions and analyses of the Blockchain issue available from credible online tech news sites, industry sector reports, and academic journal articles.

These themes are as follows:

- Cybersecurity
- Anti-Money Laundering
- File Storage and Data Management
- Accounting
- Contract and Title Registration
- Online Finance and e-Commerce
- Government
- Business

These themes could in theory apply to any economic sector, yet, as shown in Table 1, they apply to specific economic sectors in different ways. This literature review then turns to the different economic sectors prevalent in the South Bay Economy (also presented in Table 1) and explores the ways in which the different Blockchain themes might apply to or impact them.

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## Cybersecurity

Blockchain has the potential to improve cybersecurity across numerous sectors and in different ways such as linked timestamping, decentralization of data, and peer-to-peer systems. Currently one of the biggest actors in Blockchain cybersecurity is Lockheed Martin, a major defense contractor. Lockheed Martin has partnered with Guardtime (Lockheed Martin, 2017), a cybersecurity startup using Blockchain technology with their innovative concept of linked timestamping. This approach adds an additional security property when it comes to formal methods and verification.

Another example is that of REMME, which has developed the technology to decentralize accounts so there is no need for passwords and builds a stronger user authentication. The decentralization of data is similar to the cloud infrastructure but on an encrypted level of security with Blockchain technology. In the past five years we have seen many data breaches due to weak or non-existent passwords. A company, such as REMME, can reduce or prevent high value accounts from being hacked.

A third example is that of Obsidian, which is paving the way for peer-to-peer communications without the need for email or phone number which in turn adds privacy to each of the end users. They also have an additional platform, which encourages professionals to communicate without having to give up their identity, like more traditional professional networking platforms.

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# Anti-Money Laundering

Money laundering is a process of conducting financial transactions in a manner that obscures the link between funds and their origin. Various types of people including criminals and terrorist to finance their illegal activities that destroys the integrity of the global economy perform this act. With the introduction of Blockchain, the financial transactions will be

integrated in a decentralized monitoring system. The immutable nature of the technology to identify and stop suspicious transaction efficiently. With a Blockchain system using smart-contracts, it will allow financial institutions to securely parse data through the anti-money laundering capacity of the Blockchain (DCosta, 2017).

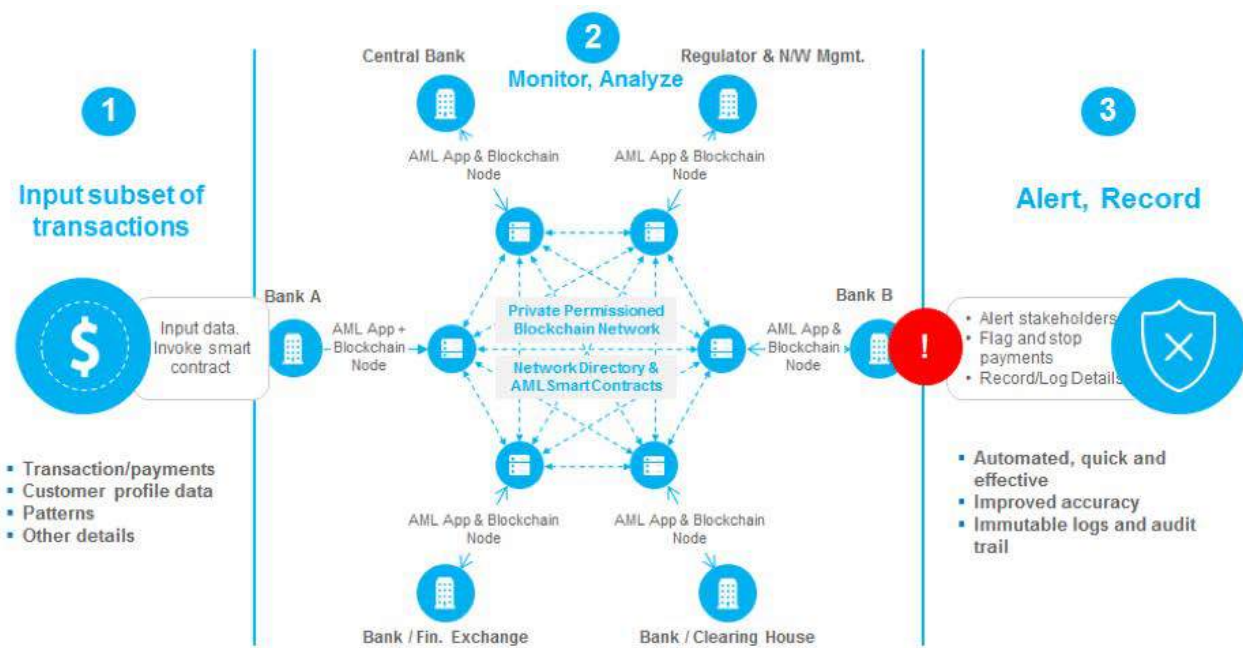


Figure 1. Anti-money laundering approach with Blockchain

Source: <https://internationalbanker.com/technology/blockchain-aml-harnessing-blockchain-technology-detect-prevent-money-laundering/>



# File Storage and Data Management

**F**ile storage services are currently centralized for most organizations and data management systems. This means that data is stored in a single location, and follows a single process for access of the data. Blockchain enables file storage services to become decentralized through the “sharding” process, whereby the data can be split up and assigned to multiple nodes of the network, each with their own access processes. Indeed, home or business computers or servers renting their hard-drives, much like vacation rentals or ride-share applications, reducing the costs of storage to IT firms and consumers, can provide these nodes. **Even if a single data point is corrupted or fails, the other pieces of the data are not accessed. Hence, Blockchain technology can improve security,** and decrease dependency on a single node or storage system. All in all this builds redundancy into data management systems, making them more resilient and cheaper for consumers.

According to Dr. John Menary, a Professor at California State University-Dominguez Hills, in Science and Technology, different sectors can use Blockchain if they are information-based, but if the “information is to be used in analysis, say as Big Data, this might be problematic. In the example of health care, each person’s health data and information [Block 1] could be accessible to a Doctor/Hospital [Block 2] and a central health agency [Block 3], eliminating the need for insurance companies and health administrative workers, or letting these health insurance agencies specialize in special health insurance people could buy if they wanted” (Personal communication, April 2018). Also, high tech companies might see Blockchain as an important tool for change, but if “it can be shown to be essential, like Microsoft’s Office, it probably will not go far. Even Bitcoin had and has problems especially when it runs up against banks. These ‘institutions’ are firmly planted, and change will be

slow” (Dr. Menary, personal communication, April 2018). It will be difficult for this change to happen especially when it involves eliminating some jobs. Also, according to Dr. Menary, Blockchain could “go the way of a fad unless an experimental program is created to show its functionality” (Personal communication, April 2018).

The process of data management includes understanding from where data is originating, how it is moving through systems, who has access to the data, and how it is being modified. Blockchain has the ability to improve monitoring of each of these steps. These are highlighted when considering the principles important to data management. First, transparency and visibility are important goals, as no one should be able to cover their tracks when accessing data. **Blockchain has the potential to be immutable and hence not adjusted by a single individual.** Second, accountability should ensure that every action could be attributable to its owner. Blockchain can achieve this principle through the tracking of access to the data. Third, privacy and security should be afforded to the user so that unwanted parties do not obtain confidential information. The decentralized structure of Blockchain can enable data to be both secure and private. Fourth, scalability is an important goal so that any data management processes can be scaled to large scale datasets. While achievable, Blockchain is currently limited in terms of operability and computationally inefficient, implying that scalability will be difficult. Fifth, portability is important so that security moves with the data, wherever the data is packaged or assigned. The decentralized nature of Blockchain means that location is less important than even for current cloud computing systems. Sixth, and also in terms of security, permanence is an important principle. Security must not be ephemeral; it must exist as long as the data exists and ideally longer. This feature is also at the heart of Blockchain.



## Accounting

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Modern financial accounting is based on a double entry system that can be enhanced by a proposed triple entry system using Blockchain technology. This method would have companies record their transactions into a joint register that involves a third entry. Instead of having both entities involved in a transaction keep separate sets of accounting records for the same entry, they can record the transaction as a transfer between wallet addresses in the same distributed, public ledger, creating an interlocking system of enduring accounting records. Entries will be distributed and cryptographically sealed to make falsification or destruction practically impossible. Another approach to using Blockchain technology in financial accounting services would have a hash string assigned to all digital records and then time-stamped by writing them into the Blockchain by way of a transaction. At any point in time after the record has been timestamped, the hash string for the entry can be generated again and compared to the original one stored in the Blockchain for accuracy and authenticity.

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**Even if a single data point is corrupted or fails, the other pieces of the data are not accessed. Hence, Blockchain technology can improve security**

## Contracting and Title Registration

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Property and title registration related information is generally available in digital and paper form that is often hosted on disparate systems that results in a lack of transparency and efficiency; resulting in high incidents of inaccuracies which lead to a great potential for fraud. The introduction of Blockchain technology to these systems could create a common and public database that can draw from private database systems for transparency (Campbell, 2019d). This shared database can be accessed and modified by the multiple entities involved in a title transaction such as owners, tenants, operators, and service providers who will be able to verify all information related to a specific contract. The inclusion of these different entities alleviates concerns of trust that are often found in title transactions where parties do not have previously established business relationships. This network allows for transactions to be independently verified and reconciled automatically, eliminating the need for traditional intermediaries.

As stated by professors Marco Iansiti and Karim R. Lakhani at the Harvard Business School, "with Blockchain, we can imagine a world in which contracts are embedded in digital code and stored in transparent, shared databases, where they are protected from deletion, tampering, and revision" (2017). The property can be physical, for example, a house, a car, and so forth or it could be non-physical, such as data keeping. Prit Sheth, a full-stack engineer and an expert in distributed systems and algorithms, believes that the benefits of Blockchain innovation outweigh the administrative issues and specialized difficulties, especially with respect to controlling the responsibility for property or resource by means of Blockchain utilizing Smart Contracts (Coleman, 2019)

# Online Finance and e-Commerce

The expansion of a bank's complex services and transactions available to clients results in an increased amount of financial intermediaries that lead to an increased in transaction costs. Blockchain technology can reduce the amount of necessary intermediaries which leads to an elimination of the costs associated with them. Blockchain can introduce smart contracts, self-executing programs that can be triggered when certain conditions have been met in order to digital assets. A bank's economic function to society as an intermediary and transaction service provider is redefined by introducing Blockchain's decentralized public ledger of transactions that are democratically owned. The benefits of Blockchain technology in the financial sector include reduction in transaction costs, increase in regulatory compliance, instantaneous settlement, increased security, and streamlines international trade finance. To date, the areas that can see the biggest impact include payment systems, banking, securities settlement, and the trade of digital and financial assets.

A lawyer with expertise in Blockchain and its intersection with supply chains and agriculture provide an interesting example here. This individual highlights that the financial payment of tokenization can replace the third party between farmer and final point of sale for agricultural products, while smart-contracts are likely to be the new way in providing services to clients in the legal industry. This form of Blockchain can created efficiency and security to his clients without worrying about alteration or physical document damage. To take advantage of the opportunities in this space, individuals must understand Blockchain- and cryptocurrency-related technicalities such as IP address protection, anti-money laundering rules, securities law aka Securities Exchange Commission, commodities, Federal Trade Commission, and privacy laws (what can be anonymous and still be legal) in order to assist his clients. This is all still at the proof of concept stage, and it is estimated that Blockchain can be implemented about within about two years into this business space. One current impediment to further implementation is the tax collection process, as the Internal Revenue Service does not have a clear set of protocols for the use of cryptocurrencies (Royce, Personal Communication, May 20, 2018).



# Projections of Blockchain Industry Development

This section looks at projections of Blockchain in the coming years. Based on interviews with experts, a model of factors influencing the rate of Blockchain implementation both globally and in the South Bay is

proposed in Table 1. Further discussion of projected implementation and outcomes are presented before an exploration of the implementation challenges.

**Table 1. Proposed Model of Factors Influencing the Rate of Blockchain Implementation**

	External Factors to the Industry	Internal Factors to the Industry
<b>Global</b>	<ul style="list-style-type: none"> <li>• Success of ICOs and cryptocurrencies and potential regulation</li> <li>• Economic conditions</li> </ul>	<ul style="list-style-type: none"> <li>• Blockchain technology overcoming interoperability and user experience issues</li> <li>• Labor supply - education and training of developers and managers</li> </ul>
<b>South Bay</b>	<ul style="list-style-type: none"> <li>• Competition from other regions within the US – e.g. Bay Area, New York, St. Louis, Oregon – and Internationally, such as EU and Asia</li> <li>• Obstacles to attract workers, including housing costs</li> </ul>	<ul style="list-style-type: none"> <li>• Implementation issues: Success at enterprise level</li> <li>• Company partnerships</li> <li>• Cost of labor</li> <li>• Entrepreneurial and innovative ideas</li> </ul>

The impacts of Blockchain could be many and varied. Blockchain can affect people across a wide range of industries and within numerous occupations. Users can be anyone, and ultimately the user base is likely to mimic the internet’s users. As discussed above, the open-ledger nature of Blockchain means it will help to equalize information for all traders and cut the intermediary out of many activities (Wintermeyer, 2017). Blockchain will also be used to verify information authenticities like employment qualifications and history (Tapscott, 2017). Governments and nonprofits will eventually be

users of Blockchain once the technology has had more vetting. Blockchain can create an era of government transparency and develop a culture of equality by using Blockchain open ledger so everyone in the chain can see changes in the chain (Tapscott, 2017). Blockchain is expected to help economic growth by streamlining procedures that create organization that is more efficient and making an environment that with fewer barriers to entry (Tapscott, 2017).

***The impacts of Blockchain could be many and varied. Blockchain can affect people across a wide range of industries and within numerous occupations.***

# Outcomes

## 1-2 Years

In the short-term impacts will be small. Public awareness is likely to increase with growing media coverage of cryptocurrency (Tapscott, 2017); individuals are likely begin to know basics of Blockchain and how it will be used. Blockchain technology is likely to become more refined and user-friendly. Blockchain will start being used in niche Blockchain markets, and organizations that are more significant are likely to start toying with the idea of using Blockchain (Wintermeyer, 2017).

It is likely that implementation will take a longer period. According to a recent survey by KPMG, 41% of responding companies perceived that it is “very likely/likely” Blockchain will be implemented within their company over the next three years. On the other hand, 28% of responding companies said that it was “not likely/not at all likely.” Over the same period, a further 48% noted that it is “very likely/likely” that Blockchain will business practices, while on the other hand, 27% stated that it was “not likely/not at all likely” (Campbell, 2019a).

Recently concerns have been raised about the “hype” surrounding Blockchain, with some market analysts suggesting the possibility of a “blockchain winter” (Bennett, 2018; Campbell, 2019g). As the promise of new ideas has given way to the reality of research, development, piloting, and implementation, there remains uncertainty about whether Blockchain solutions can deliver on the potential. Rajesh Kandaswamy, an analyst at Gartner Inc. argues “the disconnection between the hype and reality is significant – I’ve never seen anything like it. In terms of actual production use, it’s very rare” (Kharif, 2018). A recent PWC survey found that 20% of responding companies were in the research phase, 30% in the development phase, 10% in the pilot phase, and 15% were running live Blockchain projects (Davies and Likens, 2018). Numerous planned projects have either be shelved or faced delays.

For example, ASX, the operator of Australia’s national stock exchange, announced in 2016 that they would release a commercial Blockchain platform by 2018. The expected rollout is now 2021 (Kharif, 2018). Similarly, Australian mining company BHP Billiton announced plans in 2016 of a 2017 Blockchain rollout to monitor rock and fluid samples. That company currently has no Blockchain projects or experiments underway (Kharif, 2018). All that said, in a new field with high degrees of innovation and entrepreneurialism, it is expected that failures and subsequent problem solving will be a common feature of the marketplace (Campbell, 2019a; Aitken, 2019).

According to Professor Bill Maurer, Dean of Social Sciences at University of California, Irvine, the fate of the ICO bubble is likely to influence significantly how Blockchain will play out in the short term. Regulations of ICO and cryptocurrencies are likely to emerge, increasing the costs of investment and probably dampening the level of interest in that field. This is likely to lead to a focus on the development of technology behind it – i.e. Blockchain (Maurer, Personal Communication, June 9, 2018).

## The US is currently behind other countries in terms of the level of development and implementation of Blockchain

(Pease, Personal Communication, June 13, 2018). Unless there is a significant or notorious breakthrough by a major company, it is likely that over the next 2 years, Blockchain will be adopted in smaller pieces in specific areas (Pease, Personal Communication, June 13, 2018; Brakeville, Personal Communication, June 14, 2018; Mirkovic, Personal Communication, June 15, 2018).





Much of the current work is at the proof-of-concept stage, and within universities; while the IT and tech sectors are not as crowded currently, this means that there is lots space for growth in regions such as Los Angeles that have less developed tech sectors (Maurer, Personal Communication, June 9, 2018). Within the US, there is notable interest in the St Louis, especially in the shipping industry, while in Orange County, there is more work around finance and legal tech/smart contracts. There is also notable work in Oregon, especially with respect to mobile payment systems and contracts, for example in bike share and goods movement. Internationally, there have been substantial efforts to develop and implement Blockchain in the area of identity management, especially in Estonia, Singapore, and Sweden (Maurer, Personal Communication, June 9, 2018).

## 3-5 Years

In the medium term, impacts might be businesses that are more significant and government implementing Blockchain in operating practices. Some experts believe that this period will see the major development and implementation of Blockchain as benefits are noted and shared adoption will grow significantly over this period by major players who are followers (Brakeville, Personal Communication, June 14, 2018; Zhao, Personal Communication, June 12, 2018). The practices could anything from employment verification to a list of vacant positions in the South Bay (Clark, 2016). The public are likely to better-understand Blockchain, and more accepted as secure information. If SBWIB helps government and business in the south bay implement Blockchain friendly policies, they will start to see a decrease in unemployment and attract talented individuals (Clark, 2016).

## 6-10 Years

Over the longer-term, we are likely to see a full integration Blockchain be widely used for securing valuable information like financial, medical, and personal information (Tapscott, 2017). Some experts believe that broader implementation of Blockchain will take place during this period, since this is a disruptive technology and the workforce is an aging population, implying that acceptance and implementation will be slow (Murty, Personal Communication, June 14, 2018). It is argued that once 10% market share adopts the technology, a major adoption wave will follow, which is likely to be during this period (Brakeville, Personal Communication, June 14, 2018).

There are likely to be higher levels of engagement in the South Bay, with the South Bay residents gaining a greater understanding of Blockchain, and the technology making its way into the school systems and becoming part of most curriculums (Clark, 2016).

## 10+ Years

It is anticipated by some experts that a new eco-system would take 10-20 year time horizon to be achieved. It would take longer still for different interests to agree to single-system (Brakeville, Personal Communication, June 14, 2018). This eco-system would require the complete redesign of logistics networks on the technology with undetermined consequences in terms of efficiency. It is anticipated that Blockchain will become as important to the South Bay and world economy as the internet is to today's economy (Wintermeyer, 2017).

# Implementation Challenges

Based on interviews with numerous Blockchain experts, the following implementation challenges are identified. Ultimately, the “success” of Blockchain – i.e. the speed of and extent to which it is implemented – depend on the type of Blockchain. For example, a Social Media or Vacation Rental disrupter would be competing against

trusted brands with advanced user buy-in, whereas an enterprise solution such as smart contract could instead be competing against the current organizational contracting system, which are long-established yet time-consuming. These challenges are framed by the questions posed by one Blockchain expert:

- How do companies determine if they should implement it?
- How should the architecture be developed?
- When we have the road map, who has the tech skills to develop?
- If innovation solutions, what are the other issues – e.g. legal, accounting, economics?

## ***Investment and business obstacles***

- Concept can be confusing
- Lack of current product or service proof of concept
- Competition between numerous services and protocol; difficult to know which to back before common standard established

## ***Technology development challenges***

- Technology is currently very clunky to implement and use; needs to be improved in terms of computational efficiency
- Integration with legacy IT systems within organizations can be challenging, especially when older
- Lack of technical and software development talent available drives up the labor wage rate for innovation start-ups

## ***Rollout challenges within organizations***

- Business process and practices need to adapt to new approach
- Users may be unaware of Blockchain adoption beyond occasional new software, creating a disconnect between IT and users
- Resistance from skeptics, especially among less flexible or tech-savvy employees
- Hardware and software solutions and training will be required for organizations to benefit fully from the new technology and processes
- IT systems implementation with respect to integration, communication, and security
- Legal and ethical implications of new data and identity management and contractual approaches

**Blockchain can create an era of government transparency and develop a culture of equality by using Blockchain open ledger so everyone in the chain can see changes in the chain (Tapscott, 2017).**

# Blockchain's Impacts on South Bay Industry Sectors and Occupations

**B**lockchain technology can benefit and impact numerous different private and public-sector establishments that are operating in the South Bay. Major industries in the South Bay include aerospace and defense, manufacturing, international trade, government, healthcare, business/professional, and hospitality/tourism.

The South Bay is a major economic engine of the Los Angeles region. With around 1.1 million residents in 2014 (LAEDC, 2015), it is 11 percent of the County of Los Angeles by nighttime population, with Torrance the largest city (148,000), followed by Inglewood (112,000) and Carson (93,000). In line with the LA County, South Bay is racially and ethnically diverse, with 45.2 percent Hispanic, 13.2 percent African American, 29.8 percent White, and 15.5 percent Asian (LAEDC, 2015). Leisure and hospitality, Transportation, warehousing and utilities, and Health services are major employers in the region, with total payroll equaling \$31.8 billion in the region. Average annual wages are \$57,502. 45,280 businesses are established in the South Bay region, around 10 percent of Los Angeles County. In particular, many of the new jobs forecasted in the South Bay economy are in the health care industry, which could be impacted significantly by Blockchain with respect to patient data records.

As highlighted in Tables 2 and 3, the South Bay economy is also very diverse in terms of the range of industry. There are a broad range of sectors, most of which are relevant to Blockchain. There is a relatively small IT sector compared to the rest of Los Angeles County. However, there is potential for growth as Silicon Beach spreads south into El Segundo and other South Bay cities. There are notable financial and business-services sectors, both of which are at the forefront of Blockchain implementation. There is a significant legacy of manufacturing in the South Bay, including high value, capital-intensive aerospace and defense industries, which would have specific needs for Blockchain in terms of supply chain management and cyber-security. There are also numerous, small health care establishments with large employment numbers, and which have significant potential for implementation of Blockchain in the area of data and identity management.

**The South Bay is a major economic engine of the Los Angeles region.**



**Table 2. Establishment Count, Employment, and Annual Average Wage (AAW) by Industry, 2016**

Industry	Los Angeles County			South Bay Region			
	Est.	Emplt.	A.A.W. (\$)	Est.	Emplt.	A.A.W. (\$)	LQ
Natural Resources	480	8,900	74,000	60	1,500	67,100	1.3
Construction	13,630	132,500	61,000	1,540	17,400	63,600	1.0
Manufacturing	12,250	355,600	68,200	1,390	75,700	107,100	1.7
Wholesale Trade	19,650	223,400	62,100	1,990	26,500	74,500	0.9
Retail Trade	26,900	416,800	34,500	3,030	51,900	34,000	1.0
Transportation Utilities	6,280	162,100	58,900	1,620	57,600	63,000	2.8
Information	9,420	227,500	106,000	590	11,500	122,000	0.4
Financial Activities	24,980	217,800	99,100	2,800	24,300	82,300	0.9
Professional/Business Services	46,990	596,900	73,700	5,120	83,100	66,400	1.1
Educational Services	3,200	98,000	56,700	390	8,600	47,500	0.7
Health Care	213,990	650,700	43,600	18,970	65,300	45,900	0.8
Leisure and Hospitality	32,000	506,200	36,500	3,070	67,000	28,500	1.0
Other Services and Unclassified	26,630	146,800	36,800	4,600	18,500	35,500	1.0
Government	6,190	562,000	69,300	730	46,100	63,600	0.6
<b>Total</b>	<b>466,350</b>	<b>4,344,600</b>	<b>59,900</b>	<b>45,890</b>	<b>555,000</b>	<b>62,200</b>	<b>N/A</b>



**Table 3. Output, Output per Worker, and Value Added by South Bay Industry, 2015**

## Industry Employment Analysis

Industry	Output (\$M)	Output per Worker (\$'000s)	Total Value Added (\$M)
Natural Resources	20,349.9	17,986.3 <sup>a</sup>	118.3
Construction	4,362.1	169.1	1,967.3
Manufacturing	29,995.2	427.4	16,679.1
Wholesale Trade	7,978.2	249.2	5,041.0
Retail Trade	5,341.2	93.7	3,732.3
Transportation/Utilities	8,458.3	259.7	4,213.6
Information	17,545.1	362.4	3,767.5
Financial Activities	446.1	234.3	2,831.1
Professional/Business Services	6,101.8	147.7	10,903.3
Educational Services	7,361.0	55.1	295.0
Health Care	13,797.8	84.1	3,919.2
Leisure and Hospitality	1,376.1	75.5	4,569.7
Other Services and Unclassified	13,797.8	272.0	9,835.8
Government	13,797.8	287.1	796.9
<b>Total</b>	<b>135,495.3</b>	<b>221.0</b>	<b>68,670.1</b>

**Source: Author calculations based on IMPLAN data**

<sup>a</sup> This outlier reflects the capital-intensive petroleum refining industry sector, which is prominent in the South Bay.

The DLT properties of Blockchain technology have the potential to change significantly the workplace in general, but the potential impacts from its adoption are expected to differ significantly in speed and magnitude among sectors, industries, and specific occupations. Disruptions to the workplace might imply merely forcing the workforce to acquire basic skills through a brief training about the challenges and opportunities from Blockchain technology or, in a more severe case; it might imply significant reductions in employment due to disruptions from a wide adoption of Blockchain technology.

Furthermore, some sectors and industries seem to be more willing and able to embrace the change than others are. Based on this research project findings, interviews, and industry experts' opinions, a wide adoption of Blockchain technology is most likely to have a significant impact on Financial Activities, Government, Health Care, Information, and Transportation/Utilities industries. Consequently, the higher dependence on these particular economic sectors, the higher the expected employment and economic impacts from the adoption of Blockchain technology.

# Employment and Projections by Occupations

Employment by occupation figures and projections by the U.S. Bureau of Labor Statistics (presented in Table 4) show that the overall employment is projected to grow by about 7.4 percent from 2016 to 2026. However, not all occupations are expected to grow at the same rate. For example, Healthcare support occupations are projected to grow at about 23.6 percent, while production and Farming, fishing, and forestry occupations are projected to shrink during the same period.

It is typically difficult to map occupational data with industry level data, but Healthcare practitioners and technical, Healthcare support, Education, training, and library, Business and financial operations, Transportation and material moving, and Management occupations might be more likely to be severely impacted from the adoption of Blockchain technology.

According to the estimates for the U.S., healthcare, management, and business and financial operations occupations are projected to grow at a significant rate, and these occupations are likely to be considerably changed if Blockchain technology is widely adopted.

In terms of the typical entry-level education needed (Table 5) for the Healthcare practitioners and technical occupations, the highest projected change occupation, Table 5 illustrates that occupations with a Bachelor's degree as the typical entry-level education needed are projected to have the highest growth. This implies that Blockchain technology is very likely to affect the jobs for a large number of Bachelors' graduates. This suggests that Blockchain technology is highly likely to become part of their workplace, so it should be also part of their educational background.

**Table 4. U.S Employment and Projections by Occupation (Thousands)**

	2016	2026*	Change	% Change
<b>Total</b>	<b>156,064</b>	<b>167,582</b>	<b>11,519</b>	<b>7.4</b>
Healthcare Practitioners and Technical	8,752	10,088	1,337	15.3
Food Preparation and Serving Related	13,206	14,439	1,232	9.3
Personal Care and Service	6,420	7,647	1,228	19.1
Healthcare Support	4,316	5,335	1,020	23.6
Education, Training, and Library	9,427	10,315	889	9.4
Management	9,533	10,340	807	8.5
Business and Financial Operations	8,067	8,841	774	9.6
Construction and Extraction	6,813	7,560	748	11
Transportation and Material Moving	10,274	10,908	634	6.2
Computer and Mathematical	4,419	5,027	608	13.7
Building and Grounds Cleaning and Maintenance	5,654	6,178	524	9.3
Sales and Related	15,748	16,207	459	2.9
Installation, Maintenance, and Repair	5,905	6,294	388	6.6
Community and Social Service	2,571	2,943	372	14.5
Architecture and Engineering	2,601	2,795	194	7.5
Arts, Design, Entertainment, Sports and Media	2,773	2,941	168	6.1
Protective Service	3,506	3,664	158	4.5
Office and Administrative Support	23,081	23,231	150	0.6
Life, Physical, and Social Science	1,300	1,424	125	9.6
Legal	1,283	1,400	116	9.1
Farming, Fishing, and Forestry	1,060	1,057	-4	-0.3
Production	9,357	8,950	-407	-4.3

**\* Projections by the U.S. Bureau of Labor Statistics Source: U.S. Bureau of Labor Statistics**

**Table 5. U.S. Employment and Projections by Occupation and Education (Thousands)**

	2016	2026*	Change	% Change
<b>Healthcare practitioners and technical</b>	<b>8,752</b>	<b>10,088</b>	<b>1,337</b>	<b>15.3</b>
Doctors or professional degree	1,613	1,850	237	14.7
Master’s degree	653	824	171	26.2
Bachelor’s degree	3,365	3,853	489	14.5
Associate’s degree	1,052	1,219	168	15.9
High school diploma or equivalent	2,070	2,342	272	13.1

*\* Projections by the U.S. Bureau of Labor Statistics  
Source: U.S. Bureau of Labor Statistics & Own Calculations*

Data on industry occupation and projections from the U.S. Bureau of Labor Statistics show that the entire Healthcare and Social Assistance industry is projected to have the largest growth from 2016 to 2026. Other industries, like Professional and Business Services, Transportation and Warehousing, and State and Local Government, are also projected to have significant growth rates for the same period. **Altogether, if widely implemented, Blockchain technology has the potential to change significantly the occupations and industries with the largest projected growth rates for the U.S. in the near future.**

For California, the employment projections by occupation are somewhat similar to the U.S. estimates. However, there are some major differences. First, the projections for employment growth are more than double in California than in the U.S. Second, Health Care Practitioners and Technical and Health Care Support occupations growth rank much lower in California than in the U.S. Third, Office and Administrations Support and Sales and Related occupations are in the top 10 occupations by growth in California but not in the U.S. Given these differences, the employment projections suggest the potential economic and employment impacts of Blockchain technology adoption might be relatively less dramatic for California than for the U.S. as a whole.

**“The South Bay economy is also very diverse in terms of the range of industry. There are a broad range of sectors, most of which are relevant to Blockchain.”**

**Table 6. California Employment and Projections by Occupation  
(Thousands)**

	<b>2016</b>	<b>2026*</b>	<b>Change</b>	<b>% Change</b>
<b>Total</b>	<b>17,135</b>	<b>19,721</b>	<b>2,586</b>	<b>15.1</b>
Food Preparation and Serving Related	1,433	1,780	347	24.2
Personal Care and Service	964	1,213	249	25.8
Office and Administrative Support	2,509	2,706	197	7.9
Construction and Extraction	678	869	191	28.3
Management	1,161	1,345	184	15.9
Business and Financial Operations	940	1,104	164	17.4
Sales and Related	1,686	1,849	164	9.7
Computer and Mathematical	552	715	163	29.5
Transportation and Material Moving	1,037	1,190	153	14.7
Healthcare Practitioners and Technical	770	912	142	18.5
Education, Training, and Library	1,008	1,137	129	12.8
Healthcare Support	366	447	81	22.2
Installation, Maintenance, and Repair	518	582	65	12.5
Building and Grounds Cleaning and Maintenance	576	525	50	10.5
Arts, Design, Entertainment, Sports and Media	412	462	50	12.0
Protective Service	377	419	41	10.9
Farming, Fishing, and Forestry	338	378	40	11.8
Community and Social Service	255	295	40	15.6
Life, Physical, and Social Science	196	233	38	19.2
Architecture and Engineering	340	377	37	11.0
Production	880	914	34	3.9
Legal	142	158	16	10.9

**\* Projections by the California EDD**  
**Source: California EDD-Labor Market Information Division**



# Employment and Projections by Industry

Employment projections in Tables 7 and 8 by industry for California and Los Angeles County shows that employment growth in Los Angeles county would be lower than for California but still significantly higher than for the U.S. as a whole. Among the industries with the highest projected employment growth in California, Educational Services, Health Care, and Social Assistance, Trade, Transportation, and Utilities, and Government industries are likely to be impacted significantly by a wide adoption of Blockchain technology. For the most part, the

top 5 industry employment growth projections are similar for California and Los Angeles County, except that Los Angeles County is expected to have lower growth than California in the Construction industry but higher growth than California in Retail Trade. Given that the Retail Trade and construction industries is less likely to be significantly impacted directly by the adoption of Blockchain technology, it could be said that the potential impacts for Los Angeles County might be similar to California as a whole.

**Table 7. California Employment and Projections by Industry (Thousands)**

	2016	2026*	Change	% Change
<b>Total Employment</b>	<b>17,135</b>	<b>19,721</b>	<b>2,586</b>	<b>15.1</b>
<b>Total Nonfarm</b>	15,586	17,940	2,354	15.1
Educational Services, Health Care, and Social Assistance	2,366	2,952	587	24.8
Professional and Business Services	2,424	2,895	471	19.4
Leisure and Hospitality	1,759	3,259	400	22.8
Trade, Transportation, and Utilities	2,863	3,175	313	10.9
Construction	674	891	217	32.1
Self-Employment	1,097	1,272	176	16.0
Government	2,414	2,579	165	6.8
Retail Trade	1,629	1,771	142	8.7
Transportation, Warehousing and Utilities	524	621	97	18.6
Information	463	542	79	17.0
Wholesale Trade	710	783	73	10.3
Financial Activities	782	845	64	8.1
Total Farm	416	468	51	12.3
Other Services	536	579	43	8.0
Durable Goods Manufacturing	796	819	23	2.8
Manufacturing	1,274	1,291	17	1.3
Private Household Workers	36	41	4	12.2
Mining and Logging	32	31	-0.4	-1.3
Nondurable Foods Manufacturing	478	473	-5	-1.1

**\* Projections by the California EDD**  
**Source: California EDD-Labor Market Information Division**

**Table 8. Los Angeles County Employment and Projections by Industry (Thousands)**

	2016	2026*	Change	% Change
<b>Total Employment</b>	<b>4,492</b>	<b>5,063</b>	<b>572</b>	<b>12.7</b>
<b>Total Nonfarm</b>	4,189	4,725	536	12.8
Educational Services, Health Care, and Social Assistance	721	930	209	29.0
Leisure and Hospitality	467	577	110	23.6
Professional and Business Services	599	680	81	13.6
Trade, Transportation, and Utilities	799	876	77	9.7
Retail Trade	413	450	37	8.9
Self-Employment	284	319	35	12.2
Construction	120	147	27	22.7
Government	556	582	26	4.6
Wholesale Trade	223	243	20	9.1
Transportation, Warehousing and Utilities	163	184	20	12.3
Other Services	151	167	17	11.0
Information	198	214	16	7.8
Financial Activities	211	219	8	3.7
Private Household Workers	14	15	2	12.5
Mining and Logging	4	5	0.2	4.7
Total Farm	5	5	-0.5	-9.6
Durable Goods Manufacturing	203	189	-14	-6.9
Nondurable Foods Manufacturing	161	140	-21	-13.0
Manufacturing	364	329	-35	-9.6

**\* Projections by the California EDD**

**Source: California EDD-Labor Market Information Division**

The estimates in Table 9 for Los Angeles County and cities in the South Bay show that Los Angeles county employment percentages in the Government, Health Care, and Information industries is significantly higher than in the South Bay. On the other hand, the South Bay has significantly higher employment percentage in manufacturing and Transportations/Utilities industries. Given these major differences, the projection estimates suggest that the economic and employment impact from a wide adoption of Blockchain technology adoption might be slightly higher for Los Angeles County than for the South Bay region. However, the South Bay has shown significant growth rates from 2008 to 2016 in Health Care, Government, and Transportation,

Warehousing, and Utilities industries, which are expected to have significant economic and employment impacts from Blockchain technology adoption.

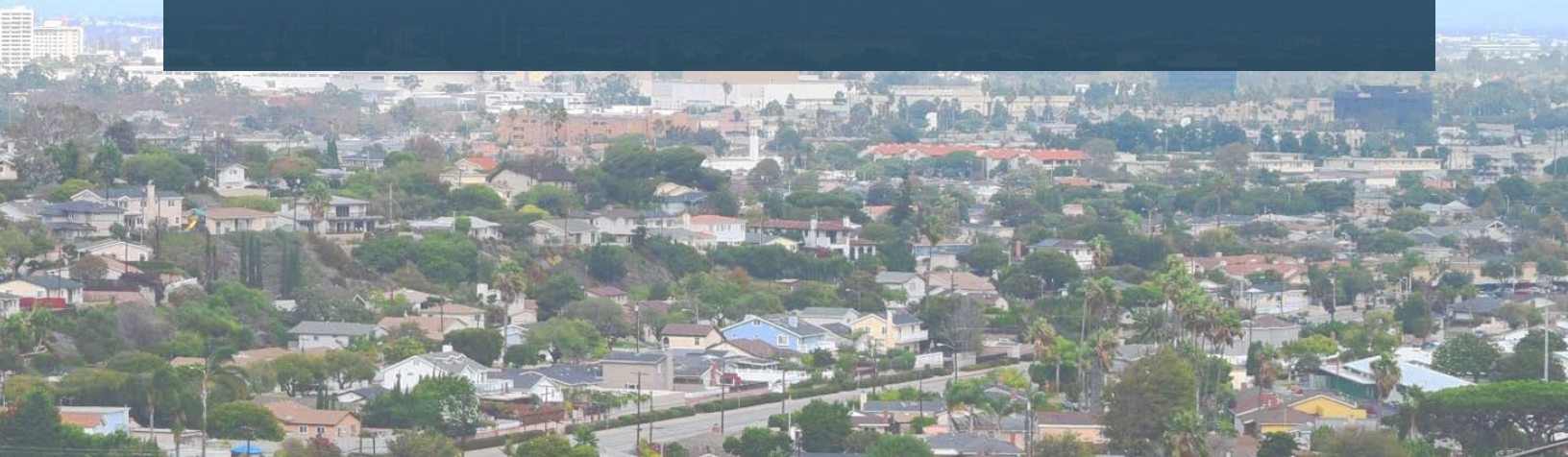
Overall, employment figures and projections for the South Bay suggest that a wide adoption of Blockchain technology is expected to have significant direct economic and employment impacts on the entire South Bay region. However, these impacts are estimated to differ significantly by industry and occupation. For further context here, please refer to which major companies in the South Bay might be impacted by these changes in Table 10.

**Table 9. Los Angeles County and South Bay Cities Employment by Industry (Thousands)**

	LA County	South Bay	Difference %
<b>Total</b>	<b>4,492</b>	<b>574</b>	
Health Care	15.0%	11.8%	3.2
Professional/ Business Services	13.7%	15.0%	-1.2
Government	12.9%	8.3%	4.6
Leisure and Hospitality	11.7%	12.1%	-0.4
Retail Trade	9.6%	9.4%	0.2
Manufacturing	8.2%	13.6%	-5.5
Information	5.2%	2.1%	3.2
Wholesale Trade	5.1%	4.8%	0.4
Financial Activities	5.0%	4.4%	0.6
Transportation/Utilities	3.7%	10.4%	-6.6
Other Services and Unclassified	3.4%	3.3%	0.0
Construction	3.0%	3.1%	-0.1
Educational Services	2.3%	1.5%	0.7
Natural Resources	0.2%	0.3%	-0.1

*Source: California EDD and Own Calculations*

**Altogether, if widely implemented, Blockchain technology has the potential to change significantly the occupations and industries with the largest projected growth rates for the U.S. in the near future.**





**Table 10. A Selection of Major Employers in the South Bay Region**

Sector	Employer
<b>Natural Resources</b>	PBF Energy refinery (prior, Exxon Mobil)
<b>Manufacturing</b>	American Honda Motor (subdiary of Honda Motor Company)
	Alcpa, Inc. (Aluminum-Lithium plant)
	Lisi Aerospace
	Honeywell
	Northrop Grumman
	Raytheon
	Boeing
	Lockheed Martin
<b>International Trade</b>	Port of Los Angeles
<b>Government</b>	Los Angeles Air Force Base
	Port of Los Angeles
<b>Health</b>	Torrance Memorial Medical Center
	Del Amo Hospital
	DaVita
	Genesis Healthcare
<b>Business and Professional Services</b>	Bank of America
	Hertz
	U.S. Bank
	AppleOneInc.
	Jumpstart Games
<b>Hospitality</b>	Marriott
<b>Education</b>	California State University, Dominguez Hills





# Blockchain's Impacts on Specific Industry Sectors

This section discusses the current and future uses and impacts of Blockchain technology across the following South Bay industry sectors of information technology, finance, insurance, manufacturing, aerospace and defense, real estate, retail trade, wholesale and foreign trade, education, and government.

## Information Technology

This sector is at the heart of the Blockchain industry. **Major corporations such as IBM, Microsoft, Oracle, Facebook and Overstock have made significant investments in Blockchain (Campbell, 2019a; 2019c; Disparte, 2019a, 2019b; La Monica, 2019; Slocum, 2018).** In order for Blockchain to be broadly implemented, IT solutions need to be created, in particular, software technology development, server and hardware investment and logistics. In these respects, the South Bay region is in a unique situation. The presence of Silicon Beach offers notable potential. The emergence of this innovation hub has attracted and nurtured entrepreneurs, developers, and business analysts within the region. These skills are all transferable to Blockchain products and services, and it is expected that many of the companies within the Silicon Beach space will also implement Blockchain technology. For example, the Venice Beach start-up Gem is engaged in software development related to Blockchain.

It remains to be seen what area of specializations might emerge for Blockchain in the Los Angeles and South Bay regions. According to Heidi Pease of BlockchainLA, the financial applications of Blockchain are expected to emerge in the New York area, while Silicon Valley is anticipated to generate IT solutions and social media-oriented Blockchain applications. This provides Los Angeles and the South Bay with the opportunity to become a hub for the development of enterprise solutions so that organizations across numerous industries can take advantage of Blockchain's potential. The international connections of the region also offer great promise for enterprise products to be developed and exported. The Los Angeles and South Bay economies are well-placed for such interactions, given their diversity in terms of economic sectors, ethnicities, and long-term investments from international companies.

## Finance

In the banking and financial services industries, Blockchain technology has the potential to introduce secure and efficient alternatives to current banking processes. **Firms like JPMorgan Chase, Citigroup, and Credit Suisse are currently investing in the technology in order to streamline their transaction processing, and hence reduce the expenses associated with their current practices (Orran & Irrera, 2017).** U.S. markets will also experience the benefits of Blockchain as discussed by Capgemini, which estimates that the automation of tasks within the organization, increased trustworthiness of digital legal documents, and incorporating external information sources into the Blockchain can result in estimated minimum savings of \$1.5 billion and \$6 billion in the U.S. market (Capgemini, 2016). This reduction in costs for all participants is possible due to a distributed ledger's system of peer-to-peer collaboration that simplifies operational processes.

Smart contracts can also both accelerate clearing activities and streamline regulatory compliance. The self-executing contract process begins with one end of the contract using data from a Blockchain record as an input and generating an output reaction that is then written to the same or a different Blockchain (Magazzeni, McBurney, Nash, 2016). By mapping more than 50 operational cost metrics in a joint survey with McLagan, a Connecticut based financial services consulting firm, **Accenture estimates that investment banks could save up to \$10 billion by using Blockchain technology to improve the processes involved in clearing and settlements. (Accenture, 2017).** Blockchain's immutable data storage feature allows for fast and accurate reporting by automating processes, making smart contracts an adequate source for proof of compliance.

Smart contracts would allow for fast and accurate reporting by automating compliance processes that draw on immutable data sources. Firms can increase their compliance efforts by granting access to data recorded on an auditable Blockchain system to regulators, who can then trace the stages of all transactions in order to verify regulatory compliance (World Economic Forum, 2016).

While many industries expect to benefit from Blockchain implementation, traditional banks may be disrupted in some important ways. Blockchain is a threat to them as intermediaries of most financial transactions. According to the company Blockchain Capital, "Blockchain technology holds the promise to disrupt legacy businesses and create entirely new markets and business models" (Cuen, 2018). Using Blockchain as a public ledger allows financial transactions to be completed without contemporary intermediaries such as banks. According to Alyse Killeen at Stillmark, this disruption of the standard financial system will open up the financial market to more people than ever before (Personal communication, 2018). Alyse Killeen is part of the Venture Capital Industry, where she expects to see a lot of change over the next several years from Blockchain, which allows the underdog to access a financial industry traditionally controlled by the top few percent. Now a broader majority of the socio-economic pyramid can be involved. Alyse Killeen also advocates

for more women and average Americans to become a part of the financial industry, and Blockchain provides that opportunity (Thompson, 2018).

Alyse Killeen expects other developments to arise from Blockchain in the near future. The intersection between the Internet of Things and Blockchain creates an opportunity for Smart Cities to form. According to Ben Algaze, "A smart city incorporates information and communication technologies to enhance the quality and performance of urban services, such as energy, transportation and utilities, in order to reduce resource consumption, wastage and overall costs. The overarching aim of a smart city is to enhance the quality of living for its citizens through smart technology" (Algaze, 2018). Smart Cities will improve the quality of life for the average American by improving the things people use most within their cities. Blockchain will also improve commerce within the smart cities by giving the community the ability to promote commerce without using services which charge fees for their use. The next area expected to evolve from the infrastructure space are easy-to-use wallets. According to Killeen, easy-to-use wallets will allow people to have better access to their financial tools and data about financial products and services (Personal communication, 2018). Most personal control over financials is what to be expected.

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**Major corporations such as IBM, Microsoft, Oracle, Facebook and Overstock have made significant investments in Blockchain (Campbell, 2019a; 2019c; Disparte, 2019a, 2019b; La Monica, 2019; Slocum, 2018 ).**

# Insurance

The insurance industry has already taken steps to incorporate Blockchain technology in their transaction processes. Allianz Risk Transfer AG (ART) and Nephila Capital Limited announced a successful pilot program that used smart contract technology for transacting a natural catastrophe swap (Allianz, 2016). The program demonstrated that it is possible to process and settle transactions between two parties faster by using smart contracts. The program specifically determined that Blockchain-based contracts can simplify and accelerate the contract management process of catastrophe bonds and swaps that transfer risk from insurers to investors in the event of a natural disaster (Allianz, 2016).

US company claiming to be the first peer-to-peer insurer (Fell, 2017). Lemonade is a property and casualty (P&C) insurer that offers renters and home insurance policies that pay out claims as soon as conditions in Blockchain-based contracts are met (Nerd Wallet, 2017). The claims process becomes automated by using third-party data sources and the programming of business guidelines on a Blockchain. These data sources provide reliable data that can be processed quickly in order to reduce the number of fraudulent claims. The loss assessment process is shortened by automating the claims and liability calculations processes using information stored on the Blockchain (IBM, 2016).

Another Blockchain application in the insurance industry has been in use since late 2016 by Lemonade, a

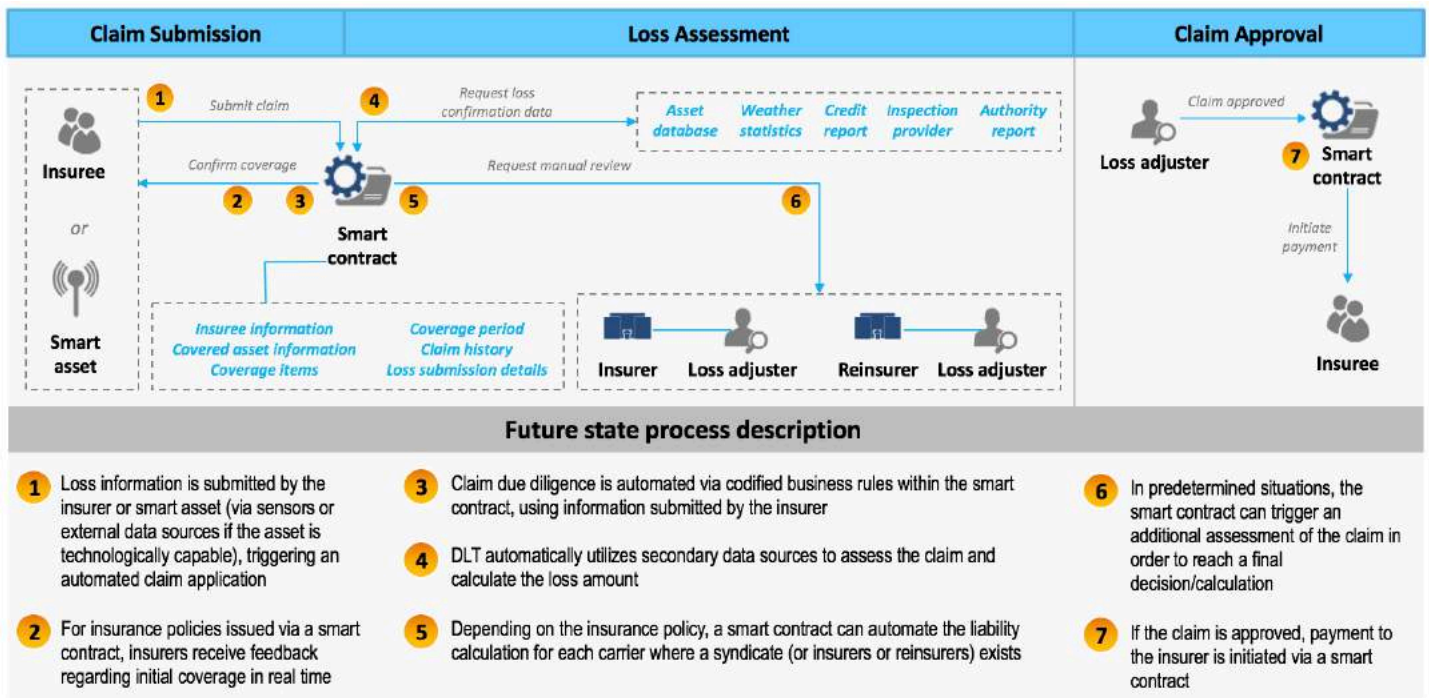


Figure 2. IBM's Blockchain-based P&C Claims Process

Source: <https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=IUW03053USEN>

# Manufacturing

Blockchain shows large potential in manufacturing, specifically in the field of “Just In Time” inventory and production. This would be advantageous to small manufacturers and even more so with large manufacturers, such as Boeing, who deal with a large number of vendors and sites. (M. MacDonald, personal communication, April 21, 2018). There is a lack of understanding of Blockchain, and currently there is no “off the shelf” solution that allows small business such as Mac’s Lift Gate in Long Beach, California to easily take advantage of a Blockchain solution for their inventory and production. Currently, a company would need to find and employ or hire programmers with knowledge in this specialized knowledge before being able to utilize it. This can pose as a tough undertaking, considering Blockchain is a new technology that not too many individuals have studied (M. MacDonald, personal communication, April 21, 2018).

There are numerous potential Blockchain applications in the manufacturing industry, and especially the automotive space when considering the Internet of Things. These include ridesharing, for which payment could be made through Blockchain, a distributed ledger ensuring that the driver and passenger are indeed who they say they are. Rideshare drivers could change insurance policy quickly in order to cover the additional passengers. Another example is charging infrastructure, whereby Blockchain could be used to secure the transaction for electric vehicles, or to support battery sharing, insurance product – real, on-time demand for a product.

The intersection of supply chains and manufacturing also offers interesting insights into the use of Blockchain. Evelozcity is a Torrance-based company using Blockchain to augment their design and manufacturing processes, as well as supply chain management. Car manufacturing is a complex multiple step process from design to assembly and inspection. It is important to identify any defective part that would otherwise have detrimental effects. When it comes to ascertaining a part that is in question, whether it be a genuine or counterfeit part placed by a garage

unknowingly (or knowingly), Blockchain supply chain management provides full traceability of part history (Jones, 2017). This process makes it easier for the warranty team to identify counterfeit parts quickly in hopes to deter fraudulent acts in the future. Furthermore, being able to target recalls will save the manufacturer time and money due to the prior knowledge of the defective part that was fitted to the specific vehicles hence being able to issue specific recalls for individual VIN numbers. Now the manufacturer can isolate just the vehicles that need those particular repairs at a lower total cost compared to if the entire fleet of cars were to be recalled. Auto supply chains are currently considering the use of Blockchain, but are expected to be implemented in a 3-5 year time frame, especially in specific industries or regions but not there yet. Global supply chains will take much longer to build out (Evelozcity, 2018).

In spite of all this potential, as with other industries, key questions remain as to how Blockchain is going to be implemented. A key challenge for industries and South Bay institutions is to bring together all of the pieces that companies are already doing within the context of Blockchain. For example, a consortium in the car industry recently founded “Mobi”, which is funded by Toyota Financial. This consortium is attempting to figure out how to build Blockchain into their cars. Given the different systems, ledgers, and codes, how will they interact? As this is early days in terms of companies coming together, it is not clear who the winners and losers will be, and which systems or technologies will come to dominate. The swift validation of the “blocks” will be critical in this industry, especially when Blockchain is incorporated into the usage of vehicles. For example, there have been recent discussions about using Blockchain to support the delivery of items into car vehicles. A critical element here is the speed of the Blockchain validation to be quick enough to support the transaction. This requires both hardware and software solutions (Evelozcity, 2018).



As with other industries, a major concern is their ability to attract talent. A generation of young professionals needs to be aware of the potential for Blockchain for how it will be implemented and where innovation can be applied to various industries and how they interconnect to other industries. One car manufacture company interviewed believed that most of the talent is based up in Silicon Valley rather than Los Angeles; a recent hire at the company's contacts are all up in the Bay Area. Nonetheless, given the potential for growth in Blockchain, Los Angeles has the opportunity to grow into that space.

Even though Blockchain can cause the elimination of some jobs especially the jobs that require paper-based processing, more jobs will be created, or new opportunities will open for citizens and companies. Also, Blockchain is now being explored by many global corporations such as "General Motors...DuPont, Dow Chemical, Tetra Pak, Port Houston, Rotterdam Port Community System Portbase, the Customs Administration of the Netherlands, U.S. Customs and Border Protection...customs and government authorities, including Singapore Customs and Peruvian Customs" (White, M., 2018). These corporations have expressed interest in Blockchain, and have explored new ways to use it. Not only that, but Blockchain has opened opportunities for the Maersk Line to do business with companies they have not done business with (Mosquera, K., personal communication, April 2018).

## Aerospace and Defense

Boeing, Honeywell, Lisi, Lockheed Martin, Northrop Grumman, Raytheon, and SpaceX makeup a large part of South Bay's aerospace sector. Recent development and research have hypothesized the benefits of large companies such as these if they implemented Blockchain technology to their current industry. Boeing, Honeywell, and Lockheed Martin have publicly announced their intention to integrate Blockchain technology within their procedures. This could improve and maintain proficient operations in manufacturing (specifically for parts life cycle tracking and maintenance), supply chain, after market, management, and customer transparency (Gutierrez, 2017).

Technology companies, like IBM, suggest that using a digital ledger shared by airlines would significantly improve processes in the aerospace industry (Bellamy III, 2017). Processes such as routine maintenance and flight operation performance monitoring are imperative when it comes to safety. Scenarios of mechanical failure or flight difficulties could inform and enlighten employees on a more efficient level if the problem were to arise at the supply chain level. Presentation of Smart Contracts, can accomplish the wants, required and up to the marked product (Madhwal & Panfilov, 2017).

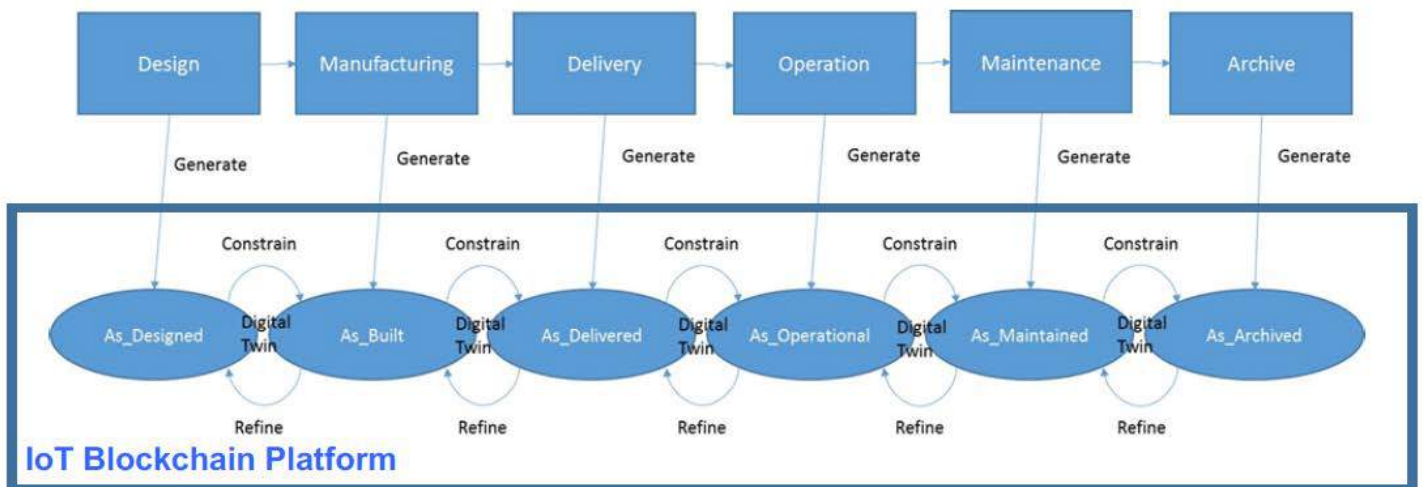


Figure 4. Boeing's Internet of Things Applications Development Process Around Blockchain

Source: <https://myibm.ibm.com/events/interconnect/all-sessions>

This procedure will have every one of the points of interest like, serial number, legitimacy of items, i.e. all the data that would ensure its verification and uniqueness. This achieves secure openness over worldwide aerospace chain supply, which will diminish imitations and decrease delays.

## Real Estate

In real estate, a great amount of time and effort is spent examining the financial and legal activities that would outline the specifics of a transaction. This is largely due to the need for physical identification documents (World Economic Forum, 2016). The use of such documents often results in lengthy verification processes and encounters with insufficient or inaccurate data. In some cases, third-party intermediaries are required, which increase the time spent on the due diligence part of a transaction. Blockchain-based systems offer a space for digital identities to be created which would secure accurate user data across a distributed ledger to which market participants can have permissioned access. This digital identifier, combined with a Blockchain MLS will result in a shortened property search process and an expedited pre-lease analysis.

Moreover, access to government property records at the county level can be cumbersome, creating market inefficiencies that are plugged by brokers, lawyers, or other occupations that add cost to the process. Government offices, such as Cook County, Illinois have trialed the use of Blockchain for property records, with the aim of reducing citizen costs and increasing market efficiency.

Key market participants in the real estate industry such as brokers, owners, and tenants typically use multiple listing service (MLS) platforms that can carry high access fees in order to find data on property listings (Coinpupil, 2018). The information found through online platforms might be inaccurate, out-of-date, or incomplete due to a dependency on broker preference, a lack of standardization, and user intervention (Deloitte, 2017). This results in a lack of trust in the information, which can increase the transaction processing time. Blockchain-based platforms can enable the data to spread throughout a distributed ledger that would allow increased transparency,

availability, and shared control of information (imbrex, 2016). Companies like imbrex and Propify offer Blockchain-based global real estate search platforms that ensure access and accuracy through a reconditioned marketing process (imbrex, 2018; Propify, 2018). Platforms like those offered by Rex and Propify make data on location and address, comparable rates, ownership history, tenant details, age of the property, and title clarity trustworthy and accessible (Nash, 2015).

## Retail Trade

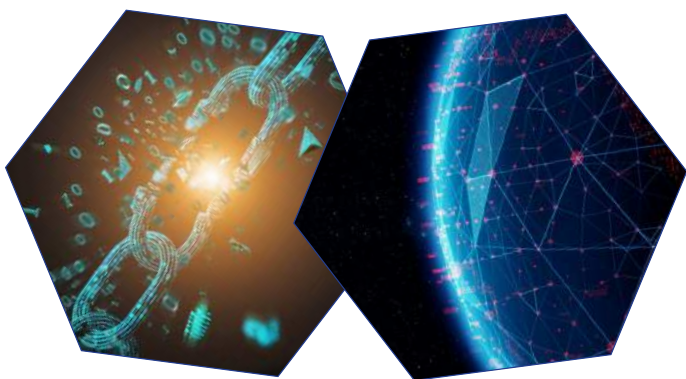
Blockchain has the ability to change significantly the retail trade industry. The technology can provide a way to reinvent key business functions, providing an added level of trust and security, as well as a new means of interaction between retailers, consumers, and other market participants. Blockchain applications in supply chain management have a demonstrated effect on recoding assets, tracking orders, verifying product information, linking physical goods to digital tags, and sharing product information between consumers, suppliers, and vendors (Vorabutra, 2016). Inventory management is enhanced by documenting an item's route across a supply chain, verifying origin, authenticity, and product details that will in turn increase trust between consumers, suppliers, vendors, and manufacturers (Gonzalez, 2015).

Customer loyalty and rewards programs are another aspect of the retail industry that can find value in adding Blockchain programs to current business operations. By assigning records to an immutable and decentralized ledger, a customer's unique digital fingerprint can be used to record transactions performed with multiple parties in order to instantly redeem loyalty points in a single database (Kowalewski, McLaughlin, and Hill, 2017).

Salespersons interviewed agreed that Blockchain is going to be the most secure way we keep track of data that needs to be secure (C. Fleischer, Personal communication, March 15, 2018). The sales professionals interviewed believed that Blockchain will be the most advanced way to protect data for the next 3-5 years (C. Fleischer, Personal communication, March 15, 2018). The salespersons thought one of Blockchain's biggest strength is how simple the technology is to understand

(C. Fleischer, Personal communication, March 15, 2018). "A technology that is simple to understand and has a complex security is a salesman dream." (C. Fleischer, Personal communication, March 15, 2018). The sale personnel liked how they could secure contracts, there could be no loopholes and everything is transparent (D. K. Hernandez, Personal communication, March 10, 2018). They believed the transparency might change how people view sales professionals (D. K. Hernandez, Personal communication, March 10, 2018).

The sales professionals interviewed seem to believe that it will affect all major industries. They anticipated the three biggest industries that will be affected will include medical, energy, and government (D. K. Hernandez, Personal communication, March 10, 2018; Hicks, 2019). The interviewees all believed that Blockchain will have a huge impact on the education systems (C. Fleischer, Personal communication, March 15, 2018). The impact would be having Blockchain specific classes taught in schools. The interviewee seemed to believe that Blockchain will be integrated in our lives so much that we will not realize that we are using Blockchain. This is akin to the role of internet systems and related technology used when surfing the web or using smart phones. Most people do not know what type of computer language is being used or type of chip set is in our phones (D. K. Hernandez, Personal communication, March 10, 2018).



## Wholesale and Foreign Trade

The potentially profound effects of Blockchain on the supply chain management described above, are likely to also impact the wholesale industry. Wholesale distribution involves multiple stakeholders in its business activity such as suppliers, transporters, customs agencies, insurance companies, and banks (Marguier, 2017). The nature of the industry allows for Blockchain's added value in operations, regulatory processes, and risk reduction to be incorporated to existing and future business models. The potential for Blockchain technology to connect producers and consumers more directly could impact the wholesale and foreign trade industries, further disrupting the position of middlemen traders. These changes could impact purchasing companies and households alike. As Internet of Things applications are by definition distributed, DLT can also begin to intersect at in-house level by restructuring the way devices communicate with each other (Bieler, 2016). This enhanced network has the potential to improve not only communications, but compliance and cost efficiency features (Gens, 2017).

Blockchain can "improve Global Trade and Digitize Supply Chains...provide more transparency and simplicity in the movement of goods across borders and trading zones...and provide more efficient and secure methods for conducting global trade" (Denmark, C., & Ny, A., 2018). Not only that, but Blockchain will "improve the cost of transportation, lack of visibility and inefficiencies with paper-based processes" (White, M., 2018). This can also be a weakness because paper-based process will be done through computer programs and not by hands, which can result in losing some jobs for some people. Not only that, but using Blockchain in global trade can lead to "fast and secure access to information, verifiable authenticity and immutability of digital documents, trusted cross-organizational workflows, better risk assessments and fewer unnecessary intervention, and lower administrative expenses and elimination of costs to move physical paper across international borders" (White, M., 2018). An example of a company that is already benefiting from Blockchain is Maersk Line. According to Katherine

Mosquera, the Strategic Communications Manager at the Maersk Line for the Greater New York City Area, "Maersk and IBM have been at the forefront of digitizing global trade since last year when we first announced our partnerships" (Personal communication, April 2018). IBM is the technology company that provides Blockchain for Maersk Line. The Shipping Industry in the South Bay can benefit from Blockchain the same way as the global trade/Maersk Line. Another example is fashion and textile manufacturers using Blockchain monitor organic cotton through their supply chains (Knapp, 2019).

The majority of Blockchain application research in wholesale trade is currently in a pre-development phase. While a distributed ledger system combined with Internet of Things applications are a significant advantage already in play, there is little available literature discussing other benefits such as risk and fraud reduction, and liquidity and capital improvement.

## Education

A selection of CSU Dominguez Hills students was surveyed in addition to the industry experts discussed below to better understand the current levels of familiarity with the technology. More than half of the students that responded had never heard of Blockchain before our group interviewed them. Seventy percent of students surveyed did not believe they would use Blockchain in their working careers. Only thirty percent of the students thought they would be using Blockchain someday in their professional careers. This could be from a lack of knowledge of what Blockchain can do to secure data that is not financial. Students surveyed thought that financial markets will be affected by Blockchain the most, but that is only the tip of the iceberg when it comes to the Blockchain (Tapscott, 2017).

There are some opportunities available for Blockchain to grow and for students to take advantage of Blockchain. **Ninety percent of students thought Blockchain should be taught in schools**, which could be an excellent opportunity for businesses to sell a class to schools or public administrators to administer Blockchain, so their students can have an edge in the professional markets. The students surveyed are open for Blockchain to be taught in public schools. The

students surveyed also believe that Blockchain will be good for the South Bay economy (Rodgers, April 26, 2018). Students and Blockchain businesses could use this knowledge to team up to create a Blockchain start-up in the South Bay, which could boost Blockchain's presence and boost the economy (Tapscott, 2017).

The most significant threat seen in the information gathered from the survey is that eighty percent of the students thought Blockchain should be federally regulated (Rodgers, April 26, 2018). Having a federal regulation on Blockchain could be detrimental at this early stage, and it may block it from future growth (Wintermeyer, 2017). The federal regulators might overstep and make it hard for smaller Blockchain companies do business and scare off potential users and investors from associating with Blockchain (Wintermeyer, 2017). Also, those responsible for regulation often are not experts on the technology they are regulating. This can pose a large problem for the future implementation of Blockchain.

## Government

The public sector can readily incorporate Blockchain solutions to address issues like fraud and risk minimization, streamlining of operations, data and identity management, monitoring and assessment of regulated goods and operations, and emergency management. Government agencies are increasingly collaborating with technology companies to innovate and develop Blockchain-based platforms for public services and internal use applications. The United States of America, Estonia, and the United Arab Emirates are currently among the top nations to explore a wide range of potential Blockchain applications. These range from business registration and banking operations to voting and share issuance (Lohade, 2017; Higgins, 2017; Irrera, 2017, Allison, 2016). In the United States, several agencies, including the Department of Homeland Security and the Health and Human Services Department, announced Blockchain programs aimed at proving the integrity of data captured by border devices and to protect and share health records (DHS, 2016; Ravindranath, 2017).

The immutable, consensus-based, smart contract

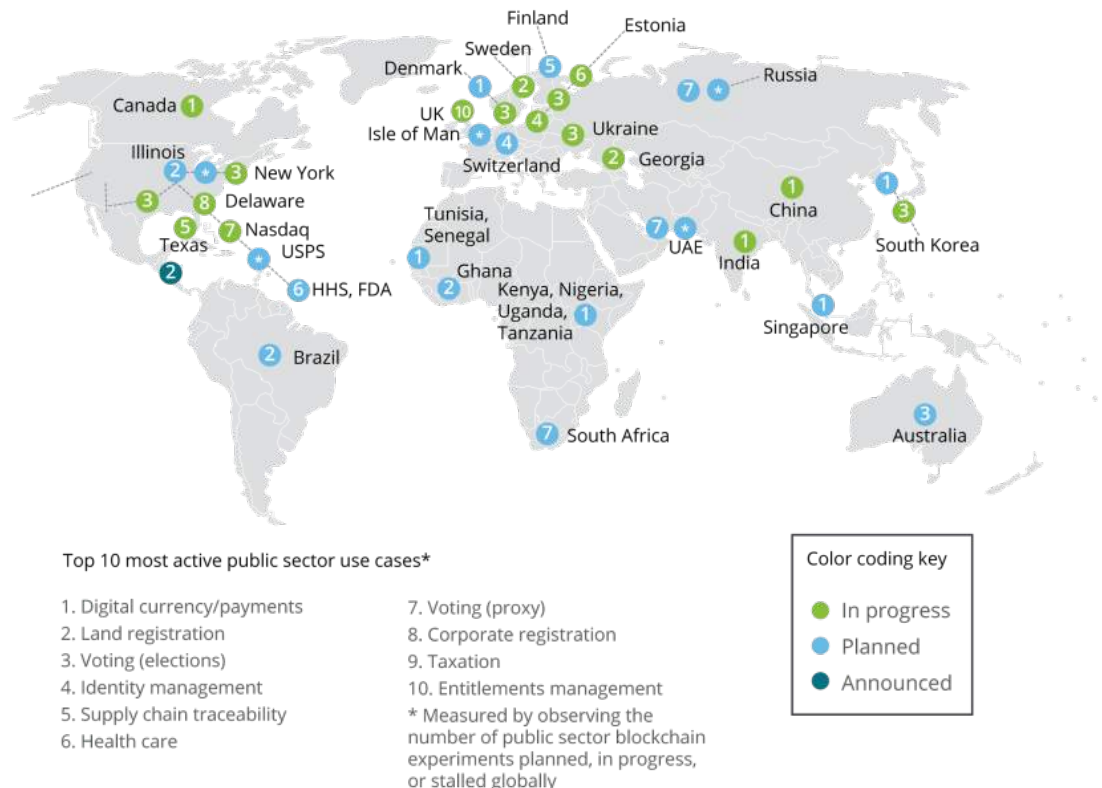


characteristics of Blockchain technology are driving governments on all continents but Antarctica to explore uses in land registration. Sweden’s launch of its own Blockchain-based platform is among the first use cases to implement a small-scale operation concentrated on

registry and property transactions (Anand, 2018). The city of South Burmington, Vermont, is the next governmental figure to pilot a Blockchain-based land registry record by partnering with Propy, a global property store specializing in decentralized title registry (De, 2018).

**Figure 1. Blockchain in the public sector, as of March 2017**

Blockchain experiments in the public sector are accelerating globally, with a concentration in the US and Europe.



Source: Deloitte analysis in conjunction with the Fletcher School at Tufts University.

Deloitte University Press | [dupress.deloitte.com](http://dupress.deloitte.com)

# Interviews

Interviews were conducted with industry experts using an open-ended, semi-structured approach (Hammer and Wildavsky, 2018). The open-ended element of the interviews is employed because they require the interviewees to answer questions with more meaning and insight about Blockchain systems (Rapley, 2001). This is particularly appropriate for the exploratory nature of this research. The semi-structured aspect of the interviews creates a guiding framework to the set of ques-

tions. Some are general Blockchain systems questions, some are geared toward a particular industry in the South Bay, and others focus on the training and curriculum development required to support the emergence of a Blockchain industry in the region. The semi-structured interview approach can provide directed insight into the interviewee’s knowledge of Blockchain systems (Aglaroz, 2010). The interviewees are from a wide variety of different occupations, as presented in Table 11 below.

# Interview questions

Below is a list of the kinds of questions that were asked during the interviews. Given the semi-structured nature of the interviews, not all questions were asked to all respondents and additional follow-up questions were asked when appropriate.

1. Which sector do you work in?
2. How might your workplace and occupations in your industry be impacted by Blockchain in the future?
3. How soon do you anticipate Blockchain being implemented in your industry sector? 1-2 years? 2-5 years? 5-10 years? 10+ years?
4. What implementation challenges do you foresee? Data management tools are being rolled out all the time; would this just be another form, or would there be new challenges? Are workers/users likely to be resistant?
5. What training/workforce development do you see as necessary to help train people up in Blockchain in your field and/or occupation? In other words, what are the major gaps in knowledge, experience, and skills with respect to Blockchain?
6. We are developing a class and certificate in Blockchain, focusing on the following:
  1. Increasing knowledge about the basic functions of Blockchain.
  2. Providing those in a broad range of occupations (including managers, administrators, data analysts, sales representatives, etc) and industries with an understanding of the practical implementation of Blockchain and the ways in which it might reshape the workplace and organizational structures.
  3. Exploring Blockchain from different perspectives, including legal, ethical, security, and entrepreneurial.For these classes and certificate, what areas are we missing? What should we improve upon?
7. What price point would you recommend for a class on Blockchain?
8. What modality (online, on campus, hybrid) do you think would attract the most interest?

## Responses

34 interviews were conducted with industry experts. These interviews tended to focus on the likely impact of Blockchain on their industry and related occupations. Responses to these questions are summarized with respect to industry sector in Table 11 below. Of this group, 68% had heard of Blockchain prior to the interview, 39% had experience of Blockchain in their workplace (indicated with a gold highlight in Table 11 below). Of those who had heard of Blockchain, 57% had experienced it in their workplace. As shown in Table 11, the responses suggest that

those in a majority of the industry sectors see the potential for Blockchain to be both a disruptive and a positive force in their workplace. Many responses highlight the potential for Blockchain investment to develop their workplaces, whether through increasing operational efficiency, reducing transaction costs, or creating new opportunities for growth. Interviews were also conducted with 19 Blockchain experts from around the U.S. These responses have been incorporated into the discussions in prior sections.

Sector	How might your workplace be impacted by Blockchain in the future?
Aerospace & Defense	<b>We are continuing to identify opportunities to improve operations throughout the aviation industry. We believe Blockchain can bring an added level of trust to the data exchanged in our ecosystem.</b>
Manufacturing	This type of technology could be used in construction industry to transfer documents or data safely, but its application is useless for recycling materials. Also, there is no fear or the need to distribute information safely, most transactions or contracts are done in person or by phone.
	<b>Sales initiation (customer orders), accounting, supply chain, vendor communication, forecasting/planning can all be impacted since these are single transactions that can be more effectively communicated and managed by blockchain. Also provides audit and responsibility and eliminated people intervention other than on the design, manufacturing and order fulfillment. Allows for seamless tracking of goods from order to delivery and beyond.</b>
Entertainment	My guess is that Blockchains could be beneficial at my workplace by: 1. Assisting with our current PII (personal identifiable information) policies, which are in place to protect our clients personal info (we work with and pay a lot of talent - actors, celebrities, etc.). 2. Perhaps adding value to our current platform, which acts as a centralized location that stores and distributes advertising creative (cloud-based).
	Meetings and companies can be entirely online and eliminate need for human interaction.
Sports Management	It would have a significant impact on the file storage and data management aspect of my workplace and maybe finally allow us to go paperless. Receiving spam emails with viruses is a common occurrence so it would help prevent against that.
	I can imagine Blockchain becoming a staple in any workplace. I don't see it changing my workplace much just simply on the basis of currency that is done manually in person. Most of my coworkers want to be paid in cash and this whole idea of getting a direct deposit or in this instance currency through Blockchain could be alarming to these coworkers. I can see it as the next big trend/fixation in the workforce and eventually become as popular as Bitcoin was when it first made its splash as an actual currency. Better to be in the moment of Blockchain and seeing its benefits rather than attempting to use it once you have been left behind.
	It replaces the third party (central bank for example) and is consistent with the peer-to-peer revolution that we've experienced in the economy over the last two decades. Since 2008, lots of people and company don't trust central authorities to run their operations plus the cost and time involved in the transaction (time to wire money is inefficient and costly). It's a matter of efficiency (faster transactions) and trust being outsourced to the network. What will be interested to observe is the resistance to change from institutions that can have their businesses hurt by such a revolution (central banks, insurance companies, all kinds of association protecting the interest of an industry (house titles) etc.. The workplace will be impacted in lots of different ways it is hard to predict the real effect between insurance, higher education, marketing, doping, e-sports digital rewards, corruption and counterfeiting in drugs and medicine or auto parts etc... As long as you keep in mind that the value is a better trust and an increase efficiency for the whole industry than you can come up with some critical factors unique to that industry.

Health Care	Blockchain might impact my workplace in a positive way. Though we have a sign in sheet that includes a checklist of completed duties, blocklist can possibly allow updates to be made electronically. It is possible for some providers to have the same concerns as other and by use of a system such as blocklist, it may be that central place that is used a platform as well. Additionally, it can be used to clock in and out and the leaders of the group will have this information at their disposal in order to complete invoicing in a timely manner (and not have to wait for everyone to send their hours).
	As a person that works in public health, patient confidentiality is our primary objective. I can see us using Blockchain to share patient information amongst our colleagues via the web with greater confidence in order to be more efficient in the work that we do.
	<b>Blockchain has the potential to create a centralized database that would allow us to cut costs and reducing the time that it takes to go through administrative motions.</b>
	I work in the medical field at a private medical practice with 3 locations. I can eventually see the use of blockchain in which patients would pay their copay and/or deductible.
	Enhanced encryption of data and improved information security. Likely to be implemented in 5-10 years. Implementation challenges are likely to include HIPAA compliance and existing vendor database standards. Workforce development needs are likely to depend on the use case for implementation. If the goal is an additional layer of security on existing data used by technical audience then little training needed. If goal is additional security on user facing data then the implementation tool must make accessing the data as seamless as possible, without noticeable barrier to access. One caveat to all answers above, if larger vendors like Microsoft, Box, and others implement blockchain then some of the existing healthcare systems in use will automatically begin using blockchain. But as far as healthcare specific vendors adopting blockchain...much longer time horizon.
Education	It can help with business office functions.
	The use of blockchain might be potentially more powerful and effective much in the same way Adobe PDF and Paypal were revolutionary in improving the workplace and introducing a common platform for financial records.
	<b>Currently, the procurement &amp; personnel system is online and has a workflow feature - from initiator to who committed funds for the transaction. I can see the blockchain model being beneficial to all aspects of my workplace - the use of blockchain for workflow, iterations of documents (curriculum, policies, program review, etc.), work orders, training, initial hiring (especially here!).</b>
	As a person that works in public health, patient confidentiality is our primary objective. I can see us using Blockchain to share patient information amongst our colleagues via the web with greater confidence in order to be more efficient in the work that we do.
	It would have a significant impact on the file storage and data management aspect of my workplace and maybe finally allow us to go paperless. Receiving spam emails with viruses is a common occurrence so it would help prevent against that.
	I work in student government and plan on being a public servant in the future. I believe Blockchain would help provide transparency and efficiency with information sharing, providing foreign aid, and in financial management.
It replaces the third party (central bank for example) and is consistent with the peer-to-peer revolution that we've experienced in the economy over the last two decades. Since 2008, lots of people and company don't trust central authorities to run their operations plus the cost and time involved in the transaction (time to wire money is inefficient and costly). It's a matter of efficiency (faster transactions) and trust being outsourced to the network. What will be interested to observe is the resistance to change from institutions that can have their businesses hurt by such a revolution (central banks, insurance companies, all kinds of association protecting the interest of an industry (house titles)	



Education (cont.)	<p>etc.. The workplace will be impacted in lots of different ways it is hard to predict the real effect between insurance, higher education, marketing, doping, esports digital rewards, corruption and counterfeiting in drugs and medicine or auto parts etc... As long as you keep in mind that the value is a better trust and an increase efficiency for the whole industry than you can come up with some critical factors unique to that industry.</p>
	<p>Blockchain can standardize industries. Can be a one-stop shop to information.</p>
	<p>Blockchain in supply chain management is another big issue that we must introduce in the curriculum. Our students need to know that companies can improve business transactions and trading relationships with secure business networks on blockchain. Some of the benefits from supply chain with blockchain are improved inventory management, reduced fraud and errors, minimize courier costs, reduce delays from paperwork, and increase customer and partner trust.</p>
International Trade	<p><b>Our team believes that the potential to offer a digital platform for simple and trustworthy exchanges across the supply chain will drive our efforts to digitize global trade. By improving communications and data exchanges; we are able to build a stronger, more efficient supply chain network.</b></p>
	<p>Blockchain-based freight tracking that would enable all parties in a supply chain to access and manage shipping data.</p>
	<p>Blockchain-based freight tracking that would enable all parties in a supply chain to access and manage shipping data.</p>
Professional/ Business Services	<p>The use of blockchain might be potentially more powerful and effective much in the same way Adobe PDF and Paypal were revolutionary in improving the workplace and introducing a common platform for financial records.</p>
	<p>Blockchain might impact my workplace in a positive way. Though we have a sign in sheet that includes a checklist of completed duties, blocklist can possibly allow updates to be made electronically. It is possible for some providers to have the same concerns as other and by use of a system such as blocklist, it may be that central place that is used a platform as well. Additionally, it can be used to clock in and out and the leaders of the group will have this information at their disposal in order to complete invoicing in a timely manner (and not have to wait for everyone to send their hours).</p>
	<p><b>The insurance industry is already experiencing the benefits of integrating blockchain systems into local information networks. It is able to provide transparency and timely verification that helps us meet the needs of our customers.</b></p>
	<p><b>Blockchain will likely change the way records are maintained and exchanged between collaborative parties. When the technology is adopted at scale, we will certainly see a change in how data and its value are transferred. Financial reporting is likely to see an incremental adoption rate as it will allow easy access to structured data that will be used for analytics and learning.</b></p>
	<p>I work for the City, which is a government entity. I don't believe blockchain will affect the government business and I wouldn't know if they company would consider using this for transactions or accounting system. The city is very confidential, to the point where they interact and monitor, block internet sites from employee's computers.</p>
	<p>We work with confidential data in some projects. This data has to be kept secure. In some cases, the security protocol requires that we store the data completely offline. If blockchain can ensure online security, we may be able to store confidential data online in a way that will reduce the time and effort needed at present to upload, use, and download confidential data under our current security protocol.</p>
	<p>It may be impacted by the way that people work, for example, it may keep accurate records for who is doing what and speeds process.</p>
	<p>Blockchain can standardize industries. Can be a one-stop shop to information.</p>
	<p>As a tech reporter, the blockchain news has already accounted for ¼ of my monthly reports. To provide a decentralized media platform, there are many blockchain projects focus on this, such as Steemit and U Network.</p>

Government	My workplace would be impacted in a positive way in regards to protecting the funds in the county and protecting information that is transported via online. However, the courthouse does not utilize personal information via internet (from the public). So it would depend on which lens I would be looking through.
	This would be a great technological addition to be used in my workplace. We would probably be able to use this to store all of our current program policy and daily practices in regard to CALFRESH, GENERAL RELIEF AND MEDI-CAL for easy access too all employees. Management would be able to make quick revisions based on up-to-date information that is delivered by federal and state government and employees would have quick access to such information.
	As a person that works in public health, patient confidentiality is our primary objective. I can see us using Blockchains to share patient information amongst our colleagues via the web with greater confidence in order to be more efficient in the work that we do.
	<b>Blockchain is helping us consolidate property information in one central database. Qualified parties can be granted access to the database in order to simplify record search.</b>
	<b>It will take time for the government to incorporate any new technology into essential functions. I do believe, however, that enabling access to verified and secure information will be beneficial.</b>
	Blockchain-based freight tracking that would enable all parties in a supply chain to access and manage shipping data.
	I work in student government and plan on being a public servant in the future. I believe Blockchain would help provide transparency and efficiency with information sharing, providing foreign aid, and in financial management.
Blockchain-based freight tracking that would enable all parties in a supply chain to access and manage shipping data.	
Technical Services	<b>I'm a blockchain entrepreneur. We're building applications that are consuming blockchain and creating applications on the technology. My workplace is intertwined with the success of blockchain adoption in the logistics industry and will likely fail or be handicapped if adoption remains limited.</b>
Transportation/Utilities	<b>Our team believes that the potential to offer a digital platform for simple and trustworthy exchanges across the supply chain will drive our efforts to digitize global trade. By improving communications and data exchanges; we are able to build a stronger, more efficient supply chain network.</b>
Financial Activities	<b>I believe blockchain is the pathway to social reorganization when it comes to the way we deal with finance, property registration, legal contracts, and identity credentialing and confirmation. Blockchain makes it possible to transfer value (such as money and information) through a smart network that requires no intermediation.</b>
	<b>The insurance industry is already experiencing the benefits of integrating blockchain systems into local information networks. It is able to provide transparency and timely verification that helps us meet the needs of our customers.</b>
	<b>Blockchain will likely change the way records are maintained and exchanged between collaborative parties. When the technology is adopted at scale, we will certainly see a change in how data and its value are transferred. Financial reporting is likely to see an incremental adoption rate as it will allow easy access to structured data that will be used for analytics and learning.</b>
	<b>The accuracy and validity of the information found on financial reporting instruments will be more inherently trustworthy and accurate.</b>

# Curriculum Development and Career Pathways

There is a clear and compelling case for Blockchain courses to be developed and delivered at South Bay educational institutions. There is a significant interest in Blockchain systems development in companies within the region and worldwide. From the worker or student's perspective there is significant opportunity to find employment in this field, and at very competitive wages that are likely inflated due to demand outstripping supply. This provides the opportunity for workers and students to make a lasting contribution to both the industries they are working in and their own career development.

The career pathways envisioned by industry focus in the short term on software developers. If companies are prepared to invest in infrastructure, then entrepreneurs and executives need to learn how Blockchain could work in their business. This is especially important given the number of cybersecurity threats and the concern over the use of technology in the workplace more generally. Once the investment decision is made, then physical infrastructure is required to support the Blockchain technology and improve the computational efficiency. IT infrastructure experts will also be required to have knowledge in the specific requirements of Blockchain in terms of servers and nodes. The major shortfall then becomes the number of software developers needed to solve the development and application problems. The next level of implementation relates to the ability of businesses to interact with Blockchain and integrate the technology into their systems in order to achieve operational efficiency gains. This step will require business analysts, product developers, and systems evaluation experts to interact with Blockchain technology. Curriculum and training should be developed with each of these occupations and steps of the process in mind.

To achieve this, industry experts have recommended including a Blockchain 101 – what it is, how it works, how will it impact the future: the who what when. They

have also suggested starting early in college and schools to bring awareness of the new technology and getting students interested in building the blocks of the future. Those studying business administration, communications, auditing and accounting, and IT can immediately apply their knowledge to gaps in this industry. Industry experts have highlighted the importance of attracting a new generation of students enthused about Blockchain beyond cryptocurrencies and to create new innovations that can impact their world and how business will be conducted. Coupled with AI in business and robotics in IT, this could transform the business models of today.

**Industry experts have recommended including a Blockchain 101 - what it is, how it works, how will it impact the future: the who, what, when.**

It is important for workforce development curricula and marketing to distinguish between enterprise solutions (systems implemented by individual organizations) and innovations (disruptive, system/society-wide), especially when highlighting which occupations might be impacted by

the new technology. On the enterprise side, the impacts to occupations will be mixed. On the one hand, job displacement likely in data processing occupations such as those used in SCM and accounting. On the other hand, many positions are likely to be reworked, or even new positions created, when the technology is both being implemented and then managed. On the innovation side there will be lots of job creation here, especially outward-facing, e.g. community managers and company partners, and customer services.

## There is a need for local educational institutions to provide courses and certificates on Blockchain, focusing on the following:

- Increasing knowledge about the basic functions of Blockchain.
- Providing those in a broad range of occupations (including managers, administrators, data analysts, sales representatives, etc) and industries with an understanding of the practical implementation of Blockchain and the ways in which it might reshape the workplace and organizational structures.
- Exploring Blockchain from different perspectives, including legal, ethical, security, and entrepreneurial.
- Providing Blockchain software development training classes with a computer science perspective that highlight the interactions between entrepreneurs, managers, and operators within organizations.
- Providing a sense of perspective about the history new technology and cryptocurrencies to enable students to evaluate the risks and rewards of joining the industry.

**Table 12. Demand for Blockchain Developers**

Location	Open Positions on LinkedIn
Worldwide	1,383
United States	461
New York	107
San Francisco	105
United Kingdom	148

Source: *The Blockchain Academy*

**Table 13. Blockchain Market Salaries in New York, March 2018**

Annual Salary Levels	Number
\$80,000+	266
\$105,000+	220
\$120,000+	165
\$130,000+	125
\$145,000+	58

Source: <https://www.indeed.com/jobs?q=blockchain&l=10018>



# Blockchain Development in the Region

In addition to the curriculum development, it is important for South Bay governments and leading agencies to facilitate the development of the Blockchain community within the region. The organization BlockchainLA is already providing an important role as a hub of the network, connecting universities and academics, industry, and government actors. It would be ideal to incorporate these different actors into the curriculum development process too. For example, specific user cases would be really helpful.

The “Silicon Beach” phenomenon is clearly very important piece of this puzzle. The spillover of expertise and innovative technology can certainly facilitate the growth of Blockchain in the South Bay region. Clearly if government could implement Blockchain, it would benefit citizens significantly. Another approach would be to support improved opportunities for communications between the different users. Industry participants have expressed their demand to connect with others testing and implementing the technology. It would be ideal to develop a series of conferences at local universities that can connect a variety of tech companies with different backgrounds and have them talk through where they are seeing it impacting their industry. Industry experts have called for a conversation about how that works, and cross-industry collaboration, as well as how it is packaged will influence how quickly it will be implemented.

## Discussion and Recommendations

The South Bay is in a prime position to take advantage of Blockchain technology. The South Bay is already part of the “Silicon Beach” area, an international hub for startups and science and technological innovation, and this phenomenon is set to spread further throughout the South Bay region. This business culture is geared for change and could implement Blockchain technology to create a brighter economic future for the South Bay. For the South Bay to receive any potential economic benefits from Blockchain, they first need to close this infor-

mation gap. The Blockchain information gap is the knowledge of industry experts versus the understanding of general end-users and the public (Tapscott, 2017). The information gap is growing larger due to the media’s coverage of Blockchain cryptocurrencies, which is only a small part of Blockchain technology’s potential (D. K. Hernandez, Personal communication, March 10, 2018). **The public has not been exposed to Blockchain technology’s many applications other than cryptocurrency (D. K. Hernandez, Personal communication, March 10, 2018).**

Blockchain is expected to have an effect on a wide array of industries. From security to efficiency, Blockchain is expected to change, and mostly improve, the industries researched. The possibilities Blockchain brings to the table is not being missed by industry experts looking for new ways of improving the processes their industry deals with on a frequent basis (MacDonald, Personal interview, March 2018). Many of the professionals interviewed expressed that Blockchain has the ability to alter the way companies work with data. In the Finance sector, Alyse Killeen anticipates greater equity to be brought to her industry since Blockchain will allow more average people to participate in fields they could not reach before. Killeen also sees how Blockchain can advance technologies such as smart wallets which can be used by everyone and will grant individuals more control over finances. In the Technology sector, Prit Seth anticipates a change in the way companies handle their data. In the Manufacturing Industry, MacDonald expects Blockchain to create a more efficient, “Just in Time” inventory and production system. College students foresee Blockchain being taught at their university in the future.

When it comes to improving processes, Blockchain has the potential to speed up information-based transactions. Efficiency improvements are expected across industries, as long as Blockchain is secure and does not negatively influence the reputation of the organizations.

# Medical Data

Many industries dealing with sensitive information, such as the health industry and financial industry, seek out Blockchain for the security factor. Other industries such as law, criminal justice, technology, and manufacturing seek out Blockchain for the efficiency it promises. Medical data is some of the most sensitive personal data industries in the South Bay manage, which is why many of the professionals we interviewed expected the medical industry to be one of the first and most heavily impacted industries by Blockchain. Data breaches are becoming increasingly frequent and damaging, and Blockchain provides a solution to that problem (Callahan, 2017). The number of data breaches from outside hacking has increased significantly in the past decade (Wallace, 2013). In the Financial industry, Blockchain is intriguing because of its ability to preserve authenticity among transactions.

Interviews with experts revealed a lack of trust in Blockchain. The lack of proven and easy-to-use business solutions in the current market place limits the number of companies investing in Blockchain. Those organizations currently investing in Blockchain are major corporations with the necessary research and development budgets, innovative start-ups, universities, and entrepreneurial non-profits and consultancies. Technology industry experts have seen many technologies they thought would influence the world, only to not get adopted by mainstream companies and therefore become dormant (D.K. Hernandez, Personal interview, March 10, 2018). This lack of awareness and trust puts the success of Blockchain in an uncertain position. One interviewee suggested that were Blockchain to experience a negative event such as a data breach, it could significantly harm the reputation and level of future implementation of the technology (D. K. Hernandez, Personal interview, March 10, 2018). Although many industry experts are enthusiastic about the possibilities of Blockchain, there are some who are also skeptical of its adoption by industries (Prit Seth, Personal interview, March 2018). It seems the biggest problem is the novelty of Blockchain (Officer Stuart Scott, Personal interview, March 2018).

## This section discusses the following Blockchain themes:

- File Storage and Data Management
- Contract and Title
- Government and Public Management
- Disaster Management
- Supply Chain Management
- Accounting
- Anti-Money Laundering
- Cybersecurity
- Finance and E-commerce,
- Cryptocurrencies and Cannabis
- Internet of Things
- Intellectual Property Rights

## All themes are discussed with respect to the following elements:

1. Future projections or expectations for the industry, occupations, and South Bay, with respect to the immediate term (within 2 years), short term (3-5 years), medium term (5-10 years), and long term (10-20 years).
2. What key challenges industries might face when implementing this technology.
3. What governments at all levels can do in terms of support, policy, or infrastructure to support Blockchain development.
4. What educational and training needs should be focused on.



## File Storage and Data Management

Internally, companies can roll out the technology quickly if they have the available capital and executive interest. The main obstacles will be in implementation and integration of Blockchain into legacy systems, finding good value business solutions, and training managers and users. The key changes are dependent on the industry, and the level of IT data management services which have been rolled out already. For example, health IT systems are definitely progressing and rolling out, and there is the potential for significantly more growth, both in general and with Blockchain in particular. Other complicating factors will include the level of regulatory oversight required over the data, the sensitivity of the

public or interest groups to data transparency, and the extent to which internal and external data management systems currently align (the interaction of data management systems can be very messy). Governments can play a role in two primary ways. Companies can be facilitated to invest with softer regulations that help to speed up implementation. More importantly, governments can make their systems Blockchain-friendly. Administrators and managers in any industry will need to adapt to the changes that Blockchain is likely to bring, and so knowledge and skills in this area will undoubtedly help in the implementation.

## Contract and Title

There is clearly great potential and opportunity here. People will have to be sold on the trustworthiness of the new technology as it is potentially disruptive. The benefits in terms of reducing transaction time/cost and increasing transparency will have to outweigh people's concerns around new technology or implementation. Technological factors influencing the transaction speed of Blockchain contracts will be important – if the transactions are slow, then they will not provide an advantage. It is not clear to what extent contract law might hinder or help Blockchain roll out. Clarifying regulations of Blockchain contracts might help to facilitate the development of the technology in this area. Administrators and managers in any industry will need to adapt to the changes that Blockchain is likely to bring, and so knowledge and skills in this area will undoubtedly help in the implementation. Those who deal with contracts regularly – lawyers, HR, procurement, etc – would need to be trained in this area.



**Blockchain has the ability to alter the way companies work with data.**

# Government and Public Management

There is the potential for Blockchain to change significantly the public sector work place, across numerous areas, including improving efficiency, administration work, contracting, data storage and management. There is also the potential for greatly improved transparency in government, which is increasingly of concern to citizens. This carries with it the potential for extra burdens on administrators to understand the impact and track their work more carefully. Security is critical, especially when the information stored is sensitive, confidential, or secret. There is a trade-off here between the increased security of Blockchain, and the overreliance upon it that could increase exposure to hacking or adaptive adversary approaches to gaining access to or manipulation the information.

Changes could be costly to government sector, both in terms of up-front costs (e.g. software and infrastructure investments) and implementation (e.g. training, adoption). Programs should be trialed and evaluated in terms of cost effectiveness. Government moves slowly, not least because of the complexity of different layers of government (federal, state, local) and different departments/agencies with each layer. Some governments worldwide have engaged in different trials of Blockchain; but the pace of implementation across a broad range of government offices is likely to be slow. There is the potential for Blockchain and cryptocurrencies to be used for tax collection purposes. This could significantly reduce the cost of filing taxes, especially for those in the cannabis industry, which is currently limited by federal banking regulations.

One Blockchain expert with experience implementing systems in government believes that the government could be transformed significantly and positively by the new technology. However, a shift in perspective by policy makers and public managers is required to realize this transformation. Through Blockchain, Government could be viewed as a hub and spoke system, with government and citizens interacting more directly, and with identity as a central element in the system. This could shift power to the individual, with the government now reshaped as the gatekeeper of the central hub. This could be applied to many areas in which government

stores key information already – such as property records, vehicle registration, tax records, permits, and education, employment and human resources systems to name but a few. Moreover, Blockchain could become the technology solution to realize the dream of the “single window”, whereby citizens interact with all forms of government through a single portal such as an internet site or data center. These applications have been tested and employed in many countries worldwide, with Estonia and UAE the most advanced when implementing so-call “e-government” processes. On an organizational level, Blockchain could reshape government to make it more efficient, as discussed for all organizations.

There is also significant scope for Blockchain to contribute to “social innovation” and “social entrepreneurship” in the non-profit sector (Disparte, 2019c; Tillemann et al, 2019). Examples of societal problems tackled by Blockchain-related projects, include providing lunches for children in Uganda (Campbell, 2019b), cleaning up environmental damages in the Niger Delta (Campbell, 2019f), UN aid provision, mobile voting in West Virginia, social investment in Berkeley, CA, and combating “fake news” (Tillemann et al, 2019).

## Disaster Management

Tracking of outbreak locations is being trialed by major corporations, and could significantly reduce costs of some kinds of disasters with respect to supply chains. Taking a broader perspective, there is a danger that systems are over-reliant on electronically stored information that is subsequently rendered unusable during major/catastrophic events. Blockchain can be used to safeguard against disruption of locally-dependent systems, e.g. intranets, and hence maintain information systems. The technology can also be used by security agencies to track illicit activities, dangerous materials, or individuals that may have a connection to terrorism.



# Supply Chain Management

Supply Chain Management deals with the transfer of goods and services along the business network. Some of the common examples are the movement of food from growers to the customer and the transfer of goods and services from one country to another.

**Leading companies in the global food supply chain (Dole, Kroger, Tyson Foods, Walmart, etc.) are collaborating with IBM to identify areas where Blockchain technology can help, like food safety (IBM, 2018).**

One of the central issues in food safety is the lack of prompt information and traceability, which are critical components when trying to contain the spread of illnesses due to food contamination. Blockchain technology is an ideal tool because it provides full end-to-end information of all transactions to all participants in the supply chain—growers, processors, distributors, retailers, and consumers – that allows for faster identification of the contamination source. Furthermore, Blockchain can also help in reducing food waste along the supply chain due to inefficiencies and reduce unnecessary disruptions to the supply chain that result from cases of food contamination. For example, a retailer might halt an entire section of their food supply for days or weeks until the source of contamination is identified. In this case, disruptions to the supply chain due to food contamination are expected to be shorter under the Blockchain system.

**Blockchain also can help in the reduction of fraud mainly due to document tampering –expensive art, wine, etc. – and the identification of conflict goods.**

Diamonds are a good example of the latter, and Blockchain technology can allow for a clear validation and identification of a source that is free from terrorist activities and human rights violations in general.

The transfer of goods from one country to another very complex due to layers of document validation by local producers, import/export brokers, logistics providers, customs agents, and financial institutions. This comp-

lexity tends to make the whole process inefficient, expensive, and prone to tampering. Blockchain's open ledger capability has the potential to increase the speed and efficiency of all steps while maintaining a level of trust needed for international trade.

To some people in supply chain management, the key challenge to the implementation of Blockchain technology is not the technical side. It might be more difficult to convince all the participants in the supply chain to participate. **A representative from the company Gartner claims that 90 percent of the challenge to implement Blockchain technology relates to cultural issues and not the technology side of things (Banker, 2018).**

**Blockchain can also help in reducing food waste along the supply chain due to inefficiencies and reduce unnecessary disruptions to the supply chain that result from cases of food contamination.**

Government can use Blockchain technology to reduce fraud, error, corruption, and time intensive processes, so one of the main

steps to support Blockchain technology development is to promote effective and clear governance and regulations (Distributed Ledger Technology: beyond block chain, UK Government Chief Scientific Adviser). Governance includes the rules set up by the owners and participants of Blockchain technology to protect their own interests. Regulations, on the other hand, relate to the rules set up to protect the interests of society as a whole. There might be a conflict between governance and regulation, so the key is for government to achieve a balance that protects society's interests but at the same time promotes the adoption and development of Blockchain technology in supply chain management and any other sectors of the economy.

Given the complexity and large number of data and document validation steps involved in the end-to-end transfer of goods and services, Blockchain technology education in supply chain management is a must for all clients and participants, but a highly technical knowledge is also necessary for decision makers in all areas of supply chain management.

# Accounting

Blockchain technology deals mainly with the transfer of assets and maintaining a decentralized ledger of accurate financial information that can be widely verified without being altered or corrupted, while the accounting profession deals mainly with the measurement and communication of financial information (Blockchain and the Future of Accountancy, The Institute of Chartered Accountants in England and Wales, 2017). Accounting is also concerned with property rights evaluation and the efficient allocations of financial resources. In that regard, Blockchain technology has the potential to reduce significantly the cost of maintaining accurate and readily available financial information related to property and all bookkeeping activities. That implies that resources can be diverted from activities related to recordkeeping, validation, and protection of information.

Auditing is a clear example of an accounting area that might be transformed considerably with the adoption of Blockchain technology. The high visibility of transactions easily verified by Blockchain technology paired with the appropriate data analytics would allow auditors to skip most of the transaction validation component of the audit, and allow them to spend more time with higher level components of the audit. However, some experts in the accounting profession believe that Blockchain technology must be developed, standardized, and optimized in order to become an integral part of the profession, but this process might take several years to be fully achieved (Blockchain and the Future of Accountancy, The Institute of Chartered Accountants in England and Wales, 2017).

**Accounting companies like Ernst & Young are already accepting Bitcoin as form of payment,** while PwC already launched their first Blockchain auditing service. Similarly, Deloitte has been in the Blockchain software platform business since 2014 and has been involved in Initial Coin Offerings (ICOs).

Contrary to most other industries and sectors,

accountancy seem to have a relatively low level of challenges to the implementation of Blockchain technology, and this is mainly due to the natural good fit of the technology in assisting the professional to perform her/his job. The industry as a whole seems to acknowledge that accounting has to get on board with the technology in order to avoid being disrupted fundamentally. In a sense, Blockchain technology adoption seems to be more a question of when rather than if for the accounting profession (Why CPAs Need to Get a Grip on Blockchain, Journal of Accountancy, June 13, 2017).

As mentioned before, government can play a supporting role in Blockchain technology adoption by promoting effective and clear governance and regulations. However, government might also help

promoting the adoption of the technology by adopting it itself. After all, Blockchain technology has the potential to reduce the cost and waste and increase accuracy, speed, and safety of recordkeeping in all levels of government.

Some experts in the field believe that Blockchain technology is not likely to replace significant

portions of the accounting workforce, but predict instead that accounting professionals might need to learn as much as possible before the technology becomes part of their everyday jobs (Blockchain is Already Changing Accounting, Accounting Today, May 7, 2018). On the other hand, some experts predict that Blockchain will have a significant impact in bookkeeping, reconciliation, and dispute management, threatening the accountant jobs in those areas. This in turn will increase the demand for technology and advisory type of jobs. In addition, the accounting professional under after Blockchain implementation will require a clear understanding of the technology, being able to identify potential opportunities for the application of the technology, and become a bridge between technology specialists and clients.

**Accounting companies like Ernst & Young are already accepting Bitcoin as form of payment**

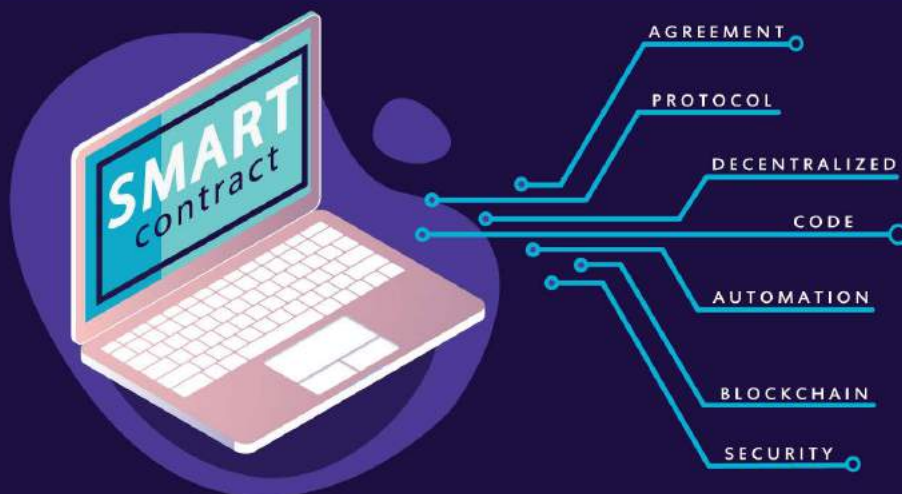
# Anti-Money Laundering

Incorporating Blockchain-based technologies could be a more efficient way to comply with increasingly strict anti-money laundering (AML) statutes and enterprise fraud management (EFM) in the financial services industry. The DLT that Blockchain provides makes it ideal as a trustworthy information depository. Large financial institutions must update their tools and privacy policies in order to cope with the decentralized nature of a Blockchain system. Blockchain lends itself as a platform by which institutions can monitor financial transactions without the need of an intermediary. An updated anti-money laundering system will use smart-contracts in order to move data through their transaction filters with confidence.

In order for banks and other firms to adopt Blockchain's architectural framework successfully, there needs to be an industry-wide update to privacy policies concerning transactional data sharing. This update to privacy policies will probably stem from the creation of a regulatory structure designed to ease Blockchain's adoption into anti-money laundering and other types of fraud. In a recent paper by Deloitte commissioned by the Structured Finance Industry Group, it is suggested that a new monitoring environment could be granted far-reaching access to data across informational nodes in order to help firms comply with regulatory reporting (Deloitte, 2017).

# Finance and E-Commerce

Blockchain can be used to streamline a firm's transaction processing in order to reduce the cost of current practices. A distributed ledger's peer-to-peer collaborative nature makes communication faster across the board. Smart contracts can be applied to accelerate clearing activities and streamlining regulatory compliance efforts. Smart contracts can also be used to quickly provide proof of compliance by storing regulatory data in immutable blocks. When it comes to auditability, the immutable nature of these blocks allows for transactional information to be recorded and distributed along a verifiable trail. Blockchain would allow fast and accurate reporting by automating compliance processes that would draw from an immutable source. The biggest challenge behind Blockchain's widespread adoption in the financial services industry is the privacy of data exchanged at the transaction level. In order to overcome this challenge, all parties involved in a transaction that takes place through a Blockchain network must remain on a private ledger. An interesting solution to this problem is being co-developed by JP Morgan and a Blockchain startup called EthLab. Their plan is to integrate both public Ethereum and private ledgers in order to recognize transactions that require a private ledger while maintaining operational functions with the public ledger (Hilska, 2018).



# Cryptocurrencies and Cannabis

In the wake of cannabis legalization, regulatory compliance and financial transaction recording are coming into the early stage cannabis market. By creating a Blockchain-based supply chain and e-commerce market, the cannabis industry will ensure best practices during audits and tax systems. (Bourque, 2019). **Moreover, if state governments allow for the collection of taxes with cryptocurrencies, then cannabis companies will be able to bypass federal banking regulations that are currently constraining their ability to do business and pay taxes.** Cannabis businesses will also be able to manage their supply chains efficiently by making sure that all level of production are working properly. **A real-time Blockchain trail can help businesses reduce operational costs and create an efficient oversight of quality control.** Both consumers and retailers will be able to track the product they are purchasing to ensure quality and manufacturer of origin. These same steps have been instrumental in making Blockchain systems the preferred means of trading cryptocurrencies. By marking these coins in a chain, buyers and sellers can authenticate information such as price and authenticity of each individual coin being traded.

**The legal cannabis industry can solve its cash-only problem by creating a Blockchain-based system of payments that would allow customers to pay without the need for cash.** Recent developments in cryptocurrency geared towards cannabis have seen companies like CLOAKcoin begin to provide cryptocurrency solutions for legal cannabis companies that currently operate on a cash-only system. Government regulation of these legal cannabis sales can incorporate Blockchain systems in order to record sales data and track the origin and destination of cannabis through the supply chain. By adopting an industry-wide Blockchain solution, the case can be made for general cryptocurrency adoption, as well as the legitimacy of the legal cannabis industry.

# Cybersecurity

Blockchain has opened the door to many possibilities in how we move forward in restructuring security in the digital age. Blockchain is a tool that can prevent identity theft, data tampering and denial of service attacks. As of now, data is centralized, but with decentralization, hackers with malicious intentions cannot breach any of the data. This is due to the hashes being varied through a distributed ledger. With the recent major breaches in business, adopting the Blockchain approach could virtually obsolete the number of leaked data breaches.

Short-term projections suggest that Blockchain will be widely discussed in all industries to not only reduce “black hat” hackers – that is, hackers with criminal motives – with the intent of tampering documents but also

**As of now, data is centralized, but with decentralization, hackers with malicious intentions cannot breach any of the data.**

enhance overall security when in use (Bishop, 2017). Blockchain is anticipated to be widely adopted, partly to improve cybersecurity, yet the key challenge for many of these industries is not to place one hundred percent of trust into Blockchain. As with the notion of adaptive adversaries in security studies, those with malicious intent are constantly adjusting to and aiming to subvert the latest security protections. Blockchain will strengthen defenses, but not provide a panacea for protection. As for government implementation, all suggested Blockchain projects, whether it has to do with sensitive file sharing or data transferring, should begin with a small pilot project in order to assess the value that it will have as a whole adaptation.



# Internet of Things

Home assistant technology devices such as Wi-Fi controlled thermostats and Amazon's Echo are becoming increasingly popular. With popularity, there is an opportunity for exploitation. Internet of Things devices need a third party to operate. One option for Internet of Things users is Tangle which is a block-less type of distributed ledger that interacts and identifies each Internet of Things device in a peer-to-peer manner making it more efficient than the traditional Blockchain. This creates a tamper-proof hash making it impossible for identity theft. This will allow users to shop confidently without worrying about if their sensitive information such as address or credit card information is being leaked. Product vulnerability awareness and multiple tests before product launch will also reduce breaches from occurring.

In the short term, we are likely to see many companies investing in the value of Internet of Things and Blockchain "co-connecting" in order to reduce the sabotaging or the commandeering of devices that have occurred in the past (Kranz, 2018). By combining, these two will create a secure audit-level tracking of Internet of Things data transactions, in turn, eliminating the need for a central, trusted intermediary between communicating devices (Kranz, 2018). The United States Government has struggled to stay above water and integrate evolving technology; which includes the Internet of Things. By 2020, more than 30 billion devices will be connected to the Internet. This challenge will force governments to keep pace with current technology within budget constraints.

**This creates a tamper-proof hash making it impossible for identity theft. This will allow users to shop confidently without worrying about if their sensitive information such as address or credit card information is being leaked.**

# Intellectual Property

Protecting the integrity of data can have earth shattering consequences if the appropriate steps aren't taken. By implementing Keyless Signature Infrastructure, it verifies original and duplicate copies of data files by running hashing algorithms and comparing the results that are stored on the Blockchain. Any altered data will be quickly identified through the evaluation of the original hashes. This type of technology is useful for all industries of all sectors including government.

We are likely to see a Blockchain disruption within the intellectual property industry in various sectors whom deal with trademark registration, contracts, and evidence of creatorship. Most likely, everyone else will be boarding the Blockchain train within a year once companies show how successful the technology has improved their bottom line. As for government, this implementation would be ideal for the patent office. As challenging as it may be, it would be worth the transfer of old patents into the Blockchain system in order to reduce problems that may occur in the future. What we know now, government has created the Congressional Blockchain Caucus, which will assist in a global standard for self-executing contracts by various organizations (Clark & McKenzie, 2018).







# Conclusion

**W**hen the internet first began the initial use of the technology was email. At the time many thought email was 'the internet' and that email was the only thing the internet did. Later however, we realized that the internet did much more than just email. From hosting websites to facilitating online payments to watching movies, the internet dramatically changed the way we live and communicate.

Like the internet in the beginning, Blockchain is still very young and misunderstood and many associate it only with cryptocurrencies, specifically Bitcoin. Yet we have shown in this report that Blockchain does much more than only power crypto. Simply, Blockchain is software that keeps track of things. Keeping track of business activity and information is a primary

function of business. Because Blockchain can accomplish this in a way that can be transparent, immutable and secure, the technology offers many powerful solutions for business and for society.

To ensure the South Bay region remains at the forefront of innovation, it is important we understand the dynamics of Blockchain and prepare our future workforce with the skills they need to succeed. It is equally important that South Bay business can find the talent they need locally without having to seek workers out of state or out of the county. We need to make sure our residents have the skills businesses need to stay competitive in a global economy; and South Bay residents can capture those well-paying employment opportunities of the future.







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