
Blockchain and International Trade in the APEC Region

Prepared for the APEC Business Advisory Council
Regional Economic Integration Working Group
by RMIT University



THE AUSTRALIAN
APEC STUDY CENTRE



Asia-Pacific
Economic Cooperation



ACKNOWLEDGEMENTS

APEC Leaders established the APEC Business Advisory Council (ABAC) in November 1995 to advise APEC Leaders and officials on issues of interest to business and provide the business perspective of specific areas of cooperation. ABAC commissioned this research activity from RMIT, supported by the APEC Australian Study Centre.

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Aaron Soans provided extensive guidance and support.

Rodrigo Suazo, Oscar Cisternas and Juan Pablo Morales from the Diego Portales University (UDP), Chile developed the case study on blockchain and renewable energy in Chile under the supervision of Maria Pía Aqueveque.

The RMIT Research Team would like to acknowledge the following individuals for their support for the project:

Robert Milliner
Lisa Barker
Kathy Douglas
Michael Fairbairn
Julie Kim
Amgad Shehata
Briony Wood-Ingram
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Sue Brennan
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CONTENTS

EXECUTIVE SUMMARY 1

INTRODUCTION 3

APEC TRADE FACILITATION ECOSYSTEM 6

 Understanding the Trade Facilitation Agenda 6

 An Overview of APEC Trade Facilitation 6

 Issues 9

 Comprehensive Implementation and Interoperability 9

 Inclusion 11

 Closing the Digital Divide in APEC 12

BLOCKCHAIN AND TRADE 13

 What is Blockchain? 13

 Types of Blockchains 14

 Emerging Trade-Related Blockchain Applications 15

 Case Study: IBM Maersk TradeLens 16

 International Transport and Logistics 17

 Case Study: UPS Blockchain 18

 Trade Finance 19

 Cross-border payments 20

 Marine Insurance 20

 Commodity Trading 21

 Energy Trade 21

 Case Study: AgriDigital 22

 Provenance, Fraud, Fair trade 23

 Case Study: Everledger 24

 Summary of findings from the developed cases 25

APEC: MANAGING BLOCKCHAIN 28

 Blockchain Application by Governments 28

 Regulation, Standards, Laws 32

 Standards 33

 Laws and Regulation around Blockchain 34

 Issues around Recognising Blockchain in Law 36

CONCLUSION 39

RECOMMENDATIONS 39

ANNEX 1 Blockchain and Renewable Energy in Chile 39

REFERENCES 49

Tables and Figures

Table 1.1: TFA Articles developing APEC economies have notified under Category B or C

Figure 1.1: Single Trade Window Environment

Figure 1.2: Overall implementation of trade facilitation measures in APEC (2017)

Figure 1.3: State of Implementation of 'trade facilitation for SMEs' measures in Asia-Pacific economies

Figure 1.4: State of implementation of 'women in trade facilitation measures' in Asia-Pacific economies

Figure 2.1: Blockchain: what it does and how it works

Table 2.1: Overview of the main characteristics of various types of blockchains

Figure 2.2: Blockchain Interoperability

Figure 2.3. The MAERSK-IBM Global Trade Digitisation

Figure 2.4: Trade Finance and Blockchain

Table 2.5: AgriDigital Benefits to Supply Chain Participants

Figure 2.6: International trade using blockchain

Figure 2.7: Blockchain Development out to 2030 (Gartner Forecast)

Figure 3.1: Notarisation of carnets and transactions

EXECUTIVE SUMMARY

In 2019, the APEC Business Advisory Council (ABAC) commissioned MBA students from RMIT University to research blockchain, trade-related blockchain applications, and associated issues for APEC consideration as the next generation of regional trade facilitation plans are formalised.

Blockchain is a digital technology used to create decentralised, shared and immutable databases of records secured and linked with cryptography. The technology which rose to prominence as the public transaction account for cryptocurrencies is now being applied in other contexts where ledgers are fundamental, including trade and international supply chain management.

Blockchain is a fast emerging but nascent technology and the hype about its revolutionary potential generally downplays myriad complex issues that must be addressed if applications are to be scaled and widely adopted. However, a review of current trade-related blockchain use-cases, private and public, suggests blockchain can deliver significant efficiencies for trade participants. It seems likely that development momentum will continue.

National and regional policy makers are therefore grappling with policy, regulatory and inclusion challenges in relation to blockchain. A proactive approach in relevant APEC fora is advisable to develop appropriate regulatory frameworks in the region and beyond, to enable blockchain to achieve its full potential.

In 2020, APEC looks forward, poised to develop a post-2020 vision including new trade facilitation priorities. Regional trade facilitation has delivered significant benefits but, despite strong leadership, APEC's priorities of paperless regional trade and harmonised Single Windows and Authorised Economic Operator (AEO) schemes across the region are yet to be fully realised. Some leading APEC economies continue to have multiple paperless trade platforms that are not fully reconciled, whilst less developed APEC members are yet to transition from outdated, paper-based systems.

Work will continue towards realising these goals within APEC and through the World Trade Organisation (WTO), with capacity building efforts to support less developed economies to implement trade reforms; deploy leading edge technologies; and shape enabling standards, laws and regulation.

Pathfinder APEC economies have been quick to embrace digital innovation. Border authorities are trialling blockchain in various ways, including making their trade processes more efficient, transparent, and accessible. However there remains a risk that adoption of incompatible blockchain platforms could further fragment the trade ecosystem. APEC economies must work pro-actively with business, international organisations and other stakeholders to develop open standards and ensure that its members have the capability to implement them.

Over the last decade, less developed economies have not had the capacity to access, adopt and use digital technologies. APEC is committed to closing the digital divide in the region and it has been suggested that blockchain offers unprecedented options to help in this regard. There is a window of opportunity for less developed economies, with marginalised groups and smaller enterprises, to approach a lack of pre-existing infrastructure not as a handicap but an opportunity to leap-frog to blockchain based systems.

In conjunction with other international bodies, APEC should implement ambitious stakeholder co-ordination and capacity building around blockchain to start closing the existing digital divide and promote 'catch up' action in trade reform that would ensure that material benefits are better shared across APEC in the future.

RECOMMENDATIONS

1. As new technologies are being developed and applied to facilitate trade, APEC should keep abreast of latest developments and consider implications for existing programs. The APEC Sub-Committee on Customs and Procedures should convene a group of customs officials and private sector representatives to consider how blockchain could address shortcomings in programs such as Single Window and Authorised Economic Operator.
2. As the emergence of competing private platforms risks creating a fragmented blockchain ecosystem, it is important to develop universally accepted open standards. APEC should engage with international organisations, industry and customs authorities to develop standards for data management and protocols for inter-ledger interoperability.
3. APEC should anticipate the legal and regulatory policies and frameworks needed to recognise blockchain data in law; resolve cross-jurisdiction disputes; standardise data capture, storage, ownership, sharing and security provisions; recognise smart contracts and digital currencies.
4. APEC should closely monitor regulatory restrictions to cross-border transfers of data as this could impede the functioning of blockchain systems. Concurrent work by ABAC to develop cross-cutting data flow principles can make an important contribution to enabling the free flow of data while maintaining privacy and security.
5. APEC economies must ensure that the basic requirements are met for blockchain to be widely adopted. This includes access to digital infrastructure and specialised training for marginalised groups such as women, MSMEs and remote communities. APEC should implement the Internet and Digital Economy Roadmap, particularly provisions on enhancing access to digital infrastructure as recommended in the ABAC report on Structural Reform and Digital Infrastructure.
6. As APEC Members have varying capabilities to adopt new technologies, APEC can play an important role as a platform for public and private entities to share best-practice examples. The APEC Committee for Trade and Investment (CTI) should organise capacity building workshops to review blockchain implementation; policy, regulatory and technical reforms; ecosystem co-ordination; and standards accreditation requirements with a view to equalising adoption rates across APEC.

INTRODUCTION

APEC Leaders established ABAC in November 1995 to advise APEC Leaders and officials on issues of interest to business and provide the business perspective of specific areas of cooperation. In 2019, ABAC commissioned MBA students from RMIT University to research the fast-emerging technology of blockchain, look at trade-related blockchain applications, and consider any issues for the APEC trade facilitation agenda as blockchain matures and the next generation of regional trade facilitation plans are developed.

Blockchain is a fast-emerging digital innovation that underpins various distributed ledgers - decentralised, shared and immutable databases of transactions secured using cryptography. There is considerable hype about blockchain's revolutionary potential. The technology rose to prominence as the public transaction account for cryptocurrencies but the technology is rapidly being adopted and applied in many other contexts. There are a growing number of real-world trade related use-cases by entrepreneurs, technology companies, logistics providers and customs/border authorities.

Chapter 1 provides an overview of policies and programs that APEC and ABAC have championed over many decades. Although much progress has been achieved, there is more to achieve around inter-operability of single windows and paperless trade systems, reducing barriers for entry to Authorised Economic Operator (AEO) programs, manual processing and improving traceability. APEC priorities have been incorporated into the World Trade Organisation's (WTO) program for global trade facilitation, along with the APEC approach of accommodating the varying capacity of members to implement reforms to meet trade facilitation goals.

Chapter 1 reviews the variable implementation of national Single Window, AEO programs, and paperless trade within APEC. Whilst some APEC economies currently lead the world in digital trade facilitation, at the other end of the spectrum, less developed APEC members are yet to transition from outdated, paper-based and inefficient national systems. It also highlights the scope for improving the benefits that flow from trade facilitation for less developed economies, marginalised groups, and micro to small and medium sized enterprises (MSME) and for starting to reverse the digital divide that has opened up in the region in the past two decades.

Work will continue towards realising these goals, within APEC and through the WTO, and on strengthening the capacity of less developed economies to implement trade reforms; deploy leading edge technologies; and help shape enabling standards, laws and regulation.

APEC is currently poised to develop a post-2020 vision including new trade facilitation priorities. This will need to take into account myriad digital technologies that are now available as tools for APEC economies from the internet, to electronic payment systems, cloud computing, and mobile technologies, to now including the Internet of Things (IoT), big data analytics, artificial intelligence (AI) and blockchain.

Chapter 2 introduces blockchain and briefly differentiates between types of blockchain before considering applications in international trade. This chapter reviews publicly available detail on a sample of relevant private sector projects, and presents selected case studies, to showcase how blockchain-based application trails are changing trade operations and international supply chain management. In general, these are still in trials or pilot phase. However, some organisations are approaching the point of scaling and rolling out more extensive programs.

Chapter Two concluded that blockchain has several features conducive to facilitating trade. It offers a decentralised ledger that can securely store information using cryptographic techniques, combining with smart contracts, IoT, and

cloud computing to enable automatic processing of routine tasks. New systems are being developed that allow trade-related data to be shared more easily and securely across the many actors in the international supply-chain ecosystem.

The review and selected case studies of noteworthy initiatives show the potential of blockchain to value add by: boosting traceability and trust as goods and components can be more effectively tracked across suppliers and borders; enabling superior information sharing through distributed ledgers that allow multiple transaction participants to access relevant data in real time; facilitating automated processing via smart contracts of identity and certificate verification, payments and work flow management; and upholding security by encrypting data and by encrypting data and carefully managing access rights.

These developments are significant for APEC's trade facilitation efforts as it looks to the future. National and international policy makers are keenly assessing this activity and associated opportunities (and challenges) that might flow from the wider deployment. Considering these developments, the imperative is mounting for policy makers in individual economies and multilateral bodies such as APEC to look more closely at blockchain.

Chapter 3 of the paper considers some of the implications that blockchain, in conjunction with other innovative digital technologies, might present for the development of APEC's post 2020 vision and the next trade facilitation action plans.

The report acknowledges that the impact of blockchain based technology in the trade context has only started to emerge. As a foundational but complex technology, it will be gradually adopted across the trade eco system in coming years. Pathfinder APEC economies have been quick to embrace digital innovation and are already trialling blockchain in various ways, including making their trade processes more efficient, transparent, and accessible. Chapter 3 looks at some of these early adopter economies and some of the innovations they are implementing in terms of customs and other trade related government processes. A review is offered of trials that have started in some jurisdictions to develop secure, intelligent automation of trade processes or interfacing with other blockchain ledgers.

If successful, these projects will lift the APEC benchmark for trade facilitation, pull the agenda further into the digital realm and further aggravate problems around regional interoperability.

This report argues that APEC should comprehensively assess the reported potential for blockchain to provide leapfrog benefits for less developed economies, MSMEs and marginalised groups. It has been suggested if these entities could approach their lack of pre-existing infrastructure and involvement not as a handicap but an opportunity to leapfrog to more advanced systems, it would deliver new market and trade opportunities.

This would require ambitious fashioning of the next generation of APEC trade facilitation and capacity building programs, to ensure that pioneering APEC economies adopting blockchain contribute lessons and support other economies committed to the leapfrog path to secure potentially unprecedented benefits.

Despite the early nature of blockchain in trade, it seems likely that development momentum will continue. As blockchain matures, pressure will mount on governments and relevant international bodies to provide the enabling legal and regulatory frameworks to facilitate blockchain and interoperability between systems.

Recognising that it is important for APEC to be on the front foot and consider the policy, regulatory and inclusion aspects of blockchain, Chapter 3 discusses possible reforms emphasising the need to clarify cross-border data regulation. Relevant APEC fora should engage with pertinent blockchain implementations to ensure high quality information sharing to inform development of appropriate regulatory reforms in the region (and beyond) and meet

the expectations of business and individual economies championing blockchain. This will also inform liaison with other international bodies.

This report stresses some factors to be considered around blockchain. It is not a silver bullet to cure all trade facilitation ills. Border processes will still need to be re-engineered to make the most of the technology. Governments and businesses will also have to develop monitoring and authentication systems to ensure that information entered on the blockchain is accurate in order to avoid a 'garbage-in, garbage-out' problem. Blockchain also might not offer unique solutions. Pursuing other paths such as Single Windows with an application programming interface (API) to share data, digital documents and payments will continue to be pursued in the region even as blockchain unfolds.

The pace of digital innovation will continue and will impact on the APEC trade facilitation agenda. Digital technologies have helped globalise supply chains and have dramatically increased the scope and scale of trade. This trend is likely to continue, strengthening the need for APEC to stay up to date with the latest developments and establishing open communication with leaders in the private and public sectors to investigate its possible applications, in order to rigorously consider the potential and implications of blockchain.

APEC TRADE FACILITATION ECOSYSTEM

Understanding the Trade Facilitation Agenda

Since inception, APEC has maintained a focus on trade facilitation, liberalisation and governance, as essential paths to achieve the Bogor goals of free and open trade and investment by 2020. Member economies have sustained momentum on individual and collective action to reduce barriers to trade through various APEC fora for nearly three decades, then converging with the WTO's agenda for global trade facilitation.

A major tranche of work involves individual governments' implementation of 'at the border' and 'behind the border' reforms to reduce excessive bureaucracy, regulation and (import, export and transit-related) documentation, streamline institutional coordination and introduce digital systems. Various APEC members have introduced Single Windows, AEO schemes, and modern digital processes. A further tranche of work 'beyond the border', focuses on the structural and regulatory obstacles that inhibit cross-border trade. APEC promotes interoperability by harmonising technical and regulatory standards, agreeing Mutual Recognition Agreements (MRAs) and digital compatibility.

During this period, myriad digital technologies have emerged from the internet, to electronic payment systems, cloud computing, and mobile technologies, to the IoT, big data analytics, AI and blockchain. Ensuring APEC agendas keep pace with technological innovation has proven challenging. Developed APEC economies have been quick to adopt digital innovations, develop enabling standards, legal and technical frameworks and act to facilitate interoperability. However, not all APEC members have had the capabilities or capacity to invest in such technologies and frameworks.

An important role of APEC has been to oversee cooperation between all members, approaching trade facilitation implementation on a voluntary basis, facilitating information and best practice sharing, and providing vital assistance to strengthen the capacity across the region to implement trade facilitation measures.

An Overview of APEC Trade Facilitation

APEC's first **Trade Facilitation Action Plan (TFAP)** ran from 2001-2006 with a second phase from 2007-2010. Both plans focused on customs procedures, standards and conformance, business mobility and electronic commerce to cut red tape at the border. TFAP II cut costs by 5 per cent between 2007-2010 saving USD 58 billion.¹

The **APEC Supply Chain Connectivity Framework Action Plans (SCFAP I and II)** which followed are now drawing to close in 2020. SCFAP II tackles five chokepoints to the flow of goods:

- (1) co-ordinated border management and border clearance procedures;
- (2) access to transportation infrastructure and services;
- (3) unreliable logistics and high costs;
- (4) limited regulatory co-operation; and
- (5) policy and regulations for e-commerce.

Initiatives were introduced to address each chokepoint though some have received more attention than others. According to a 2018 stocktake conducted by the Committee on Trade and Investment (CTI), chokepoint 1 had fifteen

¹ APEC PSU, 2012. *APEC's Achievements in Trade Facilitation 2007-2010 - Final Assessment of TFAP II*

initiatives while chokepoint 3 had only three.² To track progress in achieving the goals of the SCFAP-II, CTI developed a monitoring framework with a set of external indicators from the World Bank, World Economic Forum and other international organisations. The 2019 Interim Review reported mixed progress.³ Chokepoints 1,2 and 5 saw improvements whilst Chokepoint 3 experienced a decline in timeliness of shipping, ease of arranging competitively priced shipments, and tracking of consignments. Chokepoint 4 fared worst with information availability, internal border agency co-operation and external border agency co-operation dropping by 10-20 per cent from 2015-2016.

APEC is a lead player supporting the **WTO Trade Facilitation Agreement** which galvanised global support for the trade facilitation cause. 136 WTO Members and all APEC members have ratified the Agreement which came into force on 22 February 2017. The Agreement contains provisions to expedite the movement, release and clearance of goods across borders with measures to boost cooperation between customs and border authorities.

The TFA allows developing and least-developed economies to choose their own implementation schedules and access technical and financial assistance for capacity building. Developed economy members committed to implementing substantive portions of the TFA by 22 February 2017 – these were nominated as Category A measures. Least developed economies were given an additional year to implement Category A measures. All economies could nominate additional time for certain measure (Category B) and seek both additional time and capacity building support to implement a further category of measures if necessary (Category C). Table 1 summarises notifications by developing APEC economies on the categories assigned for each WTO TFA articles.

Table 1.1: TFA Articles developing APEC economies have notified under Category B or C⁴

| WTO TFA Article | Notified as Category B | Notified as Category C |
|---|------------------------|------------------------|
| 1.1 Publication | 1 | |
| 1.2 Information available through internet | | 1 |
| 3 Advance rulings | 2 | 1 |
| 4.4 Procedures for appeal or review | 2 | |
| 5.1 Notifications for enhanced controls or inspections | 3 | 1 |
| 5.2 Detention | 1 | |
| 5.3 Test procedures | 1 | 2 |
| 6.3 Penalty disciplines | 2 | |
| 7.1 Pre-arrival processing | 1 | 1 |
| 7.2 Electronic payment | 1 | |
| 7.3 Separation of release from final determination of customs | 1 | |
| 7.4 Risk management | 1 | 1 |
| 7.5 Post-customs clearance inspection | 1 | |
| 7.6 Average release times | 2 | |
| 7.7 Authorised Operators | 2 | |
| 7.8 Expedited shipments | 1 | |
| 7.9 Perishable goods | 1 | |
| 8 Border agency cooperation | 2 | 1 |
| 10.3 Use of international standards | 1 | |
| 10.4 Single window | 2 | 2 |
| 10.8 Rejected goods | 2 | |
| 10.9 Temporary admission of goods and inward and outward processing | | 1 |
| 11 Transit | 3 | 1 |
| 12 Customs cooperation | 3 | |

It shows that APEC economies require additional time mostly for article 7 of the TFA, the release and clearance of goods. Of note were the shortcomings in notifications for enhanced controls or inspections, average release times, authorised operators, border agency co-operation, single windows and customs co-operation. The areas that were identified as most requiring capacity building were test procedures and single windows.

² APEC, 2018. '2018 Stocktake of the APEC Supply-Chain Connectivity Framework Action Plan (SCFAP) II 2017-2020'

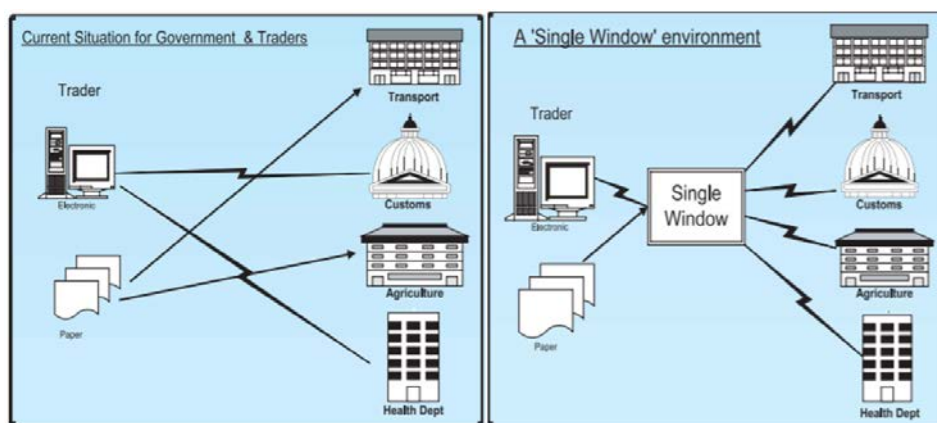
³ APEC, 2019. 'APEC Supply-Chain Connectivity Framework Action Plan 2017-2020: Interim Review of External Indicators'

⁴ ESCAP, 2019. 'WTO TFA+ Implementation State of Play in Asia and the Pacific: Moving Towards Digital and Sustainable Trade Facilitation', ESCAP Trade Insights: Issue No. 28. APEC PSU, 2019. 'Trade Facilitation in APEC: Progress and Impact', Policy Brief No. 25

APEC initiatives on Single Windows and AEO schemes have been central to APEC’s trade facilitation agenda. These programs aim to reduce trade costs and processing times, increase safety, and streamline border processes. The Single Window program is geared to reducing trade costs while AEOs focus on safety, security and reducing clearance times.

Single Windows refers to an electronic facility that allows traders to submit required documentation at a single-entry point. Developed APEC economies have been developing Single Windows for over a decade to reduce barriers in international trade amongst APEC members and to enable regulatory bodies to continue to improve supply chain security.⁵ Implementation of Single Windows (with regional interoperability) helps drive paperless trade systems.

Figure 1.1: Single Trade Window Environment⁶



APEC is home to several world-leading fully operational and well-established Single Windows. The UN ESCAP has identified best practice examples from Hong Kong (HK), China; Japan; Republic of Korea; and Singapore with: single entry and submission of information; paperless environment; standardized documents and data; information sharing; centralised risk management; coordination of agencies and stakeholders; analytical capability; and electronic payments. However, Single Windows have been implemented to varying degrees and even established systems suffer from shortcomings for example where systems used by border agencies are not well aligned with those of other government departments, creating a ‘double window’ problem. Even Singapore, HK, and Korea, pioneers in the use of paperless trade systems still are contending with multiple paperless trade platforms within their own economies.⁷

APEC and the WTO TFA actively promote the development of interoperability between national single windows. According to the UN Trade Facilitation Survey, only a handful of European economies and Canada report full engagement in cross border electronic trade data exchanges while a further 48 economies reported partial exchanges. Some bilateral or sub-regional interoperability have been achieved in the APEC region. ASEAN single windows can share electronic certificates of origin between ASEAN Member States. Pacific Alliance members can share phytosanitary and origin certificates. In 2016, APEC stepped-up efforts to further international interoperability of single windows in response to statements made by the APEC Ministers Responsible for Trade. An APEC PSU report in 2018 also highlighted the need for greater harmonisation of terminology, processes and technologies to foster higher interoperability.⁸

⁵ APEC, 2014. ‘Paperless system speeds up trade’

⁶ UNECE –UN/CEFACT (UNECE Recommendation 33)

⁷ ESCAP, 2018. ‘Single Window for Trade Facilitation: Regional Best Practices and Future Development’

⁸ APEC PSU 2018. ‘Study on Single Window Systems’ International Interoperability: Key Issues for Its Implementation’

The Authorised Economic Operator (AEO) scheme operates as accreditation for businesses that are compliant with requisite trade practices and able to demonstrate a secure supply chain. This accreditation demonstrates that the government has independently assessed and accredited a business against World Customs Organisation standards that incorporate guidelines in regard to a Trader Identification Number and the SAFE Framework of Standards to Secure and Facilitate Global Trade.⁹ The core aims of AEO schemes is to establish an international corporate identity system and encourage supply chain enterprises to maintain high best practice security whilst trading.¹⁰

APEC endorsed AEO programs in the 2011 APEC Consolidated Counter Terrorism and Secure Trade Strategy, the APEC Framework on Secure Trade, and the 2014 Customs 3M Strategic Framework. Article 7 of the WTO TFA also encourages economies to provide additional trade facilitation benefits to businesses that meet specified criteria. The benefits can be significant, for example, in Australia a Trusted Trader scheme was estimated to represent savings of AUD\$3.2 billion to Australian industry over a ten-year period to 2025. To date the scheme has 200 accredited Trusted Traders and this is expected to grow to 1000 participants by the end of 2020. 17 APEC Members have AEO programs in development. Benefits associated with participation in this scheme include:

- priority processing of tariffs, valuation and origin, duty drawback claims and import duty applications;
- priority treatment of goods at the border; and
- MRAs with countries that recognise ATT status providing faster access to international markets.¹¹

APEC economies are working to spread the benefits of AEO programs by extending participation to MSMEs. Large firms were the greatest beneficiaries of AEO schemes as they had the scale and financial resources needed to modify processes to meet the specified criteria. The Boracay Action Agenda (2015) called for further efforts to include MSMEs, estimating that these businesses account for 97% of all businesses and half of the labour force in APEC economies.¹²

APEC economies are also in the process of developing MRAs between AEO programs across jurisdictions. Chile and Peru for example have signed a MRA with Pacific Alliance members to reduce administrative costs and allow full benefits to flow from their respective AEO programs for business including MSMEs.

Issues

Comprehensive Implementation and Interoperability

Individual and collective APEC trade facilitation achievements to date have improved market access, increased efficiency of procedures, and lowered costs to business but only partially meet the requirements of globalised supply and value chains. Furthermore, these improvements have not been quickly, easily or uniformly won. The early sections in Chapter 1 highlight the variable implementation of national Single Window, AEO programs, and paperless trade within APEC. Whilst some APEC economies currently lead the world in digital trade facilitation, at the other end of the spectrum, less developed APEC members are yet to transition from outdated, paper-based and inefficient national systems. This is evident in Figure 1.2.

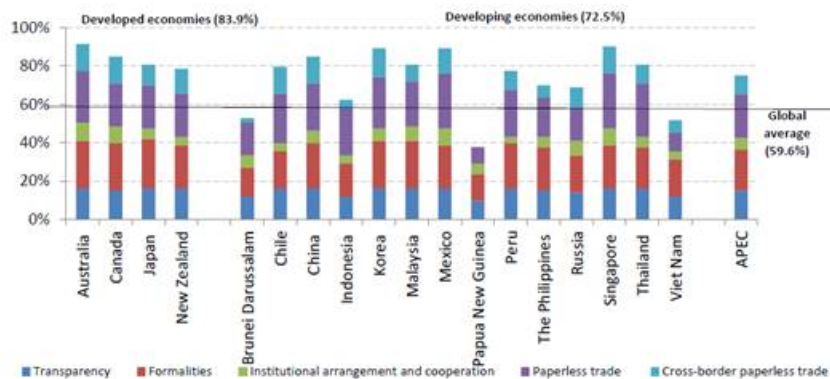
⁹ World Customs Organisation, 2019. *Guidelines on Trader Identification Number (TIN)*

¹⁰ Liwen Chen, Yongfei Ma. 2015. *Study of the Role of Customs in Global Supply Chain Management and Trade Security Based on the Authorized Economic Operator System*, Journal of Risk Analysis and Crisis Response, Vol 5, Issue 2

¹¹ Australian Border Force (ABF), 2019. *'Benefits of Being a Trusted Trader'*

¹² APEC SOM Steering Committee on Economic and Technical Cooperation, 2019. *'Small and Medium Enterprises'*

Figure 1.2: Overall implementation of trade facilitation measures in APEC (2017)¹³



Fragmented implementation of key trade facilitation initiatives compromises and limits the effect at regional level. Trade facilitation benefits countries by allowing better access for businesses to production inputs from abroad and supports greater participation in global value chains (GVCs). Countries where inputs can be imported and exported in a quick and reliable manner are also more attractive locations for investment and consumers generally access lower prices, higher quality products, and a greater array of goods.

Programs like AEO allow customs authorities better visibility of the supply chains of selected companies. Single Windows and MRAs allow businesses to more easily transfer information to customs and border agencies within and across economies. At a regional level, the optimum solution is achieved when there are established national programs offering benefits behind and at the border with interoperability that allows benefits beyond the border.

APEC reports acknowledge that gains have been largely at national level. Interoperability has been limited to bilateral or sub-regional groups. In late 2018, the United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP) assesses that customs and tax procedures and cargo inspections still account for up to 75 per cent of delays, and 'red tape' costs up to 15 per cent of the value of goods traded.¹⁴ In 2020, APEC faces the challenge of developing and implementing a further decade of impactful trade facilitation in an inclusive and sustainable fashion. At the start of this decade, whilst significant progress has been achieved, work continues to resolve issues in key areas, including:

- Incomplete development of national Single Windows and AEO programs.
- Limited inter-operability between national single windows which have been established.
- High barriers to entry to AEO programs.
- Limited agreement on data standards.
- Persistence of paper based rather than digital systems across the region.

Blockchain might offer a model that brings together supply chain operators and government authorities onto a common platform where systems can interface, and information is shared securely. Private companies would then gain higher visibility of goods and components as they move through the entire ecosystem, enabling more precise planning. They would benefit from streamlined processing of imports, exports and goods in transit. Border authorities could interface their inspection regimes on top of existing commercial information exchange, using this data to

¹³ ESCAP, 2019. 'WTO TFA+ Implementation State of Play in Asia and the Pacific: Moving Towards Digital and Sustainable Trade Facilitation', ESCAP Trade Insights: Issue No. 28

¹⁴ SciDevNet, 2018. 'Benefits of paperless trade'

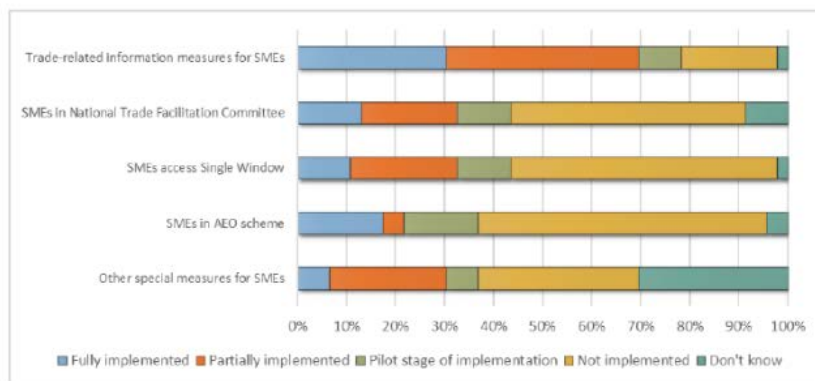
conduct risk assessments and process imports. This would benefit businesses by eliminating the need to reproduce this information through various letters, bills and declarations. It would benefit border agencies by providing greater visibility of the entire supply chain ecosystem, enabling more accurate risk assessment and customs valuations.

Later chapters examine the efforts to develop interface and interoperability systems between blockchains and between blockchains and legacy systems.

Inclusion

Whilst digital technologies have enabled global value chains, there remains significant scope for improving the benefits that flow from trade facilitation for less developed economies, marginalised groups, and micro to small to medium sized enterprises (MSME). Trade facilitation also helps MSMEs to participate and benefit from global trade by stripping out imposts related to trade procedures that stop MSMEs taking full advantage of new market openings. Micro- and SMEs can find the costs associated with trading are disproportionately large. As Figure 1.3 shows, there is considerable variability across APEC in the implementation of reforms that impact on SMEs (and micros businesses).

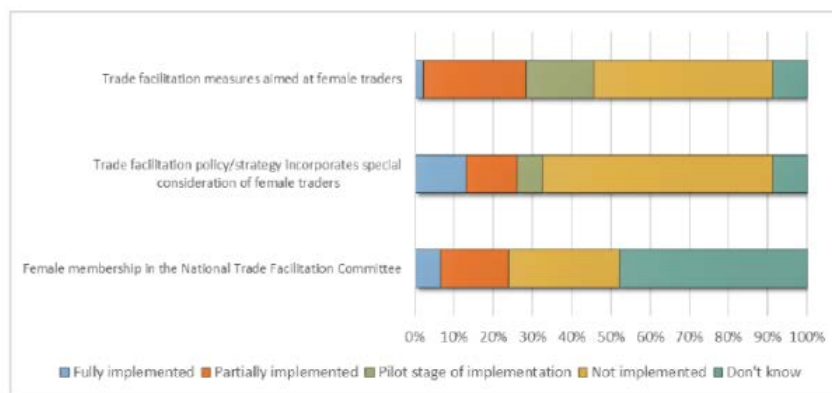
Figure 1.3: State of Implementation of ‘trade facilitation for SMEs’ measures in Asia-Pacific economies¹⁵



There is a similar picture with regards to marginalised groups within APEC. For example, many women currently stand on the side-lines of the global economy. Women already make a huge contribution to global prosperity and exclusion of women prevents the world from reaping the full benefits of global trade. A high proportion of micro and small enterprises (MSMEs) in the region are owned by women. There are many opportunities for women to trade internationally but information gaps, impediments and barriers to entry impact heavily on women. Trade facilitation can benefit women and measures to make trade facilitation gender responsive have been identified in APEC and the WTO. However, realisation of these reforms has also been patchy across the region as shown by Figure 1.4.

¹⁵ UNECE, 2019. 'Third Global Survey on Digital and Sustainable Trade Facilitation 2019'

Figure 1.4: State of implementation of ‘women in trade facilitation measures’ in Asia-Pacific economies¹⁶



Closing the Digital Divide in APEC

APEC is committed to closing the digital divide in the region and blockchain is said to offer unprecedented options to help in this regard. There is a window of opportunity for less developed economies, along with marginalised groups and smaller enterprises, to approach their lack of pre-existing infrastructure not as a handicap but an opportunity to leap-frog to blockchain based systems in trade as well as other contexts.

In conjunction with other relevant international bodies, APEC should consider implementing ambitious capacity building around blockchain to start closing the existing digital divide and promote ‘catch up’ action in trade reform that would ensure that material benefits are better shared across APEC in the future.

The pace of digital innovation will continue to maintain pressure on the APEC trade facilitation agenda and individual economies. Digital technologies have helped globalise supply chains and have dramatically increased the scope and scale of trade. This trend is likely to continue to feature in the coming decade, strengthening the need for APEC to rigorously consider the potential and implications of new technologies such as blockchain.

¹⁶ UNECE, 2019. ‘Third Global Survey on Digital and Sustainable Trade Facilitation 2019’

BLOCKCHAIN AND TRADE

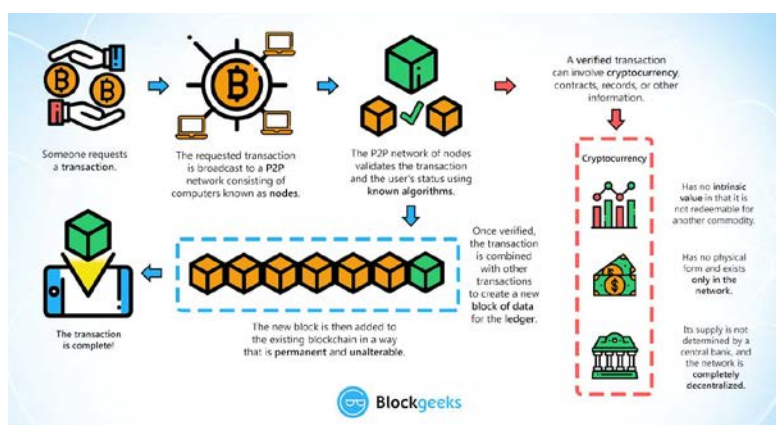
This chapter introduces blockchain and looks at how, in conjunction with other new technologies, blockchain is starting to alter the ways the world trades. Blockchain rose to prominence as the public transaction account for cryptocurrencies but the technology is rapidly being adopted for many other innovative applications. An increasing number of private sector companies are using the technology to remove frictions from international trade. These early projects, many of which keep making headlines as transformative, are surveyed in the second half of the chapter.

Whilst it is beyond the scope of this report to provide primary research of all such pilots, this chapter provides publicly available detail on a sample of relevant projects, and selected case studies to showcase how blockchain-based applications being trialled around the world are changing trade operations and international supply chain management. In general, these are still in development or pilot phase. However, some organisations are potentially on the way to scaling and rolling out more extensive programs. National and international policy makers are keenly assessing this activity and associated opportunities (and challenges) that might flow from the wider deployment.

What is Blockchain?

Blockchain underpins Distributed Ledger Technology (DLT) used to create decentralised, shared and immutable databases of transactions, grouped, validated and chained by consensus protocols and secured by cryptography.¹⁷ Blockchain is valued for streamlining and democratising exchanges of data, goods and services, and payments, creating a transparent time-stamped, linked and traceable record of interactions between parties.¹⁸

Figure 2.1: Blockchain: what it does and how it works¹⁹



Authentication of transactions is achieved through cryptographic means and a consensus protocol sets the rules by which the blockchain ledger is updated, enabling participants to collaborate without relying on trusted third parties.²⁰

¹⁷ Shin, L. 2017. 'Blockchain Summit Examines the Role of Privilege in Spreading A Democratizing Technology'. Capgemini, 2019. 'Blockchain: Beyond the Buzz'

¹⁸ Hofmann, Strewe and Bosia 2017. 'Supply Chain Finance and Blockchain Technology'

¹⁹ Note: 'P2P' means 'peer-to-peer' <https://blockgeeks.com/guides/what-is-blockchain-technology/>

²⁰ Ganne, E. 2019. *Can blockchain revolutionize international trade?* World Trade Organization

Types of Blockchains

Permissioned and Permissionless: Blockchain networks can be open and permissionless (allowing access to any user with the requisite computing power) or closed and permissioned (restricting the capacity to enter or validate data).²¹

Public Blockchain: Public blockchains let anyone access and transact according to the consensus protocol that underpins the ledger as long as necessary computing power is available to run the complex cryptographic algorithms that synchronise data for all blockchain network members.²² A public blockchain enables any members of the network to securely transact, democratising transactional relationships and ending the need for third party validation. Public networks have worked well for currency trading but pose issues when transactions need to be private or restricted.

Private Blockchain: A private blockchain restricts access to a network of approved and trusted users and the data and transactions are validated by a centralised entity. Private blockchains are relatively more easily scaled they are not beholden to the consensus mechanisms of public networks that require significant computational power. Research suggests that owing to the centralised structure and validation processes, a private network can be more vulnerable to security threats than a public blockchain.²³ In some cases, centralised databases may be more appropriate.

Consortium Blockchain: A consortium blockchain is a variation of a private blockchain but controlled by a group, creating a 'partially decentralised' platform, where nodes have permission to read or write data and access the blockchain but no single entity has complete control of the ledger thereby enabling trust between participants.²⁴ They offer that combines elements of both private and public blockchains. Consortium blockchains can process transactions quicker than public permissionless blockchains and use less computing power and energy and can scale more easily.

Table 2.1: Overview of the main characteristics of various types of blockchains²⁵

| Degree of centralization | Public | | Consortium | | Private |
|---|--|---|--|---|---|
| Management | No centralized management | | Multiple organizations | | Single entity |
| Access | Permissionless | Permissioned | Permissioned | Permissionless | Permissioned |
| | Open read/open validation of transactions | Open read/permissioned validation of transactions | Permissioned OR open read/permissioned validation of transactions | Open read/open validation of transactions | Permissioned read/ validation of transactions |
| Participants | Anonymous/ pseudonymous | Anonymous/ pseudonymous | Identified | Usually identified | Identified |
| Validation based on consensus protocol | Open to every participant in the network | Open to every participant in the network, subject to certain conditions | By pre-approved participants (across the organizations involved) | Depending on the consensus protocol chosen for the platform | By pre-approved participants (within the single entity) |
| Speed of validation | Slow | Quicker | Quick | Quick | Quick |
| Users' level of privacy | None | None | Tailored to the needs of participants | Tailored to the needs of participants | Tailored to the needs of participants |
| Computing power required (energy consumption) | High (but variable depending on the consensus mechanism) | Intermediate. Variable depending on the consensus mechanism | Lower | Lower | Lower |
| Transaction fees | Yes | Yes | Optional – depending on the rules of the blockchain | Optional – depending on the rules of the blockchain | Optional – depending on the rules of the blockchain |
| Scalability | Low | Slightly higher | Higher | Higher | Higher |
| Example(s) | Proof of Work (Bitcoin, Ethereum) | Proof of Stake (Nxt) | Blockchains built on Hyperledger Fabric. Permissioned blockchains built on Ethereum. | FastTrackTrade | Private blockchains built on Ethereum |

A note on blockchain interoperability: The development of interoperable blockchain protocols, software overlays, network design, security models, etc. has been an area of activity with for example the launch of Cosmos and the Polkadot Network to allow existing blockchains to safely and reliably network and facilitate data transfer between

²¹ Bit Fury Group and Jeff Garzik, 2015. 'Public versus Private Blockchains'

²² Jayachandran, 2017. 'The difference between public and private blockchain'

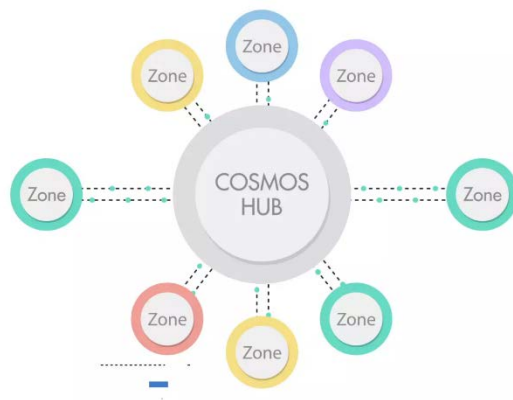
²³ Hirbli, T. 2018. 'Palm Oil traceability: Blockchain meets supply chain'

²⁴ Buterin, V., 2015. 'On Public and Private Blockchains'

²⁵ WTO, 2018 'Can blockchain revolutionise international trade'

each other.²⁶ Blockchain interoperability will increase scalability, speed, and extensibility of blockchains, allow private, public and consortium blockchains to connect and to possibly interface with non-blockchain systems.

Figure 2.2: Blockchain Interoperability²⁷



A note on energy usage: Large public blockchains, like Ethereum, are computationally expensive, involve high bandwidth overheads and have been criticised for extreme energy consumption and carbon emissions. These permissionless, decentralised blockchains, involving anonymous users, consume large amounts of energy to power the algorithmic consensus protocol across all nodes of the network. Alternative protocols that consume far less energy are currently in development. Ethereum for example is looking to implement a ‘proof-of-stake’ protocol that replaces the need for heavy computation that drives up energy consumption. Private and consortium blockchains which are most often used by supply chains generally operate across partially de-centralised and permissioned networks of often identified users. These blockchains do not require as much energy.

Emerging Trade-Related Blockchain Applications

Blockchain was initially associated with cryptocurrency trading but business has been quick to explore applications to simplify and speed up supply chain, procurement and financial exchanges in various contexts. Trade and GVCs still run largely on time-consuming, labour- and paper-intensive ledgers. Processes are arduous. Friction is common. Everyone wants to digitalise. Blockchain digitalises, decentralises and distributes ledgers across networks allowing data to be shared securely across organisational and national boundaries. Combined with IoT devices and with smart contracts, automation can be further extended. Software can be overlaid to promote interoperability between systems.

Around the world, start-ups, technology companies, and consortiums involving business and sometimes governments are investing in and evaluating blockchain-based applications, including to improve cross-border trade operations. It is beyond the scope of this report to provide a comprehensive account of all trade-related blockchain initiatives but a cross sample of private use cases and selected case studies in the areas of transport, logistics, trade finance operations, cross border payments insurance, commodity and energy trading, provenance, fair trade and fraud are presented in following pages.

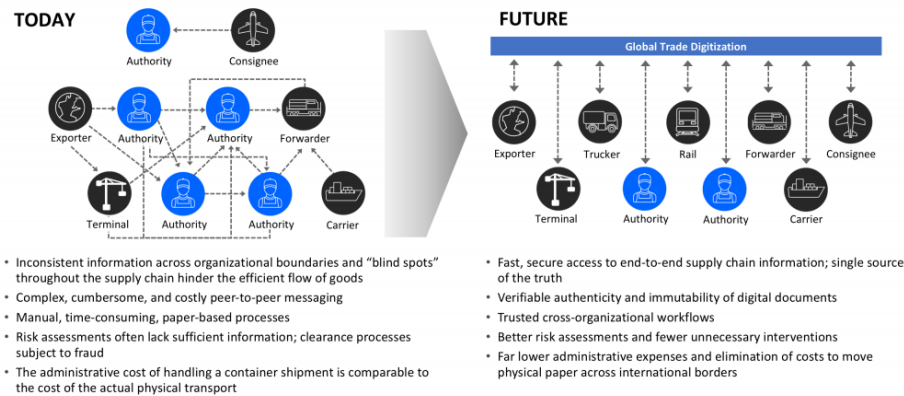
²⁶ Faridi, O. 2019. ‘Difference Between Cosmos and Polkadot’

²⁷ Kajpust, D. 2018. ‘Blockchain Interoperability: Cosmos vs. Polkadot’

Case Study: IBM Maersk TradeLens

In 2018, IBM and Maersk launched blockchain-based TradeLens, to manage global shipments. TradeLens allows trading partners to collaborate on transactions without compromising details, privacy or confidentiality, improving efficiency, security, lowering costs.²⁸ It provides users with access to their own node on the blockchain, cutting out up to five middle agents per shipment, even for simple queries such as the location of a shipping container. Users have a real-time view of information, e.g. of products ready for transport and locations of empty containers.

Figure 2.3. The MAERSK-IBM Global Trade Digitisation



TradeLens facilitates shippers, shipping lines, freight forwarders, port and terminal operators, inland transportation and customs interacting efficiently and exchanging data through blockchain with integration of IoT and sensors for data on temperature control, container weight and location.

- Participants can view progress of goods through the supply chain and status of import/export processes
- It allows real time exchange of original supply chain events and documents
- No one party can modify, delete or append any record without the consensus from others on the network
- Increased transparency reduces fraud and errors, transit and processing time, waste and costs
- Using smart contracts, TradeLens enables digital collaboration across multiple parties.²⁹

For shippers, TradeLens reduces documentation and processing costs and eliminates delays from paper-based errors. It provides insight into cargo along the supply chain. For customs authorities, TradeLens gives real time visibility plus data for risk analysis increasing safety, security and efficiency of border and clearance procedures.

ClearWay, a blockchain-based trade document module was released to enable importers/exporters, customs brokers, and Custom authorities to collaborate on processes and information exchanges in a secure, non-repudiable audit trail. The system allows each stakeholder in the supply chain to view the progress of goods in transit and the status of customs documents. Blockchain ensures secure data exchange and a tamper-proof repository for documents. Unlike permissionless blockchains there is an access fee for TradeLens’ distributed ledger.³⁰

TradeLens launched with 20 users - port and terminal operators covering 235 marine gateways globally – and by the end of 2019, had over 100 users - shippers, carriers, ports, terminal operators, third party logistics providers, and freight forwarders including in APEC economies and is processing over 10 million events every week.³¹

²⁸ BM Newsroom, 2018. ‘Maersk and IBM Introduce TradeLens Blockchain Shipping Solution’

²⁹ Safety 4 Sea, 2018. ‘Maersk, IBM name joint blockchain venture ‘TradeLens’

³⁰ DHL Accenture 2018. ‘Blockchain in Logistics: Perspectives on upcoming impact of blockchain technology and use cases for the logistics industry’

International Transport and Logistics

The logistics sector - the backbone of trade and projected to be worth \$15.5 trillion by 2023³² - emerged as an early investor in blockchain based applications to tackle issues in international transportation and update outdated infrastructure. The industry faces a diverse range of issues including:

- Inconsistent data;
- Inequitable sharing of data across supply chains;
- Continued 'blind spots' across organisations and geographic boundaries;
- Complex, cumbersome and often expensive peer-to-peer messaging;
- Many manual, time-consuming processes that increase costs and delay cargoes;
- Inefficient clearance processes which can open the door to fraud.³³

A 2018 report from DHL and Accenture on how blockchain can unlock trapped value in logistics noted that the technology was far from maturity with many challenges to overcome before it can be deployed at scale in the logistics sector, including coordination across diverse supply chains with differing capabilities, legacy processes and varying interests. However, the report concluded that even early applications suggest there is a favourable chance of blockchain will achieve its full potential in the future facilitating efficiency and new business models. It acknowledged that blockchain could underpin 'faster and leaner global trade logistics, superior transparency and traceability in the supply chain, and increased automation of commercial processes in logistics.'³⁴ Early use cases include:

- The Blockchain in Transport Alliance (BiTA) was formed with 500+ member companies from 25 countries to determine best practices and standards for blockchain in the transportation industry.
- Maersk and IBM joint venture TradeLens (see case study) using blockchain technology to create an open platform for the world to participate in to improve global trade.
- UPS is implementing blockchain to improve its transportation, logistics and delivery service (see case study)
- Wells Fargo and the Commonwealth Bank of Australia used blockchain to complete a global transaction on smart contracts in order to ship cotton from the U.S. to China.
- EU funded Proof-of-concept blockchain and IoT based SmartLog has been running since 2016 to cut cargo unit transportation times by storing shipment transactions on the SmartLog blockchain, tracking them using IoT, and automating tasks using smart contracts. Six organizations from four different countries are currently working on the project.
- The Global Shipping Business Network (GSBN) is rolling out a blockchain system allowing gateways for parties to interact along the supply chain, across borders and together including over finance and insurance matters.
- Unilever, Nestle, and Walmart have tested IBM blockchain systems based on Hyperledger Fabric to track their inventory and procurement. Walmart traced the origins and the delivery of a pork shipment from China. It has also patented a blockchain-powered solution for delivery by drones.

³¹ Del Costello, M. 2018. 'IBM-Maersk Blockchain Platform Adds Clients as Part of Global Launch'. TradeLens, 2019. *Digitalising Global Supply Chains*

³² Transparency Market Research, 2019. 'Logistics Market - Global Industry Analysis, Size, Share, Growth, Trends and Forecast, 2016 – 2024'

³³ Safety 4 Sea, 2018. 'Maersk, IBM name joint blockchain venture 'TradeLens'

³⁴ DHL Accenture 2018. 'Blockchain in Logistics: Perspectives on the impact of blockchain and use cases for the logistics industry, DHL Publishing

Case Study: UPS Blockchain

UPS, formerly the United Parcel Service, operates at the coalface of international supply chains, providing just-in-time delivery of parts and components and customs brokerage services to move goods as quickly as possible across borders. UPS is investing in blockchain to improve its transportation, logistics and delivery services, with several trials designed to enhance transparency, auditability, accountability and streamline customs processing.

In 2018, UPS filed a patent for a blockchain-based worldwide delivery system. The application describes a system that stores different types of data within a distributed ledger, including information on a package's destination, its movement and transportation plan. Information is shared enabling timely coordination, potentially 'automated determination' of progress, determining optimal routes and initiating payments via smart contracts on delivery.³⁵

In partnership with Inxception, UPS integrated blockchain into its new 2019 B2B e-commerce platform so manufacturers, distributors and wholesalers could easily set-up an online e-commerce brand and track transactions and customer information.³⁶ Every interaction on the platform is appended onto a 'block' that is 'chained' to other blocks creating a secure and immutable ledger. Blockchain ensures the data is authentic, reliable and trustworthy.

In partnership with Intel and Flex, UPS also started a 2019 trial of a blockchain-based platform and mobile app that uses QR codes to verify cargo pickup and release and executed more than a dozen trades. The platform facilitates end-to-end processes through the supply chain using smart contracts on a cloud-based blockchain built on Hyperledger Fabric. The platform has built-in predefined templates that set which parties are involved at each stage, which documents they are required to provide, whether they are mandatory and who has visibility of them.

The key advantages for UPS in using blockchain are:

- Real-time tracking of goods and documentation throughout the supply chain, giving visibility to business partners where required.
- Harmonised ecosystem where all parties- companies, carriers, brokers, customs authorities- are on the same platform allowing a smooth transition of goods across corporate entities and national borders.
- Automated and streamlined end-to-end processes using smart contracts that remove inefficiencies in the transfer of goods and documents.
- Tamper-proof data provided by all parties which enables continuous audit and establishes provenance.

UPS has identified its key challenge in utilising blockchain across the trade ecosystem is developing common blockchain standards across industry and government. Differing standards create a digital divide in shipping with rival consortiums developing incompatible systems.

UPS is working with partners on developing standards through the Blockchain in Transport Alliance.

UPS is also working with traditional rivals, FedEx and DHL, to develop global standards in partnership with Customs and Standards authorities.

³⁵ Wadawadigi, G. 2019. 'UPS Test Blockchain Proof of Concept'

³⁶ UPS, 2019. 'UPS and Inxception Collaborate to Make B2B E-Commerce Easier for Merchants'

Trade Finance

The trade finance sector with its mix of producers, exporters, importers and third-party intermediaries such as banks, financial institutions and service providers, inject liquidity and mitigate credit risk in both domestic and international trade transactions.³⁷ Traditional trade finance mechanisms such as letters of credit or bank guarantees are often associated with high costs and burdensome compliance requirements while trading on open account terms can introduce higher risks and exposure to fraud. Blockchain is one source of innovation for trade finance that potentially delivers better transparency, lower costs and risks, faster access and validation, and less risky open account.

Lead projects include:

- Bank of America, HSBC and Infocomm Development Authority of Singapore (IDA) are developing a blockchain application built on the Hyperledger Fabric that improves the letter of credit process by sharing information between exporters, importers and their respective banks on a permissioned ledger and supporting the use of smart contracts which allow deals to be executed automatically.³⁸
- Cargill, a US commodity giant investing heavily in blockchain engineering, has used the Corda blockchain platform to carry out a letter of credit transaction for a shipment of soya beans from Argentina to Malaysia.
- We.trade is a trade finance blockchain application owned by a consortium of twelve major European banks – CaixaBank, Deutsche Bank, Erste Group, HSBC, KBC, Natixis, Nordea, Rabobank, Santander, Société Générale, UBS and UniCredit - backed by IBM and based on Hyperledger Fabric which uses smart contract to guarantee payments and automatic settlement when pre-agreed conditions are met.

Figure 2.4: Trade Finance and Blockchain³⁹



- Regulators Monetary Authority of Singapore (MAS) and the Hong Kong Monetary Authority (HKMA) are collaborating with IBM to develop a cross-border trade finance platform - the Global Trade Connectivity Network (GTCN).⁴⁰ The aim is to digitally solve regulatory disparities and (differing) documentation standards, by integrating the GTCN with Singapore's National Trade Platform (NTP) and HK's Trade Finance Platform using Application Programming Interfaces (APIs). An anticipated deliverable is that cross-border trade between the two countries will be virtually paperless. Connections with other jurisdictions – Japan, China, and Thailand are planned for rollout soon.

³⁷ EU Blockchain Forum, 2019. 'Blockchain in Trade Finance and Supply Chain report'

³⁸ Ledger Insights, 2019. 'Blockchain and Letters of Credit'

³⁹ Ledger Insights, 2017. 'Trade finance blockchain race is about to start'

⁴⁰ Hong Kong Monetary Authority, 2019. 'Trade Finance News'

Cross-border payments

Cross-border payments (essential to trade and global remittance payments that are key in developing economies) are plagued with high costs, delays, intermediaries and cumbersome processes to meet regulatory requirements.

The payments industry has witnessed a rapid disruption over the last few decades with the rise of internet and mobile based providers such as PayPal, AliPay, M-Pesa and the like but most cross-border payments are still routed via bilateral correspondent banking relationships, a network of banks that use the SWIFT messaging protocol to execute transactions. More recently start-ups and institutional banks have invested in developing blockchain based alternatives. Examples include:

- SWIFT is investigating blockchain with pilot Global Payments Innovation (GPI), aimed at modernising B2B cross-border payments by making them faster and more transparent.⁴¹
- Wyre, a start-up that uses mainly the bitcoin blockchain cuts the time and expense of cross border payments. While banks take up to three days and charge around 5 per cent for international money transfers, Wyre completes transactions in less than six hours charging less than 1 per cent.⁴²
- Circle, a US based peer-to-peer payments technology company set up in 2013, moved from being a consumer bitcoin exchange, launching blockchain based Circle Pay service which is now available in 29 countries allowing seamless transfers between US Dollars, British Pounds, and Euros. Their website reports that they charge zero fees and zero exchange rate markups.
- Ripple has created a blockchain-based platform for financial institutions to exchange currencies, cryptocurrencies, commodities and other tokens at little to no costs without financial intermediaries.
- IBM is working with NZ based KlickEx Group and Stellar.org, a non-profit, to develop an open sourced blockchain platform to enable the exchange of 12 currencies across Australia, NZ, Pacific Islands and the UK.
- 'Project Ubin', an initiative by the Monetary Authority of Singapore (MAS), is creating a digital token for the Singapore dollar on the Ethereum Blockchain. Each token is supported by the equivalent amount of Singapore dollars held by the government, which will ensure that the overall money supply is not impacted by the token and has full redemption possibilities. The project will make financial transactions cheaper and more efficient.
- Tallysticks has built a blockchain-based platform that can process invoicing and payments for logistics and other businesses using smart contracts to approve a payment that corresponds to an invoice.

Marine Insurance

Blockchain could disrupt the insurance industry by simplifying procedures, speeding up claim resolution and increasing trust, transparency and security. Shared ledgers enable visibility into coverage and premium payment while smart contracts enable automatic verification of identity, claims and payments when certain conditions are met. In the trade space, the largely paper based marine insurance is ripe for disruption. Ernst & Young, Maersk and Guardtime are developing Insurwave, a blockchain platform focusing on marine hull and war coverage. The platform allows shipping companies, brokers, insurers and suppliers to access a ledger updated in real time. Insurwave has processed over 30,000 transactions, supports risk management of over 1,000 vessels and plans to offer unbundled claims, payment and contract management functionality in 2020.⁴³

⁴¹ SWIFT, 2019. 'Swift explores blockchain'

⁴² Maurya, N. 2019. 'Ripple, Circle, JP Morgan all Using DLT Technology for Cross Border Payments: World Bank'

⁴³ Business Insurance Innovation Awards, 2019

Commodity Trading

Agricultural supply chains are complex (multiple participants, data duplication, manual handling) resulting in low transparency and trust. In addition, matching payments with title and asset transfers are difficult.⁴⁴ Global counterfeit goods are about US\$40 billion annually (about 0.7% of the total).⁴⁵ Counterparty risk in payment security, as payment is often received months after delivery of the commodity. The risk often falls on the farmer, and paper-based systems do not provide adequate security when buyers fail to complete payment. The supply chain is paper-based, manual and error-prone. Connectivity and digital technical skills are often limited in the agricultural sector.

Blockchain technology in agricultural trade could be a game changer if it can improve food traceability, speed up transactions, facilitate access to credit, create new marketplaces, connect producers with buyers, or facilitate better transport. Some early blockchain projects in agriculture include:

- AgriDigital (see case study).
- A large food trader, Louis Dreyfus Company (LDC), with Dutch and French banks, performed the first blockchain-based agricultural commodity trade, through the sale of a cargo of U.S. soybeans to a retailer based in China. The project cut costs and significantly reduced transaction and document processing times.
- The Australian Beef Industry is investing in a project using blockchain and IoT to create an unbreakable, immutable record to track beef from paddock to plate, credentialing the provenance of Australian beef. This will drive ups for consumers and suppliers. The consortium is also integrating smart contracts to replace letters of credit, packaging with a range of embedded anti-counterfeiting measures and investigating how cryptocurrencies could incentivise compliance along the supply chain.⁴⁶

Energy Trade

Traditional centralised power grids are not well-suited to the influx of distributed renewable energy generation. There is a natural role for blockchain to enable peer-to-peer energy transactions between end users. Deloitte argues that these localised commercial networks could alleviate systemic inefficiencies, such as losses in transmission lines, congestion and volatile prices.⁴⁷ Several experiments are underway around the world including:

- In Japan, a blockchain pilot connects several Marubeni production facilities on a common platform to manage energy transactions and track its source. Users set preferences through a dedicated mobile application, choosing preferred energy sources and how much they will pay for renewable energy.⁴⁸
- In Thailand, Thai state-owned oil and gas' company, PTT and the nonprofit Energy Web Foundation (EWF) have built a platform that allows producers to certify the origins of renewable energy.
- Chile has emerged as a leader in this space with projects and broad regulatory support. The National Energy Commission (NEC), is using blockchain to certify renewable energy sources. The Chilean Economic Development Agency has developed 'Solar Tokens' to allow renewable energy to be commercialized worldwide. Private projects like Dexentralize are creating an energy trading platform to allow users to commercialize their renewable energy generation and access information on the origins of energy consumed. For more information on Chile's experience with blockchain and renewable energy, see Annex 1.

⁴⁴ Xu X, Weber I, Staples M 2019, *'Architecture for Blockchain applications'*, Springer International Publishing

⁴⁵ Watson, E. 2018. *'Blockchain and what it could mean for Agriculture'*

⁴⁶ <https://www.foodagility.com/projects/beefledger-export-smart-contracts>

⁴⁷ Deloitte, 2018. *'Blockchain: A true disruptor for the energy industry'*

⁴⁸ Hype Codes, 2017. *'Japan will use blockchain for renewable energy transactions'*

Case Study: AgriDigital

AgriDigital is an Australian-based company established in 2015 to facilitate agricultural trade between market participants based on a blockchain solution for participants in the Australian market with grain and cotton commodities. AgriDigital provides commodity trading on a blockchain platform, with live settlement between grain growers and buyers, digitalising all documents (contracts, delivery details, pricing) to streamline management of supply chains, and keep farmers informed of the state of trade, title transfer, finance, and delivery requirements.

The blockchain platform allows for more efficient management of supply chains in an industry where margins are low and allows for real-time price adjustments visible to all parties such as farmers, storage owners, and traders. AgriDigital digitises trade through blockchain by creating digital assets that move along the supply chain as blockchain records. Participants attach data (certificates, production records etc) as the digital assets move along the supply chain. AgriDigital indicate that this establishes 'digital trust'.

A smart contract library and agri-blockchain applications create a digital title to commodities providing end-to-end provenance data and a 'single source of truth' enabling market efficiencies as outlined below.

Table 2.5: AgriDigital Benefits to Supply Chain Participants⁴⁹

| GROWER | TRADER | PURCHASER |
|---|---|---|
| Flexible payment options secured to underlying commodity | Real time overview: price updates, deliveries, position management, invoices & payments | Increased efficiencies & reduced costs of operation |
| Immediate payment on the delivery of commodity | Overview of value chain in one solution & reduction of operational steps | Proof of ownership & auto settlement |
| Reduced counterparty risk | Simplified reconciliation & monitoring | Automated commodity financing, simultaneous payment to grower |
| Improved liquidity enabling better decision making | Single version of the truth | Single version of the truth |
| Efficiencies due to automated deduction and payment of levies and for services provided | Immutable chain of custody | Atomic transfer of digital title to commodity against payment reduces documentary fraud |

AgriDigital successfully executed the world's first settlement of an agricultural commodity on blockchain in 2016. The company has since transacted 6.27 million tons of grain through the platform (Au\$1.22 billion) and over 70000 cotton bales since its introduction to the platform in 2018. The company plans to expand its offering to include capturing inventory stored on farm.

AgriDigital cites difficulties such as low connectivity and digital skills. Industry digitalisation must expand to fully exploit blockchain's advantages. Furthermore, AgriDigital is a private Blockchain which is not a fully decentralised platform and therefore (for privacy restrictions) is not yet commercially scalable. Finally, the legal standing of smart contracts is not clearly regulated yet.⁵⁰

⁴⁹ AgriDigital, 2017. 'Reimagining B2B Contracting'

⁵⁰ Mgcini (MG) Moyo. 2019. 'Are Smart Contracts Legally Binding?'

Provenance, Fraud, Fair Trade

Blockchain has been used in pilot programs to help producers determine fair prices for good:

- in Cambodia Oxfam has implemented a blockchain called BlocRice that creates a transparent supply chain for rice-growers delivering information and clout in price negotiations.⁵¹
- Bumble Bee Foods uses IoT and blockchain to prove the provenance of its tuna products, tracking tuna from when and where it is caught up until it is packaged. The company hopes to integrate tagging of boats and fish in order to track them using IoT and build apps to increase communication between fishing crews in order to triangulate the locations of large schools of fish.⁵²
- Everledger (see case study)
- Blood diamonds are diamonds been mined under violent circumstances or in unsuitable conditions sometimes sold to fund conflicts in Africa. The world's largest diamond producer, De Beers, seeks to end the sale of blood diamonds through a blockchain supply chain program called Tracr. In a pilot, Tracr tracked 100 diamonds from mine to cutter and polisher, to jeweller. Photos of a diamond and information concerning its colour, quality, and location are uploaded to Tracr for consumers at the purchase point.
- Kahawa 1893 is a direct trade coffee company, which utilizes the services of blockchain platform Bext 360, to ensure economic equality for women in its production chain. Bext 360's blockchain tracks production, establishes environmental goals and facilitates payments for women coffee producers in Kenya.⁵³
- Cassava is a crop produced in Zambia for beer production. BanQu partnered with Anheuser-Busch InBev and piloted the first case study connecting 2,000 Zambian cassava farmers to a blockchain to give them more economic power and compete globally by tracking their crops through the supply chain.⁵⁴

Blockchain offers potential for leapfrogging for countries (LDCs), company (MSMEs) or individual (marginalised groups) to take a lack of pre-existing infrastructure not as a handicap but an opportunity to adopt a most advanced methods and apply these technologies to enter new markets, and drive economic growth and development.

⁵¹ WTO. 2018. *'Blockchain and International Trade: Opportunities, Challenges and Implications for International Trade Cooperation'*

⁵² Hofer, L. 2019. *'Bumble Bee Foods and SAP to Track Tuna Using Blockchain'*

⁵³ McCormack, M. 2019. *'One Blockchain Solution That Deserves the Buzz'*.

⁵⁴ Yafimava, D. 2019. *'Blockchain In the Supply Chain: 10 Real-Life Use Cases and Examples'*

Case Study: Everledger

Everledger is a London-based independent technology company founded in 2015 that helps businesses surface and converges asset information, using a variety of secure technologies including Blockchain, Artificial Intelligence, and Internet-of-Things. The company's focus is to contribute greater clarity and confidence in the marketplace where transparency is of strategic importance.⁵⁵

Everledger indicates that its blockchain platform creates secure and permanent digital records of an asset's origin, characteristics and ownership across its lifetime, which benefits those industries requiring evidence of traceability and provenance of their products; this includes diamonds, gemstones, fine wine, and luxury goods.

Everledger describes itself as a permanent, digital, global ledger that tracks and protects diamonds and other valuable goods on their lifetime journey and addresses the diamond industry's expensive fraud and theft problem.⁵⁶

An example of an industry requiring traceability and provenance is the diamond trade. Though the trade of illegally mined 'blood diamonds' that finance guerrilla war efforts in developing economies has reduced from 25% of the diamond industry in 2003 to between 5 and 10% in 2019 the rise of conscious consumption has demanded a further increase in transparency to ensure that consumers are purchasing ethically sourced diamonds.⁵⁷

Much of the diamond industry still relies on validation of diamonds by experts, who are unable to determine a diamond's origin from its physical features. Recently, diamond passports, containing information such as source of origin, statement of validation and cut and polish details have been utilised. However, these are easily manipulated to protect retailers' brand image, and often exaggerate diamond value.

An example of a major challenge addressed is the diamond industry. Everledger provides a private blockchain for supply chain members that combines IoT and AI to create a digital twin for each diamond. This digital twin ensures that the physical product has not been tampered with or replaced, addressing a major concern of using blockchain for physical goods, namely tampering with the physical product; maintaining a digital database of the size, weight and shape of the diamond greatly reduces this concern.

Everledger reported in September 2019 that it has grown 300% in the last year, having reached a global footprint with 90 members, five offices, and customers in five continents.

In September 2019, Everledger reported that they have upgraded their platform to meet the needs of clients whose own customers and partners pursue evidenced traceability. These include US-based retailer Fred Meyer Jewellers using the Everledger platform in 100 stores, and Spanish jewellery designer and manufacturer Facet to support a new collection of traceable jewellery in Europe.

⁵⁵ Everledger, 2019. *Industry Solutions*

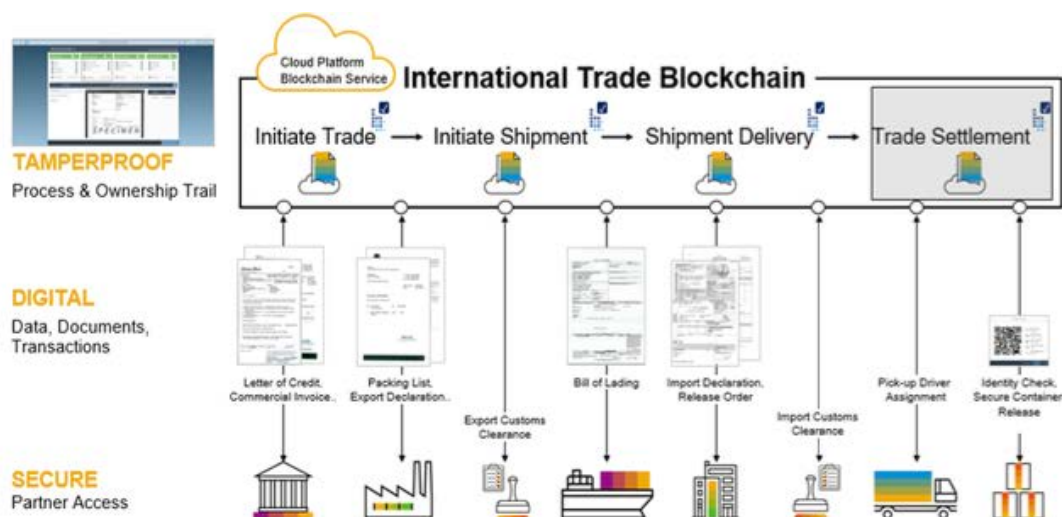
⁵⁶ IBM Marketplace, Kemp, L. 2019. 'Everledger's Pioneering Blockchain Work for Diamonds'

⁵⁷ Baker and Tshikapa, 2019. 'Blood Diamonds'

Summary of findings from the developed cases

The above use cases show that early trade-related applications of blockchain technology, often in combination with other digital innovations, are delivering benefits for participating organisations, improving supply chain management and trade processes. The vision of trade under blockchain is usefully illustrated in the diagram devised by UPS below.

Figure 2.6: International trade using blockchain⁵⁸



Organisations are improving multiple issues through blockchain applications including:

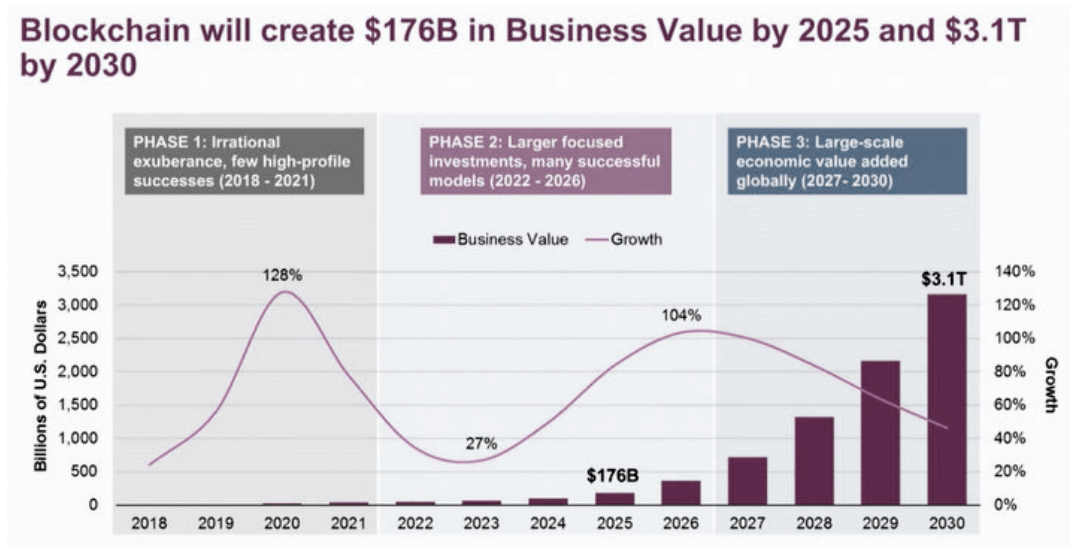
- **Traceability and Trust:** Blockchain enables goods and components to be more effectively tracked as they move through suppliers and across borders. Improving supply chain traceability and transparency improves trust and reduces fraud.
- **Paperless Information sharing:** Replacing supply chain and trade paper-based systems introduces new efficiencies and blockchain catalyses digitalisation. Distributed ledgers allow multiple participants involved in a transaction – importers, exporters, logistics services providers, insurers, financiers – to access relevant data in real time for improved decision making. The digitisation of trade throughout the region is estimated to increase exports by as much as \$257 billion by 2027 while reducing the time to export by up to 44 per cent.⁵⁹
- **Automated processing:** Smart contracts replace the need for manual processes to verify identity, check certificates, issue payments and manage workflow. Introducing automation to time-consuming processes such as exchange rate costs, financial intermediation and coordination, and facilitating real-time trade settlements with clear transparency of ownership of goods and services, without the involvement of third parties provides significant cost reductions and time savings.
- **Secure data:** Cryptographic techniques ensure that data is securely held, and access rights carefully managed in the case of permissioned/consortium blockchains.

⁵⁸ Wadawadigi, G. 2019. 'UPS Test Blockchain Proof of Concept'

⁵⁹ UNECE, 2017. *Overview of Blockchain for Trade*

The potential is great. The WTO estimated that blockchain could possibly add as much as \$3 trillion to the international trade market by 2030.⁶⁰ However, it is widely acknowledged that whilst while blockchain has demonstrated its potential to disrupt individual businesses and sectors, its broader adoption and integration will likely take decades.⁶¹ For blockchain to become a truly foundational technology, like a decentralised internet for example, will involve years of trials and coordination of parties working together to generate value from the technology. Early commentators predicted a 30-year development process for widescale adoption of blockchain. Figure 2.4 was produced in 2017.

Figure 2.7: Blockchain Development out to 2030 (Gartner Forecast)⁶²



Critical issues include:⁶³

- Blockchain is still immature despite exciting pilot applications. Widescale adoption is still to be realised.
- The scalability of blockchain is still being proven. Even leading applications are only scaling gradually: Tradelens platform has achieved 100 organisations in the shipping trade ecosystem; Everledger has a global footprint of 90 members; UPS is now starting to partner to improve efficiencies in the supply chain.
- Large public blockchains are computationally expensive, involve high bandwidth overheads and have been criticised for extreme energy consumption.
- Private and consortium blockchains, more often used for supply chains, can more easily implement energy efficient protocols.
- Start-up costs - IT development, energy costs, infrastructure and maintenance - will add up making adoption or participation by MSMEs, individuals and even some economies challenging until the return on Investment (ROI) is clearer.
- Moving from legacy systems to blockchain will require considerable process reengineering investment.
- Blockchain also faces technical issues of interoperability that need to be overcome. The current proliferation of individual blockchains are largely unable to 'talk' to each other, requiring further innovation.

⁶⁰ WTO. 2018. 'Blockchain and International Trade: Opportunities, Challenges and Implications for International Trade Cooperation'

⁶¹ Marco Iansiti and Karim R. Lakhani, 2017. 'The truth about Blockchain', Harvard Business Review

⁶² Gartner, 2017. 'Forecast: Blockchain Business Value, Worldwide, 2017-2030'

⁶³ EU Blockchain Observatory reports, 2019.

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- Importantly, many legal and regulatory questions are unanswered, including a lack of common blockchain standards, lack of digital currencies by governments, uncertainty about the legality and enforceability of smart contracts, and data transparency and privacy issues.
 - The benefits of the digital economy and emerging technologies including blockchain are increasingly concentrated in leading companies and economies.⁶⁴
 - The current digital divide that exist globally creates significant pockets of low digital skills and connectivity also requires attention if blockchain benefits are to be shared by all.

Blockchain is an emerging technology, proven by applications around crypto currencies to be secure and resilient, but still at proof of concept in trade related areas. Nevertheless, as some have noted, ledgers are so fundamental to trade that any innovations – including blockchain – that make it more efficient, transparent, accessible and effective will be attractive to many. Blockchain is demonstrating a capacity to be fundamentally disruptive and even if it only reaches part of the way towards projected potential, it will re-shape many elements of trade over coming years. It is critical that individual economies do not miss material opportunities and along with multilateral agencies such as APEC collaborate to lead and shape blockchain’s future by applying it to government business as appropriate and developing enabling regulation, standards, and implementation policies.⁶⁵ Their ability to address these challenges will inform the scalability of blockchain solutions in the future. Any innovation– especially one so disruptive– needs a supportive infrastructure to succeed and individual governments will need to make a concerted effort to choose whether or not to participate in the development and implementation of these platforms and reap the benefits, and secondly to facilitate its development more broadly.

⁶⁴ World Bank, 2016. *World Bank Report: Digital Dividends*

⁶⁵ Dr Stuart Gill, 2019. *'The new kid on the block for trade and development'*, DFAT InnovationXchange

APEC: MANAGING BLOCKCHAIN

The investment in and development of blockchain applications, including in the trade arena outlined in Chapter 2, is pressuring policy makers everywhere and will impact on the APEC Trade Facilitation agenda discussed in Chapter 1.

This chapter examines some of these issues – a mix of challenges and opportunities – for APEC policy makers. It reviews some current initiatives to use blockchain to improve public services including border and other trade services.

Emerging blockchain initiatives cast the issue of achieving regional and global interoperability in a new light and raise the prospect of supporting lesser developed economies to ‘catch up’ with blockchain, leapfrogging current issues to adopt cutting edge technology and interoperability.

It then discusses a range of national and international responses to the issue of developing regulations and laws for their own jurisdictions as well as international harmonisation. APEC should fully consider legal and regulatory policies and frameworks needed to enable blockchain development.

Blockchain Application by Governments

There is also public activity to test blockchain, including by customs authorities, in border management systems. This is a relatively recent development with pilots and trials in the last two to three years. Blockchain appears to make a valuable contribution by streamlining processes and reducing inefficiencies though it has not yet witnessed widescale adoption or replaced legacy systems. Nevertheless, there are important lessons that can be learned from the experiments of these pathfinders. It is beyond the remit of this paper to provide details of all activities, but this paper presents a sample of pertinent trade-related initiatives in non-APEC and APEC economies: pathfinder trials, consortia participations, and discussions with industry and user stakeholders. Along with the private sector developments discussed earlier these are driving interest in new standards, regulations and laws for blockchain.

Trade related applications driven by digital ledger technology can help to reduce the huge volumes of paperwork and multiple bureaucratic interventions which are considered necessary in pursuit of legitimate trade and foster the digitalisation of contracts, financial instruments and traditional trade and shipping documents. Blockchain technology represents a potential change in the processes associated with the import, export and transit of goods and services, interactions with government and the verification of authenticity of all transactional relationships. Some examples of economies that are leading the way in this regard are examined below.

For example, the **United Arab Emirates (UAE)** has adopted blockchain to make Dubai fully powered by the technology and paperless by 2021. The Dubai Blockchain Strategy establishes a roadmap for blockchain adoption to make government more efficient, create industries and provide international leadership in smart city developments. Led by a Global Blockchain Council of representatives from government entities, leading UAE banks, blockchain technology firms and international technology companies, Dubai has introduced a Dubai Future Accelerators program to foster industry activity locally and a suite of proof of concept blockchain projects, including:

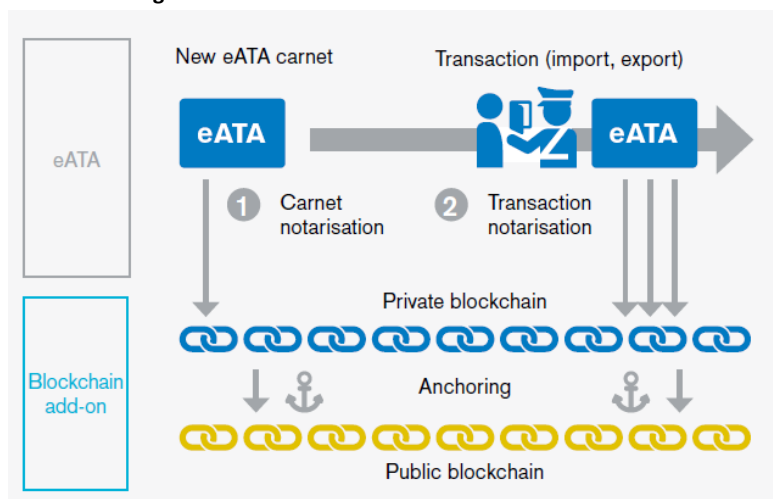
- applying blockchain to trade finance to more effectively exchange goods and the financing.
- transferring titles of illiquid assets on blockchain to increase trade efficiency.

- Working with IBM and eight organizations across three countries to test a platform using Hyperledger Fabric, IBM Cloud Watson IoT to track goods in and out of Dubai, provide real-time shipment data, replace paper-based contracts with smart contracts, and harmonise the trade finance lifecycle within a single platform.⁶⁶

In the Middle East customs for shipping is one of the most active areas for blockchain adoption. Mid-2019, **Saudi** Customs reported tracking a shipment from Dammam to Rotterdam after integrating the department’s electronic data interchange (EDI) systems with the Tradelens blockchain.⁶⁷

In Europe the EU Directorate-General for Taxation and Customs Union (DG TAXUD), in collaboration with International Chamber of Commerce World Chambers Federation (ICC WCF) has trialled blockchain to digitalise and verify ATA Carnet documents using smart contracts. The ATA Carnet is an international customs document used in 87 countries that permits duty free temporary admission of most goods for up to one year. The system (see Figure 3.1) uses a combination of private and public blockchains. The private blockchain is used to ensure the integrity and traceability of Carnets and periodic information is then anchored to the public blockchain to deliver an independent notarization function. As the blockchain only stores a cryptographic hash function of the original Carnet document, it enables users to perform consistency checks while preventing the release of the underlying data.⁶⁸

Figure 3.1: Notarisation of carnets and transactions⁶⁹



Within APEC some economies are emerging as blockchain pathfinders including testing blockchain to improve trade facilitation - the Republic of Korea, Chile, Singapore and Hong Kong, China, and Thailand. This highlights APEC issues of regional interoperability and using blockchain applications to leapfrog less developed economies across the divide that has opened in recent years as trade digitalisation has started to can traction.

In the **United States**, with industry support and lobbying, the U.S. government has been live testing blockchain projects for international trade and intellectual property rights. The US Customs and Border Protection (CBP) website details blockchain trials including one to facilitate shipments by storing credentials on a blockchain with automated verification of identities and licenses of firms and another to trial an interoperable customs system focused on the submission process for cargo complying with the CAFTA/NAFTA trade agreements. It found that the technology

⁶⁶ IBM Marketplace, Ereiqtat, S. 'Blockchain in Dubai'. Smart Dubai, 2019. 'Blockchain Initiatives'

⁶⁷ Rajamanickam, V. 2019. 'Saudi customs pilots shipment movement via blockchain'

⁶⁸ Yotaro Okazaki, 2018. *Unveiling the Potential of Blockchain for Customs*, World Customs Organisation, *Blockchain Free Zones*, WCO News no 87

⁶⁹ Yotaro Okazaki, 2018. *Unveiling the Potential of Blockchain for Customs*, World Customs Organisation

allowed for nearly instant communications and eliminated the need for paper-based documentation and reported no drawbacks in using blockchain.⁷⁰

Chile has trialled a Treasury Blockchain to improve taxation processes, public payment methods, and connect ‘citizens, financial intermediaries and suppliers...using a blockchain database’ and is committed to implementing similar initiatives in all sectors of government.⁷¹ The National Energy Commission of Chile launched a pilot blockchain network to store transactional information relating to average market prices, emission factors, electricity generation and capacity data.⁷² As a result of this Chile has been recognised by the International Energy Agency as a global leader in investment in renewable energy. (see Annex 1)

Korea has tested the application of blockchain to its import/export clearance process, e-commerce and cross-border information exchange.⁷³ Working with a consortium of 41 entities, including technology companies (Samsung), government agencies (Customs, Maritime Affairs and Fisheries), transporters and consignors, they developed a private blockchain platform built on the Hyperledger fabric to discover technical and institutional challenges and develop methods to gradually integrate blockchain into existing customs systems. Three types of applications were tested. The first allowed participants to share 22 types of documents related to export clearance in real time. This greatly facilitated the export clearance process. The second application allowed e-commerce and transport companies to share data more easily with the customs authority. This application used smart contracts to automatically determine which transactions meet the *de minimus* threshold and can get cleared on the spot. The third application allowed certificates of origin to be exchanged across borders between Korea and Vietnam. Customs authorities from both economies worked together to allow certificates of origin issued in Korea to be shared in real time with Korean exporters, Vietnamese importers and Vietnamese customs authorities. To facilitate this program, Korea also provided technical assistance to Vietnam on upgrading their IT infrastructure.

Singapore encourages the development of blockchain technology through several measures, including the development of a reliable legal framework for digital currencies, and tax-friendly and light-touch regulation and state funding to encourage blockchain companies and start-ups to invest locally.⁷⁴ A recent report indicates that there are over 500 Blockchain start-ups in Singapore. The Singapore government’s confidence in blockchain technology is evident in the development of ‘Project Ubin’, backed by the Monetary Authority of Singapore (MAS), to create a digital token for the Singapore dollar on the Ethereum Blockchain. Each ledger is supported by the equivalent amount of Singapore dollars held by the government to ensure that the overall money supply is not impacted by the token and has full redemption possibilities. The project aims to make financial transactions cheaper and more efficient.⁷⁵

Singapore is also undertaking a pilot to connect the economy’s National Trade Platform (NTP) with a prototype blockchain trade platform to be developed by a consortium of Japanese companies – an extension of the Global Trade Connectivity Network (GTCN) project between Singapore and HK discussed in Chapter 2. The vision is for a national trade information management platform that provides the foundation for Singapore to be the world’s leading trade, supply chain and trade financing hub and to enable the flow of digital trade data with trade partners globally.⁷⁶

⁷⁰ Wood, M. 2019. ‘U.S. Customs to trial blockchain system for shipping’ Ledger Insights

⁷¹ Akilo David, 2019. ‘Chilean Government Unveils Blockchain Project for Public Payment Processing’

⁷² Sharma, 2019. ‘Chilean Treasury Introduces Blockchain Platform for Public Payments’. Barley, 2018

⁷³ WCO 2019, *Smart Borders*, WCO News no 88

⁷⁴ Deloitte Insights, 2019. ‘Deloitte 2019 Global Blockchain Survey’

⁷⁵ Global Legal Insights, 2019. ‘Blockchain and Cryptocurrency Regulation 2019’

⁷⁶ Singapore Customs, 2019. ‘Hong Kong-Singapore blockchain trade platform to go live in 2019’, Global Trade Review

China has started rolled out its own cross border blockchain technology, starting with Nanning Customs, which manages 26 cross border trading points along the nearly 500-mile border of southwest China as one of the ‘National Customs Cross Border Technology Innovation Initiatives’. China Customs is huge, with 43 districts, six national centres of excellence for revenue management and compliance risk management, 450 ports of entry and a staff of about 70,000.⁷⁷ The new platform aims to increase customs efficiency by using DLT technology to monitor the flow of imports and export, inform risk assessments, store documentation and increase contact between government authorities and ports, enabling faster compliance checks.

In **Thailand** a blockchain trial involving electronic trade documents for international trade were examined by 47 trial participants from 24 cross-industry companies, including Thai banks, Thai forwarders, Thai carriers, Thai exporters, Thai insurers, Thai certificate of origin providers and Japanese importers.⁷⁸ Meanwhile customs authorities in **Australia** and **Peru** are participating in the TradeLens project with national trials.

The above examples of APEC economies already examining benefits of blockchain applications could usefully inform APEC fora, including the APEC Sub-Committee on Customs and Procedures, on the potential for blockchain to benefit regional AOE and Single Window schemes, and the existing Supply Chain Connectivity Framework Action Plan. It will be timely to increase the awareness, capacity, and skills of stakeholders in blockchain trade applications across APEC. The APEC Committee for Trade and Investment (CTI) could commission capacity building workshops reviewing blockchain implementation, best practice policy and regulatory reform, technical processes and development of standards. These workshops will allow trade policy, customs and standards officials to dialogue with experts, supply chain operators, and companies implementing blockchain in trade to learn from recent developments.

The trade-related blockchain applications currently being explored across industry and geographic boundaries are being implemented using a variety of protocols and standards. Some are open-source public ledgers while others are private and permissioned. This raises issues of interoperability both between blockchain systems and between blockchain and legacy systems. There is considerable innovation occurring focused on these issues, albeit still in early stages and requiring further development before large scale utilisation.

In addition to the examples offered above, the **Inter-American Development Bank (IADB)** and customs authorities of **Mexico, Peru and Costa Rica**, are working with Microsoft to develop a blockchain application that facilitates the sharing of AEO certifications. As discussed in Chapter 1, AEO certification allows businesses to move goods more easily across borders by reducing physical inspection and documentary requirements. MRAs extend these benefits to all participating countries and currently there are over 60 MRAs with more in negotiation globally. However, sharing information between authorities securely and in real time continues to be problematic, often involving sending un-encrypted AEO data via email using excel spreadsheets on a periodic basis, usually once a month. The IADB and its partners have developed a blockchain platform called CADENA which allows both customs authorities as well as businesses to view the status of AEO certification securely and in real-time. Smart contracts enable automated validation of AEOs under an MRA. Preliminary results from a trial indicate that CADENA has improved the efficiency and effectiveness of AEO MRA management through advances in security, trust and transparency.⁷⁹

Another APEC priority would be to consider the potential for blockchain applications in trade to expand the inclusion of and benefits for women, MSMEs and remote communities, and reverse the growing digital divide in the region.

⁷⁷ <https://www.freightwaves.com/news/qa-chinas-21st-century-approach-to-trade-and-customs-modernization>

⁷⁸ Henderson, J. 2019. ‘NTT Data trials blockchain in Thai paperless trade project’

⁷⁹ WTO. 2018. ‘Blockchain and International Trade: Opportunities, Challenges and Implications for International Trade Cooperation’ Global Industry Group, World Customs Organisation News, October 2018. ‘Blockchain Free Zones’

Blockchains are not only for developed countries. In less developed economies, in recent years, there has been a noted uptake of mobile technology to access the global digital economy. This increased connectivity raises the prospect of blockchain perhaps providing leapfrog benefits to marginalised groups: increased access to markets and finance, reduced costs and corruption, and simplified processes if connectivity, access, and skills development are assured.

APEC should implement the Internet and Digital Economy Roadmap, particularly provisions on enhancing access to digital infrastructure as recommended in the ABAC report on Structural Reform and Digital Infrastructure. The APEC HRDWG and DEWG could extend collaboration to develop skills frameworks that cover emerging technologies including blockchain. As digitization marches forward, APEC must continue to pay heed to the diverse ability of economies to adopt new technologies and try to ensure that maximum public value is obtained. As a recent APEC paper noted: While the promotion of universal broadband access is already a focus of the APEC Internet and Digital Economy Roadmap, blockchain adoption has the potential to increase the isolation of developing economies where this remains an unsolved challenge.⁸⁰

It remains to be seen whether the technology offers developing economies the opportunity to leapfrog legacy system or whether they will continue lag. Capacity building programs can help to equalise adoption rates across the APEC region. This issue is under consideration in other international bodies such as the WTO, World Bank and UN.⁸¹ APEC could be key to shaping the critical partnerships and alliances required for less developed economies to benefit fully from blockchain. Education, skilling and re-skilling to ensure workers can transition to jobs utilising new technologies and to avoid skills shortages are a priority in all economies.⁸²

Regulation, Standards, Laws

The emergence of blockchain as the technology associated with Bitcoin and other crypto currencies, and the expansion of the technology into applications in other areas, including the trade applications that concern this paper, have driven activity globally around the questions of what standards, laws and associated regulations are required. Blockchain is the new frontier. Governments have grappled with similar issues in association with the rise of other digital technologies, modern digital processes and hybrid technologies and resulting developments such as electronic payments and the gig economy, however blockchain, as a foundational technology is on par with the internet. At the turn of the century, the growth and influence of the internet provoked similar activity by Governments to identify parts of standards, legal and regulatory frameworks, responsibilities and functions to enable adoption of the internet whilst protecting certain rights of society and consumers. Therefore, the challenge of legal and other reform to stay abreast of new technologies and their usage, and even to accommodate unknown future technologies, is not new. The process of reviewing laws, repealing outdated provisions, developing appropriate new provisions, and educating policy makers, regulators, the public and industry on evolving frameworks, is ongoing around new technology.

The potential success of blockchain technology, as noted by a WTO study, will be determined by the appetite and willingness of regulatory bodies to put in place a 'conducive regulatory framework that recognises the legal validity of blockchain transactions, clarifies applicable laws and liabilities and regulates the way data can be accessed.'⁸³ This requires further consideration of policies, regulations and laws.

⁸⁰ APEC Internet and Digital Economy Roadmap, 2017

⁸¹ <https://www.worldbank.org/en/news/video/2017/08/15/will-blockchain-technology>.
https://www.wto.org/english/res_e/reser_e/workshop_blockchain_271118_e.htm.

⁸² Gratton, L. 2019. 'New Frontiers in Re-skilling and Upskilling' Sloan MIT review

⁸³ Ganne, E. 2019. *Can blockchain revolutionize international trade?*

There has been considerable uncertainty around standards, regulations and laws for blockchain (along with associated features such as smart contracts or crypto currencies, tokens etc) and there are many diverging approaches at present. Industry attitudes range from no regulation (arguing that the foundation technology will be stifled) to maintaining existing regulation as adequate with minimal light touch reform. At national level, approaches vary significantly. Highly interventionist prohibitive regulations and laws that have been introduced by some countries are in the main focused on regulating cryptocurrencies. For broader blockchain applications, the picture is still evolving. Approaches range from proactive legislation to ensure they attract blockchain innovation (incentivising industry investment by creating certainty around registration, licencing and other legal issues), to being largely non-interventionist, allowing innovation to evolve before responding and to avoid creating unnecessary technical standards and regulatory barriers to trade, including through regulatory cooperation and alignment to relevant international standards. Most countries are currently reviewing their legal and regulatory regimes and consulting at international level.

Standards

Standards are documents that provide requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose.⁸⁴ They rule on the question of “what's the best way of doing this?” on common, shared issues and are developed by expert technical committees who consider all aspects of the standard, including its scope, key definitions and content in depth and consult with interested stakeholders in an open process. Standards give consumers, industry, governments and regulators a common reference point and set of benchmarks around products, services, and processes. In the case of blockchain standards will help to overcome the effect of the many differing approaches and processes in applications currently being trialed and developed that will hamper interoperability if not resolved.⁸⁵

The International Standards Organisation (ISO) has been producing internationally accepted proprietary, industrial, and commercial standards for over 70 years. Standards can be developed by national, regional and international standards authorities and by businesses or industry. Standards are voluntary but adherence to accepted standards provides confidence to consumers, and standards can be referenced in law. Industry can however be directed to use relevant standards if a Government enacts enforcing legislation and regulations.

Industry can and does generate industry standards when there is a perceived need to endorse an industry ruling on optimum characteristics, features or processes to meet a market need. In the case of blockchain, industry has moved to develop technical standards to establish consistent product protocols to be adopted to help sound innovation, interoperability and provide guidance to developers, users of blockchain technologies (and regulators). For example, the Enterprise Ethereum Alliance, a group of 500 companies, developed a standard for a business-centric distributed ledger that promises to speed up transactions while increasing privacy.⁸⁶ As mentioned in Chapter 2, the Blockchain in Transport Alliance (BiTA) is likewise developing standards on blockchain data structures and location tracking in the transportation industry.⁸⁷

⁸⁴ <https://www.iso.org/standards.html>

⁸⁵ WTO. 2018. Supplychain@MIT, 2019. ‘Will Blockchain Create a Digital Divide in Shipping?’

⁸⁶ <https://www.computerworld.com/article/3273931/businesses-join-to-create-enterprise-standard-for-blockchain-networks.html>

⁸⁷ BiTA, 2020. ‘Blockchain Standards’

At national level the picture is still solidifying, and companies are calling on governments to develop universally interoperable blockchain standards.⁸⁸ At the international level the World Customs Organisation,⁸⁹ UN CEFACT⁹⁰ and ISO⁹¹ are considering the implications of blockchain for supply chains. The ISO has commissioned development of a suite of standards that will support blockchain development, **ISO/TC 307, Blockchain and Distributed Ledger Technologies** led by Standards Australia. Work is progressing on the architecture, ontology and taxonomy of these standards, including definitions, terminology, smart contracts, governance, privacy, security and identity, referencing current use cases and interoperability, including in supply chain and trade facilitation, security evaluation of consensus models, and data flow.⁹² The Expert Technical Committee is considering blockchain standards topics including interoperability, terminology, privacy, security and auditing and has issued a Roadmap for Blockchain Standards.

Standards Australia is identifying current ISO member and International Standards that could be used to support blockchain. After the foundational standards for blockchain and DLT terminology are set, governance and risk-related issues will be addressed, with reference to existing standards, affecting privacy, security, and identity, and then a reference architecture standard for blockchain and interoperability standards to provide stakeholders with a framework for developing and using blockchain (in technical rather than legal terms). ISO currently reports that there is 1 published ISO standard relating to blockchain, a further 10 ISO standards under development and in the process, there are 43 participating members and 13 observing members around blockchain standard development.⁹³

APEC economies must work with these bodies and private sector operators to develop universal standards that will allow trade-related data to flow seamlessly across borders and organisations, thereby enhancing trust. APEC should engage with international organisations developing blockchain standards such as the International Standards Organisation (ISO), World Customs Organisation (WCO) and UN Centre for Trade Facilitation and Electronic Business (UN/CEFACT) to develop standards for blockchain in trade acceptable to industry and customs authorities. APEC's work on Global Data Standards which aims to provide a unified language in the capture and sharing of supply chain data using barcodes and RFID tags can also be updated to include blockchain.⁹⁴

Blockchain innovation relies on cross-border data flows and an open environment, facilitates operations without a central intermediary, and validation of transactions on the ledger through consensus protocols in a peer-to-peer network. There are concerns and uncertainty around aspects of blockchain including privacy, security and cross border data flows. These issues vary according to whether a blockchain is open and permissionless, permissioned and controlled, or a blend of the two. These issues will be addressed collectively through the development of the suite of standards under ISO/TC 307, emphasising the need for APEC involvement in ISO and other processes. These standards serve as reference for regulators and legislators.

Laws and Regulation around Blockchain

Countries who are generally receptive to cryptocurrencies and therefore adopting a more hands-off approach include the US, Germany, the Republic of Korea, and the UK, Belarus and the Ukraine. Some countries such as Switzerland and Dubai have reviewed existing laws and regulations and formally concluded that the current frameworks provided

⁸⁸ <https://www.computerworld.com/article/3391070/fedex-cio-its-time-to-mandate-blockchain-for-international-shipping.html>

⁸⁹ http://www.wcoomd.org/-/media/wco/public/global/pdf/topics/research/research-paper-series/45_yotaro_okazaki_unveiling_the_potential_of_blockchain_for_customs.pdf?la=en

⁹⁰ <http://www.unece.org/fileadmin/DAM/cefact/GuidanceMaterials/WhitePaperBlockchain.pdf>

⁹¹ <https://www.iso.org/news/Ref2188.htm>

⁹² https://www.standards.org.au/getmedia/ad5d74db-8da9-4685-b171-90142ee0a2e1/Roadmap_for_Blockchain_Standards_report.pdf.aspx

⁹³ <https://www.iso.org/committee/6266604.html>

⁹⁴ APEC PSU, 2017. Study on the Application of Global Data Standards for Supply Chain Connectivity – Phase 2

adequate regulation for DLT and blockchain with amendments.⁹⁵ **Dubai** is regulating Blockchain and DLT through technology certification via a system auditor that reviews and assesses the technology arrangement and provides assurance on the solution's quality and characteristics. Beyond that Dubai regulates the token economy, has introduced laws to support the use of Blockchain for conducting business, and highlighted the role of competent authorities and their responsibility of providing further guidance and working with international organizations on the development of technical standards. **Switzerland** has amended six existing laws to support blockchain, recognising data as an asset, amending the scope of the Anti-Money Laundering Act, easing restrictions on blockchain securities trading, and decentralising exchanges. **France** has defined the technical requirements of DLTs used to issue, register and transfer unlisted securities and introduced enforceable provisions around pledging of blockchain-based securities.

Others like Liechtenstein have developed a comprehensive legal framework for blockchain, regulating currencies and crypto trading to create certainty and enable blockchain businesses to integrate more smoothly into the traditional economy. At the other end of the spectrum, Bangladesh, Vietnam, Ecuador (despite having a government backed cryptocurrency) and Algeria have introduced restrictive regulations affecting blockchain whilst China first banned and then allowed bitcoin mining. Several USA States are working to provide a solid legal foundation to support blockchain implementation including enforcing Smart Contracts and Digital Signatures on blockchain. The EU recognises the need to have a legal system for blockchain and is working towards establishing this foundation across its member state.

A new index concerning the extent of public policy accommodation towards usage of blockchain technology considers four categories of blockchain policy: extent of policy restrictiveness towards cryptocurrency initial coin offerings; extent of policy restrictiveness toward cryptocurrency exchanges; taxation treatment toward cryptocurrencies; type and extent of general public policy interest in blockchain-related activity. It reports that APEC members in late 2018 had diverse approaches to blockchain regulation but Singapore (with HK, Australia, US, and Canada) is rated as a relatively crypto-friendly location, reflecting efforts to develop a balanced legal and regulatory regime for digital currencies and foster an environment that attract blockchain start-ups and tech companies.⁹⁶

Harmonising regulation across borders: Some dedicated international bodies have been formalised to tackle these challenges. In Europe, 22 countries have signed a Declaration establishing a European Blockchain Partnership to facilitate cooperation amongst Member States to exchange experience and expertise in technical and regulatory fields and prepare for the launch of EU-wide blockchain applications across the Digital Single Market for the benefit of the public and private sectors.⁹⁷ International bodies are engaging with members to facilitate cooperation to develop regulatory and policy frameworks conducive to the deployment of this technology while mitigating the risks that may arise. Some view blockchain as a mechanism that can 'create a decentralised economic order where people directly transact in the global market'.⁹⁸ Others are focused blockchain being a tool to secure financial inclusion for previously excluded participants. OECD, G20, and WTO are working in the areas of regulating emerging technologies.

The World Customs Organization (WCO) has initiated work to identify possible case studies and uses of blockchain for Customs and other border agencies with a view to improving compliance, trade facilitation, and fraud detection (including curbing of illicit trade through the misuse of blockchains and Bitcoins), while touching on associated adjustments in legal and regulatory frameworks.⁹⁹ APEC should likewise anticipate the legal and regulatory policies

⁹⁵ <https://www.globallegalinsights.com/.../blockchain-laws-and-regulations/switzerland>

⁹⁶ Novak and Pochesneva, 2019. Live Bitcoin News, 2018

⁹⁷ <https://www.intellectsoft.net/blog/blockchain-government-regulation/>

⁹⁸ Maupin, J. 2019. <https://www.thecoinspost.com/julie-maupin-of-iota-interview-about-blockchain-history>

⁹⁹ WCO Research Paper No. 45 Unveiling the Potential of Blockchain for Customs (June 2018) Yotaro Okazaki

and frameworks needed to recognise blockchain data in law; resolve cross-jurisdiction disputes; standardise data capture, storage, ownership, sharing and security provisions; recognise smart contracts and digital currencies.

Issues around Recognising Blockchain in Law

Privacy, Data Localisation and Capture (and Cross-Border Data Flows): Blockchain will increase the flow of data across borders. Concerns about the global flow of data raises legitimate concerns regarding data privacy and is an issue that governments have responded to by implementing new data privacy laws, chief among which is the requirement for data localisation.¹⁰⁰ The deployment of blockchain technology could be limited by the rights granted to individuals under national data protection regulations. Data localisation and capture is a significant threat to the potential implementation of blockchain technology and needs to be addressed.

Industry leaders have tackled Data Privacy and Confidentiality by mainly designing a single validation source and strict Data Access Rights, like Ripple with xCurrent, or by providing API database shielding functionality, like TradeLens.

Estonia, Singapore, and Australia have developed solutions and implemented policies to protect Data Privacy and Confidentiality, focusing on limiting the distribution of data to only what is necessary. Dubai and the UAE are developing new Data Protection laws and Classification Standards. It is currently unclear whether there is going to be an incompatibility between the European General Data Protection Regulation (GDPR), which entered into force in 2018, and blockchain. Some argue that adherence to GDPR might potentially render blockchain unachievable.¹⁰¹

The practical impact of this consideration is that a blockchain that is designed to cross international borders may not be implementable if expected participants are forced by regulatory policies to interact in a pre-determined and approved manner. While some countries have implemented regulation and legislation that recognises blockchain and smart contracts some economies have been hesitant to legislate something that is not yet widely understood.¹⁰² This has created considerable regulatory and policy grey-areas.

In APEC, 50 per cent of countries have passed data protection laws, importantly though the definition of personal data remains inconsistent across the APEC economies. The APEC Privacy Framework and Cross Border Privacy Rules (CBPR) are examples of regional data privacy initiatives that are based on internationally accepted data protection principles.¹⁰³ If blockchain solutions are to innovate in the provision of government services in the APEC region agreement on data localisation and privacy will need to be reached, or restrictions put in place regarding the use of personally identifiable information is used in blockchain solutions.

The emergence of global supply chains in international trade have heightened the scrutiny placed on country-specific requirements for the capture and storage of specific types of data. If blockchain technology is to realise its potential in simplifying global supply chains and international trade processes regulators will need to address the potential for disparity in data flow requirements.

APEC should review restrictions to trade-related cross border data flows and how these may be impacted using blockchain. APEC should develop cross-cutting data flow principles that enable the free flow of data while maintaining privacy and security. Blockchain allows data to be securely transmitted and would reduce the requirements for cross-

¹⁰⁰ Cory, N. 2017, 'Cross-Border Data Flows: Where Are the Barriers, and What Do They Cost?'

¹⁰¹ Toth, A. 2018 'GDPR and Blockchain'

¹⁰² Schatsky, Arora and Dongre, 2018. Schatsky, Arora and Dongre 2019. Deloitte 'Blockchain and the five vectors of progress'

¹⁰³ Cory, N. 2017, 'Cross-Border Data Flows: Where Are the Barriers, and What Do They Cost?'

border data flows. ABAC is documenting data flow restrictions in APEC economies to inform recommendations on a set of APEC data flow principles to inform the development of a consistent regional framework.

Security: One of the key attributes of blockchain is that it is said to be virtually un-hackable due to the complex cryptography and the distributed nature of the ledger. Blockchain has proven secure to date. Emerging technologies such as quantum computing could potentially be used to decrypt blockchain transactions thereby rendering them vulnerable. Research has suggested that quantum computing technology may possess enough power to hack nodes within a blockchain network.¹⁰⁴ However, work is also underway to develop quantum resistant cryptography.¹⁰⁵

Jurisdiction: Essentially because blockchain can cross jurisdictional boundaries depending on where its nodes are located means that there is a grey area around which jurisdiction holds sway in terms of the principles of contract and title. It is therefore vital that standards include provisions to indicate an exclusive governing law and jurisdiction clause so users have certainty as to the law to be applied to determine the rights and obligations of the parties to the agreement and which courts will handle any disputes.¹⁰⁶

Ownership Rights and Transfers (and licencing requirements): Blockchain is not clearly owned by a single entity. Lots of people own little parts of the system: individual miners control their servers, the development community controls the code, and each user controls their own address. This has highlighted a need to clarify the treatment of digital, including blockchain assets under existing commercial laws. Countries are moving to clarify ownership/ direct property rights for individual owners of digital assets of all types (virtual currencies, digital securities and utility tokens).

Smart Contracts: Contracts only represented in code are not currently equivalent to traditional contracts in the eyes of the law. There is the risk that the code in 'smart contracts' may not include all or some aspects which are present in a legal contract and the surrounding legal framework. Standards can provide guidance to developers and users of blockchain technologies, but that these standards are not able to take priority over the law or act as a substitute.

Audit and Compliance: Where a regulated sector covers the application deployed on top of blockchain technology, then these actions will fall under the current regulatory framework applied by such sector/industry regulator, including audit and compliance, but beyond that it still an evolving issue.

Intellectual Property regulation: Blockchain technology will require a portfolio of Intellectual Property protections to properly cover the different elements of the technology, including ledgers, algorithms, and network design. While the general approach to Blockchain development has been open source, companies and consortiums, like IBM and TradeLens, have been applying for IP protection for their use case specific platforms. Open Source licensing will accelerate innovation in blockchain technology, but closed source development can protect specific implementations. The EU and other governing bodies are tackling IP in Blockchain technology by applying existing laws and regulations

APEC will be interested in progress pertaining to the development of standards, regulation or a binding international legal framework relating to blockchain, and will want to cross reference blockchain work with any work undertaken in digital trade more broadly, given the overlap around cross-border data flows that affect the ability of companies to use not only blockchain but also more integrated and accepted innovations tools like cloud computing, AI, machine learning and big data analytics (see the APEC Internet and Digital Economy Roadmap work acknowledging these issues and calling for regional regulatory coherency and cooperation, and the forthcoming work from ABAC on data flow

¹⁰⁴ Ganne, E. 2019. *Can blockchain revolutionize international trade?*

¹⁰⁵ Mellor, C. 2019. *'IBM makes world's first quantum computing-safe tape drive'*

¹⁰⁶ <https://www.dlapiper.com/en/denmark/insights/publications/2017/06/blockchain-background-challenges-legal-issues/>

restrictions in APEC to inform the development of detailed recommendations on APEC data flow principles). APEC should aim for an informed, stable and prudential approach, considering national and international developments.

Next Steps

APEC needs to facilitate discussion between members on:

- Current and new developments, within APEC and globally.
- Review existing APEC programs and ensure blockchain is covered.
- Facilitate ongoing discussion with blockchain stakeholders including business through ABAC
- Ensure appropriate legislation, regulation and governance provisions are developed to allow ongoing development of blockchain, innovation in manner that facilitates regional and global harmonisation.
- Incorporate blockchain issues in forthcoming strategies, priorities and action plans

CONCLUSION

This report has examined the nature of blockchain technology, its usage to date in APEC economies, and the potential benefits and challenges that blockchain technology represents to APEC.

Interest and investment in blockchain technology is in line with the Bogor goals established by APEC, and in the very mission statement of APEC in reducing barriers to trade and engagement among economies in the region.

Whilst blockchain has been proffered as a solution to a diverse number of challenges, particularly those encountered in developing economies, it comes with the caveat that blockchain relies on the potential for significant hurdles to be overcome, the least of which is the realisation of Global Data Standards. As a technology that remains in the nascent stages of development further investment and policy analysis will determine the viability of the solution.

There are significant opportunities represented by blockchain technology, of which the most compelling and viable in the future is the potential realisation of efficiencies in supply chains. Further reduction in trade barriers and continued digitisation of trade infrastructure with technologies like blockchain could lead to extensive GDP growth in the region. Plus, blockchain represents tangible opportunities to reduce barriers to international trade for MSMEs, delivering efficiencies and benefits for developing economies and marginalised communities. Work is already underway expanding the viability of blockchain, but the success of the technology will depend on the ability of economies to collaborate to realise the benefits in full.

RECOMMENDATIONS

1. As new technologies are being developed and applied to facilitate trade, APEC should keep abreast of latest developments and consider implications for existing programs. The APEC Sub-Committee on Customs and Procedures should convene a group of customs officials and private sector representatives to consider how blockchain could address shortcomings in programs such as Single Window and Authorised Economic Operator.
2. As the emergence of competing private platforms risks creating a fragmented blockchain ecosystem, it is important to develop universally accepted open standards. APEC should engage with international organisations, industry and customs authorities to develop standards for data management and protocols for inter-ledger interoperability.
3. APEC should anticipate the legal and regulatory policies and frameworks needed to recognise blockchain data in law; resolve cross-jurisdiction disputes; standardise data capture, storage, ownership, sharing and security provisions; recognise smart contracts and digital currencies.
4. APEC should closely monitor regulatory restrictions to cross-border transfers of data as this could impede the functioning of blockchain systems. Concurrent work by ABAC to develop cross-cutting data flow principles can make an important contribution to enabling the free flow of data while maintaining privacy and security.
5. APEC economies must ensure that the basic requirements are met for blockchain to be widely adopted. This includes access to digital infrastructure and specialised training for marginalised groups such as women, MSMEs and remote communities. APEC should implement the Internet and Digital Economy Roadmap, particularly provisions on enhancing access to digital infrastructure as recommended in the ABAC report on Structural Reform and Digital Infrastructure.
6. As APEC Members have varying capabilities to adopt new technologies, APEC can play an important role as a platform for public and private entities to share best-practice examples. The APEC Committee for Trade and Investment (CTI) should organise capacity building workshops to review blockchain implementation; policy, regulatory and technical reforms; ecosystem co-ordination; and standards accreditation requirements with a view to equalising adoption rates across APEC.

ANNEX 1 Blockchain and Renewable Energy in Chile

Nowadays, the design of the grid makes decarbonization difficult. Even for suppliers adding new renewable generation is not easy. Incentives for a distributed renewable energy supply are limited. Consumers cannot choose their preferred source of energy from the grid. Trusted source of energy generation and marketplace is also required.

These challenges highlight the need for transition to a new energy ecosystem that ensures energy access, resiliency and efficiency. At the same time, it requires to bring more security, decarbonization, and democratization of the grid, at the lowest cost possible. In this new scenario, “transactive energy” emerges as a pathway to cleaner and smarter services.

Blockchain technology will disrupt the existing energy hierarchy and on the grid edge, which is impossible with ordinary databases, offering new possibilities. Blockchain allows to trust the origin of energy generation and to track transactions. Everything in a much more secure way and with higher standards of data privacy. In another hand, the distributed nature of block-chain means no central entity serves as gatekeeper to massive information.

A transactive energy ecosystem will require smart infrastructure with trusted certificates of origin and a trading platform based on a token system. This token approach, as Lawrence Orsini¹⁰⁷ (2018) says: “... enable a common extensible platform that can facilitate valuable network utility from diverse but synergistic use cases, opening paths for effective community participation”. Orsini, suggests that a token-based transactive-energy platform should operate in two layers:

- i) establishing and managing a global network of energy market participants; and
- ii) set of local, fast-acting, and resilient blockchains around the world powered by grid-edge smart assets.

However, the token approach on energy have practical limitations and barriers such as rigid regulations and its needs of standardized protocols among the stakeholders to ensure interoperability. Although this challenges it is an opportunity to leapfrog to a decentralized and distributed energy market through a smart infrastructure that is more resilient, cost-effective, and better for the environment.

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¹⁰⁷ Insights based on Orsini, Lawrence, ‘DISTRIBUTED POWER: How Blockchain Will Transform Global Energy Markets’, Blockchain Research Institute. October 2018.

General Context

Blockchain is a digital transaction ledger, shared, decentralized and immutable. Transactions are added in the so-called blocks (which contain the defined information) which are chained together using cryptographic tools. This blockchain is in a peer-to-peer network (P2P), so each node or participant shares a replica of the digitally signed transaction ledger. Blockchain technology is a type of distributed ledger technology (DLT) that currently supports Bitcoin.¹⁰⁸

According to the World Economic Forum (WEC) survey of different industries about blockchain, there are three main attributes generating changes in sectors: complete traceability; the immutability of the data; and increased security.¹⁰⁹ In contrast, the least valued were transparency for all appropriate parties and new commercial products or services. This reflects that, on average, in all the surveyed industries, the low valuation they see in that there is greater transparency of the business and that Blockchain does not create new business models, but rather is a technological upgrade.

In Chile, both the private and the public world have shown interest in developing projects that consider Blockchain as their central focus. Without going any further, In August 2018, the Ministry of Economy, Chile Tourism Development organized six public-private round tables in order to make proposals in different sectors for the incorporation of the Blockchain to various aspects of the national reality.¹¹⁰ The sectors that represented the collaborators were the following: (a) Digital Identity, (b) Commerce, (c) Financial Services, (d) Registration Systems, (e) Energy and (f) Health.

The sector that has most embraced blockchain is the financial sector. For example, the Santiago Stock Exchange uses Blockchain technology for its short sales system. The Santiago Stock Exchange solution helps reduce errors, possible fraud and the processing time of each transaction, while providing transparency and security to the entire business chain in its short sales and securities loans.

Recently, the Santiago Stock Exchange, the Central Securities Depository (DCV) and the Telecommunications Services Company GTD, announced the formation of an alliance for the development of various fintech applications based on blockchain technology. It is about the formation of a Technological Consortium and which in turn contemplates the formation of a Business Blockchain Network. The infrastructure will allow the connection of local and international clients of the stock market through nodes provided by the Technological Consortium itself or installed in the clients' systems.

Together DCV initiatives, Central Bank also will incorporate Blockchain technology in the issuance of its financial instruments.

Blockchain in the Renewable Energy Sector

In the energy industry, both traceability and data in immutability were the most preferred benefits. Another important attribute, although not within the top-three in the industry based on WEF Study, are the Smart Contracts. In simple words, Smart Contracts correspond to a series of instructions and programmed rules in some Blockchain network that trigger the automatic execution of agreed actions if pre-established conditions fulfill. For example, if the share price exceeds a predefined value, the return to the shareholder will automatically be deposited, this translates into greater speed and lower cost by not having to validate these transactions by a judge or notary.

In addition to the above, a Deloitte document (“Blockchain: A true disruptor for the energy industry”) notes that: “... Specifically in the energy sector, as distributed energy resources continue to penetrate the network, blockchain has the

¹⁰⁸ World Economic Forum, https://www.wto.org/english/res_e/booksp_e/blockchainrev18_e.pdf

¹⁰⁹ World Economic Forum, http://www3.weforum.org/docs/WEF_Building_Value_with_Blockchain.pdf

¹¹⁰ ‘Blockchain: a way to the 4th Industrial Revolution’ (Ministerio de Economía, Fomento y Turismo de Chile, 2018)

potential to allow peer-to-peer transactions between end users. These localized commercial networks could alleviate systemic inefficiencies, such as losses in transmission lines, congestion and volatile price formation...”.¹¹¹

The above is reflected and materialized in different cases of use in the world. To exemplify, in Japan, blockchain operation is evaluated through a pilot project that will manage an energy market by connecting several Marubeni production facilities around Japan. The project will simulate energy transactions to prove the viability of the concept with the goal of creating a commercial network on a real scale in the future.

The platform will allow measuring useful energy data and information on energy quality, communicating with other devices on the network to activate energy transactions and improve efficiency in their use. Real electrons flow through the normal network transmission network, but the Blockchain manages the transactional element: the definition of the energy source and the contract to pay for it. Users set preferences through a dedicated mobile application, giving consumers the opportunity to choose preferred energy sources and how much they are willing to pay for renewable energy.¹¹²

In Thailand, Thai state-owned oil and gas’ company, PTT and the nonprofit Energy Web Foundation (EWF) took the initiative to build a platform for renewable energy based on blockchain to develop a regional solution based on the Energy Web Chain that meets the International Renewable Energy Certificate (I-REC) allowing producers to certify the renewable origin of energy. In this way, the intention is to better adapt the demand with the available supply, help achieve sustainability objectives, create additional income flows for the assets in operation and unlock new investments in renewable energy in the region.¹¹³

In United States, Clearway Energy Group launched a pilot program based on blockchain to issue certificates and exchange renewable energy credits. This initiative gives confidence in blockchain since this technology had not been related to environmental conservation and demonstrate its versatility. The opportunity is clear as the current US market reaches a value exceeding 3 billion dollars.¹¹⁴

What has been done in Chile with Blockchain in the renewable energy sector?

The use of blockchain technology in the energy sector began from the National Energy Commission (NEC) as a record of its statistics to create greater confidence and transparency due to its immutability characteristic.

Since then, there are several projects in Chile that are under development and some of them have had an approach with the National Energy Commission (NEC), which are using Blockchain technology for the certification of renewable energy sources.¹¹⁵ It is worth mentioning that the Energy Data Certification Project was selected among 20 innovative initiatives from around the world to be part of the Innovation Week 2018, which took place between September 4 and 7, in Bonn, Germany.¹¹⁶

On the other hand, there are other projects, supported by the Chilean Economic Development Agency, that has gained some fame in recent times known as “Solar Token”¹¹⁷ that will allow renewable energy to be commercialized worldwide. This is a Chilean project called BELINUS, this project contemplates the use of “token” instruments, based on Blockchain technology. This project uses two tokens, one called Solartoken and the other called Kali-Token. (According to William

¹¹¹ ‘Blockchain: A true disruptor for the energy industry’. (Deloitte, 2018)

¹¹² ‘Japan will use blockchain for renewable energy transactions’ (World Energy Trade, 2019)

¹¹³ ‘Oil and Gas Thai Company develops renewable energy platform based on Blockchain’. (Cointelegraph, 2019)

¹¹⁴ ‘Clearway Energy Group will use Blockchain to issue renewable energy certificates’. (Crypto Trend, 2019)

¹¹⁵ Meeting Mauricio Utreras, from NEC (August 28, 2019)

¹¹⁶ Revista Electricidad, <http://www.revistaei.cl/2018/09/13/blockchain-la-cne-fue-seleccionado-20-iniciativas-mas-innovadoras-del-mundo/#>

¹¹⁷ ‘Solar Token will be launched within Renewable Energy Blockchain Project.’ (Cointelegraph, 2019)

Mougayar¹¹⁸, a token is “a unit of value that an organization creates to govern its business model and empower its users to interact with its products, while facilitating the distribution and distribution of benefits among all its shareholders.)

The project brings together photovoltaic energy producers that need monetary resources to realize their project and potential energy consumers through its platform. The project is currently in the process of raising financing through the launch of an ICO (Initial Coin Offering, a way to raise capital, or participate in an investment)¹¹⁹ a new method that thanks to blockchain has allowed raising capital for a value of 7.3 billion dollars between 2013-2017 and 13.7 billion dollars only in the first half of 2018. Solartoken is an active crypto (of natural resources)¹²⁰ that can be marketed on exchange platforms worldwide. On the other hand, Kali-token is an ecosystem token instrument (utility token)¹²¹ which will work only within the BELINUS platform and will represent a smart contract, which provides rights of energy production to the holder, of the generators that They have issued it. These tokens cannot be acquired on crypto exchange platforms and will only exist within the BELINUS platform. Each Kali-token represents 1 Kwh, at a given price, generation point and time. The platform will allow to acquire the Kali-tokens that the generators create as well as exchange them, sell and / or buy with other users of the platform.

The benefits that this initiative once the platform is implemented will be:

- Renewable energy producers can pre-sell their production in a global market and acquire the necessary capital with lower costs than the traditional system.
- Investors / consumers get better investment terms (lower costs and greater liquidity) as well as access to green energy projects worldwide in a standardized way and access to more convenient energy rates.
- The traditional investment model turns simple with a safe, transparent, simple and efficient system.

Considering the project proposal stage and obtaining all necessary permits as the starting point of the investment model, the traditional model, in general, consists of the following steps:

- Project proposal
- Financing Search
- Debt Generation
- Equity Distribution
- Project Development (Construction and Operation)

The model proposed by BELINUS through its tokens simplifies the investment in three stages: Project Proposal, Financing with BELINUS platform and Project Development.¹²²

Other projects, private projects like Dexentralize, emerged in January 2018 as a new model and technological solution that seeks to harness the full potential of renewable energies, internet, clean technologies and blockchain to boost the construction of a new decentralized energy model, 100% clean, safe, resilient, accessible, affordable and without intermediaries, in response to the problems that the current model throws. The solution Dexentralize is working on is a “Energy Trading Platform with Blockchain Base” with P2P marketing in the local market; P2P in the regional market; Electric Car Charging System; and Carbon Bonds and Certificates.

¹¹⁸ William Mougayar, ‘The Business Blockchain’

¹¹⁹ U.S Securities and Exchange Commission.

¹²⁰ ‘Regulation in Tokenized Age: The New FinTech Age’, (Aqueveque, 2019)

¹²¹ ‘Regulation in Tokenized Age: The New FinTech Age’, (Aqueveque, 2019)

¹²² ‘Whitepaper. Belinus’ (Belinus, 2019)

The following are among the benefits we can highlight:

- It will allow the commercialization of peer energy within a micro grid, the local and / or regional market among energy producers, consumers, prosumers,¹²³ aggregators and electricity companies.
- It will allow all users to access relevant information with the necessary quality and frequency that will allow them to be more efficient, make better decisions and share that information safely with other companies that provide energy products and services to access better offers.
- It will allow users to know exactly date, origin, price of how much energy they have consumed or generated and by whom.
- Promote the transformation of the consumer into Prosumer: homes, communities, companies and organizations that can generate, consume, store and sell their own electricity with other members of their community (within a micro grid or local market).
- It will allow large, medium and small producers of energy to sell part or all the energy produced in a safe, stable, transparent manner at more convenient prices.

What is the strategic relevance of the Chilean renewable energy sector? The way blockchain technology adds value to it.

First-of-all, it is important to mention all relevant stakeholders in the national electricity market:

- Generating Companies:
 - o Corresponds to all organizations that inject energy from any source into the transmission system
- Transmission system:
 - o It is divided into three subsystems, all coordinated by the Electric Coordinator:
 - National Electric System
 - Aysén Electric System
 - Magellan Electric System
- Electric Coordinator:
 - o The technical and independent body, which is responsible for coordinating the operation for all infrastructure that operate interconnected with each other in the national territory.
- Distributor Companies:
 - o They are those companies that buy energy in the transmission system and take it to the final recipients (customers). In Chile, they are about 10 groups distributed geographically.
- Consumers:
 - o The final recipients of energy. These can be from homes to large companies (free customers).

¹²³ A person who consumes and produces a particular commodity (in this case energy).

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- Status and regulation of the electricity market in general.

Currently, the challenges facing the electricity sector and in particular is non-conventional renewable energy is linked to becoming a reliable source from the point of view of operational continuity, that is, the challenge is to be an active agent in the market 24 hours a day, representing an alternative with the same conditions as the "traditional" electricity generation. I understand as traditional all those conventional or non-renewable sources. This challenge is being encouraged by several factors, but mainly by the need to reduce the participation in the energy matrix of the plants that generate fossil fuels or gas. Also, but in a second order, given the current situation of the availability of water resources, hydroelectric plants have had to lower their contribution to the electrical system due to the decrease in precipitation in much of the watersheds of Chile.

Chile's energy matrix has hydroelectric plants (small and large), thermoelectric, wind, solar and geothermal (Cerro Pabellón - ENEL)

According to data, the Association of Generating Companies of Chile, in July 2019 the different energy sources contributed to the electrical system in the following proportion: Hydroelectric (27.29%), Thermoelectric (54.13%), Wind (7.73%), Solar (10.67%) and Geothermal (0.18%).

Today there is a high potential for photovoltaic generation in Chile and the growing demand for "green energy" is that there is a focus of research and development for the application of Blockchain in the electricity market both at the micro-network level and at the Transmission level. This will be possible through a joint effort between private parties and the State, which should begin to study the necessary legislation to carry out this type of projects and promote the respective modifications in the current electricity market infrastructure.

Focusing only on photovoltaic generation in Chile, there are 162 plants operating that contributed 10.67% of the total energy in July 2019. Since this source is considered as "clean energy", at Like wind energy, there is a growing demand for it. However, at present, there is no certification solution for the green origin of energy. Moreover, a generator can sell its installed capacity several times to different consumers, without consumers having certainty of the origin of the energy.

This is how Blockchain offers an opportunity to choose in an informed way the energy source to use, present the related information in a transparent way, provide control tools, certify the origin of the energy and thus cooperate with sustainability.

Daniel Espinoza, founder of the Dexentralize project, points out that blockchain can help us build a new energy model. To do this, he first explains the use of Blockchain for the transaction of information or value (through the creation of tokens) between two or more points (users), without the need of a central or intermediary authority. It also allows the immutable certification of the information, the completed value and transactions, which results in security for all users and can provide business intelligence to assets (value creation) under a principle of neutrality. These potentials, says Espinoza, can drive the definitive change of our energy model, initiated some time ago by renewable energies, batteries, energy efficiency, digitalization and Microgrids.¹²⁴

Many of the companies in Chile have made part of their values to Sustainability and particularly they have integrated the Global Objectives for Sustainable Development of the UN in their production processes. In that sense, the consumption of clean energy is directly attached to the objective number 7 of the UN (energy consumption and accessible) and therefore motivates the interest of companies to certify the origin and traceability of their energy consumption. Considering that Blockchain is in an early stage of maturity, this technology can help us overcome the

¹²⁴ Interview and working meeting with Daniel Espinoza (September 2019). Daniel Espinoza is businessman, specialist in engineer projects, Project management, Founder of Re-Imagine Group and Dexentralize (company with Renewable projects, specially photovoltaics, in Chile using Blockchain).

great challenges facing the energy sector such as sustainability, costs and accessibility, generating great benefits for people, companies, organizations, cities, countries and for the system

Espinoza adds that Blockchain opens up great opportunities for homes, communities, companies, organizations and electricity companies to conduct transactions in a secure, transparent manner and without intermediaries. Thanks to its automated and transparent nature, it gives households, communities, businesses and suppliers the ability to work more efficiently while providing greater flexibility in the way they document and distribute services.

Electric companies, thanks to blockchain, can access an easier way to exchange assets and services with other companies, which would allow them to maximize revenue potential and help reduce costs for their users or consumers. Blockchain will help accelerate the speed, security and accuracy of payments to the multiple participating actors that make transactions between them or with the system.

The use of blockchain in combination with other clean technologies can help improve interoperability within the entire industry, encouraging greater decentralization.

How should large-scale certification of origin work in practice?

From a renewable energy source located at a point A, which must carry energy at a point B through the distribution networks, considering that both have signed a PPA (Power Purchase Agreement)¹²⁵ contract, it is not possible to certify that the energy delivered to B is actually of A renewable source. The only thing that the PPA insures is the price and the energy must be delivered to B, but it does not assure the origin since energy is injected in the distribution network from different sources and not all of them are "green". The Electric Coordinator "takes" the energy and according to the demand in the system, distributes it. In turn, according to its system attributes, it indicates that it must carry a certain amount of energy from B, but this energy is not necessarily from "clean" sources or does not necessarily come from A. Electrons cannot be tracked or marked.

According to the one indicated by Engie and the "Energy Web Foundation", hereinafter EWF, in a presentation made in December 2017 in Paris (France), the certification of origin in the current market (without Blockchain), distributes it in three phases: (i) incorporation and issuance, (ii) trading and monitoring of the owner and (iii) claims, withdrawals and reports. In phase (i), before the injection into the transmission system, at least four different entities participate to certify the origin of the energy. It even requires an auditor to certify that there is no phenomenon of double sale of "green" energy.

In stage (ii), the energy is sold through a broker or an aggregator, which in turn, has the possibility of selling the bonds resulting from the emission of green energy (CO2 bonds) in formal or over-the-counter markets.

Finally, in phase (iii), the figure of the buyer appears, which, in addition to receiving the energy and the bonds, must provide certain documentation to another entity with the consequent general expense.

How does Blockchain solve this? That is how it certifies the origin of energy and eliminates most of the entities currently participating in that market. With Blockchain, it can certify that a company A is effectively injecting a certain amount of energy into the system from an unconventional (or "clean", renewable, source as it is popularly known). When this energy injected into the system mixed with other sources that are not necessarily clean and, therefore, there is no certainty that 100% of the energy consumed by B is "green."

¹²⁵ A PPA (Power Purchase Agreement) is a long-term energy sale contract (5+ years) between producers and consumers or traders. Some guarantee income with which to finance their projects and the others set their long-term electricity supply costs.

In other words, when installing two IoT devices (hardware), one at the exit and one at the entrance and both devices are coupled through the Smart Contract. In this way it is known that the energy that is producing A for B comes from the agreed source (NCRE or not).

Taking as an example what was indicated by EWF and Engie (Engie and Energy Web Foundation, 2017), the certification considering Blockchain would work as follows:

- a) The generation source has permission to write data / modify blockchain after the process of incorporating energy into the system.
- b) As each KWh is generated, the meters linked to the generation sources automatically update blockchain with the recently issued KWh.
- c) The buyer acquires a certain amount of KWh, depending on their demand, and automates it through a smart contract. This purchase is executed in real time, without the participation of as many entities as in the current market.
- d) After purchasing the KWh of the “green” source, it can automatically claim or request the respective carbon credits (green attribute), which are automatically withdrawn from the market. Not allowing the double sale of these.
- e) Information about the “green” KWh purchase certificates can be automatically sent to the entity that requires them, without intermediaries.

In a scenario where there is a “marketer”, a person who does not find energy available on his local market, could look for another person's energy in a regional market and consume it at his point of interest. Using blockchain, with Smart Contract and IoT devices, you can identify the lack of supply in one market and look for it in another one with economic similar conditions to the one requested, certifying the origin of the energy.

In that same scenario, people will not only have the possibility to choose the energy source, but they will also be able to choose the company from which they want to consume their energy. In that sense, the Expert points out that this scenario is quite near since an application is being developed that will provide the following information:

- Company name
- Type of energy produced (referred to the source of generation)
- Yields
- Prices and their comparison with the spot market.

Therefore, Blockchain will enable the entry of new agents to the market that Espinoza calls "Demand Aggregator", as well as the “marketer” and the "prosumer". In his opinion, prosumers are not only those agents that buy, sell and consume energy, but also those that produce savings. In other words, a prosumer who does not have the economic capacity to make the investment to install some source of power generation in his home, could also participate in the market just by having an intelligent meter (Smartmeter) that alerts on times where there is not a sufficient offer for all or times where energy is more expensive. Therefore, he could schedule his consumption at times when energy is cheaper or when there is greater availability. By saving energy, it is possible to generate a payment towards that consumer.

All previous actions are under the figure of the “Demand Aggregator”. Is it possible to generate these market conditions without Blockchain? In the Expert's opinion, it is possible. He mentions that even though Blockchain is not required to build a micro grid and that a P2P trade already exists, the advantage of considering this technology is to allow it to be transparent, traceable, decentralized, more agile and cheaper because it lowers friction costs between transactions.

Blockchain as a solution to the challenges of NCRE market in Chile.

Under current regulations governing the Chilean electricity market, the companies that generate energy are required to prove that a percentage of the withdrawals made in the system for their customers come from non-conventional renewable primary energy. National Electric Coordinator validates this through the balance of non-conventional renewable energies (NCRE), as established in Law N° 20,257 and its respective implementing regulations. Energy generators and free customers can trade freely the remaining NCRE that exists in the electrical system.

There is a growing interest from energy consumers in proving that the energy purchased from electricity generation companies, above the percentage required by law, comes from renewable generation sources (based on sustainability, commercial and/or operational policies). The problem is that there is no clear, reliable, and transparent source of public information on total renewable generation commitments, with the possibility of duplication between actors. For all the above, it is necessary to develop in the short term an integral solution to certify the renewable attributes allowing the market to have complete visibility, traceability, and reliability of the product that is acquired. Given all its attributes, this raises from the National Electric Coordinator the alternative of using Blockchain technology.

What is next in Chile?

As with any other technology or tool, success will come once a massive use. For this technology to take-off in Chile, the benefits of its applications should reach all stakeholders (community, private sector, public sector, environment) generating an ecosystem around technology. The urgency that exists worldwide to modify the way we carry out economic activities and the way Humanity relates to the environment is increasingly evident. From a solely economic perspective, when reviewing the behavior of the GDP growth trend worldwide, the World Bank indicates that this indicator is continuously going down.¹²⁶ In 1961, the world growth was of the order of 4.6% while the year 2018 was close to 3.0%.

According to Jeremy Rifkin in his book "The Third Industrial Revolution", the previous phenomenon is because commercial and productive activities of humanity are fossil energy consumption based. Increasing productivity requires changing the energy matrix. In contrast in the Fourth Industrial Revolution has to do with technology-driven change in order to create a human centered future. In concordance with this new revolution Blockchain would allow traceability of energy generation, not only certifying the origin but also empowering communities to be part of the solution in the generation of energy. In addition, they could exchange energy by converting them into prosumers, enabling them to produce and sell energy (the case of Brooklyn Micro Grid¹²⁷ in the United States).

In addition to helping to make economic activities more sustainable, these types of initiatives are a real alternative for growth in different countries, especially Chile having the greatest photovoltaic potential in the world. In the public world, the recently approved draft resolution No. 300 that request the President to develop studies to implement Blockchain or similar system, allowing its use in all public services in Chile, analyzing the possibility of sending a bill to the National Congress. This initiative denotes an intention of the State in favor of the adoption of Blockchain, to evaluate the possible uses and benefits of technology and to serve as a bridge to bring entrepreneurs, MSMEs and the community in general to be part of this ecosystem.

In conclusion, this technology presents a real alternative to enlarge market and more incentives for generating renewable energy, promoting the development of new businesses and the growth of the country. Therefore, modifying the current legislation, in electrical terms, could be the turning point for the local energy matrix.

¹²⁶ World Bank: <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?end=2018&start=1961&view=chart>

¹²⁷ Orsini, L. 'DISTRIBUTED POWER: How Blockchain Will Transform Global Energy Markets', Blockchain Research Institute. 2018

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