



Australia-Singapore Digital Economy Cooperation on Standards

Research Report

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Executive Summary

The digital economies of Australia and Singapore have been growing rapidly as both countries increasingly adopt digital technologies to expand various industry sectors. The two countries already enjoy a strong trading relationship but, as this report highlights, there is significant scope to further increase and accelerate *overall* trade between the two economies through harnessing their national digitalisation efforts. Greater use of new and emerging technologies is not only creating trade opportunities in digital goods and services, it is also increasing the trade in physical goods and services that can be delivered digitally or otherwise enhanced through digital enablers.

As such in this report, we define digital trade to be more than just e-commerce, encompassing the digitalisation of all aspects of trade including: (i) digital goods and services; (ii) digital delivery of tangible goods and services; (iii) digital enablers of trade; and (iv) emerging technologies that have the potential to significantly transform trade in terms of speed, scale, and scope.

Singapore is Australia's fifth largest trade partner and bilateral trade was estimated to be AUD25.9bn in 2019.¹ Singapore is Australia's sixth largest investor with AUD85.4bn² worth of investments in 2019. Australia is equally important to Singapore, being its fourth largest trading partner for exports.³ The trading partnership has been facilitated by the *Singapore-Australia Free Trade Agreement (SAFTA)*,⁴ first signed in 2003, with the *Singapore-Australia Digital Economy Agreement (DEA)*⁵ now aiming to deepen bilateral digital economy collaboration and enhance digital connectivity.

Digital technologies can significantly lower barriers to trade, improve trade efficiencies and open access to markets, creating new trade possibilities. For Australia, this report estimates that—at a minimum—digital trade could increase to a total projected **AUD216.2bn by 2030**, while for Singapore, a similar totalling of digital trade components could conservatively reach **AUD95.6bn by 2030**. This suggests that the economic value of digital trade has the potential to increase **60% and 70% for Australia and Singapore respectively**.

While digital economies and the flow of data grows, approaches to implementing new digital technologies are becoming more complex and, in some cases, divergent. New standards are being created by domestic standards bodies in order to put in place safeguards for government agencies, businesses and consumers that use digital technologies. While there are benefits to setting standards and there may be valid regulatory objectives, there is a risk that national efforts may create barriers that impede trade. It could lead to disparate technologies and platforms that are unconnected and unable to facilitate a seamless flow of cross-border trade.

To maximise the gains from digital trade, it is recommended that both countries should:

¹ MTI, Singapore Concludes Negotiations for Digital Economy Agreement with Australia, <https://www.mti.gov.sg/-/media/MTI/Newsroom/Press-Releases/2020/03/Joint-press-release--Conclusion-of-Negotiations-for-the-SingaporeAustralia-Digital-Economy-Agreement.pdf>

² Australia Bureau of Statistics (May 2019)

³ Department of Statistics, Singapore, <https://www.singstat.gov.sg/modules/infographics/singapore-international-trade>

⁴ DFAT, Singapore-Australia FTA, <https://dfat.gov.au/trade/agreements/in-force/safta/Pages/singapore-australia-fta.aspx>

⁵ MTI, Singapore Concludes Negotiations for Digital Economy Agreement with Australia, <https://www.mti.gov.sg/-/media/MTI/Newsroom/Press-Releases/2020/03/Joint-press-release--Conclusion-of-Negotiations-for-the-SingaporeAustralia-Digital-Economy-Agreement.pdf>

- (i) Explicitly recognise the enhancing economic value of digital trade and its enormous promise for economic growth and prosperity;
- (ii) Understand that digital trade encompasses *physical* trade facilitation as well as trade in digital goods and technologies;
- (iii) Identify areas of cooperation on digital trade and digital trade standards of mutual benefit to both economies so as to ensure increases in trade; and
- (iv) Focus on participation in international standards settings and adoption, so as to accelerate digital trade availability and growth.

This last point is particularly important, for as this report illustrates, in digital trade, standards are often coming to play the role that regulation has traditionally played: facilitating market access and participation, reducing compliance costs, and ensuring competition.

This report recommends **ten areas of mutual benefit** where Australia and Singapore can work on specific projects and programmes and align on international standards. These are listed below in Figure 1, and set out in further detail in Table 1, and throughout the report.

Cooperation between government agencies is critical in assessing areas for alignment, knowledge sharing, and prioritisation. Notably, some agencies in Australia and Singapore have already begun collaborating.

Figure 1: Recommended Priorities for Cooperation



These efforts should add to those of the current prioritisation focus by Standards Australia and Enterprise Singapore on **AI, distributed ledger technology (DLT) which includes blockchain technology, and smart cities**. We recommend continuing and accelerating cooperation in these three areas, and expanding the focus to encompass a portfolio of standards that will accelerate overall trade beyond a select group of disruptive technologies.

The aim is to create a ‘culture of alignment’ among government agencies and businesses in using technologies that are interconnected and interoperable. Without this focus the gains from digital trade cannot be maximised.

Table 1: Recommended Priorities for Cooperation for Australia and Singapore

Recommended Priorities for Cooperation	Expected Benefits and Rationale for Prioritisation	Estimated Economic Benefit	Suggested Standard Focus
Artificial Intelligence (AI)	AI stands to dramatically improve business productivity as well as enabling accurate demand forecasting, predictive maintenance using sensor technologies, and personalisation of services.	AU: AUD2bn (2025) ⁶ SG: AUD11.9bn (2024) ⁷	<ul style="list-style-type: none"> Autonomous and Intelligent Systems (A/IS) P7000 SER⁸ ITU-T Y.3172⁹
Distributed ledger technology (DLT)	Potential to transform supply chains and trade finance, initially in food (providence) and manufacturing, but then throughout.	SG: AUD3.9bn (2024) ¹⁰	<ul style="list-style-type: none"> ISO/TR 23455:2019¹¹ IEEE P2418.1¹²
Smart cities	Potential to improve systems integrations and labour mobility, as well as enhance data externalities in everything from household items and consumption through transportation systems, and climate change.	AU: AUD10bn (2030) ¹³	<ul style="list-style-type: none"> ISO/IEC 20005:2013¹⁴ ISO/IEC 29182-7:2015¹⁵

⁶ Australian Trade and Investment Commission (2019) Artificial intelligence expert selects Sydney for Asia-Pacific launch pad, <https://www.austrade.gov.au/international/invest/investor-updates/2019/artificial-intelligence-expert-selects-sydney-for-asia-pacific-launch-pad>

⁷ Digital Reality (2019) Digital Capital Singapore Report, <https://info.digitalrealty.com/XmE0NzZ0N000Jd0qm001Yj0>

⁸ IEEE SA, The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems, <https://standards.ieee.org/industry-connections/ec/autonomous-systems.html>

⁹ ITU-T (2019), Y.3172 Architectural framework for machine learning in future networks including IMT-2020, <https://www.itu.int/rec/T-REC-Y.3172-201906-I/en>

¹⁰ CAGR of 15%. Digital Reality (2019) Digital Capital Singapore Report, <https://info.digitalrealty.com/XmE0NzZ0N000Jd0qm001Yj0>. Also scope to reduce cost of processing trade documents by as much as 20%. See Maersk Paper Trail Research 2014.

¹¹ ISO(2019), ISO/TR 23455:2019 Blockchain and distributed ledger technologies — Overview of and interactions between smart contracts in blockchain and distributed ledger technology systems, <https://www.iso.org/standard/75624.html>

¹² IEEE(2017), P2418.1 - Standard for the Framework of Blockchain Use in Internet of Things (IoT), https://standards.ieee.org/project/2418_1.html

¹³ Estimated total due to “improved travel times” alone, illustrating the conservative nature of all estimates used in this report. ACS Australia’s Digital Pulse 2019, <https://www2.deloitte.com/au/en/pages/economics/articles/australias-digital-pulse.html>

¹⁴ ISO(2013), ISO/IEC 20005:2013 Information technology — Sensor networks — Services and interfaces supporting collaborative information processing in intelligent sensor networks, <https://www.iso.org/standard/50952.html>

¹⁵ ISO (2015), ISO/IEC 29182-7:2015, Information technology — Sensor networks: Sensor Network Reference Architecture (SNRA) — Part 7: Interoperability guidelines

Recommended Priorities for Cooperation	Expected Benefits and Rationale for Prioritisation	Estimated Economic Benefit	Suggested Standard Focus
Digital identity	Can enable use of almost all other digital technologies, and undergird digital transactions. Should be seen as 'soft infrastructure'.	AU: AUD75.8bn (2030) ¹⁶ SG: AUD17.9bn (2030) ¹⁷	<ul style="list-style-type: none"> • ISO/IEC 24760-1:2019¹⁸ • ISO/IEC 19784-1:2018¹⁹ • FIDO Universal Authentication Framework²⁰
E-payments	Potential to enhance <i>all</i> aspects of trade, particularly improving trade in e-commerce and fintech sectors. Instant and faster payments, across borders will have profound impacts on trade and consumption. QR codes can support online payments for a significant volume of goods and services.	AU: AUD36.4bn (2020) ²¹ SG: AUD12.1bn (2025) ²²	<ul style="list-style-type: none"> • ISO 20022²³ • EMVCo Technical Specifications²⁴

¹⁶ TRPC estimation based on data from Oxford Economics that Australia GDP Real (LCU) 2030 is 2527.154 bn, and McKinsey Global Institute (2019) Digital identification: A key to inclusive growth, digital identities will unlock economic value equivalent of 3% of GDP in 2030 for mature economies. <https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/digital-identification-a-key-to-inclusive-growth>

¹⁷ TRPC estimation based on data from Oxford Economics that Singapore GDP Real (LCU) 2030 is 604.047 bn, and McKinsey Global Institute (2019) Digital identification: A key to inclusive growth, digital identities will unlock economic value equivalent of 3% of GDP in 2030 for mature economies. <https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/digital-identification-a-key-to-inclusive-growth>

¹⁸ ISO (2019), ISO/IEC 24760-1:2019, IT Security and Privacy — A framework for identity management — Part 1: Terminology and concepts, <https://www.iso.org/standard/77582.html>

¹⁹ ISO (2018), ISO/IEC 19784-1:2018, Information technology — Biometric application programming interface — Part 1: BioAPI specification, <https://www.iso.org/standard/70866.html>

²⁰ FIDO Alliance, <https://fidoalliance.org/>

²¹ TRPC estimation based on the assumption that digital payment market and alternative financing market grows at an annual rate of 3.7% and 88% respectively in 2020. Please see Appendix A for sources and detailed calculation.

²² Google, Temasek and Bain & Company (2019), The Future of Southeast Asia's Digital Financial Services, <https://www.bain.com/globalassets/noindex/2019/bain-report-fulfilling-its-promise.pdf>. We have estimated a CAGR of 14%, which is conservative.

²³ ISO, Universal financial industry message scheme, <https://www.iso20022.org/>

²⁴ EMV were originally the companies of Europay, Mastercard, and Visa, who created the standard for cards and chip payments. Today EMV is known as EMVCo, a consortium of financial companies, which develops standards in mobile, Payment Tokenisation, 3-D Secure, QR Code, Secure Remote Commerce. <https://www.emvco.com/about/overview/>

Recommended Priorities for Cooperation	Expected Benefits and Rationale for Prioritisation	Estimated Economic Benefit	Suggested Standard Focus
E-invoicing	Invoice automatically generated in supplier's accounting system and transmitted electronically to recipients for automatic processing. Significant savings—time and capital—for <i>all</i> sizes of businesses.	AU: AUD28bn (2028) ²⁵	<ul style="list-style-type: none"> EN16931 (including Peppol BIS Billing 3.0)²⁶
IoT	Distinct yet complementary technology to smart cities and AI; will drive much of the progress in domestic supply chain and logistics developments; stands to have a transformational impact upon regional and global trade if integrated between countries.	AU: AUD33.7bn (2024) ²⁷ SG: AUD10.5bn (2024) ²⁸	<ul style="list-style-type: none"> IEC 61850:2019 SER²⁹ IEEE P2418.1³⁰
Data Protection and Privacy	Robust and consistent data protection and privacy measures increase community trust in all types of digital initiatives, driving adoption and use. Enables companies to expand operations, share and use data in an efficient and secure manner.	AU: Costs businesses on average AUD332,004 (2020) ³¹	<ul style="list-style-type: none"> ISO/IEC 27018:2019³³ ISO/IEC 27701:2019³⁴ (including ISO/IEC 27001 and ISO/IEC 27002)

²⁵The Treasury, Australia, 2018, e-Invoicing, <https://treasury.gov.au/consultation/e-invoicing>

²⁶ CEN (2017), EN 16931-1:2017+A1:2019, https://infostore.saiglobal.com/en-au/Standards/EN-16931-1-2017-A1-2019-342638_SAIG_CEN_CEN_2785568/

²⁷ TechSci Research, Australia Internet of Things (IoT) Market By Platform, By Component, By Application, Competition, Forecast & Opportunities, 2024, <https://www.techsciresearch.com/report/australia-internet-of-things-iot-market/1393.html>

²⁸ Digital Reality (2019) Digital Capital Singapore Report, <https://info.digitalreality.com/XmEONzZ0N000Jd0qm001Yi0>

²⁹ IEC(2020), IEC 61850:2020 SER, Communication networks and systems for power utility automation, <https://webstore.iec.ch/publication/6028>

³⁰ IEEE(2017), P2418.1 - Standard for the Framework of Blockchain Use in Internet of Things (IoT), https://standards.ieee.org/project/2418_1.html

³⁰ Estimated total due to “improved travel times” alone, illustrating the conservative nature of all estimates used in this report. ACS Australia’s Digital Pulse 2019, <https://www2.deloitte.com/au/en/pages/economics/articles/australias-digital-pulse.html>

³¹ Measures the average cost of a cyberattack to organisations in Australia. Australian Cybersecurity Magazine (2020) Businesses in the dark: McAfee survey reveals disconnect in cybersecurity culture and cyber resilience, <https://australiancybersecuritymagazine.com.au/businesses-in-the-dark-mcafee-survey-reveals-disconnect-in-cybersecurity-culture-and-cyber-resilience/>

³³ ISO (2019), ISO/IEC 27018:2019 Information technology — Security techniques — Code of practice for protection of personally identifiable information (PII) in public clouds acting as PII processors, <https://www.iso.org/standard/76559.html>

³⁴ ISO (2019), ISO/IEC 27701:2019 Security techniques — Extension to ISO/IEC 27001 and ISO/IEC 27002 for privacy information management — Requirements and guidelines, <https://www.iso.org/standard/71670.html>

Recommended Priorities for Cooperation	Expected Benefits and Rationale for Prioritisation	Estimated Economic Benefit	Suggested Standard Focus
		SG: Costs businesses AUD1.68mn per breach (2020) ³²	
Cross-border Data	Fundamental to building digital economy through trade growth and enhancement; disproportionately beneficial to SMEs and sole traders.	Data flows directly increased global GDP by 3% (2016) ³⁵	<ul style="list-style-type: none"> • ISO/IEC 22624:2020³⁶ • APEC CBPR System³⁷
Data Portability	Required for ensuring competitive access to data pools and data resources, and that consumers are not faced with technology lock-in.	AU: AUD64bn per annum (2018) ³⁸	<ul style="list-style-type: none"> • ISO/IEC 38505-1:2017³⁹ • ISO/IEC 38505-1:2017⁴⁰ • ISO/TS 23029:2020⁴¹

³² Measures the average cost of a cyberattack to organisations in Singapore. ChannelAsia (2020) Security attacks cost Singaporean businesses \$1.7m per breach, <https://www.channelasia.tech/article/670400/security-attacks-cost-singaporean-businesses-1-7m-per-breach/>

³⁵ McKinsey Global Institute (2016) Digital Globalization: The New Era of Global Flows, <https://www.mckinsey.com/~media/McKinsey/Business%20Functions/McKinsey%20Digital/Our%20Insights/Digital%20globalization%20The%20new%20era%20of%20global%20flows/MGI-Digital-globalization-Full-report.pdf>

³⁶ ISO (2020), ISO/IEC 22624:2020 Information technology — Cloud computing — Taxonomy based data handling for cloud services, <https://www.iso.org/standard/73614.html>

³⁷ APEC (2019) What is the Cross-Border Privacy Rules System? <https://www.apec.org/About-Us/About-APEC/Fact-Sheets/What-is-the-Cross-Border-Privacy-Rules-System>

³⁸ Measures data-driven innovation per annum. Australian Government Department of the Prime Minister and Cabinet (2018) The Australian Government's response to the Productivity Commission Data Availability and Use Inquiry, <https://dataavailability.pmc.gov.au/sites/default/files/govt-response-pc-dau-inquiry.pdf>

³⁹ ISO (2017) ISO/IEC 38505-1:2017 Information technology — Governance of IT — Governance of data — Part 1: Application of ISO/IEC 38500 to the governance of data, <https://www.iso.org/standard/56639.html>

⁴⁰ ISO (2017) ISO/IEC 38505-1:2017 Information technology — Governance of IT — Governance of data — Part 1: Application of ISO/IEC 38500 to the governance of data, <https://www.iso.org/standard/56639.html>

⁴¹ ISO (2020), Web-service-based application programming interface (WAPI) in financial services, <https://www.iso.org/standard/74353.html>

1. Introduction

The digital economies of Australia and Singapore have been growing rapidly and the two countries are strong trading partners. However, there is significant scope for harnessing national digitalisation efforts to further increase, accelerate and amplify overall trade between the two economies. Greater use of new and emerging technologies is not only creating trade opportunities in digital goods and services, it is also increasing trade in physical goods and services that can be exchanged seamlessly through enhanced digital enablers. Australia-Singapore cooperation in digital standards will facilitate trade with interoperable technologies.

Without proactive cooperation, trade between the two countries risks not being maximised. The global trade environment is increasingly becoming divergent—particularly in regard to the development of digital economies and data flows; and these trends have been exacerbated by the current pandemic crisis. This has been leading to an emerging rush of independently developed standards (and proposed or potential standards), touching upon a wide and cross-cutting array of commercial and trade areas. Problematically, a number of such standards are being promoted and promulgated outside of accepted, collaborative, and multilateral international standards setting processes. This wider use of domestic standards could very likely increase compliance costs, restrict market access, and fragment the landscape for digital trade. Such barriers to trade would diminish trade opportunities across the Indo-Pacific region and with other trading partners.

In order to foster the growth potential of digital trade between Australia and Singapore, we recommend consideration of two key requirements:

- (i) Adoption of a *holistic* approach to digital trade and digital trade standards. In particular this means focusing upon the interoperability of digital processes and applications;
- (ii) Alignment of regulatory and governance frameworks that facilitate trade. In particular this means recognising the more agile process and use of standards to facilitate digital technology use, and ensuring mutual recognition processes are established and fit for purpose.

Both of these considerations are further elaborated on in the report. However, the key objective should be fewer barriers to trade, and capturing the efficiencies of digitalisation through ensuring the necessary scale and scope are enabled. Achievement of this objective leads to lower costs, more transactions and greater economic benefit. A third important benefit is the guiding example that such a cooperative approach between Singapore and Australia can provide to other trading partners.

The strengthening of digital trade and cooperation on international standards in the region has increased in importance as a result of the COVID-19 pandemic. As discussed in Box 1 below, not only has the demand and use of digital technologies been critical in enabling working and learning from home, but has assisted government agencies to fast-track financial support to boost the economy. COVID-19 has raised the importance of standards to help businesses digitalise and adapt quickly to disruptions. In Singapore, the government has made over 40 international and Singapore standards across different areas, freely available to help enterprises mitigate the impact of COVID-19.⁴²

⁴² OpenGov (2020) Singapore develops new standards to support resilience and sustainability, <https://www.opengovasia.com/singapore-develops-new-standards-to-support-resilience-and-sustainability/>

Box 1: Impact of COVID-19

Since the start of 2020, the novel Coronavirus Disease 2019 (COVID-19) pandemic has resulted in many countries including Australia and Singapore implementing measures that restrict the movement of people, goods and services. As a result, cross-border trade has suffered.

However, the COVID-19 crisis has highlighted the critical role that digital technologies play keeping the economy moving during the pandemic. For example, digital technology has provided economic and social stability for individuals:

- Working or studying from home, or for those simply isolated in their homes during lockdowns;
- In urgent need of medical attention, or seeking medical advice, through telemedicine;
- Ordering essential services, food and goods purchased online, through a marketplace, or app;
- Processing payments, including remittances, government disbursements.

COVID-19 has:

- Accelerated the adoption of digital technologies—from improving transparency and enabling greater supply chain flexibility to real-time response abilities, and automating processes both online and remotely.
- Reinforced the need to have enabling processes in place—to ensure, for example, both the widespread use of track-and-trace apps and the requirement for privacy and security features.
- Required coordination across the world for many essential measures—from coordinated plans to keep vital supply chains open to the exchange of information on ways to combat the virus, to financial and technical assistance.

2. Background and Objectives

As part of our ‘deep dive’ into digital trade between Australia and Singapore we analysed areas of the digital economy and digital trade development in the two economies, in order to identify areas of mutual interest and opportunity, and recommend priorities for cooperation. This report aims to highlight prioritised digital trade standards that the Australian and Singapore governments could consider *jointly* focusing on, to facilitate digital trade and accelerate growth between the two countries.

This report outlines:

- (i) The areas of economic activity *digital trade* encompass given the increasing pervasiveness of digitalisation;
- (ii) Some initial empirical scoping of the size of digital trade between Australia and Singapore in the short- to medium-term;
- (iii) Areas of mutual interest and opportunity in digital trade;
- (iv) The increasing focus on the use of standards when it comes to enabling digital economy development and digital trade growth; and
- (v) An initial set of areas of digital trade standards to be focused upon and prioritised for cooperation.

2.1 Trade Relationship between Australia-Singapore

Australia and Singapore have enjoyed a strong trade partnership. Singapore is Australia’s fifth largest trade partner and bilateral trade was estimated to be AUD25.9bn in 2019.⁴³ Singapore is Australia’s sixth largest investor with AUD85.4bn⁴⁴ worth of investments in 2019. Australia is equally important to Singapore, being its fourth largest trading partner for exports.⁴⁵

The partnership is built on principles of mutual respect and cooperation, to the gain of both economies. Several key components have led to this successful collaboration:

- (i) Formalisation of **trade agreements and partnerships** such as Australia-Singapore Free Trade Agreement (established 28 Jul 2003), and the Australia-Singapore Comprehensive Strategic Partnership (CSP) established 29 June 2015, the Australia and Singapore Digital Cooperation Initiative (announced 7 Jun 2019), and participating in the same regional cooperation pacts such as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP);

⁴³ MTI, Singapore Concludes Negotiations for Digital Economy Agreement with Australia, <https://www.mti.gov.sg/-/media/MTI/Newsroom/Press-Releases/2020/03/Joint-press-release--Conclusion-of-Negotiations-for-the-SingaporeAustralia-Digital-Economy-Agreement.pdf>

⁴⁴ Australia Bureau of Statistics (May 2019)

⁴⁵ Department of Statistics, Singapore, <https://www.singstat.gov.sg/modules/infographics/singapore-international-trade>

- (ii) **Refinement and adjustments to existing arrangements**, for example, the Third Review of the trade agreement was concluded on 6 May 2016 and was enacted into force on 1 Dec 2017; and
- (iii) **Committed activities** to enable dialogue and cooperation on trade enablement mechanisms, especially its technical aspects, such as participation in the International Standards Organisations (ISO) technical committees and working groups, and World Trade Organisation (WTO) trade standards discussions.

Building on the partnership of the two countries recently, Australia and Singapore successfully negotiated a **Digital Economy Agreement (DEA)**⁴⁶ which aims to deepen bilateral collaboration on digital trade and connectivity. The DEA is anticipated to facilitate end-to-end digital trade, including e-invoicing, e-payments, digital identities, and e-certification of exports. In addition, it will seek to establish cooperation in areas such as data protection, cross-border data flows, fintech and AI.

⁴⁶ MTI, Singapore Concludes Negotiations for Digital Economy Agreement with Australia, <https://www.mti.gov.sg/-/media/MTI/Newsroom/Press-Releases/2020/03/Joint-press-release--Conclusion-of-Negotiations-for-the-SingaporeAustralia-Digital-Economy-Agreement.pdf>

3. Digital Trade Growth

Growth trajectories can be seen in both Singapore and Australia. The Australian Bureau of Statistics estimated that Australia's digital economy grew from approximately AUD79bn in 2012–13 to AUD93.5bn in 2016–17.⁴⁷ Singapore's digital economy is estimated to have reached USD12bn in 2019 (AUD18.3bn).⁴⁸

As digitalisation efforts take centre stage in both economies, the adoption of digital technologies has been increasing by individuals and firms alike. In Australia, export sectors like finance, health, transport, mining are using technologies like robotics, AI, sensors.

Singapore has encouraged government agencies and businesses to digitally transform and developed Industry Transformation Maps (ITMs) for 23 industries under six clusters between 2016 and 2018.⁴⁹ Each ITM integrates productivity improvement, innovation, internationalisation and skills development to promote growth and competitiveness. Research estimates that by 2021, digital transformation will add an estimated AUD15.32bn to Singapore's GDP, and increase the growth rate by 0.6% annually.⁵⁰ With Internet penetration at 88% and 84% in Australia and Singapore respectively, greater adoption of advanced digital technologies, improvements in productivity and access to markets will create new trade possibilities.⁵¹ It is estimated that mobile technology will be worth AUD65bn to the Australian economy by 2023, as a result of labour and capital productivity improvements.⁵² The contribution of digital to GDP is expected to grow 40% between 2018 and 2023, with new business opportunities continuing to be generated by the roll out of 5G mobile technology.

However, both countries are pursuing their own national strategies to grow their digital economies and there are significant opportunities to work together to achieve a coordinated approach on digital standards that will allow for faster implementation of current and new technologies that can accelerate the benefits of trade. For instance, the Australian government has recognised the strong relationship with Singapore and has highlighted trading opportunities in industries like aerospace, healthcare and aged care, infrastructure, building and construction, business services, technology (including fintech, medtech and edutech), education (VET, skills development, research), and food and beverages.⁵³ Each of these sectors are undergoing digital transformation and have scope for closer economic integration between the two economies.

⁴⁷ Australian Bureau of Statistics, Measuring Digital Activities in the Australian Economy,

<https://www.abs.gov.au/websitedbs/D3310114.nsf/home/ABS+Chief+Economist+-+Full+Paper+of+Measuring+Digital+Activities+in+the+Australian+Economy>

⁴⁸ Bain & Company (2019) e-Conomy SEA 2019, <https://www.bain.com/insights/e-conomy-sea-2019/>

⁴⁹ MTI, Transforming Industries, <https://www.mti.gov.sg/Transforming-Industries/For-Industries>

⁵⁰ Microsoft, Digital transformation to contribute US\$10 billion to Singapore GDP by 2021, <https://news.microsoft.com/en-sg/2018/02/21/digital-transformation-contribute-us10-billion-singapore-gdp-2021/>

⁵¹ Henrich Foundation, From resource boom to digital boom: Capturing Australia's digital trade opportunity at home and abroad. https://www.alphabeta.com/wp-content/uploads/2018/10/digital-trade-fa_oct-2018.pdf

⁵² ACS Australia's Digital Pulse 2019, <https://www2.deloitte.com/au/en/pages/economics/articles/australias-digital-pulse.html>

⁵³ Austrade, Doing Business, Singapore, <https://www.austrade.gov.au/Australian/Export/Export-markets/Countries/Singapore/Doing-business>

First, to truly understand the impact of digitalisation on trade, one must first understand what value is being captured in an economic assessment. To fully gauge the impact of digital trade, one must capture *both* the digitalisation of an ever-increasing flow of *tangible* goods and service, *and* the exchange of new *digital* goods and services in and out of the two countries.

The following sections examine the definition and key components of digital trade.

3.1 Defining Digital Trade

‘Digital trade’ is a relatively young and developing aspect of trade and many of the broader implications of it are not yet fully understood. This can in part be explained by the absence of a common understanding and measure of the impact of digitalisation, and the need to use a narrower definition of digital trade to identify, size, and sometimes determine public policy.⁵⁴ Several efforts to characterise digital trade are described in Box 2 for context. Our research leads us to define digital trade to include all aspects of the economy.

Digital technologies are serving to expand existing markets *and* create new trade possibilities, in both cases, contributing to the creation of new jobs, increased labour opportunities and wages, and contributing to a higher standard of living. For instance, the OECD in developing a framework for digital trade highlights that digital technology is changing how countries trade, in terms of the speed, scope and scale, as well as increasing the value of trade.⁵⁵

The term ‘digital trade’ is sometimes used interchangeably with that of ‘e-commerce’, or other similar proxies, **digital trade in fact has far broader scope, encompassing the increasing digitalisation of almost all economic and social sectors, the use of digital technologies in supply chains and logistics, the invention of new, commercially valuable communications and market access channels, and the value of the data that is created, transferred, and processed**—not least because the data itself is increasingly both an asset input into the supply chain process, and is being traded as its own discernible commodity.

Box 2: Illustrative Digital Trade Definitions

- The **Organisation for Economic Co-operation and Development (OECD)** has perhaps the closest definition used by this report which recognises digital trade as “digitally-enabled transactions of trade in goods and services that can either be digitally or physically delivered, and that involve consumers, firms, and governments.”⁵⁶ It considers that all forms of digital trade are enabled by digital technologies, but not all digital trade is digitally delivered. The OECD also highlights that underpinning digital trade is the movement of data which can facilitate new supply models, like cloud computing, the Internet of Things (IoT), and 3D/additive manufacturing.

⁵⁴ Some governments may have their own definitions of trade

⁵⁵ López González, J. and M. Jouanjean (2017), Digital Trade: Developing a Framework for Analysis, <http://dx.doi.org/10.1787/524c8c83-en>

⁵⁶ OECD, Digital trade, <https://www.oecd.org/trade/topics/digital-trade/>

- The **World Trade Organisation (WTO)** uses the term “electronic commerce” instead of “digital trade”, and defines it as “the trade of goods and services using the Internet, including the transmission of information and data across borders.”⁵⁷
- The **United States International Trade Commission (USITC)** defines digital trade as the delivery of goods and services over digital networks, including the use of digital goods and services as well as online sales of goods and services over e-commerce platforms.⁵⁸
- The **UNESCAP report, ‘International Trade in the Digital Age’**, states “digital trade” is broadly understood as “e-commerce” [the report acknowledges there is no formal definition of “e-commerce”]. It goes on to note, “[yet,] the use of automated data exchange systems, cloud computing, big data and open source operating systems can help businesses run international supply chain management more efficiently. However, the use of digital technology in trade activities can, in fact, go beyond online buying/selling; the term “digital trade” [also] refers to the use of digital technologies to facilitate businesses without limiting it to just online sales or purchases.”

3.1.1 Four components of digital trade

There are four components of digital trade for which economic impact ought to be measured. These categories are not mutually exclusive and may in combination be a part of a single transaction, product or service. In addition, with the ever-expanding use of digital technologies, there will be an ongoing shift as the proportion of digital goods and services to tangible products continues to grow.

Based on our research and analysis, we consider digital trade to include the following:⁵⁹

- (i) **Digital goods and services:** We describe this component to include:
 - (a) Digital goods that are shipped electronically to the consumer through e-mail or download from the Internet. This is in line with the definitions used by the Productivity Commission in New Zealand and Australia in its joint report on growing the digital economy.⁶⁰ We adopt this definition and describe digital goods as those that are stored, delivered and used in electronic format. Examples of digital goods include e-publishing, music files, software, digital images, Web site templates, manuals in electronic format, and any item which can be electronically stored in a file or multiple files. It can also include digital content which can be news, as well as the intellectual property rights of the content.
 - (b) Digitally enabled purchases of digital services—as defined by the OECD⁶¹—considered to be a service, delivered via the Internet (platform or email), or an electronic network and is

⁵⁷ UN ESCAP (2016) International trade in a digital age, <https://www.unescap.org/sites/default/files/aptir-2016-ch7.pdf>

⁵⁸ USITC (2017) Global Digital Trade 1:Market Opportunities and Key Foreign Trade Restrictions, <https://www.usitc.gov/publications/332/pub4716.pdf>

⁵⁹ The definition of digital trade is based on TRPC research and analysis and may differ from definitions used and applied by the Australian or Singapore Government.

⁶⁰ Productivity Commissions of Australia and New Zealand (2019) Growing the Digital Economy and Maximising Opportunities for SMEs, <https://www.pc.gov.au/research/completed/growing-digital-economy>

⁶¹ López González, J. and M. Jouanjean (2017) Digital Trade: Developing a Framework for Analysis, <http://dx.doi.org/10.1787/524c8c83-en>

impossible to provide in the absence of information technology. Examples include cloud computing services, digital video telephony services.

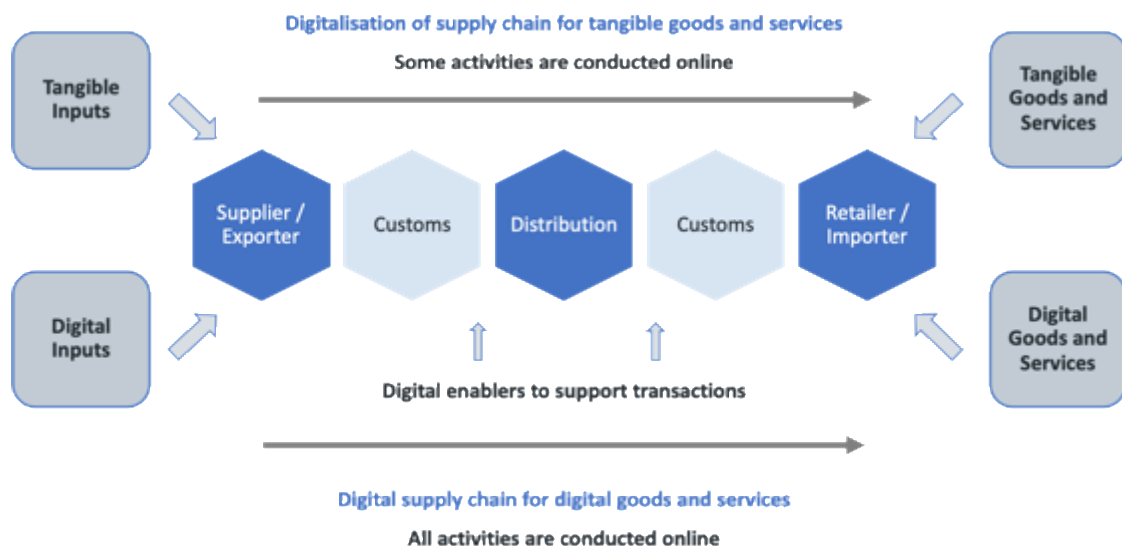
- (ii) **Digital delivery (full or partial) of tangible goods and services:** As defined by the OECD, the delivery and purchase of a product can be online and could be via a digital platform. However, the good or service is consumed physically. This component is growing as the supply of tangible goods and services in a number of industry sectors is increasingly being digitalised.
- (iii) **Digital enablers of trade:** The OECD defines this component as the hard and soft infrastructure, (cables and wires, platforms and devices) to regulations that protect data and IT systems like digital logistics systems, goods tracking, privacy and cybersecurity, which support digital trade transactions. In this report, we consider four key digital enablers that increase the capabilities and reliability of the systems and technology, that can be deployed to support all forms of digital trade.
 - **Connectivity:** gives all users a means to access services, content and communications. The movement of goods and services can be facilitated by virtual networks and platforms that can communicate with one another.
 - **Digital Identities:** provides the ability to validate the parties to a transaction and audit and authenticate those transactions in all parts of the digital trade process.
 - **Digital Payments:** whether on smartphones or online, digital payments can provide increased efficiency, speed, transparency and security by increasing accountability and tracking and reducing the scope for fraud.
 - **Cybersecurity and Privacy:** refers to a broad range of issues related to privacy protection, piracy and theft, censorship, and national security. Such measures are essential in developing user confidence that the systems are secure and incorporate appropriate privacy protections.
- (iv) **Emerging digital technologies:** Technologies that are transforming, or have the potential to transform aspects of trade practices. This component is defined as new technologies that are currently developing or will be developed over the next five to ten years, and which will substantially alter the business and social environment. Examples of emerging areas include 5G, blockchain technology, AI and IoT.

The above definitions of digital trade are adopted throughout this report. In applying this comprehensive definition of digital trade, we are able to better identify and recommend priorities for cooperation between Australia and Singapore.

3.1.2 Digitalisation of Supply Chains

The supply chain for cross-border trade is being transformed through digital technologies and online platforms that facilitate the trade process. Figure 2 below summarises the key aspects of trade and the different types of goods and services that are traded.

Figure 2: Supply Chain for Digital and Tangible Goods and Services



The supply chain shown is adapted from the United Nations Centre for Trade Facilitation and Electronic Business Buy Ship Model.⁶² The United Nations Model identifies the key commercial, logistical, regulatory and payment procedures involved in the international supply chain and provides an overview of the information exchanged between the parties throughout its various steps.

The Model has been revised to show the impact of digitalisation as per Figure 2. It outlines how tangible/digital inputs are used to produce tangible/digital goods or services which are ordered by customers and distributed across borders with the relevant customs and border control. Customs interactions for both the exporter and importer can be made more efficient through digitalisation.

The above **digital enablers** are used at different parts of the supply chain to help facilitate the trade process and manage and protect the **flow of data** between participants, platforms and technologies.

⁶² Trade Facilitation Implementation Guide, The Buy-Ship-Pay Reference Models, www.tfig.unece.org/contents/buy-ship-pay-model.htm

4. Benefits of Digital Trade

Existing and emerging technologies are changing the scope, speed and scale of trade, creating new 'digital' trade opportunities.⁶³ Digitalisation has resulted in two types of benefits:

- **Product improvements** where there are new or higher quality products and services available for trading and/or at less cost; and/or
- **Process improvements** through supply chain efficiencies and stages of supply chain are bypassed or made more seamless through digitalisation.

Digitalisation has also created new business models like online platforms that act as intermediaries in connecting different groups of customers. For instance, there are platforms that are business-to-consumer like the e-commerce retailer Amazon, trade platforms that connect exporters and importers and government platforms to facilitate seamless e-government services like the Networked Trade Platform in Singapore⁶⁴ and the Single Window Project in Australia which allows businesses to fulfil border clearance requirements across all agencies through a single digital entry point. Singapore is also working with forward looking countries to realise an open global digital infrastructure called the Business sans Borders (BSB) meta-hub⁶⁵ that will aid platforms, governments and SMEs to increase domestic and cross border connectivity opportunities for trade and business services.

4.1 Creation of New Goods and Services

Digital goods and services have led to the creation of new products (e-books, apps and software) and services (cloud computing, video telephony), which can be sold to Internet users via mobile or desktop, all around the world. As a result, businesses of all sizes, can access a large customer base, with no distribution costs and benefit from economies of scale and scope. For example, over the past decade, the growing use and capability of smartphones has led to a number of different mobile apps being developed and sold, serving different purposes like business, travel, leisure, health or entertainment.

In the future, digitalisation and advanced technologies could create products like AVs. The use of advanced technology in developing driverless cars is likely to open up new industries, not just for the vehicle itself but also for software components, creating new jobs and trade channels. The global AV and near-AV industry is estimated by McKinsey to be worth USD1.9 trillion by 2025 (AUD2.9 trillion).⁶⁶

4.2 Faster Delivery of Existing Goods and Services

Digitalisation is helping the supply chain become more efficient, helping tangible goods and services move faster across borders and meet "just in time" delivery. Greater information sharing through digital connections is enabling more efficient coordination of activities along global value chains, helping businesses and consumers track packages and facilitating border crossings. For example, online platforms can help customs and border processes and electronic payment of duties and fees with cargo declarations.

⁶³ López González, J. and M. Jouanjean (2017-07-27), "Digital Trade: Developing a Framework for Analysis", OECD Trade Policy Papers, No. 205, OECD Publishing, Paris. <http://dx.doi.org/10.1787/524c8c83-en>

⁶⁴ Networked Trade Platform (2020) Networked Trade Platform, <https://www.ntp.gov.sg/home/?TYPE=login>

⁶⁵ Business sans Borders (BSB) is an initiative to connect domestic and cross-border online business platforms and marketplaces to improve discovery of businesses across multiple platforms and matching of buyers and sellers. <http://www.imda.gov.sg/bsb>

⁶⁶ McKinsey Global Institute (2013) Disruptive technologies: Advances that will transform life, business, and the global economy, <https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/disruptive-technologies>

At the same time, the delivery of goods and services have become faster as technology allows supply chains to be safer. Data flows between different industry participants in the supply chain can take place in a secure manner. Greater security minimises supply chain disruptions like trade-based money laundering, false declarations including valuation or classification of goods, false certificates and declarations of origin. Such disruptions can result in a slower movement of goods due to delays in submitting and examining the necessary documents.

Trade in services are benefitting from digital technologies and increased data. A key benefit is providing faster, convenient and 'on demand', services, so that consumers can have instant access to the services they need when they need them. The most established service sector that has transformed is the retail sector. E-commerce allows businesses and consumers to shop online, beyond borders, rather than in-store in their local vicinity. Other traditional services are also being digitalised. For example, access to education is being transformed by (among other initiatives) Massive Open Online Courses (MOOCs), which allow students to attend online classes of unlimited size, from a wide range of institutions, across the globe. Healthcare is also transforming digitally, facilitating real-time access to healthcare providers and expanding in-institution (hospital or clinic) to in-home care like telemedicine.

4.3 Emerging Technologies in Digital Trade

Emerging digital technologies and business models based thereon will have a greater impact than what has been seen previously with the Internet and, more recently, cloud computing and mobile devices. The emerging technologies discussed in this report are:

- **5G** when fully deployed is designed to transmit data at dramatically higher speeds and volumes than previous wireless systems. This will allow for new services and products delivered in real-time. 5G will enable other emerging technologies such as logistics management, operation of AVs (ships, loading systems or personal vehicles). It will also facilitate digital financial transactions, access to new mass-audience, personalised online services, real-time video for the delivery of remote medicine, or commands for remote additive manufacturing.
- **IoT** applications have the potential to increase operational efficiency and revenue generation, and are being actively applied in logistics and supply chain functions. IoT technologies enhance visibility in the supply chain and provide better location tracking and prediction of arrival time, offering the possibility of managing routes and speed in real-time. This minimises losses and avoids misplaced or delayed shipments and deliveries. IoT may also be used in better fleet and fuel cost management, providing timely information on delivery vehicles, drivers, and traffic.
- **DLT/Blockchain** is widely expected to increase efficiencies and trust across the logistics process, improving trade finance, customs collaboration transportation management, goods tracing, procurement and many other aspects of global trade. According to the World Economic Forum, the costs of processing trade documents can be as much as 20% of those of shifting goods.⁶⁷ DLT could assist in reducing those costs by adopting paperless trading with secure verification.
- **3D (Additive) Printing** allows for mass production of high-quality products in a short amount of time. In addition, the technology could lead to a future where more goods are manufactured near the final

⁶⁷ World Economic Forum (2017) Paperless Trading: How Does It Impact the Trade System?
http://www3.weforum.org/docs/WEF_36073_Paperless_Trading_How_Does_It_Impact_the_Trade_System.pdf

consumer, and the goods are shipped from that manufacturing plant on a “built to order” basis. This manufacturing process could apply to small items such as nails and medical implants and to larger products such as machines (e.g. the machines to build new products) and even buildings

- **AI** will play an ever-increasing role in trade, in particular, the manufacturing process, in ensuring the efficacy of the supply chain, authorising a transaction, or controlling the flow of goods, through data management and operations controls such as those used in a port.

5. Measuring Australia and Singapore's Digital Trade

Given the four components of digital trade defined in Section 4, it is important to measure the economic value of each component so as to better understand the extent of the opportunities that lie ahead, and how standards can play a key role in multiplying the benefits of trade and technology.

There is no study that measures all aspects of digital trade and this is no surprise given its complexity, variation in definitions and availability of data, as well as, the rapid developments in digital transformation and business models around the world. For example, a book can be sold overseas in different ways using different forms of digital technology at each part of the supply chain process. It could be sold by a publisher to a physical bookstore that sells it online to a customer overseas. Alternatively, it could be sold by a global e-commerce platform like Amazon or it could be traded as an e-book where purchase, distribution and consumption is all online. As such the cross-border sale of products between Australia and Singapore could potentially fall into more than one of component of digital trade and separate statistics on the value of those different book sales would be required.

Given the challenges with measurement, we find that there are many studies that have used various methods to estimate the value of a subset of what we can comprehensively identify as digital trade.

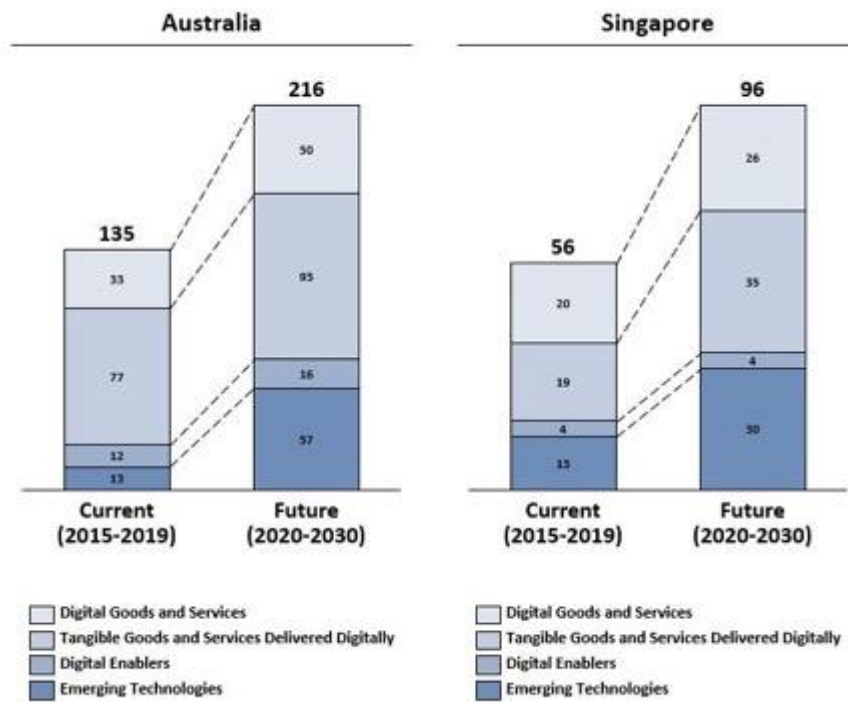
A literature review has been carried out to identify key estimates of categories in each of the four components of digital trade for Australia and Singapore. This section presents and discusses our findings and their limitations.

5.1 Value of Digital Trade in Australia and Singapore

To estimate the size of the components of digital trade of Australia and Singapore, two time periods are taken—current and future. For the current time period, estimates range from 2015 to 2019, and the future time period estimates range from 2020 to 2030. The four components of digital trade—**digital goods and services, tangible goods and services delivered digitally, digital enablers and emerging technologies**—are summed together to arrive at a total digital trade estimate for each time period. As shown in Figure 3, the components of digital trade in Australia at the minimum can be estimated to be **AUD134.75bn**, which could rise to a projected **AUD216.21bn**. For Singapore, the components of digital trade could increase from **AUD56.26bn** to a projected **AUD95.62bn**.⁶⁸ This shows that economic value of digital trade has the potential to increase **60%** and **70%** for Australia and Singapore respectively. Details of digital trade components for both countries are set out in Appendix I.

⁶⁸ All values are converted to AUD using the following exchange rates: Australian to US Dollar Exchange Rate (2015 – 2019 average) = 0.742 (<https://www.macrotrends.net/2551/australian-us-dollar-exchange-rate-historical-chart>); Singapore to Australian Dollar Exchange Rate (2015 – 2019 average) = 0.986 (<https://www.ofx.com/en-sg/forex-news/historical-exchange-rates/yearly-average-rates/>)

Figure 3: Current and Future Digital Trade of Australia and Singapore (AUDbn)



5.1.1 Digital Goods and Services

Table 2 below shows the projected value of key examples of digital goods and services in Australia and Singapore. The software industry in Australia and Singapore are projected to grow at a CAGR of 9% and 10% respectively between 2018 and 2022, with market value in both countries surpassing AUD20bn by 2022. The market size of public cloud computing services, including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS), is forecast to expand at a higher rate of 17-20% in the next three years totalling AUD18.87bn for the two countries.

Comprising video games, OTT media content, digital music, e-books and e-magazines, digital media services will experience an average CAGR of 4% between 2020 and 2024, generating estimated market revenue of AUD2.3bn and AUD460m respectively for Australia and Singapore. The market for digital advertising, defined as marketing messages, general advertisement displays, classifieds delivered online, will see moderate growth to reach AUD11.12bn (7.1%) in Australia and AUD610m (8.4%) in Singapore by 2022.

Altogether the values of these key digital goods and services will amount to AUD49.72bn and AUD26.17bn for the two countries by 2024 and these projections have not taken into consideration the impact of COVID-19 where services such as video-conferencing, data storage, cloud computing services become vital and demand for digital media services could surge substantially when people are confined to their homes during lockdown.

Table 2: Digital Goods and Services (2020-2030)

Industry	Australia	Singapore
<i>(AUD billions)</i>		
Software	21.20	20.38
Cloud computing	14.15	4.72
Videoconferencing	0.98	NA
Video games	0.69	0.18
Video-on-demand	0.61	0.13
e-Publishing	0.35	0.06
Digital music	0.63	0.09
Digital advertising	11.12	0.61
Total	49.72	26.17

Note: See Appendix I for the detailed projections and references

5.1.2 Tangible Goods and Services Delivered Digitally

Table 3 below shows the projected value of key industry sectors that have already been significantly digitalised in Australia and Singapore. With high levels of Internet penetration and smartphone ownership, and consumers increasingly comfortable in shopping online, e-commerce is booming in both Australia and Singapore. In the coming years it is expected to grow at a CAGR of 5% and 9.1% respectively.

Accessibility and affordability of ride-hailing services has seen the market grow exponentially in the past few years. Intense competition, especially in Australia, will see companies offer deeper discounts and promotions to rein in customers. The market is expected to grow at 2.9% and 4.5% in Australia and Singapore respectively.

Digital Financial Services is a dynamic and innovative sector in both countries. In Australia, they are measured as a combination of digital payments and alternative financing markets which are expected to reach AUD36.44bn in 2020, with the former expected to grow at a CAGR of 3.7%, whereas the latter will see a growth rate of 88%. The Digital Financial Services market in Singapore is expected to reach AUD12.13bn in 2025, at a CAGR of 14%.

Online travel and E-services are other categories that will continue to experience rapid growth and expansion in the coming years. E-services for instance, includes online event tickets, fitness wearables and apps, online dating services, and online food delivery. They are expected to grow at a CAGR of 6.4 and 10.2 % of Australia and Singapore respectively.

Table 3: Tangible Goods and Services Delivered Digitally (2020-2030)

Industry	Australia	Singapore
<i>(AUD billions)</i>		
E-commerce	37.36	5.31
Ride Hailing & Taxi	5.05	1.89
Digital Finance Services	36.44	12.13
Online Travel	8.45	14.82
E-services	5.93	1.19

Industry	Australia	Singapore
Total	93.23	35.34

Noted: See Appendix I for the detailed projections and references

Table 3 above reflects two factors: (1) these sectors are expanding due to digitalisation and increased digital trade, and (2) traditional trade in Australia and Singapore is also currently leveraging the use of digital technologies. In both cases, the two countries have the potential to further accelerate economic growth as they become more digitalised and take greater advantage of digital trade enablers.

In addition to the sectors highlighted above, there are several other sectors that are increasingly using digital technology to improve their product and services. Some of these sectors are of particular relevance to Australia and Singapore.⁶⁹ For instance, healthcare and education services are sectors where there are current and future trade opportunities between the countries. Energy, food and agricultural sectors are where Australia has a comparative advantage and exports to Singapore. Electronic manufacturing is where Singapore has its comparative advantage and exports to Australia. The economic impact of these technologies in key sectors is highlighted in Table 4 below.

Table 4: Key Sectors being Digitalised (2020-2030)

Industry	Examples of Digitalisation/Technology	Australia	Singapore
<i>(AUD billions)</i>			
Healthcare	Digital transformation through telemedicine, AI enabled medical devices, 3D printing of medical tools, and blockchain electronic health records.	Medical technology market to reach 19.78bn by 2023	Medical technology manufacturing to reach 17.55bn by 2023
Education	Education apps and digital platforms for educational content. Also includes mobile e-learning, learning management system, podcasts, rapid e-learning, virtual classroom and application simulation tool.	Online education market to reach 9.43bn by 2024	NA
Energy and Resources	Digital innovations to optimize supply and demand management, maintenance, workforce management, transmission and distribution, collection and analysis of data through smart meters and sensors.	Mining sector profits to improve by 40bn by 2025	Energy and Chemicals industry value added of 12.52bn by 2025
Food and Agriculture	Farm equipment automation, satellite data and sensors for input optimization and monitoring of crops, logistics technologies and advanced analytics for better farm to market access, traceability and reduced food wastage.	Value of agriculture production to increase by 20.30bn by 2023	NA
Electronics Manufacturing	Technologies that impact supply chains to support planning, logistics, smart procurement, warehousing and advanced analytics.	NA	Manufacturing value added of 21.89bn by 2020

⁶⁹ Austrade, Export Markets: Singapore, <https://www.austrade.gov.au/Australian/Export/Export-markets/Countries/Singapore/Doing-business>

Industry	Examples of Digitalisation/Technology	Australia	Singapore
Jobs	Digital marketplaces and tools that connect individuals with work opportunities.	Online talent platforms impact on GDP by 37.74bn	Online talent platforms impact on GDP by 12.13bn

Note: See Appendix I for the detailed projections and references

5.1.3 Digital Enablers

We identified digital enablers that can support digital transactions, either by reducing costs, preventing fraud and corruption or increasing sales. Table 5 below seeks to provide some estimates of the benefits that these enablers provide.

Table 5: Digital Enablers (2020-2030)

Industry	Australia	Singapore
<i>(AUD bn)</i>		
IT Equipment	10.31	3.05
Cybersecurity	6	0.99
Total	16.31	4.03

Note: See Appendix I for the detailed projections and references

Digital enablers can include the hard and soft infrastructure such as IT equipment, cybersecurity technologies and the provision of digital identification. In the Singapore and Australia context, revenue generated from IT equipment, ranging from desktops, laptops, servers to hardware deployed in networks, and cybersecurity technologies are estimated to be AUD16.3 bn and 4 bn. Apart from making direct contributions to GDP, cybersecurity technologies also save businesses and the economy from incurring huge economic losses. For instance, it is estimated that direct cost associated with cybersecurity incidents can be as high as AUD29bn per year or 1.9% of GDP in Australia⁷⁰ and AUD23.5bn in Singapore.

As a critical enabler for the development of a digital economy, the implementation of digital ID programs can unlock economic values in terms of more inclusive access to education, healthcare, financial services and employment; improvement in transparency and rights protection as well as acceleration in digital transformation. In 2030, these accrued economic benefits will be equivalent to 3% of GDP in developed economies and amount to AUD75.8bn and AUD17.9bn in Australia and Singapore respectively based on estimates from McKinsey Global Institute.⁷¹

⁷⁰ Microsoft (2018) Direct costs associated with cybersecurity incidents costs Australian businesses \$29 bn per annum, <https://news.microsoft.com/en-au/features/direct-costs-associated-with-cybersecurity-incidents-costs-australian-businesses-29-billion-per-annum/>

⁷¹ McKinsey Global Institute (2019) Digital identification: A key to inclusive growth, <https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/digital-identification-a-key-to-inclusive-growth>

5.1.4 Emerging Technologies

Emerging digital technologies present a significant growth opportunity for Australia and Singapore. Table 6 below provides some projections of the potential value add to the respective economies. Some of these technologies, such as 5G and 3D printing, will be used in many, if not all industries, enabling growth across sectors and use cases, as well as leading to the development of new business opportunities and business models. For instance, research has suggested that 5G could enable a 48% incremental revenue opportunity for Australian telecom operators by 2026. In Singapore, 5G is expected to be launched in 2020, with over 50 per cent penetration by 2025. This will result in an estimated AUD2.77bn contribution to the economy in 2024.⁷²

The value of the IoT industry in Australia, which includes platforms, components and applications was worth USD7.9bn in 2018 (AUD10.7bn), and expected to grow at a significant 21% CAGR to reach AUD33.69bn by 2024.⁷³ Research suggests there is an opportunity for Australia to develop an expertise in core elements of the IoT ecosystem, including identity and security, applications, domestic communications and networking, as well as the development of specific IoT hardware that supports industries where Australia has expertise, for instance agriculture or mining.⁷⁴ For Singapore, the IoT market grows at a CAGR of 10.7%, estimated to reach AUD10.46bn in 2024.⁷⁵ Favourable infrastructure such as high fibre connectivity, data centres and submarine cables and 5G networks, as well as enabling regulations and policies will likely present more opportunities for growth of the IoT market.⁷⁶

Even though blockchain is still in the early stages of adoption, the Singaporean blockchain market has the potential to contribute AUD3.85bn to the economy by 2024, with a CAGR of 15%.⁷⁷ While the opportunities are limitless, Singapore's current ecosystem includes businesses concentrating on asset tokenization, transport, insurance, digital identity and mobility.

3D printing in Asia Pacific is growing at 18%, and the region is expected to spend AUD4.85bn on it by 2024.⁷⁸ Both Australia and Singapore will see significant growth in this market in the coming years, with a focus on high-value technologies, and applications in medical, aerospace, marine and defence-related sectors.

AI is a key technology area for both countries. The Australian market is expected to reach AUD1.98bn by 2025, growing at an estimated 22% each year.⁷⁹ It is already making contributions in education, retail, health and financial services. The Singaporean market on the other hand will grow at a CAGR of 25.3%, to reach an estimated AUD11.89bn by 2024.⁸⁰

⁷² Digital Reality (2019) Digital Capital Singapore Report, <https://info.digitalreality.com/XmEONzZON000Jd0qm001Yj0>

⁷³ TechSci Research, Australia Internet of Things (IoT) Market By Platform, By Component, By Application, Competition, Forecast & Opportunities, 2024, <https://www.techsciresearch.com/report/australia-internet-of-things-iot-market/1393.html>

⁷⁴ ACS (2018), Australia's IoT Opportunity: Driving Future Growth <https://www.pwc.com.au/consulting/assets/publications/acs-pwc-iot-report-web.pdf>

⁷⁵ Digital Reality (2019) Digital Capital Singapore Report, <https://info.digitalreality.com/XmEONzZON000Jd0qm001Yj0>

⁷⁶ IMDA Future Communications and Internet of Things, <https://www.imda.gov.sg/-/media/Imda/Files/Industry-Development/Infrastructure/Technology/Technology-Roadmap/WG1-Executive-Summary-for-Future-Communications-and-IoT.pdf>

⁷⁷ Digital Reality (2019) Digital Capital Singapore Report, <https://info.digitalreality.com/XmEONzZON000Jd0qm001Yj0>

⁷⁸ AMFG (2019) AM Around the World: How Mature is 3D Printing in the Asia-Pacific Region?, <https://amfg.ai/2019/11/20/am-around-the-world-how-mature-is-3d-printing-in-the-asia-pacific-region/>

⁷⁹ Australian Trade and Investment Commission (2019) Artificial intelligence expert selects Sydney for Asia-Pacific launch pad, <https://www.austrade.gov.au/international/invest/investor-updates/2019/artificial-intelligence-expert-selects-sydney-for-asia-pacific-launch-pad>

⁸⁰ Digital Reality (2019) Digital Capital Singapore Report, <https://info.digitalreality.com/XmEONzZON000Jd0qm001Yj0>

Table 6: Emerging Transformative Digital Technologies (2020-2030)

Industry	Australia	Singapore
<i>(AUD billions)</i>		
5G	18.19	2.77
IoT	33.69	10.46
Blockchain	NA	3.85
3D Printing	0.24	0.13
AI	1.98	11.89
Big Data & Analytics	2.83	0.98
Total	56.93	30.09

Note: See Appendix I for the detailed projections and references

The above estimates in Table 6 are based on both countries developing their own national roadmaps for their digital economy. With cooperation, and alignment on standards for new and current technologies, there is scope for new markets and businesses and greater expansion of existing markets, as potential trade barriers are reduced. This would allow increase the scope, speed of trade between Australia and Singapore.

5.2 Limitations to Measuring Digital Trade

There are challenges to measuring the value of digital trade and this too has been recognised at an international level by the United Nations Conference on Trade and Development (UNCTAD), International Monetary Fund (IMF) and the OECD. An UNCTAD report refers to the challenge of having reliable statistics on the digital economy and its key components and dimensions.⁸¹

The IMF highlights that producers or consumers may struggle to determine whether they engaged in a cross-border transaction, especially if the transaction was intermediated by a local affiliate of a multinational firm and/or if transaction was facilitated by a foreign digital platform intermediating between two resident actors.⁸²

In addition, the OECD⁸³ notes that: (i) separating digitally enabled from non-digitally enabled transactions can be complex, classification issues can also complicate identifying which sectors are involved in transactions; and (ii) trade flows which do not result in a monetary transaction, but which might support one also pose challenges. Nonetheless, the OECD states that efforts are underway to better reflect digital trade in international trade statistics to assist policymakers. While this a positive step, the OECD recognises that it will take some time before robust measures are identified it recommends proceeding with caution.

For the purposes of this report to estimate the potential value of digital trade between Australia and Singapore, efforts have been made to obtain comparable country estimates from reliable sources. The projections have some limitations including the possibility of double counting. For instance, in some cases a suitable breakdown of statistics has not been available or have not been completely aligned to the definitions applied. In addition, our projected values of the four components of digital trade have included key and obvious categories and sectors that are being digitalised. Our estimates do not include the entire

⁸¹ UNCTAD, Digital Economy report 2019, Value Creation and Capture, Implications for Developing Countries

⁸² How to Move Forward on Measuring Digital Trade <https://www.imf.org/external/pubs/ft/bop/2019/pdf/19-07.pdf>

⁸³ OECD, Digital trade, <https://www.oecd.org/trade/topics/digital-trade/>

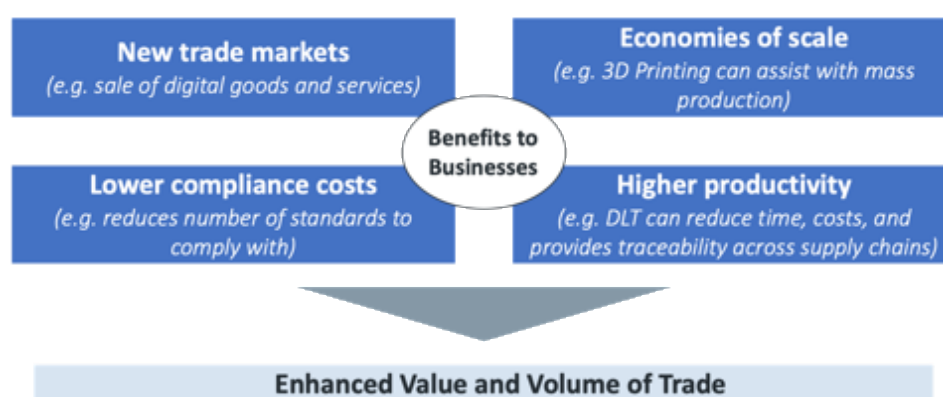
universe of products and services, in each component, as this would be a challenging exercise and access to such statistics is not available.

6. The Importance of International Standards in Digital Trade

Standards are typically a published document setting out specifications and procedures to ensure consistent implementation of processes, technologies and methods. The use of standards, when developed properly and deployed well, can enable a high benchmark for security, safety, quality and reliability of goods and services being delivered into a market. In turn, the *implementation* of standards increases the interoperability of the processes, technologies or methods standardised across the range of producers, suppliers and consumers.

Standards bring benefits to businesses (shown below in Figure 4) in terms of substantially larger (potentially global) markets, reduced costs, standardised processes and compliance, as well as enhanced productivity. By making trade easier and more efficient, they bring benefits to the overall economy. For instance, a report commissioned by the British Standards Institute (BSI) found that standards contributed towards 37.4% of annual productivity growth in the UK, translating to an extra AUD15.63m of GDP in 2013. An additional AUD11.63bn exports per year can also be attributed to standards.⁸⁴

Figure 4: Benefits of Standards to Businesses

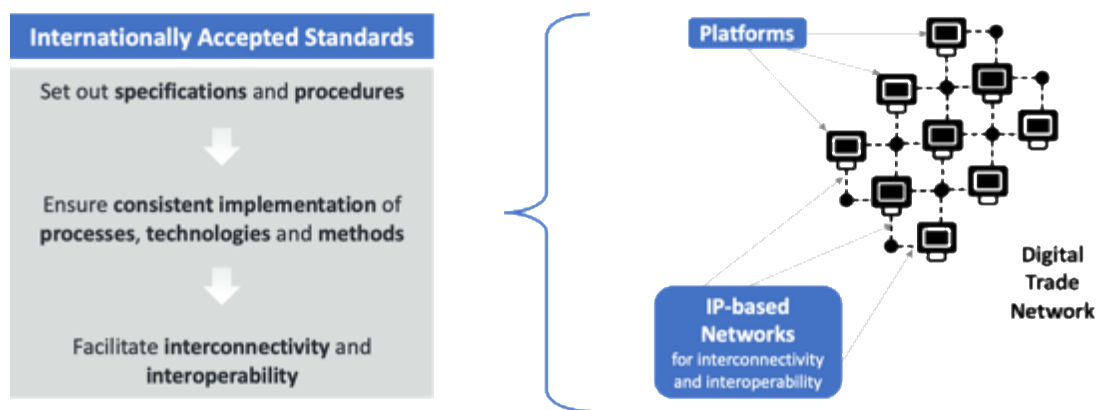


International standards facilitate **interconnectivity** and **interoperability** by setting out specifications and procedures to ensure consistent implementation of processes, technologies and methods (Figure 5). Interconnectivity of networks allows traffic to travel across and between networks. This will for instance, enable economies of scale as the fixed costs of infrastructure rollout are spread across a greater level of output bringing about a fall in unit costs.

Interoperability of systems, software and operating platforms means that traffic can run effectively across different types of networks (e.g. from telecoms to banking to logistics to educational to health networks and so on). This too enables economies of scale, as fixed costs are spread across a wider range of output of different goods and services. Scale is associated with reach—the ability of a system to serve the greatest number of users. Enabling access by those previously unable to benefit from new systems.

⁸⁴ CEBR 2015, The Economic Contribution of Standards to the UK Economy <https://www.bsigroup.com/LocalFiles/en-GB/standards/BSI-The-Economic-Contribution-of-Standards-to-the-UK-Economy-UK-EN.pdf>

Figure 5: Progressing Digital Trade Through Standards



International standards play a key role in aligning rules and processes across borders to minimise both incompatibilities among national approaches as well as regulatory uncertainty. With the development of new industries such as components for AVs or use of new technologies such as blockchain for existing industries—failure to participate in international standards and processes can inevitably lead to product or service incompatibility, causing market inefficiencies.

Certain new developments in technology will demand greater interoperability to meet the objectives for the innovations. For example, where telecommunication and wireless standards have long been based on distinctive, non-interoperable, national standards (which, for example, in the European Union were developed by national champions as a competitive advantage) the envisioned objective of ubiquitous 5G connectivity requires the adoption of common 5G standards, ensuring compatibility across geopolitical borders. For policymakers in Australia and Singapore, aligning the use of standards will help lower physical and infrastructural costs through economies of scale and lower barriers to information exchange for digital trade. For consumers and enterprises, mass adoption and scale are enabled when devices and apps can work seamlessly regardless of whether they are Australian consumers ordering a product online from Singapore, or Singapore tourists visiting Australia and using a smartphone over a local network to hail a taxi.

6.1 Key Stakeholders

International standards are developed in a transparent, consensus-based environment, that includes a range of stakeholders. Participants may include technical, legal, regulatory, social, cultural, finance and economic experts participating from affected industry, government, and academia. Given the range of participants and levels of expertise of those participating, the standard-setting process can deliver quicker benefits than the development of long-term regulation. For example, conformance to international standards involves assessing what devices and equipment need to align with standards. Existing and emerging digital technologies need to be considered based on their use case and application. This suggests that voluntary standards are more suitable than regulations enforced through the rule of law. However, good internationally aligned standards could provide a foundation for future regulations if required.

Depending on the nature of the standard being set, a number of stakeholders is ideal. For example, it may be relevant to have the input from raw material producers, manufacturers, sellers, platform operators, and connectivity and service providers. At different stages there may also be logistics intermediaries involved (such as transport and storage/warehousing), intellectual property licensors and licensees, and health/safety/security experts. Participation of private sector stakeholders—who are oftentimes the early adopters and frequently creators of new technologies—may serve as key participants/delegates in any sound standards setting process.

In general, Table 7 categorises key stakeholders.

Table 7: Different types of Stakeholders Related to Standards

Stakeholder	Description
International Standards Bodies (ISBs)	<p>The International Organisation for Standardisation (ISO) is an independent, non-governmental, international organisation with membership of 164 national standards bodies. It has published 22,985 international standards in a diverse set of areas including industry, technology, food safety, agriculture and healthcare.</p> <p>Other international organisations include International Electrotechnical Commission (IEC), that prepares and publishes standards for all fields of electrotechnology and International Telecommunication Union - Telecommunication Standardisation Sector (ITU-T) serves the ICT field and develops technical standards for networks. Others include the National Institute of Standards and Technology (NIST), European Telecommunications Standards Institute (ETSI) and the United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) which serves as a focal point within the United Nations Economic and Social Council for trade facilitation recommendations and electronic business standards.</p>
Non-Traditional Standards Bodies	Standards Developing Organisations (SDOs) are industry or sector-based standards organisations that develop and publish industry standards. IEEE and Audio Engineering Society (AES) are international, industry based SDOs. SDOs such as the Singapore Manufacturing Federation (SMF) may be qualified to develop standards using open and transparent processes, and may also directly liaison with international standardisation activities.
National Standards Bodies	Each country or economy has a single recognised National Standards Body (NSB) which facilitates committees of technical experts and other interested commercial, government and consumer representatives to develop standards
Other Government Agencies	In addition to standards bodies, other policymakers and government agencies may include those responsible for the flow and security of goods, regulation of trade (national regulation, coordinated with trading partners and key participants in the marketplace relevant to the particular standard), port management, transportation infrastructure, national security and law enforcement, and oversight of affected regulated industries (e.g. automotive products).
Private Sector Businesses	Private sector stakeholders consisting of both large and small and medium-sized enterprises can assist in developing standards to ensure that they meet market needs, facilitate business interaction, speed up the introduction of innovative products to market and provide interoperability between new and existing products, services and processes. These stakeholders can also provide guidance on how easy it would be for businesses to implement the standards.
Academia	Stakeholders from academia can assist with providing research and guidance on the safety, quality and technical features and requirements of digital technologies.

In Australia, the national standards body is Standards Australia, which actively participates in the development and adoption of a wide range of International Standards. Standards Australia is an independent, non-governmental, not-for-profit organisation.

In Singapore, the national standards body is Enterprise Singapore, which promotes the adoption of local and international standards amongst businesses. Unlike Australia, Enterprise Singapore is a government agency.

Further details on the role and activities of these bodies can be found in Appendix II.

6.2 Key Issues with Standards

Despite the benefits of standards in supporting digital trade, there are three key issues that may inadvertently impede trade between countries. These are as follows:

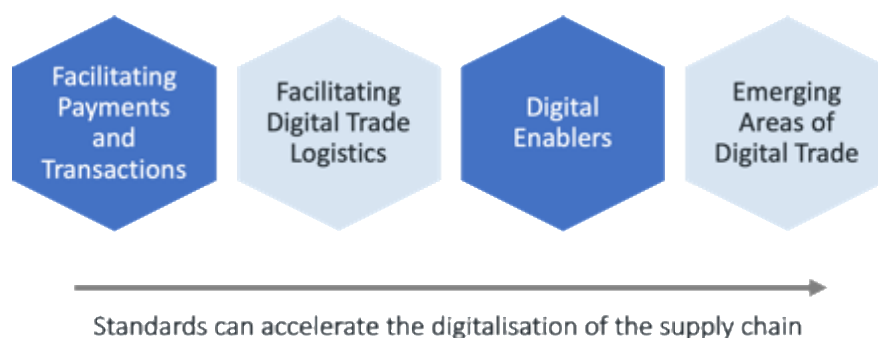
- (i) **Increasing number of national standards are being developed which are not aligned with international standards slowing down the potential growth in trade.** In the absence of international standards, economies may develop distinctive national standards to support the adoption of new technologies and new business models in their economy. However, these standards must be aligned with international standards, when they become available, as without harmonisation the fragmented environment will create barriers to trade. Without cooperation on standards between the national and international organisations and supporting stakeholders, there is a risk that domestic economic growth could be slow as businesses in each other's country maybe faced with hurdles when trying to expand into each other's markets. International standards enable a business to expand/move operations from one country to another without having to adapt methods, practices or functions to meet requirements not consistent with the requirements in the initial country.
- (ii) **Increasing number of international standards by non-traditional bodies are being developed but not being recognised.** Standards are also being set by bodies that aren't the traditional ISBs like ISO, IEC. For example, QR code is a standout example here both Australia and Singapore follow EMV specifications. Further, IEEE are active in developing standards for IoT, AVs and Blockchain. NIST develops standards for AI and cybersecurity and FIDO Universal Authentication Framework is developing standards for digital identity. Hence, countries cannot ignore standards being developed by these organisations. There could even be scope for countries to coordinate and partner with non-traditional bodies through existing partnerships with traditional bodies.
- (iii) **Often businesses don't understand the benefits of standards and there is scope to provide education and training.** Once a standard has been developed, its success depends on the take-up rate by the private sector. In the first instance, a core group of large businesses users could be identified. However, to achieve widespread adoption more education and training can be provided, particularly for SMEs. A lack of guidance for businesses on how to adopt standards, or which international standards to take advantage could hinder the benefits of digital trade.

7. Digital Trade Standards

Digital trade between Singapore and Australia can be increased through the implementation and harmonisation of international digital trade standards. Accomplishing this would require government agencies in both countries to support globally recognised standards, and to actively participate in international standards-setting processes.

This section sets out examples of international standards that apply to digitalisation and/or digital technologies that are relevant to the supply chain for cross-border trade in goods and services.

Figure 6: Standards Related to the Supply Chain



7.1 Accelerating Trade with Standards

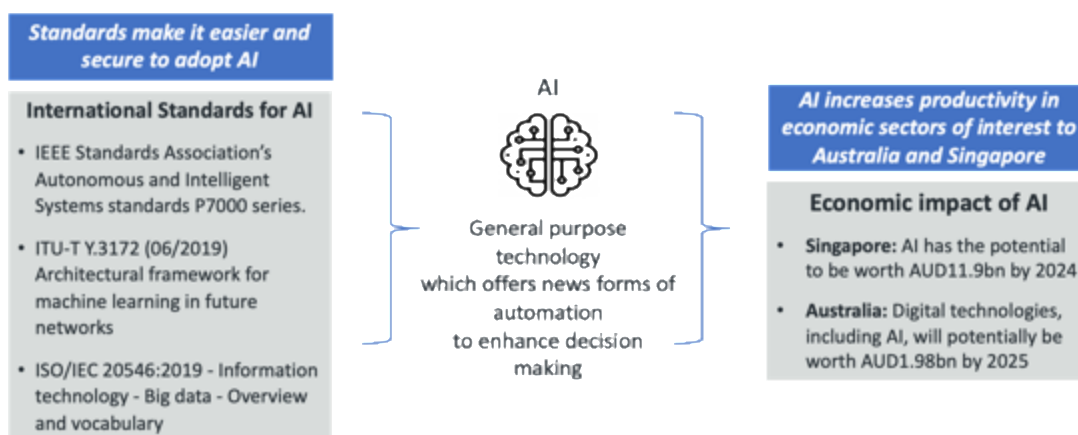
Standards can accelerate the use of digital technologies at different stages of the supply chain, which in turn can increase the scope, speed and scale of trade. For example, if Australia and Singapore cooperate on aligning standards for AI, then it has the potential to allow businesses in their countries to use AI technology in a consistent manner and benefit by improving the efficiency, safety and quality of their processes and services when engaging in trade. For instance, Australian firm HIVERY uses AI to help retail and FMCG businesses in Australia, the US, Japan and China.⁸⁵ It has a platform that analyses data to help companies like Coca-Cola optimise product mix, pricing formulae and retail space. HIVERY has been able to attract international business, with 80% of revenue from international sources. In Singapore, fintech firms are using AI-powered tools to enhance productivity with document mining, pattern recognition for fraud detection, information extraction and analysis, thus transforming and innovating ways to generate insights.⁸⁶

With more businesses using AI technology and following the same AI standards, there is the potential for the economic value or impact of the technology to exceed the benefit to Australia and extend to cross-border trade with Singapore.

⁸⁵ Austrade, Export Market Development Grants, <https://www.austrade.gov.au/australian/export/export-grants/news/success-stories/turning-raw-data-into-retail-insights>

⁸⁶ CIO, 2019, How Singapore is using artificial intelligence, <https://www.cio.com/article/3292616/how-singapore-is-using-artificial-intelligence.html>

Figure 7: Accelerating Use of AI



7.2 Examples of International Standards

Table 8 below highlights standards in the following supply chain categories: (i) Payments and Transactions; (ii) Logistics; and (iii) Digital Enablers. Detailed description of the standards themselves can be found in Appendix III. The table also outlines why Australia and Singapore should consider taking action in these trade areas.

Table 8: Examples of Standards Relevant to the Supply Chain

Digital Trade Areas	Impact of Digitalisation	Description	Recommendations for Australia and Singapore	Example of Digital Standards
Facilitating digital trade purchases and ordering				
Financial messaging and payments standards	<i>Process improvements</i>	Messaging rules which define message types for financial transactions and payment procedures.	Australia and Singapore could seek to develop and promote financial messaging standards to improve trade in e-commerce and fintech.	<ul style="list-style-type: none"> • SWIFT Message Types (MT) and ISO 15022 • ISO 8583 -Financial transaction card originated messages - Interchange message specifications • ISO 20022 universal financial industry message scheme
Application Programming Interface and Web Service Based Application Programming Interface (APIs)	<i>Process improvements and new services</i>	Allows secure data exchange between businesses.	Australia and Singapore could develop and promote Open Banking standards, ensuring that banks in each country can access financial data and offer businesses and consumers better cross-border banking services.	<ul style="list-style-type: none"> • ISO/TC 68/SC 9/WG 2 is responsible for the standardisation of ISO/DTS 23029 WAPI in Financial Services

Digital Trade Areas	Impact of Digitalisation	Description	Recommendations for Australia and Singapore	Example of Digital Standards
QR Codes	<i>Process improvements</i>	Provides a single common QR Code that allows payment from multiple payment service operators.	Australia and Singapore could align on QR code standards to support digital payments for a significant volume of goods and services between the two countries.	<ul style="list-style-type: none"> • EMVCo⁸⁷ technical specifications for “QR Code Specification for Payment System – Merchant-Presented Mode”. • ISO/IEC 18004 – automatic identification and data capture techniques — QR Code bar code symbology specification • ISO/IEC JTC 1/SC 31 - Automatic identification and data capture techniques Technical Committee.
E-procurement	<i>Process improvements</i>	Multiple components and procedures like bid submission, e-auction, evaluation, finalisation and contract management.	Australia and Singapore could seek to improve the ease of doing business in within the two countries by aligning e-procurement standards. This will make it easier for businesses to participate in contract work in each country.	<ul style="list-style-type: none"> • Electronic Public Procurement CEN/TR 17014-101:2018 • Open Contracting Data Standard (OCDS) • The Peppol framework also supports e-procurement
Facilitating digital trade logistics				
Cross-border logistics platform	<i>Process improvements</i>	Connection of customs single window systems that facilitates collaboration among traders, transport operators and governments along the international supply chain.	Australia and Singapore could develop and align standards related to national single-window platforms, in order to reduce paperwork and lower compliance costs for businesses to import and export between the two countries.	<ul style="list-style-type: none"> • UN/EDIFACT - set of standards, directories, and guidelines for the electronic interchange of structured data, between independent computerized information systems • WCO Cross Border E-Commerce Framework of Standards- the Standard 1 Advance Electronic Data for e-commerce goods. • The Peppol framework could also support e-Logistics

⁸⁷ EMV were originally the companies of Europay, Mastercard, and Visa, who created the standard for cards and chip payments. Today EMV is known as EMVCo, a consortium of financial companies, which develops standards in mobile, Payment Tokenisation, 3-D Secure, QR Code, Secure Remote Commerce. <https://www.emvco.com/about/overview/>

Digital Trade Areas	Impact of Digitalisation	Description	Recommendations for Australia and Singapore	Example of Digital Standards
Last mile delivery	<i>Process improvements</i>	Rules related to how goods are delivered to end-customers, including common communication protocols between logistics players.	Australia and Singapore can benefit from efficiency gains in logistics by promoting and developing last mile delivery standards to support e-commerce.	<ul style="list-style-type: none"> • TR 46:2016 for Last Mile Delivery - eCommerce Data Interchange • TR61:2018 Technical Reference on Data Interchange for Last-Mile Delivery Using Parcel Locker Network
E-commerce	<i>Process improvements</i>	Guidelines provide comprehensive end-to-end coverage of the e-commerce transactions' process, from pre-purchase activities, purchasing and payment procedures, to post-purchase activities.	Australia and Singapore can work together to promote e-commerce standards that provide best practices for e-retailers, and online intermediaries such as e-marketplaces to bolster SMEs' online presence.	<ul style="list-style-type: none"> • TR 76 on Guidelines for Electronic Commerce Transactions
E-invoicing	<i>Process Improvements</i>	Invoice is automatically generated in a supplier's accounting system and transmitted electronically to the recipient s for automatic processing.	<p>Australia and Singapore can help business save time and money by allowing the direct exchange of invoices between suppliers' and buyers' financial systems.</p> <p>Interoperable e-Invoicing will significantly improve productivity between the two countries.</p>	<ul style="list-style-type: none"> • EN16931 – European standard on e-invoicing for public procurement • Peppol BIS Billing 3.0 is a Core Invoice Usage Specification (CIUS) of the European standard for e-invoicing (EN16931)
Digital trade enablers				
Wireless Communication	<i>Process improvements and new products</i>	Communication protocols and interconnectivity between consumers, service providers,	Australia and Singapore could seek to promote and align wireless communication standards to better connect IoT	<ul style="list-style-type: none"> • ITU-R M.1652 • IEEE P802.11ax

Digital Trade Areas	Impact of Digitalisation	Description	Recommendations for Australia and Singapore	Example of Digital Standards
		and supply-chain stakeholders.	<p>devices, to support the introduction of new goods and services.</p> <p>This promotion will also improve business efficiency in producing and delivering goods and services, like cloud computing.</p>	
Digital identities	Process improvements	Includes use of biometrics, smart cards, digital signatures, 2D bar cards, and federation protocols for users to prove their identities when making and verifying digital transactions.	Australia and Singapore could support and enhance digital interactions between individuals, businesses, and governments (e.g. facilitate wider access to financial services, assist with business registration and payment of taxes) by aligning on standards related to digital identities.	<ul style="list-style-type: none"> • ISO /IEC 24760-1:2019 IT Security and Privacy – A Framework for Identity Management • ISO/IEC 24745:2011 Information Technology - Security Techniques - Biometric Information Protection • ISO/IEC 19784-1:2018 Information technology — Biometric application programming interface — Part 1: BioAPI specification • ISO/IEC 19794-x:2011 - Information technology - Biometric data interchange formats — Part 1: Framework; Part 2: Finger minutiae data; Part 4: Finger image data; Part 5: Face image data; Part 6: Iris image data • FIDO Universal Authentication Framework
Cybersecurity	Process improvements	Protects IT systems from fraud and builds trust in cross-border trade.	Australia and Singapore could cooperate and develop risk management tools and solutions that protect IT and data systems and prevent cyberattacks.	<ul style="list-style-type: none"> • ISO/IEC 27001: 2013 Information technology -- Security techniques -- Information security management systems -- Requirements • ISO/IEC 27002:2013 Information technology -- Security techniques -- Code of practice for information security controls • ISA/IEC 62443 • Control Objectives for Information and Related Technology (COBIT) • National Institute of Standards and Technology's (NIST) Cybersecurity Framework

Digital Trade Areas	Impact of Digitalisation	Description	Recommendations for Australia and Singapore	Example of Digital Standards
Data Protection and Privacy	<i>Process improvements</i>	Data Protection and Privacy frameworks and principles to manage how personal data is collected, maintained, and protected.	Australia and Singapore could continue to review and maintain their data protection and privacy frameworks to ensure they are fit for purpose, and enable companies to expand operations into each other's country and share back office data in an efficient and secure manner.	<ul style="list-style-type: none"> • ISO/IEC 29100:2011: Information technology -- Security techniques -- Privacy framework • ISO/IEC 29101:2018: Information technology -- Security techniques -- Privacy architecture framework • ISO/IEC 27018:2019: Information technology -- Security techniques -- Code of practice for protection of personally identifiable information (PII) in public clouds acting as PII processors • ISO/IEC 27701:2019: Security techniques -- Extension to ISO/IEC 27001 and ISO/IEC 27002 for privacy information management -- Requirements and guidelines
Cross-border data	<i>Process improvements</i>	Allows for the transfer of data between economies for business purposes	Australia and Singapore could continue to participate in the APEC Cross-Border Privacy Rules (CBPR) System, in order to assist businesses to gain access to market intelligence and access data storage centres in each other's country.	<ul style="list-style-type: none"> • ISO/IEC 22624:202040- Information technology — Cloud computing — Taxonomy based data handling for cloud services • APEC Cross-Border Privacy Rules (CBPR) System
Data Portability	<i>Process improvements</i>	Allows individuals to obtain and reuse their personal data for their own purposes across different services.	Australia and Singapore could adopt and implement data portability standards in order to make it easy for customers to switch between suppliers (e.g. banks) and allow new entrants to access customer data.	<ul style="list-style-type: none"> • ISO/IEC 38505-1:2017 Information technology — Governance of IT — Governance of data — Part 1: Application of ISO/IEC 38500 to the governance of data • ISO/TS 23029:202043 - Web-service-based application programming interface (WAPI) in financial services

Digital Trade Areas	Impact of Digitalisation	Description	Recommendations for Australia and Singapore	Example of Digital Standards
				<ul style="list-style-type: none"> FAIR Guiding Principles for scientific data management and stewardship⁸⁸ Financial Industry Business Ontology (FIBO): Open Semantic Standard for the Financial Industry⁸⁹ Australian Consumer Data Right Standard

As mentioned earlier in this report, there are a number of emerging digital technologies. In these areas, new standards are being considered and developed by various international standards bodies, often simultaneously. Australia and Singapore would benefit from cooperation with each other and by getting involved and actively participating (or if appropriate, observing) in these standards setting processes.

Table 9 below provides some example of standards for: (i) IoT; (ii) AVs; (iii), Blockchain Technologies; (iv) 3D printing; (v) AI; and (vi) Smart Cities.

Table 9: Examples of Benefits and Standards of Emerging Digital Areas

Emerging Digital Trade Areas	Impact of Digitalisation	Description	Recommendations for Australia and Singapore	Examples of standards
IoT	<i>Product improvements</i>	Refers to physical devices that are connected to the Internet, and can transmit real-time data.	Australia and Singapore could promote IoT standards as it enhances visibility in the supply chain and can provide better location tracking and prediction of arrival time, offering the possibility of managing routes and speed in real-time.	<ul style="list-style-type: none"> IEC 61850:2019 SER - Communication networks and systems for power utility automation (All Parts) IEEE P2418.1 - Standard for the Framework of Blockchain Use in Internet of Things (IoT) ISO/IEC/IEEE 42010: 2011 Systems and software engineering — Architecture description
DLT/ Blockchain technology	<i>Process improvement</i>	Transforms supply chains by providing traceability of goods and	Australia and Singapore have the potential to improve supply chains for trade in food,	<ul style="list-style-type: none"> ISO/TR 23455:2019; Overview of and interactions between smart contracts in blockchain and distributed ledger technology systems

⁸⁸ Wilkinson, M, et al. (2016) The Fair Guiding Principles for scientific data management and stewardship, <https://www.nature.com/articles/sdata201618>

⁸⁹ EDM Council (2019) About FIBO: Open Semantic Standard for the Financial Industry, <https://edmcouncil.org/page/aboutfiboreview>

Emerging Digital Trade Areas	Impact of Digitalisation	Description	Recommendations for Australia and Singapore	Examples of standards
		services along with safer and cheaper payment mechanisms	manufacturing and finance by promoting DLT/Blockchain standards.	<ul style="list-style-type: none"> IEEE P2418.1 Standard for the Framework of Blockchain Use in IoT
AI	<i>Process improvement</i>	AI can improve business productivity by enabling accurate demand forecasting, predictive maintenance which uses sensors to track the conditions of equipment and data and personalisation of products and services.	Australia and Singapore have the potential to improve productivity in a wide variety of trade sectors like health, education, and finance, by promoting AI standards.	<ul style="list-style-type: none"> IEEE Standards Association (SA)'s Autonomous and Intelligent Systems (A/IS) standards P7000 series. International Telecommunications Union (ITU), ITU-T Y.3172 (06/2019) Architectural framework for machine learning in future networks ISO/IEC 20546:2019 - Information technology - Big data - Overview and vocabulary ISO/IEC TR 20547-2:2018 - Information technology - Big data reference architecture - Part 2: Use cases and derived requirements ISO/IEC TR 20547-5:2018 - Information technology - Big data reference architecture - Part 5: Standards roadmap
Smart cities	<i>Process improvement</i>	Smart cities rely on integrated and interconnected strategies and systems to effectively provide better services and increase quality of life. Addresses challenges like climate change, rapid population growth,	Australia and Singapore have the potential to improve labour mobility between the two countries by promoting standards related to Smart Cities.	<ul style="list-style-type: none"> ISO/IEC 20005:2013 Information technology -- Sensor networks -- Services and interfaces supporting collaborative information processing in intelligent sensor networks ISO/IEC 29182-1:2013 Information technology -- Sensor networks: Sensor Network Reference Architecture (SNRA) -- Part 1: General overview and requirements ISO/IEC 29182-7:2015 Information technology -- Sensor networks: Sensor Network Reference Architecture (SNRA) -- Part 7: Interoperability guidelines
AVs	<i>Product improvement</i>	Driverless cars for passenger and business use like (ships, loading systems or personal vehicles	Australia and Singapore could work together to promote the use of AVs, as they will not only provide better transport systems (e.g. through	<ul style="list-style-type: none"> ISO 26262 for the Functional Safety of Automotive Systems IEEE P2020 - Standard for Automotive System Image Quality SAE J2735 Dedicated Short Range Communications (DSRC) Message Set Dictionary

Emerging Digital Trade Areas	Impact of Digitalisation	Description	Recommendations for Australia and Singapore	Examples of standards
			reduced traffic congestion, reduced road accidents), but also increase trade in the electrical components for building and designing of AVs.	
3D Printing	<i>Product improvement</i>	In 3D printing processes almost all raw material goes into the final manufactured object, with little waste.	Australia and Singapore could promote 3D printing, resulting in savings on logistics and production costs for businesses in each country. These savings would be due to the reduction in the number of steps in the production chain as 3D printing can produce a variety of products from a single printer.	<ul style="list-style-type: none"> • ISO/TC 261 on Standardisation in the field of Additive Manufacturing concerning the processes, terms and definitions, process chains (Hard- and Software), test procedures, quality parameters, supply agreements and all kind of fundamentals. There are 14 Standards published so far and 23 standards are in development • ISO/TC 184/SC 4 which relates to industrial data

8. Cooperation Between Australia and Singapore

In order to grow both economies, Australia and Singapore need to prioritise key digital trade areas of mutual interest. While we have identified a total of 18 areas where standards can play a role in digital trade, as a starting point, we recommend Australia and Singapore cooperate on those areas where there are greater gains to be made.

Focused cooperation between Australia and Singapore can provide economic benefits in the form of trade opportunities and cost savings. It can also support both countries as their economies seek to recover from the global pandemic. For instance, Enterprise Singapore has stressed that standards support business

resilience and continuity planning and that close partnerships with industry, government and academia will be crucial to develop standards that meet business, industry and market needs.⁹⁰

An example of successful collaboration on standards between countries and relevant stakeholders, can be found between Australia and New Zealand. Australia developed an e-invoicing standard in 2015, through the Digital Business Council in Australia with technical support from the Australian Tax Office (ATO). This standard, was then implemented in 2018 by the New Zealand Government to support trans-Tasman use. The alignment of e-invoicing standards was estimated to deliver AUD30bn in savings over 10 years in Australia and New Zealand.⁹¹ Both governments have since adopted the Peppol interoperability framework for e-Invoicing to increase opportunities for businesses trading globally.

8.1 Framework for Cooperation

There are a number of different ways of prioritising where efforts should be focussed. For example, areas can be identified based on current trade patterns between the countries, like the top three industries or most rapidly growing industries. However, there are some drawbacks with this approach as current trade patterns may not reflect future trade patterns as existing industries are being digitally transformed and new industries are emerging with new technology.

In this report, we have taken a holistic approach and developed and applied criteria, which takes into account trade patterns and current and future industries, that are experiencing significant degree of digital transformation. Areas for prioritisation can include sectors or technologies that deliver:

- (i) Significant value of current trade between Australia and Singapore (e.g. food, education and tourism sectors);
- (ii) Significant value of digital trade between Australia and Singapore (e.g. financial services and digital payments);
- (iii) Significant value of future trade (e.g. trade opportunities related to development of smart cities); and
- (iv) Comparative advantage by both or one of the countries (e.g. Singapore is a stronger exporter of electronics).

We have also considered feedback from government agencies. In order to ensure that the potential benefits of standards setting materialise and lead to increased trade, it is essential for both Singapore and Australian government agencies to take the lead in advocating the benefits. This involves encouraging relevant national agencies and their counterparts to update current and future workplans relating to new and emerging technologies and market needs and to consider relevant standards to help train and educate businesses in their countries. It also involves continuing to partner with industry and academia.

Cooperation between government agencies is critical in assessing areas for alignment, knowledge (and potential project) sharing, and prioritisation. For instance, if one country's agency is advanced in a particular development, the other country can learn from their knowledge and align accordingly, saving time and resources. For example, Standards Australia is leading the development of international blockchain

⁹⁰ Enterprise Singapore (2020) New standards to be developed to support resilience and sustainability, <https://www.enterprisesg.gov.sg/media-centre/media-releases/2020/june/new-standards-to-be-developed-to-support-resilience-and-sustainability>

⁹¹ PM Australia, Media Release (2019) Joint Statement by Prime Ministers the Rt Hon Jacinda Ardern and the Hon Scott Morrison MP, <https://www.pm.gov.au/media/joint-statement-prime-ministers-rt-hon-jacinda-ardern-and-hon-scott-morrison-mp>

standards. It was appointed by the International Organisation for Standardisation (ISO) to lead a technical committee on the development of international standards for blockchain. The Committee already has 39 different contributing countries, with 11 Standards currently at various stages of development. While Singapore is a participating member there is scope for closer cooperation.

There is also the strong possibility for the two countries to identify where standards can serve to accelerate opportunities and so activate regional developments and regional focus in international standards bodies. Strengthening digital trade and cooperation on international standards in the region has increased in importance as a result of the COVID-19 pandemic, as the demand and use of digital technology has risen to keep economies functioning. By accelerating the use of technology and data like e-payments, telemedicine, and robots, that can reduce economic harm and loss of life, Australia and Singapore will showcase the pervasive role that digital enablement is going to play in each country's recovery efforts.⁹² It is noted that Singapore's Personal Data Protection Commission (PDPC) and the Office of Australia Information Commissioner (OAIC) have a good working relationship and have recently signed an MOU to foster closer collaboration and cooperation in safeguarding the data protection rights of Australians and Singaporeans.

Both Australia and Singapore are active and positive contributors of APEC Standards and Conformance Sub Committee (SCSC) and AANZFTA SC-STRACAP. These forums could potentially help drive regional digital standards activities and agendas and Australia and Singapore could consider jointly developing proposals for APEC SCSC.

8.2 Recommended Priorities for Cooperation

Out of the 18 areas identified in Section 7, we recommend that Australia and Singapore government agencies prioritise ten areas for cooperation as set out in Figure 8 below.

Three of these areas relate to data as it is a key resource for facilitating digital trade. While data privacy is critical to protect cross border data flows in an increasing number of industries, we also consider data portability in the banking sector to be of mutual benefit to both countries.

⁹² Australian Government Department of Foreign Affairs and Trade (DFAT) (2020) Partnerships for Recovery: Australia's COVID-19 Development Response, <https://www.dfat.gov.au/sites/default/files/partnerships-for-recovery-australias-covid-19-development-response.pdf>

Figure 8: Recommended Priorities for Cooperation



In the first instance, in each of the above recommended priorities for cooperation, government agencies in each country have developed their own programmes and initiatives to develop their respective digital economies. A detailed list of those programmes and initiatives is set out in Appendix IV, demonstrating that there are several workplan activities where there is scope to cooperate, lead, implement standards and work with standard-setting bodies. For example, one of the initiatives includes Singapore's Trade Trust initiatives which involves removing trade barriers created from manual submissions of trading documents (See Box 3). The other involves using standards to maximise the benefits of Australia's Digital Identity programme (See Box 4).

Box 3: Reducing Trade Barriers with Standards

- Trade Trust comprises a set of legal frameworks, international standards and digital infrastructure, to connect governments and businesses to a public blockchain and enable interoperability of electronic trade documents across digital platforms. It addresses the inefficiencies of cross-border trade from paper-based documentation through distributed ledger technology (DLT), thereby providing proof of authenticity and source of origins for these documents.⁹³
- Singapore has been active in efforts to drive and align TradeTrust with standards development such as inter-system interoperability (ISO TC/307) and process standards to exchange electronic trade documents at the United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT). Another area that TradeTrust deals with is title transfer through digital means that are compliant with requirements laid out in the Model Law on Electronic Transferable Records (MLETR) published by the United Nations Commission on International Trade Law.
- This presents opportunities for Australia and Singapore to explore the interoperability of Electronic Transferable Records (ETRs). At present, the World Economic Forum estimates that the costs of processing trade documents are as much as 20% of those of shifting goods. If both

⁹³ IMDA, Factsheet, TradeTrust, <https://www.imda.gov.sg/-/media/Imda/Files/About/Media-Releases/2020/Annex-B-TradeTrust-Fact-Sheet.pdf>

countries cooperate, it can bring numerous benefits to the shipping and logistics industry, including lowering cost of business, reducing risk of mis-deliveries, and enhancing security.

Box 4: Standards Can Enhance the Benefits of Digital Enablers

Australia's **Digital Transformation Agency** has a Digital Identity program that will deliver benefits to:

- **Individuals:** the ability to interact with government easily and safely will reduce citizens' time spent establishing their identity with each government service they are seeking to access with cost benefits attributed to reducing red-tape.
- **Businesses:** will benefit from reduced operating costs. The need to maintain costly identity and access management systems and associated support systems such as help desks to support customers will be significantly reduced, enabling staff to be reallocated to focus on the delivery of services.
- **Government:** there are benefits at the whole of government level, gained through improved security and streamlining of processes across government agencies. Reduced need for multiple teams from different agencies to provide identity verification services across government agencies. Reduction in the cost of fraud and improving fraud prevention.
- With alignment to international standards, these benefits could increase in magnitude, achieved at a faster rate and spread across orders facilitating trade in goods and services. Key areas for alignment could include Biometrics Standards including presentation attack detection and face matching algorithms.

A key aspect of collaboration will be the provision of training and capacity building among businesses. To reap the benefits, harmonisation of standards is required not just at government level but also among businesses that are engaged in trade. Both Australia and Singapore already have programmes that provide training (see Appendix IV) and so there is scope for these initiatives to be revised to incorporate standards of benefit to Singapore and Australia. For example, Standards Australia has developed the **NEXTgen Program** that develops the next generation of standards leaders and experts, building a national network of stakeholders and peers across industry sectors. In Singapore, PDPC has developed an Implementation and Self-Assessment Guide for Organisations (ISAGO) for businesses adopting AI technology, together with a Compendium of Use Cases.

8.2.1 Government Projects and Programmes

Table 10 below provides specific examples of projects and programmes where government agencies can cooperate. In some cases, there is already a commitment from government agencies to cooperate through the Australia-Singapore DEA.

Table 10: Recommended Priorities for Cooperation

Digital Standards	Rationale for prioritisation	Estimated Economic Benefit	Australia and Singapore adoption of standards and recommended area of co-operation
AI	<i>Potential to enhance all sectors related to current and</i>	In Australia, AI is valued at AUD1.98bn (2025), growing at an	Singapore has issued the Model AI Governance Framework.

Digital Standards	Rationale for prioritisation	Estimated Economic Benefit	Australia and Singapore adoption of standards and recommended area of co-operation
	<i>future digital trade</i>	<p>estimated 22% a year.⁹⁴</p> <p>AI in Singapore is estimated to grow at a CAGR of 25.3%, and to reach an estimated AUD11.89bn by 2024.</p>	<p>Australia is developing an AI Ethics Framework for businesses and governments.</p> <p>While both Singapore and Australia are participating in the international AI standard ISO/IEC JTC 1/SC 42 there is scope for knowledge sharing.</p> <p>Singapore's Infocomm Media Development Authority (IMDA), Smart Nation and Digital Government Office (SNDGO) and Australia's Department of Industry, Science, Energy and Resources (DISER) will work together on governance and ethics of AI.⁹⁵</p> <p>In Singapore, the Monetary Authority of Singapore has introduced a set of principles on the use of AI and data analytics in Singapore's financial sector.⁹⁶ MAS could collaborate with the Reserve Bank of Australia to promote responsible use of AI in financial sector.</p>
Distributed Ledger Technology	<i>Potential to enhance all aspects of trade</i>	<p>In Singapore blockchain technology has the potential to achieve market spending of AUD3.85bn by 2024, with a CAGR of 15%.</p> <p>There is also scope to reduce the cost of processing trade documents by as much as 20%</p>	<p>Australia is leading the ISO technical committee on international development of blockchain standards ISO TC 307. The Committee has 11 standards currently at various stages of development.</p> <p>Singapore participates ISO TC307. It is also looking to align towards the Model Law on Electronic Transferable Records (MLETR) standards published by the United Nations Commission on International Trade Law in Sept 2017. Singapore is leading the Project working on MLETR-compliant Title Transfer standards at UN/CEFACT.</p> <p>Singapore's IMDA is actively working on developing and promoting an open framework called TradeTrust to promote digitalisation in cross-border trade by</p>

⁹⁴ Australian Trade and Investment Commission (2019) Artificial intelligence expert selects Sydney for Asia-Pacific launch pad, <https://www.austrade.gov.au/international/invest/investor-updates/2019/artificial-intelligence-expert-selects-sydney-for-asia-pacific-launch-pad>

⁹⁵ MTI, Singapore Concludes Negotiations for Digital Economy Agreement with Australia, <https://www.mti.gov.sg/-/media/MTI/Newsroom/Press-Releases/2020/03/Joint-press-release--Conclusion-of-Negotiations-for-the-SingaporeAustralia-Digital-Economy-Agreement.pdf>

⁹⁶ MAS, Principles to Promote Fairness, Ethics, Accountability and Transparency (FEAT) in the Use of Artificial Intelligence and Data Analytics in Singapore's Financial Sector <https://www.mas.gov.sg/~media/MAS/News%20and%20Publications/Monographs%20and%20Information%20Papers/FEAT%20Principles%20Final.pdf>
<https://www.mas.gov.sg/~media/MAS/News%20and%20Publications/Monographs%20and%20Information%20Papers/FEAT%20Principles%20Final.pdf>

Digital Standards	Rationale for prioritisation	Estimated Economic Benefit	Australia and Singapore adoption of standards and recommended area of co-operation
		of the cost of shifting goods. ⁹⁷	utilising public blockchain technology (Ethereum as a start) to grant trust in trade documents. Singapore Customs, IMDA and the Australian Border Force will cooperate on the use of distributed ledger technology in the sharing and verification of trade administration documents such as Certificates of Origin, Certificates of Non-Manipulation and E-bills of Lading. ⁹⁸
Smart Cities	<i>Potential to enhance all aspects of trade</i>	In Australia, total benefits due to improved travel times could be almost AUD10bn. ⁹⁹ In Singapore, public data and analytics for urban transportation resulted in 92% reduction in buses with crowding issues, and shortened average waiting times by 3-7 minutes. ¹⁰⁰	Australia is looking to develop smart city solutions to ensure low-congestion cities. Singapore's 'Smart Nation' programme focuses on innovation and commercialisation of technologies. Australia is currently participating in ISO/TC 268 for smart cities, while Singapore is observing. There are 10 published standards and 15 developing standards which suggests there is scope for both Singapore to become involved and gain from Australia's current knowledge.

⁹⁷ Maersk Paper Trail Research 2014

⁹⁸ MTI, Singapore Concludes Negotiations for Digital Economy Agreement with Australia, <https://www.mti.gov.sg/-/media/MTI/Newsroom/Press-Releases/2020/03/Joint-press-release--Conclusion-of-Negotiations-for-the-SingaporeAustralia-Digital-Economy-Agreement.pdf>

⁹⁹ ACS Australia's Digital Pulse 2019, <https://www2.deloitte.com/au/en/pages/economics/articles/australias-digital-pulse.html>

¹⁰⁰ Smart Nation Initiatives, Open Data and Analytics for Urban Transportation, <https://www.smartnation.gov.sg/what-is-smart-nation/initiatives/Transport/open-data-and-analytics-for-urban-transportation-1>

Digital Standards	Rationale for prioritisation	Estimated Economic Benefit	Australia and Singapore adoption of standards and recommended area of co-operation
Digital Identity	<i>Potential to enhance digital trade</i>	<p>In Australia economic value estimated to be AUD75.8bn (2030).¹⁰¹</p> <p>In Singapore, the economic value estimated to be AUD17.9bn (2030).¹⁰²</p>	<p>Singapore's SNDGO and Australia's Digital Transformation Agency (DTA) have developed a roadmap for each phase of the journey towards mutual recognition.¹⁰³ The agencies will study potential pilot projects such as opening bank accounts and applying for visas using Digital IDs.</p> <p>In particular there is scope to cooperate on Biometric standards. Singapore is planning to adopt ISO standards for Biometric System-on-Cards to facilitate widespread adoption in payments and Australia is looking a Biometric standards as part of its Digital Identity programme.</p>
E-payments	<i>Potential to enhance all aspects of trade</i>	<p>In Australia, digital payments and alternative financing markets are expected to reach AUD36.44bn in 2020.</p> <p>In Singapore, it is expected to reach AUD12.13bn in 2025, at a CAGR of 14%.</p>	<p>Singapore has a standardised set of QR code specifications for e-payments called SGQR. It is based on EMVCo standards and has been further customised for the local market.</p> <p>MAS and IMDA are co-owners of the SGQR scheme, and chair a SGQR Taskforce that brings together industry players and their expertise in the payment QR space. The Taskforce continues its work in (a) solving payment QR code fragmentation by adopting the SGQR standards; (b) promoting payment QR code interoperability through SGQR; and (c) propagating best practices for consumer and merchant adoption of SGQR.</p> <p>Australia has also adopted EMVCo standards for QR code payments under the New Payments Platform.</p> <p>Singapore and Australia can encourage internationally accepted standards such as the ISO20022 and</p>

¹⁰¹ Oxford Economics, Australia GDP Real (LCU) 2030 is 2527.154 bn. Based on estimates from McKinsey Global Institute (2019) Digital identification: A key to inclusive growth, digital identities will unlock economic value equivalent of 3% of GDP in 2030 for mature economies. <https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/digital-identification-a-key-to-inclusive-growth>

¹⁰² Oxford Economics, Singapore GDP Real (LCU) 2030 is 604.047 bn. Based on estimates from McKinsey Global Institute (2019) Digital identification: A key to inclusive growth, digital identities will unlock economic value equivalent of 3% of GDP in 2030 for mature economies.

<https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/digital-identification-a-key-to-inclusive-growth>

¹⁰³ MTI, Singapore Concludes Negotiations for Digital Economy Agreement with Australia, <https://www.mti.gov.sg/-/media/MTI/Newsroom/Press-Releases/2020/03/Joint-press-release--Conclusion-of-Negotiations-for-the-SingaporeAustralia-Digital-Economy-Agreement.pdf>

Digital Standards	Rationale for prioritisation	Estimated Economic Benefit	Australia and Singapore adoption of standards and recommended area of co-operation
			<p>promote interoperability between their national e-payment systems.¹⁰⁴</p> <p>Other areas of for co-operation in the finance sector include trade/trade-related financing, digital services and business indexes.</p>
E-invoicing	<i>Potential to enhance all aspects of current and future trade</i>	<p>Estimated to benefit the Australian economy by AUD28bn over ten years.¹⁰⁵</p> <p>In Singapore, an IMDA study in 2018 estimated that it cost companies SGD8.00 to process each manual invoice. E-invoicing could reduce these costs.</p>	<p>Singapore introduced Peppol e-invoicing standard in 2018, becoming the first national authority outside Europe to do so.</p> <p>Australia adopted Peppol in 2019.</p> <p>IMDA and Australian Tax Office (ATO) will jointly promote e-invoicing standards between Australian businesses and Singapore businesses.¹⁰⁶ Both agencies can also lead in the region and encourage adoption of the Peppol standard as it can benefit business all over the region, in all aspects of trade. The Peppol framework can also potentially support e-procurement and e-Logistics.</p>
IoT	<i>Potential to enhance digital trade and future trade</i>	<p>Value of market in Australia estimated to be AUD33.69bn by 2024.</p> <p>Value of market in Singapore estimated to be AUD10.47bn (2024).</p>	<p>Australia is currently developing the IoT Code of Practice. Jointly overseen by the Department of Home Affairs and the Australian Signals Directorate, the first version was released for consultation in November 2019. It is a voluntary code, aimed at industry and outlines security principles for device manufacturers, IoT service providers and application developers.</p> <p>IMDA has an IoT Cyber Security Guide, for enterprise users intending to procure IoT systems, as well as for vendors, providing baseline recommendations, foundational concepts and checklists, focusing on the security aspects of IoT systems.</p>

¹⁰⁴ <https://www.mti.gov.sg/-/media/MTI/Newsroom/Press-Releases/2020/03/Joint-press-release--Conclusion-of-Negotiations-for-the-SingaporeAustralia-Digital-Economy-Agreement.pdf>

¹⁰⁵ The Treasury, Australia, 2018, e-Invoicing, <https://treasury.gov.au/consultation/e-invoicing>

¹⁰⁶ DFAT, Australia-Singapore Digital Economy Agreement: summary of key outcomes, <https://www.dfat.gov.au/trade/services-and-digital-trade/australia-singapore-digital-economy-agreement-summary-key-outcomes>

Digital Standards	Rationale for prioritisation	Estimated Economic Benefit	Australia and Singapore adoption of standards and recommended area of co-operation
			On a broader level, ISO/IEC JTC 1/SC 41 focuses on standardisation in the area of IoT and related technologies. Australia and Singapore are members of working groups, focusing on IoT architecture, IoT interoperability and IoT applications.
Data Protection and Privacy	<i>Strong privacy protections can increase community trust in digital initiatives which may have a positive impact on trade</i>	A study found that the average cost of a cybersecurity attack for organisations in Singapore was estimated to be AUD1.68million per breach. ¹⁰⁷ The same study found the cost in Australia to be AUD332,044.	On March 2020, Singapore's PDPC and the OAIC signed a Memorandum of Understanding to foster closer collaboration and cooperation in safeguarding the data protection rights of Australians and Singaporeans, given the importance of data governance and cross border data flows to global trade. ¹⁰⁸ Singapore and Australia could work together to promote interoperability of data protection frameworks such as APEC Cross Border Privacy Rules (CBPR), which both Singapore and Australia are participants.
Cross-border Data	<i>Potential to enhance digital trade</i>	Promotes the exchange of data and allows businesses to access digital technologies. International data flows increased global GDP by 3%, and all global flows (including goods, trade, data, migration and foreign direct investment (FDI)—	Singapore and Australia agreed to jointly promote the APEC CBPR System to increase adoption by companies to facilitate data flows. ¹¹⁰ The Australian Border Force (ABF) has signed a MOU on Trade Facilitation with Singapore's IMDA to trial the digital exchange of trade documentation and to explore how trade single windows can be connected to facilitate customs data exchange. ¹¹¹ IMDA and DISER will promote benefits of trusted cross-border data flows through Identifying and supporting suitable cross-border data sharing projects to test innovative cross-border data sharing use cases. ¹¹²

¹⁰⁷The McAfee Cyber Risk & Resilience (MCRR) White Paper

<https://www.mcafee.com/enterprise/en-us/solutions/lp/mcafee-cyber-resilience-report.html>

¹⁰⁸ The Australian Office of the Australian Information Commissioner and the Singaporean Personal Data Protection Commission's Memorandum of Understanding: <https://www.oaic.gov.au/about-us/our-corporate-information/memorandums-of-understanding/mous/mou-with-pdpc/>.

¹¹⁰ Cross Border Privacy Rules System, Government, <http://cbprs.org/government/>

¹¹¹ <https://newsroom.abf.gov.au/channels/NEWS/releases/e2f458e8-4603-4c8d-be43-12e98d726c9f>

¹¹² MTI, Singapore Concludes Negotiations for Digital Economy Agreement with Australia, <https://www.mti.gov.sg/-/media/MTI/Newsroom/Press-Releases/2020/03/Joint-press-release--Conclusion-of-Negotiations-for-the-SingaporeAustralia-Digital-Economy-Agreement.pdf>

Digital Standards	Rationale for prioritisation	Estimated Economic Benefit	Australia and Singapore adoption of standards and recommended area of co-operation
		which data flows facilitates) increased global GDP by 10%. ¹⁰⁹	<p>Australia would be a good partner with Singapore in the BSB initiative. Tourism, e-commerce are examples of industries where cross border data initiatives between the two countries could be beneficial.</p> <p>IMDA and MAS are driving an initiative called Business sans Borders (BSB), which connects domestic and cross-border online business platforms and marketplaces. Through open data, BSB will leverage AI to match goods and digital services between business buyers and sellers domestically, regionally, and internationally across participating platforms. Third-party value-added services such as logistics and trade financing will also be made available on BSB, and recommended after a trade is matched. As a global initiative, BSB will improve the discoverability of businesses (including SMEs) and enhance trade opportunities across a wide spectrum of industries. IMDA and MAS are open to work with forward looking countries, such as Australia, to connect platforms and marketplaces to BSB, for greater cross border connectivity, better market reach, and deeper value chain digitalisation for our businesses.</p>
Data Portability	<i>Potential to enhance digital and future trade</i>	Data mobility in financial services supports development of innovative financial services, assists with risk management and compliance programmes. Data-driven innovation has been estimated to	<p>Australia introduced the Consumer Data Right (CDR) to give consumers greater control over their own data, including the ability to securely share data with a trusted third party. The CDR will be introduced in the banking sector from July 2020 and will roll out across other sectors of the economy, including energy and telecommunications.¹¹⁴</p> <p>Singapore is proposing Data Portability Obligations giving consumers control of personal data to strengthen accountability among organisations and consumer trust in the management of personal data.¹¹⁵</p>

¹⁰⁹ McKinsey Global Institute (2016) Digital Globalization: The New Era of Global Flows, <https://www.mckinsey.com/~media/McKinsey/Business%20Functions/McKinsey%20Digital/Our%20Insights/Digital%20globalization%20The%20new%20era%20of%20global%20flows/MGI-Digital-globalization-Full-report.pdf>

¹¹⁴ Data61 (2020) Consumer Data Standards, <https://data61.csiro.au/en/Our-Research/Focus-Areas/Special-Projects/Consumer-Data-Standards>

¹¹⁵ Personal Data Protection Commission (2019) Public Consultation on Review of the Personal Data Protection Act 2012 – Proposed Data Portability and Data Innovation Provisions, [https://www.pdpc.gov.sg/-/media/Files/PDPC/PDF-Files/Legislation-and-Guidelines/PDPC-Public-Consultation-Paper-on-Data-Portability-and-Data-Innovation-Provisions-\(220519\).pdf?la=en](https://www.pdpc.gov.sg/-/media/Files/PDPC/PDF-Files/Legislation-and-Guidelines/PDPC-Public-Consultation-Paper-on-Data-Portability-and-Data-Innovation-Provisions-(220519).pdf?la=en)

Digital Standards	Rationale for prioritisation	Estimated Economic Benefit	Australia and Singapore adoption of standards and recommended area of co-operation
		add up to AUD64bn per annum to the Australian economy. ¹¹³	Singapore and Australia will promote transparent and facilitative rules encouraging open APIs. ¹¹⁶

8.2.2 Initial Priority Areas

At present, both standards bodies, Enterprise Singapore and Standards Australia, have been prioritising standards for particular emerging areas, namely AI, Blockchain/ DLT and Smart Cities. As a starting point, cooperation on these areas can provide the following benefits to both countries.

- **Grow industry sectors with scope for mutual trade**

AI has been identified as particularly valuable for both countries. Australia has developed a roadmap commissioned by DISER, which highlights standards for AI and the strategic importance of Australia's international engagement and alignment. The roadmap recommends that Australia specialises its AI capability in: (i) **health, aged care and disability services; (ii) towns, cities and infrastructure; and (iii) managing the environment and natural resources.**¹¹⁷ As such Australia is developing its Artificial Intelligence Ethics Framework to guide businesses and governments looking to design, develop and implement AI.¹¹⁸

Singapore has identified five National AI Projects in **transport and logistics, smart cities and estates, healthcare, education, and safety and security**, where AI technologies will be used.¹¹⁹ To support the adoption of AI technology, it has developed Model AI Governance Framework for broader consultation, adoption and feedback.¹²⁰

¹¹³ Measures data-driven innovation per annum. Australian Government Department of the Prime Minister and Cabinet (2018) The Australian Government's response to the Productivity Commission Data Availability and Use Inquiry, <https://dataavailability.pmc.gov.au/sites/default/files/govt-response-pc-dau-inquiry.pdf>

¹¹⁶ MTI, Singapore Concludes Negotiations for Digital Economy Agreement with Australia, <https://www.mti.gov.sg/-/media/MTI/Newsroom/Press-Releases/2020/03/Joint-press-release--Conclusion-of-Negotiations-for-the-SingaporeAustralia-Digital-Economy-Agreement.pdf>

¹¹⁷ CSIRO, 2019, Australia's AI roadmap launched: Solving problems, growing the economy and improving our quality of life, <https://research.csiro.au/robotics/australias-ai-roadmap-launched-solving-problems-growing-the-economy-and-improving-our-quality-of-life/>

¹¹⁸ DISER, AI Ethics Framework, <https://www.industry.gov.au/data-and-publications/building-australias-artificial-intelligence-capability/ai-ethics-framework>

¹¹⁹ Smart Nation, Singapore, <https://www.smartnation.sg/why-Smart-Nation/NationalAIStrategy>

¹²⁰ IMDA, Artificial Intelligence, <https://www.imda.gov.sg/infocomm-media-landscape/SGDigital/tech-pillars/Artificial-Intelligence>

While both Singapore and Australia are participating in the international standard ISO/IEC JTC 1/SC 42¹²¹ there is scope for each country to provide further learnings to each other, to support the identified industries and increase current and future trade opportunities in those sectors. Together they can lead the conversation in encouraging more widescale adoption of international standards for AI.

- **Knowledge sharing to increase digital trade**

Australia's financial services sector undertakes nearly 40% of blockchain activity in the country. The professional, scientific and technical services sector represents nearly 20%, with the remaining activity spread across a wide range of sectors, from retail through to mining, contributing to approximately 40% of overall blockchain activity in Australia.¹²²

Australia has developed a roadmap that identifies the potential economic benefit of the strategic deployment of blockchain technology in the areas of **supply chain, educational qualifications and credentials and identity**.

Singapore is using blockchain across a number of applications, infrastructure which include financial services, digital identity and digital assets.¹²³ The government agency, IMDA has developed TradeTrust, a blockchain-based framework for the **trade and logistics** community. TradeTrust aims to facilitate the interoperability of electronic trade documents exchanged between different digital ecosystems, and seeks to reduce inefficiencies and complexities of cross-border trade arising from the current usage of paper-based documentation.

Australia has been leading the international development of a suite of blockchain standards with reference to architecture, taxonomy, ontology, security, privacy, identity and smart contracts.¹²⁴ Joint cooperation on emerging blockchain standards can deliver productivity improvements in a number of industries where digital trade occurs between the two countries now and in the future.

- **Grow future digital trade**

Both countries are keen to develop smart cities, which includes AVs, smart ports, and smart grids. Smart cities implement integrated and interconnected digital technologies to manage resources, services and assets efficiently. The objectives for Smart Cities are to improve social, economic and environmental sustainability outcomes for the city by providing better services more efficiently while improving quality of life and responding to urban challenges including climate change and rapid population migration and

¹²¹ ISO/IEC JTC 1/SC 42, Artificial Intelligence, <https://www.iso.org/committee/6794475.html?view=participation>

¹²² <https://www.industry.gov.au/data-and-publications/national-blockchain-roadmap/sectoral-opportunities>

¹²³ Fintech News, 2019, Singapore's Blockchain Map Proves That It Is a Hotbed for Blockchain Innovation, <https://fintechnews.sg/34478/blockchain/blockchain-singapore-map/>

¹²⁴ ISO/TC 307 TC, Blockchain and distributed ledger technologies, <https://www.iso.org/committee-/6266604.html>

growth. Smart City plans require applying collaborative leadership methods working across disciplines and city systems.¹²⁵

Australia is seeking smart city solutions to reduce congestion between now and 2030. It is the total benefits due to improved travel times are estimated to be almost AUD10bn.¹²⁶ Similarly, Singapore 'Smart Nation' programme focuses on innovation and commercialisation of technologies provide opportunities for collaboration and commercial partnerships across sectors including cyber security and big data.

The main standards setting working group for smart cities is **ISO TC 268 Sustainable Cities and Communities**, where **ISO/TC 268/SC1** has already published 13 standards and with another 13 under development.¹²⁷ This includes standardisation in the development of requirements, frameworks, guidance and supporting techniques and tools related to the achievement of sustainable development considering smartness and resilience, to help all cities and communities and their interested parties in both rural and urban areas become more sustainable. Both Australia and Singapore are participating in ISO/TC 268 for smart cities.¹²⁸ This suggests that is scope for knowledge sharing between the two countries Australia.

¹²⁵ ISO, #worldsmartcity, <https://www.iso.org/sites/worldsmartcity/>

¹²⁶ ACS Australia's Digital Pulse 2019, <https://www2.deloitte.com/au/en/pages/economics/articles/australias-digital-pulse.html>

¹²⁷ ISO/TC 268/SC 1, Smart community infrastructures, <https://www.iso.org/committee/656967.html>

¹²⁸ ISO/TC 268, Sustainable cities and communities, <https://www.iso.org/committee/656906.html?view=participation>

9. Conclusions and Next Steps

Australia and Singapore are already significant trading partners and have the opportunity through the DEA to further accelerate trade. At present each country has a growing digital economy. For instance, the Australian Bureau of Statistics estimated that Australia's digital economy grew from approximately AUD79bn in 2012–13 to AUD93.5bn in 2016–17.¹²⁹ Singapore's Internet economy¹³⁰ is also booming, estimated to have reached AUD18.4bn in 2019.¹³¹

Digital technologies lower barriers to trade, improve efficiency, and open access to markets creating new trade possibilities. For Australia, our research and analysis suggests that at a minimum, digital trade (as defined in this report) could rise to a projected **AUD216.21bn by 2030**. For Singapore, digital trade could conservatively reach **AUD95.62bn**. This suggests that the economic value of digital trade has the potential to increase **60% and 70% for Australia and Singapore respectively**. However, current efforts are based on leveraging of current comparative advantages and developing national policies, programmes that seek to promote and develop future digital technologies which they believe will drive economic growth. This approach creates significant risks to future technologies developed may not connect across borders and/or with other technologies. Cooperation on standards can lead to enhanced economic integration between the two economies and allows greater ease of doing businesses and economies of scale. For example, the payment sector in both countries is highly regulated with national regulations to serve national objectives. Payment mechanisms are essential to all forms of trade and it is important to detect fraud activities. Alignment on payment standards, will make it easier for businesses and consumers in Australia and Singapore to transact in a safe and secure manner. For example, standards underpinning Australia's New Payments Platform (NPP) and Singapore's PayNow could be expanded to allow seamless cross-border bank transfers at a lower cost. Similarly, joint standards for payment gateways could make it easier to complete e-commerce transactions.

In this report, we highlight the relevant international standards that can support four aspects of digital trade, namely, (i) trade in digital goods and services, (ii) digital technologies that can assist trade in physical goods and services, (iii) digital enablers as well as (iv) emerging digital technologies.

International standards set out specifications and procedures and provide the following benefits:

- (i) **Interoperability:** in digital systems for transparency, simplicity, and compliance;
- (ii) **Mutual Compatibility:** in products, components and services;
- (iii) **Flexibility and Promptness:** in responding to new challenges or changes; and
- (iv) **Consistent Quality:** of product or service with appropriate safety and security safeguards

Alignment on international standards could be more beneficial than long-term regulatory frameworks. For example, conformance to international standards involves assessing what devices and equipment need to

¹²⁹ Australian Bureau of Statistics, Measuring Digital Activities in the Australian Economy, <https://www.abs.gov.au/websitedbs/D3310114.nsf/home/ABS+Chief+Economist+-+Full+Paper+of+Measuring+Digital+Activities+in+the+Australian+Economy>

¹³⁰ Though the terms Internet economy and the digital economy are often used interchangeably, the distinction rests of the difference in sectoral impact. The Internet economy refer to the economic activities, inputs, outputs and employment directly associated with the use of the Internet. By contrast, the digital economy relies on enhanced interconnectivity of networks and the interoperability of digital platforms in all sectors of the economy and society to offer convergent services.

¹³¹ Bain & Company (2019) e-Conomy SEA 2019, <https://www.bain.com/insights/e-conomy-sea-2019/>

align with standards. Existing and emerging digital technologies need to be considered based on their use case and application, making voluntary standards more suitable.

Such cooperation must take place not just around well-known international trading bodies but also those that are less known but actively developing standards for new technologies. For example, QR code standardisation have been set by EMV. Further, IEEE are active in developing standards for IoT, AVs and Blockchain. NIST develops standards for AI and cybersecurity and FIDO Universal Authentication Framework is developing standards for digital identity.

To summarise, Australia and Singapore can accelerate trade between the two countries by:

- (i) Adopting a holistic approach to enhance interoperability and improve efficiencies for digital trade within the countries;
- (ii) Increasing digitalisation across all sectors using systems that can interoperate and interconnect with one another;
- (iii) Leveraging the use of international digital trade standards; and
- (iv) Aligning national standards with international standards when they are available.

We recommend Australia and Singapore government agencies prioritise cooperation in the following ten areas:

- 1. AI;
- 2. DLT;
- 3. Smart cities;
- 4. Digital identities;
- 5. E-payments;
- 6. E-invoicing;
- 7. IoT;
- 8. Data protection and privacy;
- 9. Cross-border sharing; and
- 10. Data portability.

These efforts should add to those of the current prioritisation focus by Standards Australia and Enterprise Singapore on AI, DLT which includes blockchain technology, and smart cities. We recommend continuing and accelerating cooperation in these three areas, and expanding the focus to encompass a portfolio of standards that will accelerate overall trade beyond a select group of disruptive technologies.

Cooperation can facilitate knowledge-sharing between the two countries. If one country's agency is advanced in an area or has the first-mover advantage, the other country can learn from their knowledge and align accordingly, saving time and resources. For example, Standards Australia is leading the development of international blockchain standards. It was appointed by ISO to lead a technical committee on the development of international standards for blockchain. The Committee already has 39 different contributing countries, with 11 Standards currently at various stages of development. While Singapore is a participating member there is scope for even closer cooperation given this potential leadership.

The success of government cooperation will depend on the extent of training and education provided to businesses on the benefits of international standards and how to implement such standards when deploying existing and future technology. Hence, a key action for government agencies will be to expand or develop training or certification programmes to help businesses understand digital standards. For example, in Singapore, PDPC encourages organisations to ensure that their cloud service provider meets relevant industry standards (e.g. ISO27001). IMDA has been organising monthly briefings via webinars for local

businesses for them to learn about the benefits of e-invoicing and the steps to on-board onto the Peppol network.

In Australia, the Australian Cyber Security Centre (ACSC) produced the Australian Government Information Security Manual to outline a cybersecurity framework that businesses can apply to protect themselves from cyber threats. It contains practical guidelines as well as recommended standards for organisations to follow. The OAIC provides guidance to entities covered by the Privacy Act 1988, including agencies, organisations, credit reporting bodies, credit providers and tax file number recipients, on reasonable steps entities are required to take to secure personal information. This includes guidance on protecting personal information entities hold from misuse, interference, loss, unauthorised access, modification or disclosure, and guidance related to the destruction and de-identification of personal information.

The aim is to create a 'culture of alignment' among government agencies and businesses to use technologies that are interconnected and interoperable, as without this focus, the gains from digital trade cannot be maximised.

Appendix I. Digital Trade Measurement

Table 11: Digital Goods and Services

Industry/Sector	Recent/Present: 2015-2019				Projected/Future: 2020-2030			
	Australia (AUD Billion) ¹²⁶	CAGR (%)	Singapore (AUD Billion)	CAGR (%)	Australia (AUD Billion)	CAGR (%)	Singapore (AUD Billion)	CAGR (%)
Software	14.6 (2018) ¹²⁷	-	17.16 (2018) ¹²⁸	-	21.2 (2022)	10 (2018-2022)	20.38 (2020) ¹²⁹	9 (2018-2020)
Cloud computing	6.33 (2018) ¹³⁰	-	2.02 (2018) ¹³¹	-	14.15 (2023)	17 (2018-2023)	4.72 (2023)	20 (2018-2023)
Videoconferencing	0.7 (2018) ¹³²	18 (2011-2017)	-	-	0.98 (2020) ¹³³	18 (2018-2020)	-	-
Digital Media								
<i>Video Games</i>	0.59 (2019)	-	0.16 (2019)	-	0.69 (2024) ¹³⁴	2.8 (2020-2024)	0.18 (2024) ¹³⁵	1.5 (2020-2024)
<i>Video-on-Demand</i>	0.44 (2019)	-	0.11 (2019)	-	0.61 (2024) ¹³⁶	6.4 (2020-2024)	0.13 (2024) ¹³⁷	5 (2020-2024)
<i>E-Publishing</i>	0.28 (2019)	-	0.05 (2019)	-	0.35 (2024) ¹³⁸	4.7 (2020-2024)	0.06 (2024) ¹³⁹	1.8 (2020-2024)
<i>Digital music</i>	0.58 (2019)	-	0.07 (2019)	-	0.63 (2024) ¹⁴⁰	1.7 (2020-2024)	0.09 (2024) ¹⁴¹	7.1 (2020-2024)
Digital advertising	9.05 (2019) ¹⁴²	7.1% increase from 2018	0.41 (2017) ¹⁴³	8.4 (2017-2022)	11.12 (2022)	7.1 (2018-2022)	0.61 (2022)	8.4 (2017-2022)

Table 12: Tangible Goods and Services Delivered Digitally

Industry/Sector	Recent/Present: 2015-2019				Projected/Future: 2020-2030			
	Australia (AUD Billion)	CAGR (%)	Singapore (AUD Billion)	CAGR (%)	Australia (AUD Billion)	CAGR (%)	Singapore (AUD Billion)	CAGR (%)
E-commerce	29.27 (2019)	-	3.44 (2019)	-	37.36 (2024) ¹⁴⁴	5 (2020-2024)	5.31 (2024) ¹⁴⁵	9.1 (2020-2024)
Transport (ride hailing and/or taxi)	4.38 (2019) ¹⁴⁶	-	1.51 (2019) ¹⁴⁷	-	5.05 (2024) ¹⁴⁸	2.9 (2020-2024)	1.89 (2024) ¹⁴⁹	4.5 (2020-2024)
Digital Financial Services	30.67 (2019)	-	5.39 (2019) ¹⁵⁰	-	36.44 (2020)	-	12.13 (2025)	14 (2019-2025)
<i>Digital Payments</i>	25.2 (2019) ¹⁵¹	3.7 (2019-2025)	-	-	26.14 (2020)	3.7 (2019-2025)	-	-
<i>Alternative Financing</i>	5.47 (2019) ¹⁵²	88% increase	-	-	10.3 (2020) ¹⁵³	-	-	-
Online Travel	8.32 (2019) ¹⁵⁴	-	8.22 (2019) ¹⁵⁵	11 (2015-2019)	8.45 (2020) ¹⁵⁶	-	14.82 (2025) ¹⁵⁷	-

E-services	4.47 (2019)	-	0.73 (2019)	-	5.93 (2024) ¹⁵⁸	6.4 (2020- 2024)	1.19 (2024) ¹⁵⁹	10.2 (2020- 2024)
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Table 13: Key Sectors being Digitalised

Industry/Sector	Recent/Present: 2015-2019				Projected/Future: 2020-2030			
	Australia (AUD Billion)	CAGR (%)	Singapore (AUD Billion)	CAGR (%)	Australia (AUD Billion)	CAGR (%)	Singapore (AUD Billion)	CAGR (%)
Healthcare	13.72 (2017) ¹⁶⁰	6 (2017- 2023)	13.11 (2018) ¹⁶¹	-	19.78 (2023)	6 (2017- 2023)	17.55(2023) ¹⁶²	6 (2018- 2023)
Education	5.39 (2018) ¹⁶³	Over 8 (2018- 2024)	-	-	9.43 (2024)	Over 8 (2018- 2024)	-	-
Energy and Resources		-	79.87(2015)	-	Increase in profits: 40 (2025) ¹⁶⁴	-	Value added: 12.52 (2025) ¹⁶⁵	-
Food and Agriculture	81 (2014- 2015) ¹⁶⁶	-	-	-	Increase in production: 20.3 (2030) ¹⁶⁷	25% increase	-	-
Electronics Manufacturing	-	-	88.74 (2017)	-	-	-	Value added: 21.89 (2020) ¹⁶⁸	-
Jobs	-	-	-	-	37.74 (2025) ¹⁶⁹	-	12.13 (2025)	-

Table 14: Digital Enablers

Industry/Sector	Recent/Present: 2015-2019				Projected/Future: 2020-2030			
	Australia (AUD Billion)	CAGR (%)	Singapore (AUD Billion)	CAGR (%)	Australia (AUD Billion)	CAGR (%)	Singapore (AUD Billion)	CAGR (%)
IT Equipment	10.13 (2019) ¹⁷⁰	1.7 (2019- 2023)	3.14 (2018) ¹⁷¹	0.6 (2014- 2018)	10.31 (2023) ¹⁷²	1.7 (2020- 2023)	3.05 (2020) ¹⁷³	0.6 (2018- 2020)
Cybersecurity	2.2 (2016) ¹⁷⁴	-	0.59 (2016) ¹⁷⁵	-	6 (2026) ¹⁷⁶	11 (2016- 2026)	0.99 (2020)	--
Digital Identities	-	-	-	-	75.81 (2030) ¹⁷⁷	-	17.92 (2030) ¹⁷⁸	-

Table 15: Emerging Transformative Digital Technologies

Industry/Sector	Recent/Present: 2015-2019				Projected/Future: 2020-2030			
	Australia (AUD Billion)	CAGR (%)	Singapore (AUD Billion)	CAGR (%)	Australia (AUD Billion)	CAGR (%)	Singapore (AUD Billion)	CAGR (%)
IoT	10.74 (2018) ¹⁷⁹	21 (2018- 2024)	6.29 (2019) ¹⁸⁰	-	33.69 (2024)	21 (2018- 2024)	10.46 (2024)	10.7 (2019 2024)

Blockchain Technology	-	-	1.91 (2019)	-	-	-	3.85 (2024)	15 (2019-2024)
3D Printing	-	-	-	-	0.24 (2024) ¹⁸¹	-	0.13 (2024) ¹⁸²	-
5G	-	-	0.25 (2019)	-	18.19 (2026) ¹⁸³	-	2.77(2024)	62.2 (2019-2024)
AI	0.33 (2016) ¹⁸⁴	-	3.85 (2019)	-	1.98 (2025) ¹⁸⁵	22 (2016-2025)	11.89 (2024)	25.3 (2019-2024)
Big Data and Advanced Analytics	1.64 (2016) ¹⁸⁶	-	0.98 (2017) ¹⁸⁷	-	2.83 (2020) ¹⁸⁸	-	0.98 each year ¹⁸⁹	-

¹²⁶ All values are converted to AUD using the following exchange rates: Australian to US Dollar Exchange Rate (2015 – 2019 average) = 0.742 (<https://www.macrotrends.net/2551/australian-us-dollar-exchange-rate-historical-chart>); Singapore to Australian Dollar Exchange Rate (2015 – 2019 average) = 0.986 (<https://www.ofx.com/en-sg/forex-news/historical-exchange-rates/yearly-average-rates/>)

¹²⁷ ARN (2019) Australia IT spending to reach \$94B in 2019, <https://www.arnnet.com.au/article/660273/australia-it-spending-reach-94b-2019/>; 2018 and 2022 estimates.

¹²⁸ IMDA, Annual Survey on Infocomm Industry 2019, <https://www.imda.gov.sg/-/media/Imda/Files/Infocomm-Media-Landscape/Research-and-Statistics/Survey-Report/II2019-Public-Report.pdf>

¹²⁹ Software industry revenue SGD 17.4 bn in 2018. Since the Infocomm industry revenue grew by 9.0% from 2013-2018, assume that software revenue will grow at the same rate till 2020, to arrive at SGD 20.67 bn.

¹³⁰ Boston Consulting Group (2019) Ascent to the Cloud: How Six Key APAC Economies Can Lift-off, <https://www.bcg.com/publications/2019/economic-impact-public-cloud-apac/australia.aspx>

¹³¹ Boston Consulting Group (2019) Ascent to the Cloud: How Six Key APAC Economies Can Lift-off, <https://www.bcg.com/publications/2019/economic-impact-public-cloud-apac/singapore.aspx>

¹³² Frost and Sullivan (2012), Australia Video Conferencing Market Opportunities and Challenges. Estimates that the market will grow at close to 18% from 2011 to 2017. <https://www.slideshare.net/FrostandSullivan/the-australia-videoconferencing-market>

¹³³ Frost and Sullivan assumed 18% growth of market, so we use 700 m estimate to calculate market size in 2020.

¹³⁴ Statista, <https://www.statista.com/outlook/203/107/video-games/australia>; Same CAGR for 2020-2024 (2.8%) is used to arrive at 2019 estimates.

¹³⁵ Statista, <https://www.statista.com/outlook/203/124/video-games/singapore>; Same CAGR for 2020-2024 (1.5%) is used to arrive at 2019 estimates.

¹³⁶ Statista, <https://www.statista.com/outlook/201/107/video-on-demand/australia>; Same CAGR (6.4%) is used to arrive at 2019 estimates.

¹³⁷ Statista, <https://www.statista.com/outlook/201/124/video-on-demand/singapore>; Same CAGR (5%) is used to arrive at 2019 estimates.

¹³⁸ Statista, <https://www.statista.com/outlook/204/107/epublishing/australia>; Same CAGR (4.7%) is used to arrive at 2019 estimates.

¹³⁹ Statista, <https://www.statista.com/outlook/204/124/epublishing/singapore>; Same CAGR (1.8%) is used to arrive at 2019 estimates.

¹⁴⁰ Statista, <https://www.statista.com/outlook/202/107/digital-music/australia>; Same CAGR (1.7%) is used to arrive at 2019 estimates.

¹⁴¹ Statista, <https://www.statista.com/outlook/202/124/digital-music/singapore>; Same CAGR (7.1%) is used to arrive at 2019 estimates.

¹⁴² Adnews (2019) Australia's online advertising growth is slowing, <https://www.adnews.com.au/news/australia-s-online-advertising-growth-is-slowing>; Australia 2022 estimated on the assumption that CAGR is 7.1% from 2018 to 2022.

¹⁴³ Marketing (2018), Singapore media and entertainment spend to see 3.5% growth in next 5 years, <https://www.marketing-interactive.com/singapore-media-and-entertainment-spend-to-see-3-5-growth-in-next-5-years/>; Based on a CAGR of 8.4, market will grow to USD 453 m by 2022.

- ¹⁴⁴ Statista estimates show that revenue is expected to have an annual growth rate of 5% from 2020-2024, we assume the same 5% growth, to get USD 21.72 bn in 2019. <https://www.statista.com/outlook/243/107/ecommerce/australia>;
- ¹⁴⁵ Statista estimates show that revenue is expected to have an annual growth rate of 9.1% from 2020-2024, we assume the same 9.1%, to get USD 2.55 bn in 2019. <https://www.statista.com/outlook/243/124/ecommerce/singapore>;
- ¹⁴⁶ Same CAGR (2.9%) is used to estimate 2019 figures.
- ¹⁴⁷ Same CAGR (4.5%) is used to estimate 2019 figures.
- ¹⁴⁸ Statista <https://www.statista.com/outlook/368/107/ride-hailing/australia>
- ¹⁴⁹ Statista <https://www.statista.com/outlook/368/124/ride-hailing/singapore>
- ¹⁵⁰ Google, Temasek and Bain & Company (2019), The Future of Southeast Asia's Digital Financial Services, <https://www.bain.com/globalassets/noindex/2019/bain-report-fulfilling-its-promise.pdf>; Singapore current and future estimates.
- ¹⁵¹ Future five (2020) Growth of digital payments set to cost Australian banks US\$3 bn, <https://futurefive.com.au/story/growth-of-digital-payments-set-to-cost-australian-banks-us-3-billion>
- ¹⁵² Statista, Market size of the alternative finance market in Australia from 2013 to 2017, <https://www.statista.com/statistics/883034/australia-alternative-finance-market-size/>; We use this to calculate 2019 numbers for alternative financing market of Australia.
- ¹⁵³ Assuming the same growth rate of 88%, we estimate the alternative financing market in Australia for 2020.
- ¹⁵⁴ Statista, <https://www.statista.com/statistics/500410/online-travel-sales-australia/>
- ¹⁵⁵ Google Temasek Bain E-conomy SEA 2019 report, https://www.bain.com/globalassets/noindex/2019/google_temasek_bain_e_conomy_sea_2019_report.pdf
- ¹⁵⁶ Statista, <https://www.statista.com/statistics/500410/online-travel-sales-australia/>
- ¹⁵⁷ Google Temasek Bain E-conomy SEA 2019 report, https://www.bain.com/globalassets/noindex/2019/google_temasek_bain_e_conomy_sea_2019_report.pdf
- ¹⁵⁸ Statista <https://www.statista.com/outlook/261/107/eservices/australia>; Same CAGR (6.4%) is used to arrive at 2019 estimates.
- ¹⁵⁹ Statista, <https://www.statista.com/outlook/261/124/eservices/singapore>; Same CAGR (10.2%) is used to arrive at 2019 estimates.
- ¹⁶⁰ McKinsey, 2018, The rise and rise of medtech in Asia, <https://www.mckinsey.com/industries/pharmaceuticals-and-medical-products/our-insights/the-rise-and-rise-of-medtech-in-asia> estimates that in 2017, APAC Medtech sector was USD 95 bn and will grow to USD 137 bn in 2023, at a CAGR of 6%. The Medical Devices and Diagnostics Industry Capability Report, <https://www.austrade.gov.au/ArticleDocuments/2814/Medical-Devices-and-Diagnostics-Industry-Capability-Report.pdf.aspx> estimates that Australia's share of the Asia-Pacific advanced medical technologies market was 10.72% in 2013. This provides estimates for 2017, and the constant market share is assumed to calculate Australia's medtech market in 2023.
- ¹⁶¹ Marshall Cavendish Business Information (2018) Riding the MedTech Wave, <https://www.singaporemedtech.com/articles/industry-articles/riding-the-medtech-wave>
- ¹⁶² Assuming Singapore market grows at the same pace as the APAC market, CAGR of 6% is applied on 2018 figures to estimate 2023 market size of Singapore. <https://www.singaporemedtech.com/articles/industry-articles/riding-the-medtech-wave>
- ¹⁶³ Research and Markets (2018), <https://www.businesswire.com/news/home/20190731005745/en/Australias-4Bn-Online-Education-Market-2018-Projected>; Both 2018 and 2024 estimates.
- ¹⁶⁴ Improvement in profits of the mining sector by digitalization, estimated to be between A40 billion and A80 billion per year by 2025. We use the lower bound of this estimate. McKinsey, 2015, How digital innovation can improve mining productivity, <https://www.mckinsey.com/featured-insights/asia-pacific/digital-australia-seizing-opportunity-from-the-fourth-industrial-revolution>
- ¹⁶⁵ Manufacturing value-added through the adoption of automation, advanced manufacturing and digital technologies. Enterprise Singapore, <https://www.enterprisesg.gov.sg/industries/type/energy-chemicals/industry-profile>
- ¹⁶⁶ Grain Central, Agtech, 2018, How well placed is Australia for the digital revolution in agriculture? <https://www.graincentral.com/ag-tech/how-well-placed-is-australia-for-the-digital-revolution-in-agriculture/>
- ¹⁶⁷ Digital technologies will increase gross value of agriculture production by AUD20.3bn to reach AUD100bn. Grain Central, Agtech, 2018, How well placed is Australia for the digital revolution in agriculture? <https://www.graincentral.com/ag-tech/how-well-placed-is-australia-for-the-digital-revolution-in-agriculture/>
- ¹⁶⁸ Manufacturing value-added through the adoption of robotics and automation, innovation in manufacturing technologies. Enterprise Singapore, <https://www.enterprisesg.gov.sg/industries/type/electronics/industry-profile>
- ¹⁶⁹ [For both AU and SG] McKinsey (2015), A Labor Market that works: Connecting Talent with Opportunity in the Digital Age, https://www.mckinsey.com/~media/McKinsey/Featured%20Insights/Employment%20and%20Growth/Connecting%20talent%20with%20Opportunity%20in%20the%20digital%20age/MGI%20Online%20talent_A_Labor_Market_That_Works_Executive_%20summary_June%202015.ashx
- ¹⁷⁰ Given that CAGR from 2020-2023 is 1.7%, we assume the same growth rate to arrive at USD 7.52 bn revenue of IT Equipment.

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- ¹⁷¹ Market Research, IT Hardware in Singapore, <https://www.marketresearch.com/MarketLine-v3883/Hardware-Singapore-12763549/>
- ¹⁷² <https://www.statista.com/outlook/611000/107/it-equipment/australia>
- ¹⁷³ Assume the same CAGR of 0.6% to get the revenue of 2020.
- ¹⁷⁴ AustCyber (2018) Australia's Cyber Security Sector Competitiveness Plan, <https://www.austcyber.com/tools-and-resources/sector-competitiveness-plan-2017>
- ¹⁷⁵ MCI, Factsheet Cybersecurity Ecosystem, <https://www.mci.gov.sg/~media/mcicorp/images/budget%20workplan/cos%202018/factsheets/factsheet%20-%20innovation%20cybersecurity%20ecosystem%20at%20block%2071.pdf?la=en>; 2016 and 2020 estimates for Singapore
- ¹⁷⁶ AustCyber (2018) Australia's Cyber Security Sector Competitiveness Plan, <https://www.austcyber.com/tools-and-resources/sector-competitiveness-plan-2017>; Industry revenue is set to double from AUD2.2bn to A\$4.7bn between 2016-2026. If Australia undertakes concerted efforts in key competitive areas, then it is estimated to grow to AUD6bn by 2026.
- ¹⁷⁷ Oxford Economics, Australia GDP Real (LCU) 2030 is 2527.154 bn. Based on estimates from McKinsey Global Institute (2019) Digital identification: A key to inclusive growth, digital identities will unlock economic value equivalent of 3% of GDP in 2030 for mature economies. <https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/digital-identification-a-key-to-inclusive-growth>
- ¹⁷⁸ Oxford Economics, Singapore GDP Real (LCU) 2030 is 604.047 bn. Based on estimates from McKinsey Global Institute (2019) Digital identification: A key to inclusive growth, digital identities will unlock economic value equivalent of 3% of GDP in 2030 for mature economies. <https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/digital-identification-a-key-to-inclusive-growth>
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- ¹⁸⁰ Current and projected figures on Singapore IoT, Blockchain technologies, 5G, AI are taken from Digital Reality (2019) Digital Capital Singapore Report, <https://info.digitalrealty.com/XmEONzZ0N000Jd0qm001Yj0>
- ¹⁸¹ Estimated based on the projection that Asia-Pacific is going to spend USD3.6 bn on additive manufacturing by 2024 and Australia market makes up around 5% of the APAC market. AMFG (2019) AM Around the World: How Mature is 3D Printing in the Asia-Pacific Region? <https://amfg.ai/2019/11/20/am-around-the-world-how-mature-is-3d-printing-in-the-asia-pacific-region/>
- ¹⁸² Calculated based on the estimation that Asia Pacific is going to spend USD3.6 bn on additive manufacturing by 2024 and Singapore market makes up around 40% of the ASEAN market which accounts for 7% of the APAC market. AMFG (2019) AM Around the World: How Mature is 3D Printing in the Asia-Pacific Region? <https://amfg.ai/2019/11/20/am-around-the-world-how-mature-is-3d-printing-in-the-asia-pacific-region/>
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Appendix II. Standards Bodies

Singapore

Enterprise Singapore (ESG), the national standards body of Singapore, was established with the goal to develop and promote the adoption of local and international standards amongst businesses. It is a government agency and manages the National Standardisation Programme under the guidance of an industry-led Singapore Standards Council (SSC).

In Singapore, there are more than 700 standards at work across all industrial sectors.¹³² ESG and the SSC have developed and reviewed over 168 Singapore Standards and Technical References, impacting 13,000 organisations over the past year. Around 91 of these standards were new, with close to 70% focused on emerging areas most of which were in smart manufacturing to support Industry 4.0 adoption.¹³³

The government recognises that for businesses to keep pace with economic transformation and the current Covid-19 pandemic, standards development will have to be carried out in parallel with the changing global landscape and emergence of new technologies. The SSC has made good progress in this regard, with new standards published in the past year to support nascent areas, which include those identified in the Industry Transformation Maps, the Smart Nation initiative and the Research, Innovation and Enterprise 2020 plan.¹³⁴ Furthermore, the SSC has announced that new standards would be developed this year for nascent areas such as drones, additive manufacturing and video analytics, and over 900 organisations are expected to adopt them.¹³⁵

ESG works with the Infocomm Media Development Authority (IMDA) on IT-related standards, and set up the IT Standards Committee (ITSC), which represents Singapore in the international standardisation forum of ISO/IEC JTC1 on Information Technology. At present under the ITSC, there are 11 Technical Committees addressing information communication standards in the areas of AI, blockchain and DLT, cloud computing standards, e-financial services, green IT, health informatics, identification technology, IoT, IT for senior

¹³² Singapore Standards Council and Enterprise Singapore (2019) Singapore Standards Council to strengthen industry collaboration efforts and focus on nascent areas for standards development, https://www.gov.sg/~sgpcmedia/media_releases/enterprise-sg/press_release/P-20190715-1/attachment/MR03019_Singapore%20Standards%20Council%20to%20strengthen%20industry%20collaboration%20efforts%20and%20focus%20on%20nascent%20areas%20for%20standards%20development_2019%2007%2015.pdf

¹³³ <https://www.opengovasia.com/singapore-develops-new-standards-to-support-resilience-and-sustainability/>

¹³⁴ Singapore Standards Council and Enterprise Singapore (2019) Singapore Standards Council to strengthen industry collaboration efforts and focus on nascent areas for standards development, https://www.gov.sg/~sgpcmedia/media_releases/enterprise-sg/press_release/P-20190715-1/attachment/MR03019_Singapore%20Standards%20Council%20to%20strengthen%20industry%20collaboration%20efforts%20and%20focus%20on%20nascent%20areas%20for%20standards%20development_2019%2007%2015.pdf

¹³⁵ Straits Times (2019) New standards being drafted for emerging business areas, <https://www.straitstimes.com/business/new-standards-being-drafted-for-emerging-business-areas>

adults, multimedia representation, and security and privacy standards.¹³⁶ In the near term, the IT Standards Committee will likely focus on AI, Blockchain / DLT, IoT and Smart Cities related standards.

The **Standards Mapping for Singapore Smart Industry Readiness Index (SmS)** was developed jointly by ESG and SSC to help companies map eight pillars¹³⁷ of focus across 60 standard areas supporting the adoption of **smart manufacturing, robotics, automation and cybersecurity**. The guide helps companies start out on the right foot in digital trade, using 60 prioritised standards as a checkbox requirement. This demystifies the standards compliance required for companies to move into **Industry 4.0** by prioritising and categorising standards across standard families, and reducing both barriers to entry to digital trade, and compliance costs for companies.

Australia

Standards Australia is the lead organisation specialising in the development of internationally aligned standards in Australia. Standards Australia is an independent, non-governmental, not-for-profit organisation.

It has three key roles:

- (i) **Standards development:** Offering stakeholders from a variety of sectors a range of pathways to develop or update new or existing standards.
- (ii) **International participation:** Participating in the development and adoption of a wide range of International Standards.
- (iii) **Accreditation of standards development organisations:** Assessing and approving other organisations to develop Australian Standards.

Standards Australia is active in developing standards in 13 different industry sectors ranging from agriculture, manufacturing, transport, oil and gas and communications and ICT. Some key initiatives that currently or potentially affect digital trade involve the following:

- (i) Developing a roadmap for **Blockchain Standards**. In particular, managing the Secretariat for ISO/TC 307 for blockchain and distributed ledger technologies.
- (ii) Developing standards for **AI** that allow Australia to take the lead at an international level.
- (iii) Developing standards for **Smart Cities**, for instance Standards Australia participated in the ISO Technical Management Board UN Sustainable Development Goals (SDG) Taskforce, which relate to smart city goals and objectives, from waste management and sanitation to city infrastructure, including transport.
- (iv) Develop the **NEXTgen Program** to train industry and technical experts in the standard development process and context.
- (v) Working with counterpart NSBs in the Indo-Pacific Digital Trade Standardisation Initiative.

¹³⁶ IMDA IT Standards Committee (ITSC), <https://www2.imda.gov.sg/regulations-and-licensing-listing/ict-standards-and-quality-of-service/industry-committees-and-working-groups/IT-Standards-Committee>

¹³⁷ Operations, Supply Chain, Product Lifecycle, Automation, Connectivity, Intelligence, Structure and Management, and Talent Readiness. See <https://www.enterprisesg.gov.sg/media-centre/media-releases/2018/october/worlds-first-standards-mapping-tool-to-help-enterprises-build-capabilities-for-industry-4>

Appendix III. Detailed Examples of Digital Standards

Artificial Intelligence

AI standards are currently being conceptualised and written, and where there is opportunity for Australia and Singapore to influence or create relevant standards for specific areas of interest. There are primarily two international standards bodies working on AI, and two further bodies to stay aware of as set out below.

Table 16: AI Standards

International Standards	Description
ISO/IEC JTC 1 ¹³⁸	The first is the ISO/IEC JTC 1 Standards Committee on Artificial Intelligence (SC 42) ¹³⁹ , whose secretariat is the American National Standards Institute (ANSI). Both Australia and Singapore are participating members of the ISO/IEC JTC 1 SC42 ¹⁴⁰ . The ISO takes its usual approach towards developing AI standards – the standards “family” is established i.e. ISO/IEC JTC 1 SC42, and groups are set up to develop the standards.
IEEE Standards Association (SA)’s Autonomous and Intelligent Systems (A/IS) standards P7000 series. ¹⁴¹	Work on the IEEE’s AI series began in 2016 as part of the IEEE’s larger Global Initiative on Ethics of Autonomous and Intelligent Systems, but has since branched out across the IEEE’s Working Groups and Sponsor Committees.
International Telecommunications Union (ITU), ITU-T Y.3172 (06/2019) Architectural framework for machine learning in future networks	Recent work that the ITU has done in the arena of AI includes the ITU-T Y.3172 (06/2019) Architectural framework for machine learning in future networks including IMT-2020 (International Mobile Telecommunications-2020), which was released by the ITU-T Study Group 13 on Future networks, with focus on IMT-2020, cloud computing and trusted network infrastructure. ¹⁴²
National Institute of Standards and Technology	NIST recently released <i>A Plan for Federal Engagement in Developing AI Technical Standards and Related Tools</i> , ¹⁴³ identifying clear stances in US agency involvement on AI standards efforts. NIST is influential in the technical and technological standards development process, and have mapped out twelve AI standards required for AI systems, including technical standards: (1) concepts and terminology, (2) data and knowledge, (3) human interaction, (4) metrics, (5) networking, (6) performance testing and reporting methodology, (7) safety, (8) risk management, and (9) trustworthiness, and non-technical standards: (10) societal and ethical considerations, (11) governance, (12) privacy.

¹³⁸ ISO/IEC JTC 1/SC 42, Artificial intelligence, <https://www.iso.org/committee/6794475.html>

¹³⁹ ISO/IEC JTC 1/SC 42, Artificial intelligence, <https://www.iso.org/committee/6794475.html>

¹⁴⁰ ISO/IEC JTC 1/SC 42, Artificial intelligence, <https://www.iso.org/committee/6794475.html?view=participation>

¹⁴¹ IEEE SA, The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems, <https://standards.ieee.org/industry-connections/ec/autonomous-systems.html>

¹⁴² ITU-T Y.3172 (06/2019), Architectural framework for machine learning in future networks including IMT-2020, <https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13894&lang=en>

¹⁴³ NIST, 2019, U.S. Leadership in AI: A Plan for Federal Engagement in Developing Technical Standards and Related Tools, https://www.nist.gov/system/files/documents/2019/08/10/ai_standards-fedengagement_plan_9aug2019.pdf

Using the NIST categorisation of AI standards to map out existing standards work (see Table 16), we can generally map out the zeitgeist of AI development from a standards perspective. Some observations:

- (i) There are a number of other areas around AI which need to be considered when dealing with AI standards, including developments in big data, machine learning, autonomous systems, and robotics.
- (ii) Core attention is currently being paid in the areas of defining concepts, and building out reference architectures and frameworks.
- (iii) Societal and ethical considerations are another category of standards which have some attention, as does the privacy and trustworthiness categories.

Distributed Ledger Technology/Blockchain

The technology is still evolving, and no international standards currently exist. While there has been some debate on whether it is too early to set the standards, failure to develop international standards could also lead to confusion and missed opportunities. There is also confusion in understanding the new technology, prompting the development of standard terminology to provide greater clarity to potential stakeholders. However, the terminology should be defined in a way that gives flexibility to support future innovation.

Currently, work on developing 11 new ISO standards is in advanced stages, and is likely to be released in 2021. In addition, many other international bodies, other than the ISO, are exploring various standards involving blockchain technology, as illustrated in Box 5.

Box 5: Blockchain Standards Development

ISO TC 307: ISO has created a Technical Committee for Standardising Blockchain and Distributed Ledger Technologies (DLT), whose Secretariat is led by Standards Australia. It is developing a suite of blockchain standards with reference to architecture, taxonomy, ontology, security, privacy, identity and smart contracts.¹⁴⁴

ITU: ITU-T, has created a Focus Group on the Application of DLT (i) to identify and analyse DLT-based applications and services, (ii) to guide and support the implementation of those applications and services on a global scale, (iii) and to propose a way forward for related standardisation work in ITU-T Study Groups. ITU standardisation work is on security and trust, identity management, environmental sustainability, protocols and test specifications, combatting counterfeiting, multimedia, digital financial services, smart cities, and data processing and management.¹⁴⁵

The World Wide Web Consortium (W3C) is a non-profit international standardisation organisation whose member organisations collaboratively develop Web standards. It has a blockchain community group to (i) generate message format standards for blockchain based on ISO200223; (ii) generate guidelines for usage of storage including torrent,

¹⁴⁴ ISO/TC 307, Blockchain and distributed ledger technologies, <https://www.iso.org/committee/6266604.html>

¹⁴⁵ ITU, Focus Group on Application of Distributed Ledger Technology, <https://www.itu.int/en/ITU-T/focusgroups/dlt/Pages/default.aspx>

public and private blockchains, side chain and CDN; and (iii) study and evaluate new technologies and use-cases such as inter-bank communications.

IEEE has been working on the Standard for the Framework of Blockchain Use in IoT and an industry connection document, the Blockchain Asset Exchange. The body is actively pursuing blockchain standardisation efforts through various activities in multiple industry sectors.¹⁴⁶

The IETF is playing a major role in defining the Internet standards used for network communications and interoperability by publishing Request For Comments (RFC) documents that can impact blockchain technologies.

Smart Cities

The main standards setting working group for smart cities is **ISO TC 268 Sustainable Cities and Communities**, where **ISO/TC 268/SC1** has already published eight standards and with another 11 under development.¹⁴⁷ This includes standardisation in the development of requirements, frameworks, guidance and supporting techniques and tools related to the achievement of sustainable development considering smartness and resilience, to help all cities and communities and their interested parties in both rural and urban areas become more sustainable.

Additional Detailed Standards

Table 17: Digital Identity

International Standards	Description
ISO/IEC 24760-1:2019 IT Security and Privacy – A Framework for Identity Management	Applicable to any information system that processes identity information. Defines terms for identity management and specifies core concepts of identity and identity management and their relationships. ¹⁴⁸
ISO/IEC 24745:2011 Information Technology - Security Techniques - Biometric Information Protection	Provides guidance for the protection of biometric information under various requirements for confidentiality, integrity and renewability/ revocability during storage and transfer. ¹⁴⁹ Additionally, provides requirements for the secure and privacy-compliant management and processing of biometric information.
FIDO Universal Authentication Framework	FIDO is a set of protocols designed to support any type of authentication including biometrics, OTP, USB security token, near-field communication (NFC), and Bluetooth for mobile devices.

¹⁴⁶ IEEE, Standards - IEEE Blockchain Initiative, <https://blockchain.ieee.org/standards>

¹⁴⁷ ISO/TC 268/SC 1, Smart community infrastructures, <https://www.iso.org/committee/656967.html>

¹⁴⁸ ISO (2019) ISO/IEC 24760-1:2019, IT Security and Privacy — A framework for identity management — Part 1: Terminology and concepts, <https://www.iso.org/standard/77582.html>

¹⁴⁹ ISO (2011) ISO/IEC 24745:2011, Information technology — Security techniques — Biometric information protection, <https://www.iso.org/standard/52946.html>

Table 18: Financial Messaging

International Standards	Description
SWIFT Message Types (MT) and ISO 15022	SWIFT Message Types (MT) are messaging schema used in transactions performed among financial institutions such as customer payments, and inter-financial institutions transfer.
ISO 8583 financial transaction message	ISO 8583 specifies the standards for systems that exchange electronic transaction requests and responses originated from payment cards. MasterCard and Visa networks base their authorisation communications on the ISO 8583 standard.
ISO 20022 universal financial industry message scheme	ISO 20022 is an emerging global standard for payments messaging. It has higher data capacity and by deploying it, the financial industry can create consistent messaging standards encompassing end-to-end payments, card transactions, foreign exchange, and trade services.

Table 19: E-invoicing

International Standards	Description
EN16931	The European standard on e-invoicing for public procurement contracts, establishes a semantic data model to define the core elements of an e-invoice to ensure legal compliance and interoperability for domestic and cross-border trade.
Peppol Business Interoperability Specifications (BIS)	Peppol BIS standardises procurement documents, such as e-orders, e-advanced shipping notes and e-invoices so that they can be exchanged and validated between sending and receiving Access Points (AP) for public sector buyers and their suppliers through an open and secure network. ¹⁵⁰

Table 20: Internet of Things (IoT)

International Standards	Description
IEEE 2413-2019 - IEEE Approved Draft Standard for an Architectural Framework for the Internet of Things (IoT)	This standard provides an architectural blueprint for IoT use across different domains (transportation, healthcare, smart grid, etc.) to aid system interoperability and functional compatibility.
IEC 61850:2019	This series of standards defines communication protocols for intelligent electronic devices at electrical substations. ¹⁵¹

¹⁵⁰ Peppol, What is Peppol?, <https://peppol.eu/what-is-peppol/>

¹⁵¹ IEC (2019) IEC 61850:2019 SER Series, <https://webstore.iec.ch/publication/6028>

Singapore's IMDA Technical Specification (TS) IoT	Defines the minimum technical requirements for IoT devices that use low power wide area network (LPWAN) technologies to operate in one of the authorised frequency bands or frequencies (and transmit within corresponding output power). ¹⁵²
Technical Reference (TR) 47: 2016	For use specifically for Singapore's Smart Nation development, provides an IoT reference framework, set of design principles, general architectural requirements, IoT reference model, and IoT reference architecture. ¹⁵³

Table 21: Data Protection and Privacy, Cross-border Data, and Data Portability

International Standards	Description
ISO/IEC 29100:2011: Information technology -- Security techniques -- Privacy framework¹⁵⁴	Provides a privacy framework using a common privacy terminology; defines the actors and their roles in processing personally identifiable information (PII); describes privacy safeguarding considerations; and provides references to known privacy principles for information technology.
ISO/IEC 29101:2018: Information technology -- Security techniques -- Privacy architecture framework¹⁵⁵	Defines a privacy architecture framework that: specifies concerns for ICT systems that process PII; lists components for the implementation of such systems; and provides architectural views contextualising these components.
ISO/IEC 27018:2019: Information technology -- Security techniques -- Code of practice for protection of personally identifiable information (PII) in public clouds acting as PII processors¹⁵⁶	Establishes commonly accepted control objectives, controls and guidelines for implementing measures to protect PII in line with the privacy principles in ISO/IEC 29100 for the public cloud computing environment.
ISO/IEC 27701:2019: Security techniques -- Extension to ISO/IEC 27001 and ISO/IEC 27002	Specifies requirements and provides guidance for establishing, implementing, maintaining and continually improving a Privacy Information Management System (PIMS) in the form of an extension to ISO/IEC 27001 and ISO/IEC 27002.

¹⁵² IMDA (2017) Technical Specification, Internet of Things, <https://www2.imda.gov.sg/-/media/Imda/Files/Regulation-Licensing-and-Consultations/ICT-Standards/Telecommunication-Standards/Radio-Comms/IMDA-TS-IOT.pdf?la=en>

¹⁵³ Singapore Standards Council (2016) Technical Reference, IoT Reference Architecture for Smart Nation, https://www.singaporestandardseshop.sg/Product/GetPdf?fileName=180331121435TR%2047-2016_Preview.pdf&pdtid=d963a0ae-022f-4132-bf0d-12f1dc9c245f

¹⁵⁴ ISO (2011) ISO/IEC 29100:2011, Information technology — Security techniques — Privacy framework, <https://www.iso.org/standard/45123.html>

¹⁵⁵ ISO ((2018) ISO/IEC 29101:2018, Information technology — Security techniques — Privacy architecture framework, <https://www.iso.org/standard/75293.html>

¹⁵⁶ ISO (2019) ISO/IEC 27018:2019, Information technology — Security techniques — Code of practice for protection of personally identifiable information (PII) in public clouds acting as PII processors, <https://www.iso.org/standard/76559.html>

for privacy information management -- Requirements and guidelines¹⁵⁷	
ISO/IEC 22624:202040- Information technology — Cloud computing — Taxonomy based data handling for cloud services	Describes a framework for the structured expression of data-related policies and practices in the cloud computing environment, based on the data taxonomy in ISO/IEC 19944. Provides guidelines on application of the taxonomy for handling of data based on data subcategory and classification. Also covers expression of data-related policies and practices including, but not limited to data geolocation, cross border flow of data, data access and data portability, data use, data management, and data governance. Describes how the framework can be used in codes of conduct for practices regarding data at rest and in transit, including cross border data transfer, as well as remote access to data; and provides use cases for data handling challenges, i.e. control, access and location of data according to ISO/IEC 19944 data categories.
APEC Cross-Border Privacy Rules (CBPR) System¹⁵⁸	The CBPR enables the essential flow of information and data across borders while at the same time providing effective protection for personal information. The system is one by which the privacy policies and practices of companies operating in the APEC region are assessed and certified by a third-party verifier (i.e. an accountability agent) and follows a set of commonly agreed upon rules, based on the APEC Privacy Framework. ¹⁵⁹ By applying this commonly agreed-upon baseline set of rules, the CBPR system bridges differences that may exist among domestic privacy approaches. To date, eight economies have joined the CBPR system—US; Canada; Mexico; Japan; Singapore; Chinese Taipei; Australia; Korea; and the Philippines. ¹⁶⁰
ISO/IEC 38505-1:2017 Information technology — Governance of IT — Governance of data — Part 1: Application of ISO/IEC 38500 to the governance of data¹⁶¹	<p>The standard is meant to apply to the governance of the current and future use of data that is created, collected, stored, or controlled by information technology systems, and impact the management processes and decisions relating to data.</p> <p>The standard applies the governance principles and model of ISO/IEC 38500 to the governance of data, assuring stakeholders that, if the principles and</p>

¹⁵⁷ ISO (2019) ISO/IEC 27701:2019, Security techniques — Extension to ISO/IEC 27001 and ISO/IEC 27002 for privacy information management — Requirements and guidelines, <https://www.iso.org/standard/71670.html>

¹⁵⁸ APEC (2019) What is the Cross-Border Privacy Rules System? <https://www.apec.org/About-Us/About-APEC/Fact-Sheets/What-is-the-Cross-Border-Privacy-Rules-System>

¹⁵⁹ APEC (2005) APEC Privacy Framework, http://publications.apec.org/publication-detail.php?pub_id=390

¹⁶⁰ Lawfare (2019) Cross-border Privacy Rules in Asia: An Overview, <https://www.lawfareblog.com/cross-border-privacy-rules-asia-overview>

¹⁶¹ ISO (2017) ISO/IEC 38505-1:2017 Information technology — Governance of IT — Governance of data — Part 1: Application of ISO/IEC 38500 to the governance of data, <https://www.iso.org/standard/56639.html>

	practices proposed by this document are followed, they can have confidence in the organisation's governance of data.
ISO/TS 23029:2020 Web-service-based application programming interface (WAPI) in financial services	Defines a logical and technical layered approach for developing APIs, including transformational rules.
FAIR Guiding Principles for scientific data management and stewardship¹⁶²	Set of guiding principles in order to make data findable, accessible, interoperable and reusable.
Financial Industry Business Ontology (FIBO): Open Semantic Standard for the Financial Industry¹⁶³	Open-source industry-standard for financial concepts, their relationships, and definitions, which provides a common language between systems and sources, reduces the cost of doing business, and promotes confidence in data among business users.
Consumer Data Right Standards¹⁶⁴	Standards have been developed as part of the Australian Government's introduction of the Consumer Data Right legislation to give Australians greater control over their data.

Table 22: Cybersecurity

International Standards	Description
ISO/IEC 27001: 2013 Information technology -- Security techniques -- Information security management systems -- Requirements¹⁶⁵	Specifies the requirements for establishing, implementing, maintaining and improving an information security management system within an organisation. The requirements set out in ISO/IEC 27001:2013 are generic and are intended to be applicable to all organisations, regardless of type, size or nature.

¹⁶² Wilkinson, M, et al. (2016) The Fair Guiding Principles for scientific data management and stewardship, <https://www.nature.com/articles/sdata201618>

¹⁶³ EDM Council (2019) About FIBO: Open Semantic Standard for the Financial Industry, <https://edmcouncil.org/page/aboutfiboreview>

¹⁶⁴ Data61 (2020) Consumer Data Standards, <https://data61.csiro.au/en/Our-Research/Focus-Areas/Special-Projects/Consumer-Data-Standards>

¹⁶⁵ ISO (2013) ISO/IEC 27001:2013, Information technology — Security techniques — Information security management systems — Requirements, <https://www.iso.org/standard/54534.html>

ISO/IEC 27002:2013 Information technology -- Security techniques -- Code of practice for information security controls ¹⁶⁶	This standard provides guidelines for organisational information security standards and information security management practices including the selection, implementation and management of controls taking into consideration the organisation's information security risk environment(s).
ISA/IEC 62443 ¹⁶⁷	The International Society of Automation (ISA)/IEC 62443 is a series of standards, technical reports, and related information that define procedures for implementing electronically secure Industrial Automation and Control Systems (IACS).
ISO/IEC 15408 Security techniques — Evaluation criteria for IT security	Contains a common set of requirements for the security functions of IT products and systems and for assurance measures applied to them during a security evaluation. Also referred to as Common Criteria for Information Technology Security Evaluation (Common Criteria).
Control Objectives for Information and Related Technology (COBIT) ¹⁶⁸	Published by the Standards Board of Information Systems Audit and Control Association (ISACA), COBIT provides a control framework for the governance and management of enterprise IT.
National Institute of Standards and Technology's (NIST) Cybersecurity Framework ¹⁶⁹	Developed and promoted through ongoing engagement with stakeholders in government, industry, and academia, the Framework provides a prioritised, flexible, and cost-effective approach to manage cybersecurity risk.

¹⁶⁶ ISO (2013) ISO/IEC 27002:2013, Information technology — Security techniques — Code of practice for information security controls, <https://www.iso.org/standard/54533.html>

¹⁶⁷ ISA (2018) New ISA/IEC 62443 standard specifies security capabilities for control system components, <https://www.isa.org/intech/201810standards/>

¹⁶⁸ ISACA, COBIT 5 Development, www.isaca.org/Knowledge-Center/cobit/Pages/Development.aspx

¹⁶⁹ NIST, Evolution of the Framework, <https://www.nist.gov/cyberframework/evolution>

Appendix IV. Government Projects and Programmes

Government Agencies	Examples of Current Initiatives/Programmes Relevant for Cooperation on Standards	Area
Facilitating Trade		
Singapore Ministry of Trade & Industry	<ul style="list-style-type: none"> MTI led the development of Industry Transformation Maps (ITMs) for 23 industries under 6 clusters between 2016 and 2018. Each ITM integrates productivity improvement, innovation, internationalisation and skills development to promote growth and competitiveness. MTI is leading the Singapore-Australia Digital Economy Agreement (DEA) 	<ul style="list-style-type: none"> <i>IoT</i> <i>3D Printing</i> <i>Last Mile Delivery</i> <i>e-Procurement</i>
Australia Department of Industry, Innovation and Science	<ul style="list-style-type: none"> Developing the Artificial Intelligence Ethics Framework to provide government and businesses with advice and proposed standards. Developing Cyber Security Tools and Training packages to support the cyber security performance of Australian SMEs Working with the Australian Taxation Office and the Treasury on the adoption of e-invoicing by business . Leads Australia's involvement in the G20 Digital Economy Taskforce which aims to capture the economic costs and benefits of the digital economy. 	
Information and Communication Technology		
Singapore Infocomm Media Development Authority	<ul style="list-style-type: none"> Focussed on emerging technologies such as 5G, IoT, AI all of which not only support digital trade but could accelerate trade through cooperation on standards. First edition of Model AI Governance Framework in January 2019. Second edition published in January 2020, together with a companion Implementation and Self Assessment Guide for Organisations (ISAGO) and a Compendium of Use Cases. It is also currently updating its Technical Specifications to incorporate the 5G specifications, and ensuring that they are aligned to international specifications/standards such as the 3rd Generation Partnership Project (3GPP) and European Telecommunications Standards Institute (ETSI). The Accreditation@SG Digital programme enables accredited companies to be better recognised overseas helping them to export capabilities and products. Mutual Recognition Arrangements (MRAs) for telecommunications conformity assessment. There are two phases in the MRA: <ul style="list-style-type: none"> Phase I: Mutual acceptance of test reports, e.g. equipment tested and approved by overseas MRA partners will not require re-testing in Singapore and vice versa. Singapore currently has a Phase 1 partnership with Australia. Phase II: Mutual acceptance of equipment certificates, e.g. equipment certified by overseas MRA partners can enter directly into Singapore market without requiring re-certification and vice versa. TradeTrust to facilitate the interoperability of electronic trade documents exchanged between digital platforms 	<ul style="list-style-type: none"> <i>5G and Wireless Telecoms</i> <i>AI Governance</i> <i>Digitalisation of trade documents</i>

Government Agencies	Examples of Current Initiatives/Programmes Relevant for Cooperation on Standards	Area
<p>Australia</p> <p>Australian Communications and Media Authority</p>	<ul style="list-style-type: none"> In February 2020, the ACMA updated rules for mobile number portability to better protect consumers which included the introduction of a new industry standard. It mandates processes for identity verification that are practicable, robust, technically feasible and do not impose undue financial and administrative costs. Leading scam technology project which examines potential technological solutions that could disrupt and reduce the level and severity of scams being perpetrated over telecommunications networks Participates in international standards setting. Domestically, the ACMA is an observer member of a range of committees including the Standards Australia Technical Committee IT-042 Internet of Things and related technologies. Developing IoT roadmap –to meet the short, medium to long term challenges posed by IoT within the context of a dynamic and evolving media and communications environment. Intelligence technologies in the media and communications sector – this work is exploring AI technologies deployment across communications and media businesses and examines anticipated regulatory implications. 	
Cybersecurity		
<p>Singapore</p> <p>Cybersecurity Agency</p>	<ul style="list-style-type: none"> The CSA Cybersecurity Certification Centre evaluates and certifies cybersecurity products. The SecureTech Track collaboration between CSA and IMDA to improve the quality of cybersecurity products through CC certification, and encourage procurement of those products by government agencies and businesses. Building of start-up hubs and accelerators, such as Innovation Cybersecurity Ecosystem @ Block71 to support businesses. Funding support through schemes such as the Proof of Concept Funding, to encourage the co-development of innovative solutions. Programmes to develop cybersecurity capabilities including Cyber Security Associates and Technologists (CSAT), SG Cyber Women, and SG Cyber Youth <p>(emerging technologies)</p>	<ul style="list-style-type: none"> Cybersecurity
<p>Australia</p> <p>Australian Cyber Security Centre</p>	<ul style="list-style-type: none"> The High Assurance Evaluations and ASD Cryptographic Evaluation (ACE) programmes test products to search for security vulnerabilities. A consumer guide is published to provide guidance on the authorised configuration and use, including any qualification. Australasian Information Security Evaluation Program (AISEP) evaluates security of ICT products through the Common Criteria Recognition Arrangement. These evaluation activities are certified by the Australasian Certification Authority (ACA). A commercial facility, Australasian Information Security Evaluation Facility (AISEF), conducts evaluations under the AISEP. ACSC produces the Australian Government Information Security Manual to outline a cybersecurity framework that businesses can apply to protect themselves from cyber threats. It contains practical 	

Government Agencies	Examples of Current Initiatives/Programmes Relevant for Cooperation on Standards	Area
	guidelines as well as recommended standards for organisations to follow.	
Smart Cities, eGovernment		
Singapore Smart Nation and Digital Government Office	<ul style="list-style-type: none"> Upgrading of digital ID Streamlining e-government services planning of a range of Smart Nation projects across sectors such as payments and transport. Core Operations Development Environment and eXchange (CODEX), for more efficient e-government service delivery E-payments, to enable seamless and secure digital transactions to be made over an interoperable national e-payments infrastructure National Digital Identity (NDI), which not only allows Singapore businesses and residents to transact securely and efficiently with the government, but is also interoperable across both public and private sectors. Businesses and individuals can verify their identity and give companies their authorisation and consent using digital signatures. Smart Nation Sensor Platform (SNSP), using sensors and data to improve urban planning, security and public transport. Smart Urban Mobility, using digital technologies to improve the public transport system, Technical Reference 68 (TR 68) to promote safe national deployment of AVs, which is the first such standard in the world 	<ul style="list-style-type: none"> Smart Cities AVs Digital Identity
Australia Digital Transformation Agency	<ul style="list-style-type: none"> Sets DTA's Digital Transformation Strategy (DTS) for the Australia government's digital transformation to 2025 and that the DTA is actively focussed on making improvements to digital ID, data-sharing and e-procurement, which have the potential to significantly accelerate trade through cooperation on standards. Rollout of myGovID aims to streamline administrative processes and increase the ease of G2B interactions by allowing various e-government services to be accessed with a single secure digital ID. Development of the National API Design Standard (NAPIDS), to facilitate data-sharing between government agencies and trusted third parties. Replacing the current cloud computing procurement vehicle, the Cloud Services Panel, with a new Cloud Marketplace this year would enable government to shop a wider range of cloud-based solutions. Participation in discussions around ISO 24760 regarding identity management Reviews of standards including Biometrics, NIST, ISO and FIDO. 	
Finance and Payment		
Singapore	<ul style="list-style-type: none"> Singapore Quick Response Code (SGQR), a common QR code specification for e-payments that allows for the creation of a single multi-tenanted QR for each merchant, and is supported by a central infrastructure. 	<ul style="list-style-type: none"> Blockchain QR Codes

Government Agencies	Examples of Current Initiatives/Programmes Relevant for Cooperation on Standards	Area
Monetary Authority of Singapore	<ul style="list-style-type: none"> MAS has been in discussion with ASEAN Bankers Association, Association of Banks in Singapore, other regional central banks and foreign banking associations to explore ASEAN QR code. API Exchange (APIX) aims to support financial innovation and inclusion in ASEAN and beyond.¹⁷⁰ As a global, open-architecture platform, APIX enables FIs and FinTech firms to discover and collaborate in innovative experiments. Business sans Borders (BSB), an open, global digital meta-hub, connecting multiple business platforms and services platforms. BSB will utilise artificial intelligence (AI) to enable traders, platforms, business associations, and SMEs to share common data, discover prices and sales opportunities in a larger global marketplace, access various supply chains, and easily source for and utilise relevant digital and financial solutions. Developed Principles to promote Fairness, Ethics, Accountability and Transparency (FEAT) in the use of AI in Singapore's financial sector. Participation in upcoming ISO/DTS 23029 standard for web-based API for financial services 	<ul style="list-style-type: none"> <i>Financial messaging and payments standards</i> <i>AI</i> <i>Data Portability</i>
Australia Reserve Bank of Australia	<ul style="list-style-type: none"> Continue the development of digital payments including QR Codes by building New Payments Platform capabilities to provide convenient, secure, and cost-effective banking services to customers. Delivery of open and secure integration services via Application Programming Interfaces (API) for agencies. Renovation of its banking applications and systems, developing reporting standards with the Australian Prudential Regulation Authority (APRA) for performance of retail banking services. 	
Standards Setting		
Singapore Enterprise Singapore	<ul style="list-style-type: none"> Developing standards for Technical Delivery, at a national level through Technical Reference 46 Developing standards for E-payments in particular, ISO/TC68-ISO 20022, which is the standard for universal financial industry message. SG is a 'Participating' member of ISO/SC 42 (AI), ISO/TC 307 (Blockchain and distributed ledger) and ISO/SC 41 (IoT). Enterprise Singapore also participates in the ASEAN Consultative Committee on Standards and Quality (ACCSQ), including the newly 	<ul style="list-style-type: none"> <i>AI</i> <i>APIs/Common Data Sharing</i>

¹⁷⁰ APIX is the flagship product developed and operated by The ASEAN Financial Innovation Network (AFIN), a not-for-profit entity formed by the Monetary Authority of Singapore, International Finance Corporation, a member of the World Bank Group, and the ASEAN Bankers Association, with the objectives of supporting financial innovation and inclusion around the world. Through APIX, financial institutions and FinTech firms can discover one another on a curated global marketplace, design experiments collaboratively in the sandbox and deploy innovative solutions rapidly at a lower cost.

Government Agencies	Examples of Current Initiatives/Programmes Relevant for Cooperation on Standards	Area
	<p>formed Digital Trade Standards and Conformance Product Working Group</p> <ul style="list-style-type: none"> Developing standards for AVs at a national level through, Technical Reference 68 and at an international level through ISO/TC 204 Intelligent Transport. Developing standards for 3D Printing, by participating in ISO/TC 261 	
<p>Australia</p> <p>Standards Australia</p>	<ul style="list-style-type: none"> Developing a roadmap for Blockchain Standards. In particular, managing the Secretariat for ISO/TC 307 for blockchain and distributed ledger technologies Developing standards for AI that allow Australia to take the lead at an international level. Developing standards for Smart Cities, for instance Standards Australia participated in the ISO Technical Management Board UN Sustainable Development Goals (SDG) Taskforce, which relate to smart city goals and objectives, from waste management and sanitation to city infrastructure, including transport. Develop the NEXTgen Program develops the next generation of standards leaders and experts, building a national network of stakeholders and peers across industry sectors. Experts participate and gain exposure to standards development work at national and international level. Indo-Pacific Digital Trade Standardisation Initiative provides capacity building to help Indo Pacific countries establish/strengthen their national standards body. Aim is better engagement in international and regional standards fora, and improved standards development processes and standards dissemination. 	<p><i>AI, data-sharing and data privacy, cyber security, blockchain and smart cities</i></p>
Customs and Logistics		
<p>Singapore</p> <p>Networked Trade Platform Office¹⁷¹</p>	<ul style="list-style-type: none"> Implementation of the Electronic Origin Data Exchange System between Singapore Customs and the General Administration of Customs of the People's Republic of China (GACC) which enables the Preferential Certificate of Origin and Certificate of Non-Manipulation to be electronically transmitted to the GACC through the NTP. Trade Finance Compliance (TFC) service to enable financial institutions to carry out compliance checks using data derived from permits issued by Singapore Customs. CamelOne Trade Finance which enables businesses to apply for trade finance products digitally from a list of participating banks using data and documents already uploaded in the NTP in standardised forms. 	<ul style="list-style-type: none"> <i>Cross Border data</i> <i>Blockchain/ DLT</i> <i>Cybersecurity</i> <i>IoT</i>

¹⁷¹ Singapore Customs and GovTech – is a one-stop trade and logistics platform which supports digitalisation efforts and connects players across the trade value chain

Government Agencies	Examples of Current Initiatives/Programmes Relevant for Cooperation on Standards	Area
	<ul style="list-style-type: none"> Removal of hard copy certificates for the import and export of agri-related commodities. 	
Australia Department of Home Affairs	<ul style="list-style-type: none"> Key project involving international trade is the Single Window Project which allows Australian businesses to fulfil border clearance requirements across all government agencies through a single digital entry point. Development of Code of Practice that will apply to all IoT devices available in Australia, device manufacturers, IoT service providers and application developers. Development of WCO Cross Border E-Commerce Framework of Standards which sets out 15 global standards, including Standard 1 Advance Electronic Data, for customs administrations who want to develop legislative and operational frameworks for cross-border e-commerce goods. Expansion of the Australian Trusted Trader (ATT) program which accredits Australian businesses with compliant trade practices and a secure supply chain. Development of the 2020 Cyber Security Strategy to advance and protect online interests 	
Data Protection and Privacy		
Singapore Personal Data Protection Commission	<ul style="list-style-type: none"> Focused on privacy policies and practices central to digital enablers such as AI and IoT, 5G PDPC recently released guidelines on cloud services and data access requests. In these guidelines, PDPC encourages organisations to ensure that the CSP they engage meets relevant industry standards (e.g. ISO27001) or to obtain assurance from the CSP that all data centres/sub-processors in overseas locations comply with similar standards. Introduced Guide to Accountability, along with PDPA Assessment Tool for Organisations (PATO), the Guide to Data Protection Impact Assessments (DPIA), Guide to Developing a Data Protection Management Programme (DPMP), the Guide to Managing Data Breaches, and the Guide to Data Protection by Design for ICT systems, which was jointly developed with Hong Kong's PCPD. PDPC introduced the Data Protection Trustmark (DPTM) certification system to recognise organisations with sound data protection practices. PDPC has developed a Guide to Managing Data Breaches ("Guide") to support organisations in managing data breaches effectively. released to allow organisations to familiarise themselves with PDPC's approach in preparation of the mandatory data breach notification obligation in the upcoming amendment of the PDPA PDPC now recognises the Asia Pacific Economic Cooperation (APEC) Cross Border Privacy Rules (CBPR) System and Privacy Recognition for Processors (PRP) System certifications as one of the modes for transfers of data overseas. It has also developed a template contract clause that transferring organisations could include in their contract with recipients. 	<ul style="list-style-type: none"> <i>Data Protection and Privacy</i> <i>Data Portability</i>

Government Agencies	Examples of Current Initiatives/Programmes Relevant for Cooperation on Standards	Area
<p>Australia</p> <p>Office of the Australian Information Commissioner</p>	<ul style="list-style-type: none"> • Supporting the Open Government Partnership Australia goals and progress commitments to enhance access to information, public accountability and participation, and technology for openness and accountability. • Working with the Australian Competition & Consumer Commission (ACCC) and the Data Standards Body (DSB) in the implementation of Consumer Data Right (CDR). • Developed Consumer Data Right Privacy Safeguard Guidelines covering consent, notifications, data use, data quality and security. • Developed a Guide to managing data breaches in accordance with the Privacy Act 1988 to assist regulated entities with preparing data breach response plans, and responding to data breaches, and provide information about Australia's Notifiable Data Breach Scheme. • Developing a new binding Privacy Code for social media and digital platforms, which trade in personal information. 	

Appendix V. Approach

In developing this report, we based our approach on the international trading supply chain. In particular, how digital trade is impacting each facet of the supply chain, including the ***identity, transaction and payment, logistics and supply processes, and the delivery and consumption***.

We defined digital trade in terms of (i) the trade in digital goods and services, (ii) the digital delivery (full or partial) of traditional or tangible goods, (iii) digital enablers of trade, and (iv) emerging disruptive technologies that are transforming, or potentially will transform, trade practices.

We then used these categories to put market sizing numbers to each of the components so as to provide a framework for prioritisation and/or greater focus going forward.

The approach for the deep dive was as follows:

- (i) **Collection and collation of relevant specific digital economy developments from targeted agencies** in each country. These include pertinent areas of emerging digital trade such as autonomous vehicles (AVs), artificial intelligence (AI), and open banking.
- (ii) **Information gathering with targeted government agencies** involved in various aspects of digital trade and/or certain areas of digital economy development in each country.
- (iii) **Further market research and intelligence** to further develop the empirical depth to the various digital trade opportunities and to provide a more detailed elaboration of the opportunities that exist for digital trade, so as to baseline future trade discussions, joint development initiatives, and areas of regulatory and policy and collaboration.
- (iv) **Detailed information gathering on national and international standards** was conducted to map the different standards adopted by Australia and Singapore, in different aspects of the trade supply chain.

A number of government stakeholders were consulted to better understand specific digital economy developments and identify areas of digital trade growth. Relevant government agencies in Australia and Singapore were approached to clearly understand current and future focus areas, areas that they see to be of particular potential, and potential blockages (particularly from a trade, coordination or standards perspective).