Asia-Pacific Economic Cooperation

Promoting the Utilization of Paperless Trade Platforms in the Post COVID-19 Era

APEC Policy Support Unit

May 2025

Prepared by:
AA Access Partnership Pte Ltd
Main contributors: Marcus Ng (APAC Principal & Head of Economics Strategy); Jing Ting Toh (Manager); Daryl Teo (Manager). With support from: Johan Marulanda (Consultant); Sonia Kim (Consultant); Yu Jing Kew (Consultant)

Akhmad Bayhaqi, Andre Wirjo, Emmanuel A. San Andres and Eldo M. Simanjuntak
Asia-Pacific Economic Cooperation Policy Support Unit
Asia-Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace
Singapore 119616
Tel: (65) 6891-9600 Fax: (65) 6891-9690
Email: psugroup@apec.org Website: www.apec.org

Produced for:
Asia-Pacific Economic Cooperation
Committee on Trade and Investment

APEC#225-SE-01.2

The views expressed in this report are those of the authors and do not necessarily represent those of APEC Member Economies. The authors would like to thank Ms Nguyen Thu Quynh and Ms Chelsea Seah Jiaqi for their valuable contributions to the project.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF BOXES

EXECUTIVE SUMMARY

As the volume and importance of trade to APEC economies increases, it becomes more essential to improve trade efficiency to continually harness international trade for growth and development. In particular, there is an opportunity to leverage paperless trade platforms to digitalise the trade process. Existing literature have established a relationship between trade facilitation measures (such as paperless trade and trade agreements) and trade cost reductions. In turn, lower trade costs make it more favourable for economies to engage in cross-border trade, increasing trade flows and stimulating greater economic activity.

Against this background, it is timely to understand the opportunities for paperless trade and the enablers of successful paperless trade platforms, so as to identify the gaps and opportunities for policymakers to promote the adoption of paperless trade. While most existing research that look at the opportunities for paperless trade took a top-down approach, this study contributes to the field by collecting empirical evidence of the impact of public and commercial paperless trade platforms, through the exporters' perspective. The economic contribution of eight public platforms (Table 3.1) and 31 commercial platforms (Table 3.2) in eight APEC economies from different geographical regions ('eight in-scope economies') are the focus in this analysis.[1] The aim is to support APEC policymakers in making evidence-based policy decisions when considering the design of policies to promote the adoption of paperless trade platforms.

The research has uncovered eight key insights for the eight in-scope economies, also relevant to policymakers in the broader APEC region:

- **The adoption of paperless trade platforms, including both public and commercial platforms, reduced exporting firms' total trade costs by 3.8 percent on average.** These cost savings pertain to costs associated with border compliance and time in transit. Firms see average cost savings of 6.7 percent in undertaking border compliance processes, leading to a 1.7 percent reduction in firm level trade costs. In addition, shorter time was spent in transit due to the adoption of paperless trade platforms, leading to average reduction in trade costs by an additional 2.1 percent.

- **In 2021, the adoption of paperless trade platforms, including both public and commercial platforms, contributed USD 383 billion in value added to the eight in-scope economies, equivalent to around 0.8 percent of their aggregate GDP.** Around USD 105 billion of the economic contribution was from the direct effects of production activities undertaken by industries to produce the goods and services that were exported; more than USD 78 billion was attributed to the indirect effects from the production activities of industries along their supply chain; and almost USD 200 billion was attributed to the consumption induced effects from workers in those industries that increased their spending as their incomes rose. This economic activity supported more than 8.5 million jobs across the eight in-scope economies.

- **APEC economies differ in their level of readiness to maximise paperless trade adoption.** The level of readiness of individual economies to adopt paperless trade measures depends on i) the availability of quality ICT infrastructure, for users to adopt

[1] The eight in-scope economies are: Canada; Chile; People's Republic of China; Republic of Korea; Mexico; Peru; Singapore; and the United States.

new IT systems or services or be able to maximise the advantage of going paperless, and ii) prior experience in integrating digital technologies by trade stakeholders, proxied by the digital intensity of the economy (the share of the economy's intermediate and capital inputs that come from digital sectors). The analysis suggests that the eight in-scope economies differ in their level of readiness to maximise paperless trade adoption.

- **Switching costs and the digital skills gap are the key barriers to exporters for adopting commercial paperless trade platforms.** The research revealed that high monetary costs of switching to commercial paperless trade platforms and the lack of sufficient digital skills to navigate them were the main deterrents to adopting paperless trade platforms. Survey respondents have indicated that initial switching costs incurred can be quite substantial – on average, switching costs are equivalent to 20 percent of an organisation's annual costs. Among exporters that use paperless trade platforms, the overall digital skill levels of employees who use paperless trade also tends to be lower for SMEs on average. This might affect the ability of smaller exporters to fully utilise all available features of paperless trade platforms.

- **Cost savings for exporters are higher if they digitalise all key components of the trade process.** The research also revealed that exporters who use paperless trade platforms across all five components of the trade process report that they experience larger percentage border compliance cost savings on average, to the tune of 8–9 percent. This was observed for both SMEs and larger firms, and across exporting destinations that exhibit varying levels of paperless trade implementation. Interestingly, adopting paperless trade for one more trade process component might not necessarily lead to higher cost savings, if some part of the trade process is still completely manual.

- **There is room for commercial platforms to further support growth in paperless trade.** Commercial platforms vary widely in their reporting of network coverage and user adoption. Rates of adoption of electronic Bills of Lading (eBLs), however, show that eBLs are used in only a small fraction of total global trade, estimated in the low single digits. WaveBL states that it has issued more than 545,000 eBLs and covers 65 percent of the eBL market but this remains just a fraction of the 45 million Bills of Lading (BLs) issued a year.

- **Increasing user adoption of commercial platforms can lead to substantial growth in adoption of paperless trade but will have to be balanced against the pressure to be commercially viable for multiple stakeholders**, as seen in failures such as TradeLens. There are encouraging signs that this remains possible; platforms such as CargoWise and IQAX eBL are performing extremely well on both growth and profitability, while venture-backed platforms such as MineHub already exhibit clear paths to profitability.

- **Commercial platforms that provide services to simplify customs processes will likely be more successful at driving user adoption.** Insights from both survey responses and expert interviews revealed that the ability to simplifying compliance processes for trade documents, export permits and trade finance was most impactful in motivating user adoption. Several commercial paperless trade platform providers indicated that onboarding regulatory authorities and offering Single Window linkage were key differentiators that successfully spurred user adoption. Nonetheless, they acknowledged that there are practical limitations as these linkages can be time- and cost-intensive to set up – linking a

platform to a government system is a bespoke undertaking that can often take 6–12 months per customs system.

Based on the above insights, a review of regional best practices and ongoing developments in APEC, five recommendations were identified under two policy pillars for policymakers in APEC to promote greater adoption of paperless trade platforms.

Pillar 1: Promote the business case for paperless trade adoption

1. **Provide government support for employee upskilling to facilitate paperless trade adoption:** Businesses have diverse options to participate in paperless trade in several ways – platforms are one way to do so, alongside commercial providers that assist in the trade process. Regardless of the mode chosen by businesses, it would be beneficial to ease barriers to adopting paperless trade in a manner that is solution- and provider-agnostic to enable free and competitive markets. For platform adoption more specifically, the research found that the large initial investment required to upgrade computer hardware and software and to reskill employees form the main barriers to adoption for businesses, especially for SMEs with less resources. With initial switching costs a key factor, governments and solution providers may consider prioritising training and upskilling workers to be able to fully utilise commercial paperless trade platforms, and to choose the best one for their companies. Other recommendations include easier access to expert consultants, capacity training programmes for businesses and their employees (e.g., Certificate in Digital Trade Strategy by ICC), and organised exhibitions to help private sector companies showcase their solutions for paperless trade to prospective users.
2. **Demonstrate the financial benefits of paperless trade adoption for businesses:** Policymakers can better articulate the cost savings and advantages of paperless trade adoption for businesses to shift industry attitudes towards trade digitalisation. An example of a recent initiative includes the Ecosystem of Trust pilot reported by the UK government, which demonstrated that decision-making time for goods entering Britain could be reduced by 17 percent. Such studies help businesses visualise their returns to investing in paperless trade implementation in tangible terms, especially in relation to the upfront and ongoing costs required to use paperless trade platforms.
3. **Drive legal recognition of electronic documents:** The lack of full legal recognition for electronic trade documents or transferable records (e.g., BLs) in some economies generates uncertainty among exporters and other stakeholders that electronic records will be able to hold up in court in the event of disputes and may hinder the switch towards paperless trade processes. Policymakers should adopt legislation that recognises digital documents and transferable records in law and encourage adoption of electronic documents within specific industries. In addition, supporting legal frameworks, such as laws to ensure legal validity of digital signatures or for data protection, need to be in place to facilitate trust in the paperless trade process among stakeholders.

Pillar 2: Fostering interoperability and integration within the paperless trade ecosystem

1. **Promote alignment of electronic data formats, syntax, nomenclature and standards:** Establishing compatible data formats, syntax, nomenclature and standards

across different paperless trade systems would increase the efficiency of paperless trade, thereby further reducing costs. It would ensure that the same set of information submitted in one platform could be seamlessly transferred to another platform between the export origin and the import destination, hence reducing the need for duplication and re-entry. This would support greater interoperability between different paperless trade systems by facilitating the sharing and tracking of data across the entire supply chain. The lack of compatible data definitions across disparate organisations was an issue repeatedly raised by interviewees as a barrier to paperless trade. Initiatives like the ICC Digital Standards Initiative (DSI) play a vital role in the data alignment process, by promoting a shared understanding and standardised data exchange practices across the supply chain. To ensure the authenticity and verifiability of electronic documents, technological mechanisms to establish digital trust will also be essential.

2. **Promoting interoperability across commercial platforms:** Despite the fact that exporters tend to use more than one platform when digitalising their trade process, many paperless trade platforms are not interoperable with one another. This means that an exporter using multiple platforms might have to repeatedly enter the same data multiple times into different systems, lowering the productivity benefits from paperless trade adoption. Effort should be made to ensure interoperability between platforms and applications without limiting their design or operation (i.e., technology neutrality). Interoperability should allow for innovation. The aim should be to ensure systems can work together, not that they be exactly the same. Potential approaches to promote interoperability could rely on international standards developed through open and transparent processes. Other options could add trusted third parties or intermediaries that are accepted internationally. International acceptance is important when the goal is making global transactions seamless for traders. Additional opportunities are expected to develop as paperless trade becomes more prevalent. For instance, IQAX eBL has developed its Interoperable Addendum to allow for inter-platform transfers of eBLs with other system providers, as long as the transfer is to a platform approved by the International Group of Protection and Indemnity (P&I) Clubs for marine liability coverage, and the eBL is governed by the law of a jurisdiction that has accepted eBLs as equivalent to paper-based BLs.

1. INTRODUCTION

APEC economies have an opportunity to leverage paperless trade to boost efficiency, reduce costs, reduce the barriers to trade, and support economic growth. In APEC economies, multiple paperless trade platforms have been launched with the aim of digitalising the trade process which enables businesses to conduct cross-border trade in a more efficient and streamlined manner. This results in reduced trade costs and increases the potential for businesses to access new markets. Promoting the use of paperless trading platforms by traders in APEC economies, particularly the interoperability between these platforms, could lead to higher cross-border trade, improved economic efficiencies, and higher economic growth.

Against this background, APEC is seeking to better understand the current landscape of cross-border paperless trade and identify the gaps and opportunities to promote the adoption of paperless trade. Eight APEC economies from different geographical regions ('eight in-scope economies') are the focus in this analysis: Canada; Chile; People's Republic of China; Republic of Korea; Mexico; Peru; Singapore; and the United States.

The analysis involved a stocktake of relevant public and commercial paperless trade platforms used by each economy and a review of each platform's functions, as well as primary research through a multi-economy survey of exporters, and interviews with relevant stakeholders interacting with these platforms. The insights further an understanding of the user benefits of paperless trade for each in-scope economy, the enablers of successful paperless trade platforms, and key recommendations to help businesses engage in paperless trade through the platforms.

2. DEVELOPMENTS IN PAPERLESS TRADE IN APEC

As the volume and importance of trade to APEC economies increase, the case for digitising trade procedures, or specifically paperless trade, becomes more urgent.[2] APEC's total merchandise trade and commercial services trade grew almost fivefold between 1994 and 2019.[3] To harness international trade for growth and development, APEC economies have consistently worked to improve trade efficiency, especially through technological solutions like automated customs systems, electronic single windows, and other trade digitisation initiatives. Paperless trade is beneficial for maintaining trade competitiveness and facilitating cross-border e-commerce. Paperless trade refers to the digitisation of information flows between relevant parties when goods and services cross borders in international trade. This involves enabling the exchange of trade-related data and documents electronically. Less formally, one can think of this as cross-border trade transactions using electronic data in lieu of paper-based documents.[4]

The potential for paperless trade to improve the trade process can be illustrated with the Bill of Lading (BL), a document of title over goods in transit, which is a key document for international trade. The BL facilitates goods release and serves vital roles in processes such as customs clearance, payment claims, and aiding negotiations in intricate cross-border shipments. The seller (exporter) engages the carrier to deliver cargo and receives a BL, which is then released to the buyer (importer) upon payment. The buyer can only collect the goods when they produce the original BL, hence the possession of the original BL is of crucial importance. This paper-based model poses costs for international trade participants. A delay in the arrival of the original BL can significantly increase cargo holding costs and hold back the issuance of other documents like Letter of Credit (L/C) and customs clearance, disrupting the entire supply chain. Furthermore, the original BL still requires many stakeholders to print, stamp, and sign various paper copies before physically transporting them from origin to destination as air express shipments, which incurs time costs, monetary costs and is vulnerable to error. The acceptance and adoption of electronic trade documents such as an electronic bill of lading (eBL) would speed up the end-to-end documentation processing, mitigate fraud risk, provide cost savings, unlock trade finance, and enable innovative business models.

The overall benefits of encouraging cross-border paperless trade have been well-established in recent studies, including progress towards economic, social, and environmental goals. At its core, it has the potential to reduce cross-border trade costs and boost trade volumes. The Asia-Pacific Trade Facilitation Report 2024 found that the implementation of paperless trade together with general facilitation measures laid out in the

---

2 This is understood to be the application of modern information and communication technologies (ICTs) to simplify and automate international trade procedures. Duval, Y. and Mengjing, K (2017). *Digital Trade Facilitation: Paperless Trade in Regional Trade Agreements. ADBI Working Paper 747. Tokyo: Asian Development Bank Institute.* Available at: https://www.adb.org/sites/default/files/publication/321851/adbi-wp747.pdf

3 APEC Policy Support Unit (2020), *Research Outcomes: Summary of Research Projects and COVID-19 Policy Briefs 2020.* Available at: https://www.apec.org/docs/default-source/Publications/2021/7/Research-Outcomes-Summary-of-Research-Projects-and-COVID-19-Policy-Briefs-2020/221_PSU_Research-Outcomes-2020.pdf

4 This leverages the United Nations Economic Commission for Europe definition of paperless trade: When goods and services cross borders in international trade, information needs to be passed between relevant parties, whether private companies or public bodies, including suppliers, logistics providers, customs, regulatory agencies, sellers, and buyers. APEC Sub-Committee on Customs Procedures (2022), *Analysis and Pathway for Paperless Trade Report.* Available at: https://www.apec.org/docs/default-source/publications/2022/3/analysis-and-pathway-for-paperless-trade-report/222_sccp_analysis-and-pathway-for-paperless-trade-report.pdf?sfvrsn=fdd43e59_2#:~:text=Paperless%20trade%20refers%20to%20the,lieu%20of%20paper%2Dbased%20documents.

WTO Trade Facilitation Agreement could yield a reduction of 11 percent in trade costs.[5] These savings come directly in the form of lower compliance costs, and indirectly through savings from faster movement of goods and lower inventory costs. The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) estimated that moving from paper-based to paperless trade in Asia and the Pacific could generate an additional USD 36 billion to 257 billion in annual exports, depending on the scale of automation and digitisation.[6]

The use of paperless trade also enhances opportunities for small and medium-sized enterprises (SMEs) to participate in cross-border trade by mitigating the disproportionately high costs associated with trading, thus increasing the level of participation and the inclusiveness of international trade. Paperless trade can also help promote women's participation in trade by making trade more accessible to women, especially when complemented with programmes to increase women's awareness of such platforms.[7] Governments also stand to benefit from increased traceability and security of documents, with paperless trade potentially reducing tax revenue losses from illicit financial flows through incorrect trade invoicing by at least USD 100 billion per year.[8] Paperless trade adoption has a noticeable environmental benefit too. By driving a reduction in the printing, dispatching, processing, exchanging, and ultimately discarding of vast quantities of paper documents used in trade, paperless trade has the potential to enable carbon dioxide equivalent (CO_2e) emission savings in Asia-Pacific of 13 million tons of CO_2e annually (equivalent to planting 400 million trees).[9]

As such, there has been significant global and regional effort directed at accelerating paperless trade, focused on promoting interoperability, and building capacity among policymakers and users. There has been significant attempts to produce and align global standards and promote interoperability, in particular the Standards Toolkit for Cross-Border Paperless Trade to help businesses and governments understand and align on the various standards already in place for facilitating paperless trade,[10] and the ICC Digital Standard Initiative (DSI) which is recommending common data elements for key trade documents such as BL, L/C and certificates of origin.[11]

With regard to government measures that can promote paperless trade, practical guides and instruments have become available to economies, such as The Framework Agreement on

---

5 Asian Development Bank and the United Nations Economic and Social Commission for Asia and the Pacific (2024), *Asia-Pacific Trade Facilitation Report 2024: Promoting Sustainability and Resilience in Global Value Chains.* Available at: https://www.unescap.org/kp/2024/asia-pacific-trade-facilitation-report-2024-promoting-sustainability-and-resilience-global

6 Shepherd and Duval (2015). *Estimating the benefits of cross-border paperless trade in Asia and the Pacific.* ESCAP. Available at: https://www.unescap.org/sites/default/d8files/Part%20II_Chapter%20V_Estimating%20the%20benefits%20of%20cross-border%20paperless%20trade_0.pdf

7 UNCTAD (2020), *Digital trade facilitation for women cross-border traders.* Available at: https://unctad.org/news/digital-trade-facilitation-women-cross-border-traders

8 Kravchenko (2023), *Estimating the effect of trade facilitation implementation on trade misinvoicing-based illicit financial flows and tax revenue in Asia and the Pacific.* Available at: https://www.unescap.org/sites/default/d8files/event-documents/ESCAP_Effect_of_trade_facilitation_StatsCafe_26Sep2022.pdf

9 Duval and Hardy (2021), *A primer on quantifying the environmental benefits of cross-border paperless trade facilitation.* ESCAP. Available at: https://www.unescap.org/kp/2021/primer-quantifying-environmental-benefits-cross-border-paperless-trade-facilitation

10 Ganne and Nguyen (2022), *Standards Toolkit for Cross-Border Paperless Trade: Accelerating Trade Digitalisation through the Use of Standards*. International Chamber of Commerce (ICC), Available at: https://www.wto.org/english/res_e/booksp_e/standtoolkit22_e.pdf

11 International Chamber of Commerce (2023), "ICC Digital Standards Initiative launches expanded recommendations for trade documents". Available at: https://iccwbo.org/news-publications/news/icc-digital-standards-initiative-launches-expanded-digitalisation-recommendations-for-14-key-trade-documents/

Facilitation of Cross-border Paperless Trade in Asia and the Pacific (CPTA), and the OECD Cross-Border Paperless Trade Toolkit for legal and technical checklists. In 2021, the Sub-Committee on Customs Procedures (SCCP) Guidelines for Paperless Trade were also published, setting out a non-exhaustive set of guidelines to assist APEC economies in implementing electronic paperless customs procedures.[12] The UNESCAP Cross-Border Paperless Trade Database provides updated information about governments' latest programmes for exchanging certified information or data. Comparative tools like the UN Global Survey on Digital and Sustainable Trade Facilitation track and highlight the progress and adoption of digital trade generally, enabling economies to benchmark themselves on a wide range of measures. Furthermore, regional trade agreements (RTAs) and free trade agreements (FTAs) such as the Regional Comprehensive Economic Partnership (RCEP) and Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) increasingly incorporate digital trade provisions related to government acceptance of electronic trade data, such as through a single window.[13]

On average, APEC economies are ahead of the rest of the world in terms of progress in implementing trade digitalisation measures, although performance varies within APEC. Built upon the UN Global Survey on Digital and Sustainable Trade Facilitation (henceforth referred to as UNTF), the Trade Digitalisation Index (TDI) specifically focuses on the 16 key measures tied to the government implementation of paperless trade measures and government enablement of private sector use of electronic documents and data for paperless trade.[14] Figure 2.1 presents the trade digitalisation scores for each APEC economy and how they compare with the global average. Among individual economies, leaders in overall paperless trade adoption include New Zealand at 96 percent; alongside Australia; the Republic of Korea; and Singapore at 93 percent. Notably, while the APEC average of 80 percent exceeds the global average of 59 percent, some disparities remain: advanced economies generally outperform developing ones in paperless trade, underscoring the call for collaborative efforts.

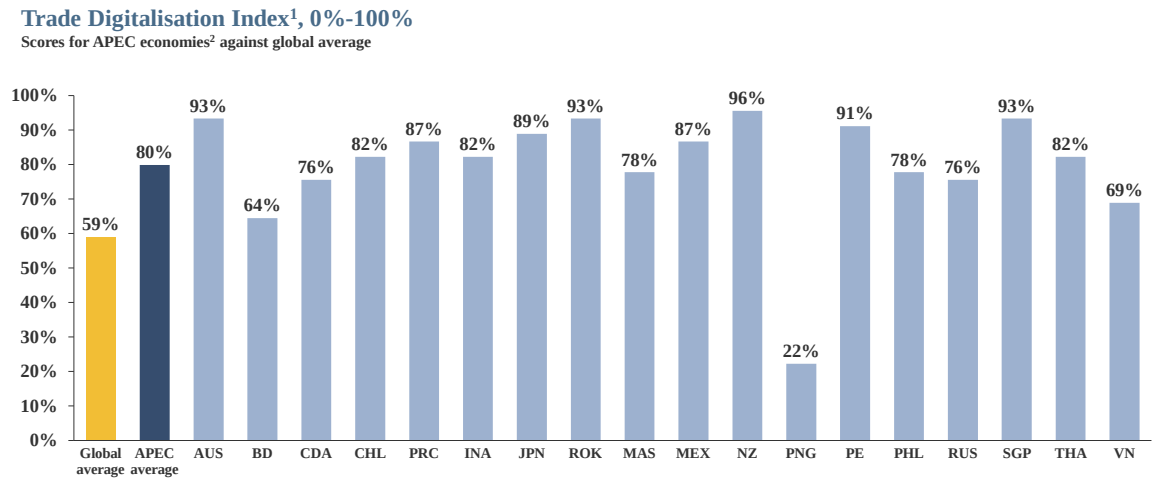
---

[12] APEC Sub-Committee on Customs Procedures (2021), *Guidelines for Paperless Trade.* Available at: https://www.apec.org/publications/2021/11/guidelines-for-paperless-trade

[13] Such provisions relate to the facilitation of electronic custom procedures to import and export goods and include commitments to provide for pre-arrival processing of trade documents electronically as well as make trade administration documents available in an electronic format. This could include the establishment of a 'trade single window' to enable traders to submit documentation for import, export, or transit of goods to the custom authorities. See Article 7.1 (Pre-arrival processing), 10.2 (Acceptance of Copies), and 10.4 (Single Window) of the WTO Trade Facilitation Agreement. A Trade Single Window allows the trader or intermediary to submit all border data needed in a standardised format. This would mean submitting only once to border authorities through a single portal. Access Partnership (2023), *Economic Impact of Adopting Digital Trade Rules: Evidence from APEC Member Economies.* Available at: https://www.apec.org/publications/2023/04/economic-impact-of-adopting-digital-trade-rules-evidence-from-apec-member-economies.

[14] Following the typology adopted in the UN Global Survey on Digital and Sustainable Trade Facilitation (UNTF) Survey, trade digitalisation is comprised of UNTF data elements related to: 'paperless trade' and 'cross-border paperless trade'. Paperless trade covers measures that governments take to digitise their border procedures for cross-border trade. Cross-border paperless trade focuses on the measures that governments can take to foster the legal recognition and exchange of trade-related data and documents in electronic form. The measure 'Electronic submission of Sea Cargo Manifests' is excluded because it is not pertinent to all domestic contexts. Duval, Prince and Utoktham (2023), "Advancing Digital Transformation: Global Insights into the Digitalisation of Trade Procedures". Available at: https://unctad.org/news/advancing-digital-transformation-global-insights-digitalisation-trade-procedures

Figure 2.1 APEC economies have fared well in implementing trade digitalisation measures



Source: UN Global Survey on Digital and Sustainable Trade Facilitation.
Notes:

- The UNTF Survey provides an implementation score, ranging from zero to three, for each of the 16 digitalisation measures. The overall index reflects how well an economy performs across the digitalisation measures, calculated as the total implementation score divided by the maximum achievable score. This index serves as a benchmark for economies aiming to gauge and enhance their advancements in trade digitalisation, offering a comprehensive understanding of the evolving landscape and promoting sustainable, digitally driven trade facilitation.
- Scores were not available for the following economies: Hong Kong, China; Chinese Taipei; and the United States.

However, APEC economies differ in their level of readiness to maximise paperless trade adoption, as measured by ICT infrastructure and digitalisation levels.

Beyond the implementation of paperless trade and cross-border paperless trade measures by economies, paperless trade also relies on the availability and usage of quality ICT infrastructure, for users to adopt new IT systems or services or be able to maximise the advantage of going paperless. All stakeholders in the economy including importers, exporters, agents, and service providers should also have access to robust networks for effective electronic interactions. Unavailability of network services could be one of the obstacles in full implementation of a trade facilitation system when the business process is incomplete due to missing parties in the network connectivity. The share of individuals using the Internet (percentage of population), a measure of network coverage and availability for current and prospective paperless trade users within each in-scope economy, reflects some differences across economies (Table 2.1). The Republic of Korea (98 percent); Singapore (97 percent); Canada (93 percent); the United States (92 percent); and Chile (90 percent) lead with more than 9 in 10 persons using the Internet, in contrast to Mexico (76 percent); People's Republic of China (73 percent); and Peru (71 percent).

In addition, trade stakeholders need to be ready to accept changes arising from re-engineered business processes in implementing paperless trade systems. Prior experience in integrating digital technologies tends to be a major factor for stakeholders' openness towards paperless trade. In this context, existing digitalisation levels are a key indicator of such readiness and enable stakeholders to maximise the advantages of paperless trade. Digitalisation should capture how digital technologies and inputs are leveraged in business operations or production activities. Based on a new approach developed by Access Partnership (Box 2.1), the level of digitalisation for each economy can be measured by its digital intensity, or the share of the economy's intermediate and capital inputs that come from digital sectors. When examining

digital intensity across economies, digitalisation levels are highest for Singapore (14.4 percent); the United States (10.4 percent); and the Republic of Korea (9.4 percent), indicating that these economies use a greater share of digital inputs in their production processes. Digitalisation levels are lowest for Peru (2.2 percent); Mexico (4.1 percent); and Chile (5.1 percent), suggesting that they may be less experienced in doing so and would require more capacity building on related factors such as digital skills and business process engineering expertise.

Table 2.1 Internet usage and digitalisation level by economy

ICT metric	CDA	CHL	PRC	ROK	MEX	PE	SGP	USA
Internet usage	93%	90%	73%	98%	76%	71%	97%	92%
Digital intensity	7.5%	5.1%	6.3%	9.4%	4.1%	2.2%	14.4%	10.4%

Source: International Telecommunication Union (ITU) World Telecommunication/ICT Indicators Database, Access Partnership analysis.

Box 2.1 Digital Intensity as an approximation of digitalisation

Existing studies typically measures digitalisation through digital connectivity indicators such as the extent of internet access or usage. However, this is unable to provide a direct indication of the extent to which the business leverages digital tools to improve or transform the process of producing goods and services. As an approximation for digitalisation, digital intensity[15] measures the extent to which output within a sector is produced using digital goods and services inputs, including digital technologies. Digitalisation can enter the production process through one of two input components used in production: (i) raw materials (intermediate inputs)[16]; and (ii) machinery and equipment (capital inputs); hence the estimation of digital intensity within each economy involves capturing digital inputs in both intermediate inputs and capital inputs as part of distinct inputs contributing to the production process.

Intermediate inputs

For intermediate inputs, digital intensity is defined as the proportion of digital inputs[17] to the total intermediate inputs within a given sector, or as follows:

$$DI_{ikt}^{m} = \frac{IC_{ikt}^{\omega}}{IC_{ikt}^{\Omega}},$$

$$where\ \omega\ and\ \Omega\ refer\ to\ the\ digital\ and\ total\ intermediate\ inputs, respectively$$

Capital inputs

Digital intensity for capital inputs is defined as the share of capital services attributed to digital capital (more commonly known as ICT capital[18])[19], and approximated[20] by the share of capital compensation[21] that is attributable to ICT capital owners, or as follows:

$$DI_{ikt}^{c} = \frac{u_{ikt}^{\omega}}{u_{ikt}^{\Omega}},$$

$$where\ \omega\ and\ \Omega\ refer\ to\ the\ digital\ and\ total\ capital\ compensation, respectively$$

To ensure analytical accuracy, changes in digital intensity over time are disaggregated into price and volume effects. This involves deflating intermediate inputs using sector-specific output deflators and capital inputs using asset-specific deflators. Adjusting for price fluctuations isolates the impact of digitalisation, measured by the volume of digital inputs as a share of total inputs in a given year, on digital trade.

---

15 See Chiappini, R. and Gaglio, C. (2023), *Digital intensity, trade costs and exports' quality upgrading.* Available at: https://onlinelibrary.wiley.com/doi/full/10.1111/twec.13448. For alternate measures of digital intensity, see Liu and McDonald-Guimond (2021*), Measuring digital intensity in the Canadian economy.* Available at: https://www150.statcan.gc.ca/n1/pub/36-28-0001/2021002/article/00003-eng.htm; and European Commission (n.d.), "Digital Intensity Index". Available at: https://ec.europa.eu/eurostat/cache/metadata/en/isoc_e_dii_esmsip2.htm

16 The Bureau of Economic Analysis (BEA) defines Intermediate Inputs as "Goods and services that are used in the production process of other goods and services and are not sold in final-demand markets."

17 Referencing the OECD's proposed definition of the digital sector, digital inputs are identified as follows: digital goods refer to the manufacture of computer, electronic, and optical products (division 26 of sector C from ISIC, revision 4), while digital services include publishing, programming, and broadcasting activities (divisions 58–60 of sector J),

Nevertheless, individual APEC economies are actively collaborating on cross-border paperless trade projects and demonstrating the viability of paperless trade. The Cross-Border Paperless Trade Database[22], a joint initiative from the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) and the International Chamber of Commerce (ICC), tracks collaborative projects managed by private and public stakeholders with the objective of reducing paper-based processes and developing new methods to exchange electronic data and documents. Drawing from the projects recorded in this database, Table 2.2 outlines the projects that the eight in-scope economies are currently collaborating on. This was performed by accessing the project database (www.digitalizetrade.org/projects) and selecting the relevant filtering parameters: these include the desired in-scope economies and project status (Operating/Pilot) in the respective dropdown lists. Only projects with two or more in-scope economies involved in collaboration were selected for inclusion in Table 2.2.

Table 2.2 Project collaboration between economies of interest

Project	APEC in-scope economies involved	Description
Asia-Pacific Model E-port Network (APMEN)	Canada; Chile; People's Republic of China; Mexico; and Peru	The APMEN project aims to create a blockchain-powered open data platform in Shanghai's Free Trade Zone for cross-border supply chain traceability, enhancing trade facilitation across Asia-Pacific.
Electronic Origin Data Exchange System, China (EODES)	Chile; People's Republic of China; Republic of Korea; and Singapore	EODES enables the electronic submission of Preferential Certificate of Origin (PCO) and e-Declaration of Origin, shortening transmission times and reducing time-to-market for goods.
PAA e-AWB	People's Republic of China; Republic of Korea; and Singapore	PAA e-AWB aims to streamline air cargo exchanges by replacing traditional paper air waybills with electronic versions, enabling secure and reliable transmission of trade data among the PAA members.
PAA Secure Cross-Border Transaction Service	People's Republic of China; Republic of Korea; and Singapore	The PAA Secure Cross-Border Transaction Service facilitates electronic exchange of trade documents between partners, regardless of their individual systems or solutions, by providing transaction services.

telecommunications (division 61 of sector J), computer programming, consultancy, and related activities, and information service activities (divisions 62–63 of sector J).

18 Leveraging the OECD's breakdown of fixed capital assets into ICT and non-ICT assets according to the 2008 System of National Accounts, ICT assets encompass Computer hardware, Telecommunication equipment, and Computer software and databases.

19 Capital services are considered to be an appropriate measure of capital input in production analysis. OECD (2021), *OECD Productivity Statistics Database: Methodological Notes.* Available at: https://www.oecd.org/sdd/productivity-stats/OECD-Productivity-Statistics-Methodological-note.pdf

20 Measures of capital services are typically based on productive capital stocks derived using the perpetual inventory method (PIM), resting on the idea that stocks constitute cumulated flows of investment, corrected for retirement and efficiency loss. While theoretically sound, severe data limitations exist for investment flows by asset and sector since 2000, making comparable capital services computations difficult.

21 The capital compensation of a specific industry is equal to the value added of the industry in question minus the wage share (i.e. labour compensation).

22 Access Partnership analysis. Accessed in January 2025. Available at: www.digitalizetrade.org/projects. The database contains a total of 98 projects: 16 global, 41 regional, and 41 bilateral.

Project	APEC in-scope economies involved	Description
Digitisation of ATA Carnet: A Step Closer with the Launch of Pilot Project (Mercury II Pilot project)	Canada; and People's Republic of China	An initiation by ICC WCF to bring seven selected economies in a pilot project to digitalise the ATA Carnet, a customs document allowing duty- and tax-free movement of goods for up to one year.
Pacific Alliance- Electronic exchange of customs information (Chile, Mexico, Peru, Columbia)	Chile; Mexico; and Peru	The Pacific Alliance interoperability project connects the single windows of member economies and standardises customs information exchange.
Exchange of electronic phytosanitary certificates (ePhytos)	Republic of Korea; and the United States	This is a digital operation to adopt the exchange of ePhyto solution developed by the Food and Agriculture Organization's (FAO) International Plant Protection Convention (IPPC).
Regional Customs Cooperation in Latin America	Chile; and Peru	Regional Customs Cooperation is an agreement boosting intra-regional trade in Latin America by making it simpler, faster and more cost-effective for AEO companies to trade across the region.
NEAL-NET	People's Republic of China; and Republic of Korea	NEAL-NET is a transnational platform that allows the exchange of logistics information about vessels and containers as they engage in cross-border trade between the participating economies.
Trade Financing Pilots to Promote Digital Trade between Singapore and China under Singapore – China (Shenzhen) Smart City Initiative (SCI)	People's Republic of China; and Singapore	Enabled by IMDA's TradeTrust framework, banks, shipping lines, buyers, sellers, platform service providers and fintech companies have collaborated on successful technical pilots on trade financing using simulated electronic Bills of Lading (eBLs).

Source: ESCAP Cross-Border Paperless Trade Database.

3. THE LANDSCAPE OF PAPERLESS TRADE PLATFORMS IN APEC

3.1 THE TYPES OF PAPERLESS TRADE PLATFORMS

Paperless trade platforms are used to digitise documents related to trade procedures, such as bills of lading (BL), letters of credit (L/C), invoices (I/V), insurance policies (I/P), shipping instructions (S/I), electronic warehouse receipts (EWR) and purchase orders (P/O). In this way, they disrupt paper-based trade documentation processes that are time- and cost-intensive, where international trade participants continue to rely heavily on legacy mechanisms based on paper.

Paperless trade platforms have very different purposes and considerations depending on whether they are government-operated systems that collect trade information primarily for regulatory purposes ('public platforms') or privately-operated systems that primarily facilitate the business-to-business exchange of trade information ('commercial platforms').[23] These two categories are discussed below:

3.1.1 Public platforms (including single windows)

Government-operated electronic trade Single Window (SW) systems streamline trade processes by enabling stakeholders to electronically submit data, information and documents through a single point, fulfilling all regulatory requirements for import, export, and transit.[24] This single entry point for submission of regulatory trade documents streamlines processes across different regulatory agencies, generating efficiency gains. Primarily functioning as Business-to-Government (B2G) and Government-to-Government (G2G) data exchanges, these SWs can evolve into domestic trade platforms, offering value-added government services like e-payments, logistics options, insurance options, and data insights.[25] For instance, the Republic of Korea's Single Window, UNI-PASS, links to uTradeHub, which offers a full range of trade-related services related to financing, insurance, transportation and logistics. The summary of individual platforms can be found in Annex D.

Table 3.1 Public platforms in place across eight in-scope APEC economies

Economy	Public platforms in place
Canada	Single Window Initiative
Chile	Integrated Foreign Trade System (Sistema Integrado de Comercio Exterior de Chile, or SICEX)
People's Republic of China	China International Trade Single Window
Republic of Korea	UTRADE HUB / UNI-PASS
Mexico	Single Window for Mexican Foreign Trade (Ventanilla Única de Comercio Exterior Mexicana, VUCEM)

[23] There are also privately-operated platforms for regulatory purposes, and government-affiliated platforms that serve business-to-business exchanges, but these tend to be the exception rather than the norm.

[24] Single Window Compendium (2017). *Understanding Single Window Environment.* Available at: https://www.wcoomd.org/-/media/wco/public/global/pdf/topics/facilitation/instruments-and-tools/tools/single-window/compendium/swcompendiumvol1parti.pdf

[25] Bayhaqi and Singh (2018), *Study on Single Window Systems' International Interoperability: Key Issues for Its Implementation.* APEC Policy Support Unit. Available at: https://www.apec.org/docs/default-source/publications/2018/8/study-on-single-windows-systems/218psustudy-on-single-windows-systems.pdf?sfvrsn=d3347f05_1

Economy	Public platforms in place
Peru	Single Window for Foreign Trade (Ventanilla Única de Comercio Exterior, or VUCE)
Singapore	Networked Trade Platform / TradeNet
United States	Automated Commercial Environment (ACE)

Source: Literature review.

3.1.2 Commercial platforms

Commercial platforms are privately operated and tend to focus on Business-to-Business (B2B) exchanges.[26] Platforms can vary in terms of geographic reach, services offered, and underlying technology.[27] 31 commercial platforms were for analysis in this paper based on their relevance and representativeness within the eight in-scope economies, regardless of their origin (Table 3.2). The summary of individual platforms can be found in Annex D.

Table 3.2 Select list of 31 commercial platforms, by economy of origin

Economy	Commercial platforms
Argentina	edoxOnline
Australia	Cargo Wise
Canada	MineHub, Morpheus.Network, Surecomp
People's Republic of China	People's Bank of China Blockchain Trade Finance Platform, Trusple, TradeGo
Germany	SAP
Hong Kong, China	GSBN, IQAX
Israel	WaveBL
Japan	TradeWaltz Inc
Malta	ICE Digital Trade
New Zealand	TradeWindow
Singapore	CrimsonLogic, dltledgers, E-Title, GUUD (CamelONE), TradeFinex
Slovenia	CargoX
Sweden	Enigio
Switzerland	Covantis, Komgo
UK	Bolero, eTEU eBL Platform, VAKT
United States	Secro, Infor Nexus, E2OPEN, EC3 (Skuchain)

Source: Literature review.

Notes: People's Bank of China Blockchain Trade Finance Platform, while managed by the Institute of Digital Currency by the central bank, is categorised among commercial platforms instead of public platforms for convenience, as it is not directly connected to the China International Trade Single Window. eTradeConnect and CargoSmart were excluded from the preliminary list due to lack of data on recent operations.

3.1.3 Functions of paperless trade platforms

Paperless trade platforms can support international trade participants across the five key components of a typical trade process (Table 3.3). Of these five process components, 'preparing documents' was naturally the most prevalent offering offered by paperless trade platforms given the main value proposition of digitising trade documents. 'Declaring customs' was a key offering for public platforms, whereas 'financing trade' and 'arranging shipment and tracking' were prominent for commercial platforms (Table 3.3).

---

[26] UNESCAP (2022). *Legal Readiness Assessment Guide.* Available at: https://readiness.digitalizetrade.org/legal-guide/iia-establishment-paperless-trade-system

[27] Boston Consulting Group (2019), *Digital Ecosystems in Trade Finance: Seeing Beyond the Technology.* Available at: https://web-assets.bcg.com/img-src/BCG_Digital_Ecosystems_in_Trade_Finance_tcm9-229964.pdf

Table 3.3 Offerings of paperless trade platforms

Process components	Prevalence of offering (i.e., offered by)	Role of paperless trade platforms
Preparing documents	8 of 8 public platforms; 31 of 31 commercial platforms	Paperless trade platforms allow for the preparation of documents required as part of the trade procedure, including invoice, export licenses and certificates of origin, in digital format, and can also include features that facilitate the consolidation of trade documents.
Financing trade	3 of 8 public platforms; 22 of 31 commercial platforms	Paperless trade platforms can digitise trade finance documents such as Letters of Credit and support the matching of traders to lenders. Platforms can also integrate automated checks to ensure compliance with relevant trade finance regulations.
Arranging shipment and tracking	4 of 8 public platforms; 20 of 31 commercial platforms	Managing documents related to freight management and booking of containers and fleets, such as eBLs and cargo manifests, can be done online through paperless trade platforms, reducing the need for complex paper documents.
Declaring customs	8 of 8 public platforms; 16 of 31 commercial platforms	Paperless trade platforms can be used to submit official documents to regulatory bodies (both domestically and in the exporting destination), such as certificates of origin and export and import declarations.
Reporting and payment	6 of 8 public platforms; 9 of 31 commercial platforms	Paperless trade platforms facilitate the reconciliation of freight invoices digitally and support the use of digital payments for cross-border transactions.

Source: Literature review.
Notes: The work of customs brokers cut across several of these process components; platforms can complement such work. See Annex D for the full stocktake of paperless trade platforms.

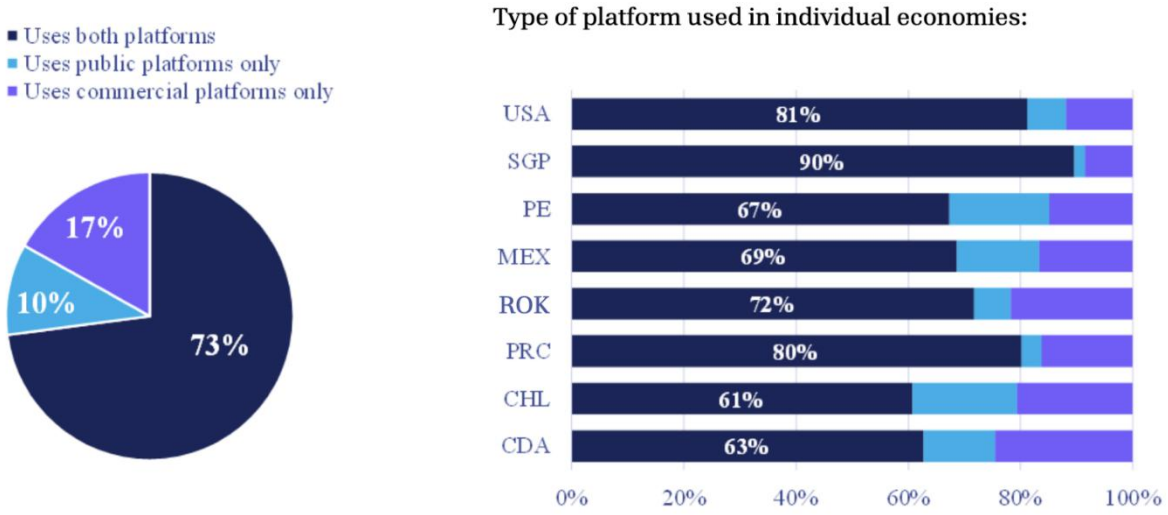
3.2 USAGE PATTERNS OF PAPERLESS TRADE PLATFORMS

To understand the actual usage patterns of paperless trade platforms by exporters in each of the eight in-scope economies, a survey was conducted with 831 exporting businesses that use cross-border paperless trade platforms, with at least 97 respondents sampled in each economy (see Annex A).

3.2.1 Types of platforms used

Most exporters use a mixture of both government and commercial platforms. 73 percent of survey respondents indicate that they use both government and commercial platforms. There is some variation by economy – only 61 percent of respondents from Peru uses both government and commercial platforms, while 90 percent do the same in Singapore (Figure 3.1).

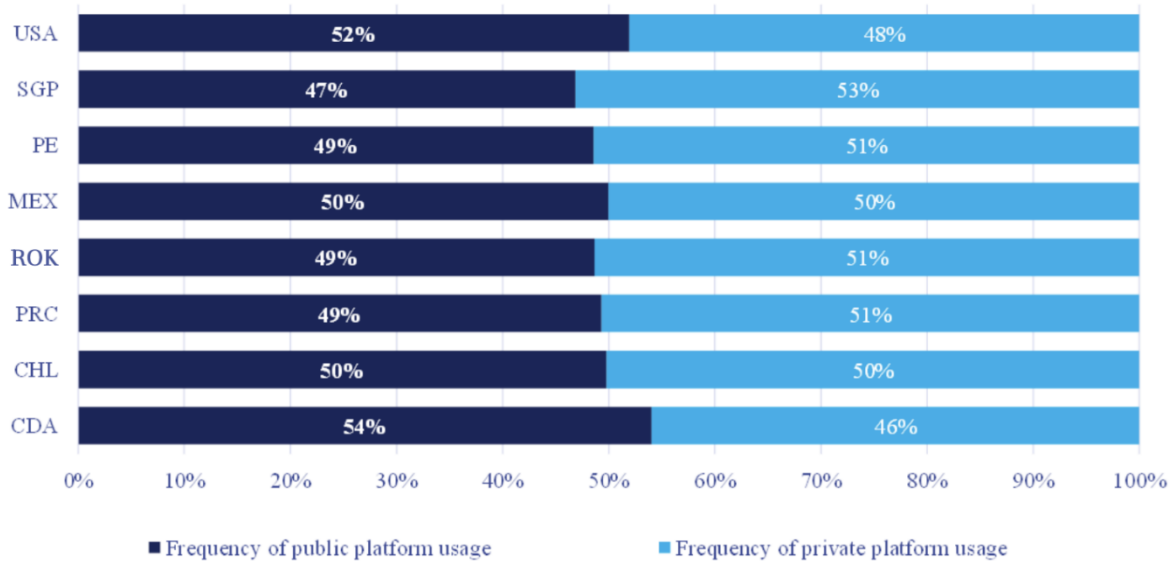
Figure 3.1 Type of paperless trade platforms used by exporting businesses in eight APEC in-scope economies (%, split by economy)



Source: Access Partnership analysis from a survey of exporters across eight in-scope economies (Canada; Chile; People's Republic of China; Republic of Korea; Mexico; Peru; Singapore; and the United States).

On average, government and commercial platforms are used to an equal extent – respondents who use both platforms use government platforms 50 percent of the time, and this was consistent across the eight in-scope economies (Figure 3.2).

Figure 3.2 Frequency of public and private platform usage by exporting businesses that use both platforms (%, split by economy)



Source: Access Partnership analysis from a survey of exporters across eight in-scope economies (Canada; Chile; People's Republic of China; Republic of Korea; Mexico; Peru; Singapore; and the United States).

Respondents also tend to use more than one commercial platform when carrying out the trade process. On average, respondents use four commercial platforms. While actual platforms used differ for exporters in each economy, CargoX and Bolero seem to be most widely used. CargoX was indicated as one of the top three commercial platforms used in six of the eight in-scope economies, while was indicated in five economies (Table 3.4).

Table 3.4 Top three commercial platforms used by exporters

CDA	CHL	PRC	ROK	MEX	PE	SGP	USA
CargoX (36%)	CargoX (33%)	People's Bank of China Blockchain Trade Finance Platform (54%)	CargoX (30%)	Cargo X (39%)	Bolero (36%)	E-Title (37%)	E-Title (50%)
Bolero (31%)	Bolero (28%)	TradeGo (34%)	ICE Digital Trade (22%)	edoxOnline (38%)	CargoX (30%) TradeGo (30%)	CargoX (32%)	WAVE (35%)
WAVE (25%)	edoxOnline (22%)	ICE Digital Trade (17%) Enigio (17%)	SAP (19%)	SAP (36%)		Bolero (31%)	Bolero (32%) CargoX (32%)

Source: Access Partnership analysis from a survey of exporters across eight in-scope economies (Canada; Chile; People's Republic of China; Republic of Korea; Mexico; Peru; Singapore; and the United States).
Note: Based on number of respondents who indicated that their business uses a platform. Respondents may use more than one platform.

3.2.2 Types of activities performed on paperless trade platforms

Platforms were most commonly used for preparing documents, most notably to align documents to international standards (Table 3.5).

Table 3.5 Types of activities carried out on paperless trade platforms by firms

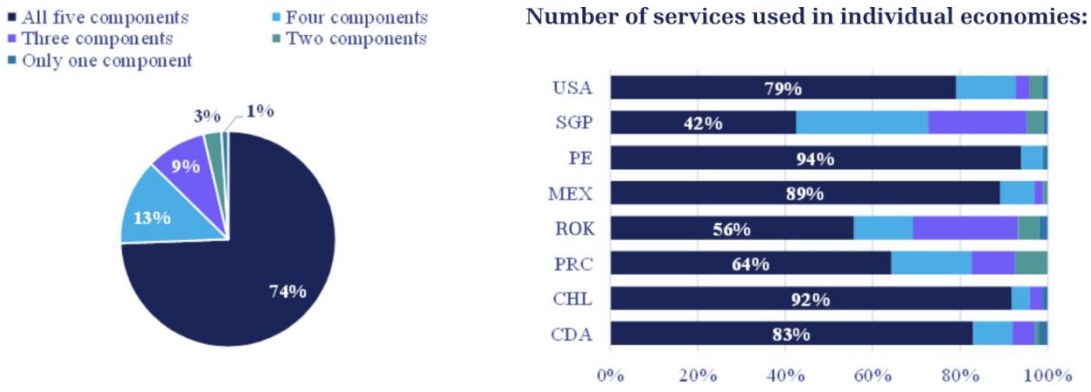
		CDA	CHL	PRC	ROK	MEX	PE	SGP	USA	Average (eight economies)
Prepare documents	**At least one of the following:**	**96%**	**93%**	**93%**	**94%**	**100%**	**97%**	**95%**	**95%**	**95%**
	Align documents to international standards	78%	75%	68%	79%	75%	73%	45%	79%	72%
	Digitise and automate workflow	57%	46%	51%	42%	52%	49%	61%	31%	49%
Finance trade	**At least one of the following:**	**89%**	**92%**	**78%**	**84%**	**95%**	**94%**	**72%**	**85%**	**86%**
	Obtain trade financing options	49%	51%	51%	55%	42%	57%	40%	39%	48%
	Ensure compliance to trade finance regulations	62%	68%	45%	49%	73%	59%	37%	63%	57%
Arrange shipment and tracking	**At least one of the following:**	**93%**	**96%**	**90%**	**86%**	**96%**	**95%**	**73%**	**85%**	**89%**
	Use freight management system (FMS)	56%	45%	59%	45%	50%	54%	23%	42%	47%
	Book shipping containers	55%	48%	53%	54%	43%	47%	40%	37%	47%
	Optimise fleet	43%	37%	35%	37%	37%	33%	19%	32%	34%

		CDA	CHL	PRC	ROK	MEX	PE	SGP	USA	Average (eight economies)
	Track and trace shipments	42%	40%	41%	28%	44%	29%	17%	13%	32%
Declare customs	**At least one of the following:**	**92%**	**94%**	**86%**	**75%**	**98%**	**95%**	**87%**	**88%**	**89%**
	Prepare and submit certificate of origin	55%	45%	59%	46%	43%	55%	23%	41%	46%
	Prepare export permits and other supporting documents	66%	54%	63%	55%	60%	56%	45%	47%	56%
	Prepare import permits and other supporting documents	56%	51%	44%	40%	51%	42%	40%	31%	44%
	Prepare trade permit reports and returns	38%	36%	41%	25%	29%	24%	17%	16%	28%
Report & payment	**At least one of the following:**	**90%**	**91%**	**84%**	**70%**	**96%**	**95%**	**83%**	**90%**	**87%**
	Reconcile freight invoices	52%	54%	56%	44%	49%	49%	23%	42%	46%
	Use dedicated B2B payment channels	56%	48%	48%	50%	48%	50%	54%	50%	50%
	Report and reconcile consumption or value-added tax, if needed	47%	50%	44%	28%	48%	48%	23%	28%	39%

Source: Access Partnership analysis from a survey of exporters across eight in-scope economies (Canada; Chile; People's Republic of China; Republic of Korea; Mexico; Peru; Singapore; and the United States).
Note: This is a multi-select question. Therefore, the total percentage for each economy might not sum to 100 percent.

Most exporters use paperless trade platforms for all five components of the trade process, with 74 percent of respondents from exporting businesses indicating that they do so. Interestingly, this differs greatly by economy – less than half of Singaporean exporters surveyed use all paperless trade platforms for all five components of their trade process (Figure 3.3). Among Singaporean exporters not using paperless trade platforms for all five components of the process, financing trade and arranging shipment and tracking were typically not done on these platforms.

Figure 3.3 Components of the trade process carried out using paperless trade platforms in the eight in-scope economies (%, split by economy)



Source: Access Partnership analysis from a survey of exporters across eight in-scope economies (Canada; Chile; People's Republic of China; Republic of Korea; Mexico; Peru; Singapore; and the United States).

3.3 THE OPERATIONAL PERFORMANCE OF COMMERCIAL PAPERLESS TRADE PLATFORMS

While there seems to be a general recognition of the benefits of paperless trade, available studies suggest that paperless trade platforms are presently used exclusively for only a small fraction of overall global trade.[28] While the objectives of individual paperless trade platforms can differ, it is useful to define what constitutes a successful paperless trade platform.

From an operational perspective, performance can be measured in both an absolute sense and relative to other platforms, by the scale of user adoption and continued commercial viability.

On these metrics, comparing the performance of public platforms across economies is much more difficult. First, user adoption may already be mandated by the government, and thus is not indicative of the merit of the platform itself. Second, a lack of commercial viability could be justified on the basis of public value and thus is not a suitable measure of operational performance. The net value created by a public platform may be examined through a cost-benefit analysis (CBA) framework instead – see Annex E for an illustrative CBA framework.

For these reasons, the operational performance in Chapter 3.3, in terms of (1) user adoption and (2) commercial viability, will focus only on commercial platforms and not public platforms.

3.3.1 User adoption

A growing user base and increasing trade volume transacted on the platform would provide an indication of a platform's success at driving user adoption and the value of its growing network effects. Users of paperless trade platforms extend beyond exporters but also include other trade stakeholders such as customs authorities, port and terminal operators, and finance and logistics intermediaries (e.g., banks and freight forwarders) which connect together on these platforms to supply and access trade documentation.

[28] FIT Alliance (2023), "FIT Alliance launches eBL declaration to secure commitment to digitalisation". Available at: https://fiata.org/n/fit-alliance-launches-ebl-declaration-to-secure-commitment/

An analysis of the 31 commercial paperless trade platforms reveals an uneven landscape of adoption and scale (see Annex D for stocktake). [29] The number of users and size of networks vary largely depending on the target users of each platform, contingent on geography, sector, offering coverage and other considerations. Separately, the lack of consistency in reporting of usage metrics across platforms makes comparison between platforms difficult. Figure 3.4 illustrates a rating of each individual platform's adoption based on a set of criteria. The criteria were number of users, trade volumes, and the extent of geographical coverage, connections and accreditations.

Narrowing in on adoption of electronic Bills of Lading (eBLs), we see that the electronic version of this important trade document is used in only a small fraction of total global trade, estimated at 3.7 percent in 2024.[30] WaveBL states that it has issued more than 545,000 eBLs and covers 65 percent of the eBL market,[31] implying an issuance of 0.8 million eBLs or about 2 percent of the 45 million BLs issued a year. Mediterranean Shipping Company estimates eBL adoption at between 3.3–5 percent.[32] While encouraging, this suggests substantial room for growth in adoption of paperless trade. A significant milestone is the pledge by nine major ocean carriers to achieve 100 percent adoption of eBLs based on Digital Container Shipping Association standards by 2030.[33]

Looking ahead, inter-platform collaboration will also be indicative of each commercial platform's potential to drive future user adoption due to network effects. The more prominent platforms, especially the 12 platforms approved by the International Group of Protection and Indemnity (P&I) Clubs for indemnity coverage, tend to have strong linkages to public platforms as well as partnerships with other commercial platforms (see Annex D for stocktake). For instance, ICE Digital Trade (formerly essDOCs), has global public linkages with chambers of commerce in 21 economies for e-Certificates of Origin (eCOO) use,[34] and has simultaneously integrated its ICE CargoDocs solution to TradeGo and MineHub's platforms.[35]

3.3.2 Commercial viability

Out of the 44 platforms originally listed on the TFG/WTO periodic table of trade-related distributed ledger technology (DLT) projects (published in 2020), which once served as a comprehensive list of digital trade finance platforms,[36] at least four major platforms – Contour, Marco Polo, we.trade, and TradeLens – are no longer operating. The failure of these platforms highlights challenges in scaling paperless trade platforms to achieve both widespread adoption and ongoing commercial viability. These two goals of scale and profitability can require trade-

---

[29] The stocktake (see Annex D) indicates that platforms report different metrics around facilitated transactions, making comparison difficult. For instance, CargoX states that it has processed over 7 million electronic trade documents. edoxOnline notes that it has documented over 160,000 containers, while CrimsonLogic clears over 13 million declarations annually. E2OPEN orchestrates over 15.9 billion transactions between parties annually.

[30] Guy (2024), "How the eBL is shaping the future of shipping". Available at: https://ship.nridigital.com/ship_sep24/ebl_shaping_future_shipping

[31] WaveBL (n.d.), "Website". Available at: https://wavebl.com/

[32] Mediterranean Shipping Company (2023), *How To Navigate The Transition From Paper Bill Of Lading (BL) to eBL*. Available at: https://www.msc.com/-/media/files/msc-cargo/msc-solutions/digital-solutions/ebl/msc-ebl-white-paper-2023

[33] Digital Container Shipping Association (2023), "DCSA's Member Carriers Commit to a Fully Standardised, Electronic Bill of Lading by 2030". Available at: https://dcsa.org/newsroom/dcsas-member-carriers-commit-to-a-fully-standardised-electronic-bill-of-lading-by-2030

[34] essCert (n.d.), "essCert Countries & Chambers". Available at: https://www.esscert.com/how-to-ecertify/countries-and-chambers

[35] ICE Digital Trade (n.d.), "Partners". Available at: https://www.essdocs.com/network/partners

[36] Trade Finance Global and World Trade Organization (2020), *Blockchain & DLT for trade finance.* Available at: https://www.tradefinanceglobal.com/blockchain/

offs, with key challenges including determining target markets, scope of offerings, partnerships, stakeholders, and governance models.

Box 3.1 presents a case study to explore the complexities of governance in multi-stakeholder models.

Box 3.1 TradeLens – Challenges in Governance

TradeLens was a supply chain platform jointly launched by IBM and Maersk in 2018.

The platform had initial success in onboarding up to 60 percent of the global ocean carriers like CMACGM, APL, ANL, CNC, Korea Marine Transport Company (KMTC), Ocean Network Express (ONE), Mediterranean Shipping Company (MSC), Seaboard Marine, Boluda, Pacific International Lines (PIL), ZIM, Namsung, Hamburg Sud, Safmarine and Hapag-Lloyd who joined as anchor carriers. Additionally, over 26 custom clearance authorities and 19 trade finance institutions had come on board. Despite these successes, Maersk announced its closure in 2022, citing a failure to reach commercial viability.

One key factor contributing to TradeLens's closure appeared to be the misalignment of visions and incentives among its founding members. Feedback from expert interview sources close to the matter suggested that the industry-led initiative faced significant challenges in reaching agreement among the platform's foundation carriers—who are competitors themselves—particularly concerning the strategic direction of the initiative.

In the beginning, IBM and Maersk made all the governance decisions. In order to encourage new carriers to join the initiative, IBM and Maersk granted each a position on the 'carrier board', providing them with a voice in governance decisions. However, the carrier board faced two major disagreements that led to the closure of the platform.[37] The first disagreement was on investment decisions – some founding members wanted to invest in the ocean terminal user interface, while others wanted to invest in the air terminal user interface. The second disagreement was on strategy – some founding members wanted TradeLens to offer end-to-end services, which was not agreed to by some ocean carriers who had clients offering services in these other areas or already offered eBL services themselves. These disagreements constrained the ability of TradeLens to expand its revenue potential and was seen by IBM and Maersk as limiting their ability to receive a return on their initial investment.

The case of TradeLens underscores the challenge of establishing workable governance arrangements, including achieving upfront alignment in the strategic vision among industry partners. This provides particularly important lessons for paperless trade platforms, which benefit from network effects and are multi-stakeholder endeavours.

[37] Wafula C. S. (2023). *BLOCKCHAIN'S WEAKEST LINKS: A Modified UTAUT Model Analysis of the TradeLens Case*. Available at: https://cadmus.eui.eu/bitstream/handle/1814/76074/Wafula_2023_Master_STG.pdf?sequence=1&isAllowed=y

Data on commercial viability, in the sense of profitability, is scarce due to confidentiality and competitive reasons. Among commercial platforms with readily available financial results, profitability is varied, with a key explanatory driver being differences in funding models and longevity.

CargoWise, acknowledged by several interviewees as a leading paperless trade platform, demonstrated strong financial results in the first half of 2024, with revenue up 19 percent year-on-year organically and supporting an EBITDA margin (a measure of profitability) of close to 50 percent for the wider WiseTech Global group.[38] It attributes its ability to combine high growth and profitability to its freedom as a bootstrapped company (i.e., no venture funding), creating a vertical SaaS platform with a unique model around product development and pricing. IQAX is another platform achieving good growth and profitability. Recognised as one of the top 10 blockchain companies of 2024 by CIO TechWorld[39] and a wholly-owned company of Orient Overseas (International) Limited, IQAX is actively contributing to the robust earnings of the wider Group.[40]

Other platforms are raising fundings from venture capital; these platforms tend to prioritise scaling but aim to achieve profitability in the future. MineHub increased its revenue by 127 percent in Q1 2025 albeit from a small base, but with losses narrowing, demonstrates a path to scale and profitability.[41] In 2021, VAKT posted revenues of just over USD 1 million and a loss of USD 10 million, though it was still in good financial shape with net current assets of more than USD 14 million due to strong fundraising.[42] VAKT is expecting another substantial trade volume jump in 2024, as much as another 50 percent.[43] TradeWindow is seeing moderate revenue growth but remains loss-making for now; it forecasts monthly EBITDA break-even in March 2025 and is attempting to reduce its cash burn.[44] For such platforms, their long-term commercial viability remains to be seen.[45]

Longer-surviving platforms have needed to adapt to sustain commercial viability. E2OPEN, established in 2000, has seen revenue growth and profitability stagnate recently and are attempting to re-accelerate to growth and re-establish profitability.[46] Founded in 1989, CrimsonLogic lost its TradeNet Contract to Accenture's National Trade Platform in 2017 and had to broaden its product portfolio to replace those revenues, providing e-government solutions (e.g., single-window services) to economies outside of ASEAN and also growing

---

38 WiseTech Global (2024), *WiseTech delivers strong financial performance and outlook*. Available at: https://www.wisetechglobal.com/media/qnypwlh0/wtc-1h24-asx-release.pdf

39 IQAX Limited (2024), "IQAX won the Top 10 Blockchain Companies of 2024 award." Available at: https://en.prnasia.com/releases/apac/iqax-won-the-top-10-blockchain-companies-of-2024-award-464280.shtml

40 Orient Overseas (International) Limited (2024), *Annual Report 2023.* Available at: https://www.ooilgroup.com/financials/interimandannualreports/Documents/2023/E-Annual%20Report%202023.pdf

41 MineHub (2024), *Condensed Consolidated Interim Financial Statements For the Three Months Ended April 30, 2024 and 2023.* Available at: https://minehub.com/wp-content/uploads/2024/06/Q1-2025-Financial-Statement.pdf

42 Ledger Insights (2022), "Gunvor, Total execute first physical oil trade confirmation using VAKT blockchain". Available at: https://www.ledgerinsights.com/vakt-blockchain-gunvor-total-oil-trade-confirmation/

43 CTRM Center (2024), "Vakt Sees Trade Volumes Grow Significantly – Expects More Growth in 2024". Available at: https://www.ctrmcenter.com/blog/vakt-sees-trade-volumes-grow-significantly-expects-more-growth-in-2024/

44 TradeWindow (2024). *FY 2024 Financial Results Investor Presentation.* Available at: https://tradewindow.io/wp-content/uploads/2024/05/TWL-FY24-Results-Presentation.pdf

45 TideMark (n.d.,). "Excellence in Action: CargoWise". Available at: https://www.tidemarkcap.com/post/bootstrapped-legends-cargowise

46 E2OPEN (2024), "E2open Announces Fiscal 2025 First Quarter Financial Results". Available at: https://investors.e2open.com/news/news-details/2024/E2open-Announces-Fiscal-2025-First-Quarter-Financial-Results/default.aspx

private sector revenues through its Global-eTrade System customs clearing solution.[47] Bolero, an early pioneer of trade finance digitisation solutions founded in 1999, was acquired in 2022 by WiseTech Global, which also runs the CargoWise platform.[48]

In the absence of consistent data across all commercial platforms however, commercial viability can alternatively be measured by the status of the business as a going concern, though it is less precise than a profitability metric. Platforms that have been operational for a long time are more likely to have more viable business models and be delivering sustained value to its users. As such, the longevity of a platform would also provide an indicator of its performance (See Figure 3.4 for scoring, and Annex D for stocktake).

- Five platforms began operations within the last three years (2021 and after). The increase in e-commerce activity over the pandemic period coincided with the introduction of many new paperless trade solutions.
- A considerable number of platforms (16) entered the market between 2018 and 2020, highlighting a period of heightened interest and optimism in leveraging technology for trade digitalisation.
- The presence of ten platforms launched in 2017 or prior illustrates the longer-standing efforts in pursuing paperless trade. Notably, entities such as CrimsonLogic (1989) and Bolero (1999) were early pioneers in this field.

Taking the metrics of adoption and commercial viability (proxied by longevity) together, the matrix in Figure 3.4 compares the various platforms. Platforms in the top left of the matrix have relatively more users and are the longest-surviving platforms.

Figure 3.4 Platforms vary in terms of longevity and level of adoption

Performance matrix		**Longevity (year of commencing operations)** [1]		
		3=High	2=Medium	1=Low
Level of adoption[2]	3=High	CrimsonLogic (1989) Bolero (1999) E2OPEN (2000) SAP (2003) ICE Digital Trade (2005) edoxOnline (2008) Cargowise (2014) WaveBL (2016)	CargoX (2018) Komgo (2018) Enigio (2019) Infor Nexus (2019) IQAX eBL (2020) TradeWaltz (2020) MineHub (2020)	GSBN (2021) Covantis (2021)
	2=Medium	Surecomp (1987) E-Title (2004)	dltledgers (2018) VAKT (2018) TradeWindow (2018) TradeFinex (2018) GUUD (2018) People's Bank of China Blockchain Trade Finance Platform (2018) Morpheus.Network (2019) EC3 Skuchain (2020)	TradeGo (2021) Secro (2022)
	1=Low		Trusple (2020)	eTEU eBL (2023)

Source: Access Partnership analysis.

[47] Nikkei Asia (2017). "Singapore state IT group forced to intensify focus overseas." Available at: https://asia.nikkei.com/Business/Singapore-state-IT-group-forced-to-intensify-focus-overseas

[48] Global Trade Review (2022), "WiseTech buys Bolero". Available at: https://www.gtreview.com/news/fintech/wisetech-buys-bolero/

Notes:

1. For longevity, the rating 'High' is for platforms launched before 2018, 'Medium' for platforms launched between 2018 and 2020, and 'Low' for platforms launched in 2021 or after.
2. For level of adoption, platforms were scored from 0–2 along three main criteria each: number of users, trade volumes, and the extent of geographical coverage, connections and accreditations. No points were awarded where information was unavailable, on the assumption that a platform would reasonably be expected to indicate its high performing characteristics as part of their external communications. Of a maximum possible total score of 6, the rating 'High' was for platforms which scored a minimum of 4, 'Medium' for platforms which scored 2 or 3, and 'Low' for platforms which scored 0 or 1.

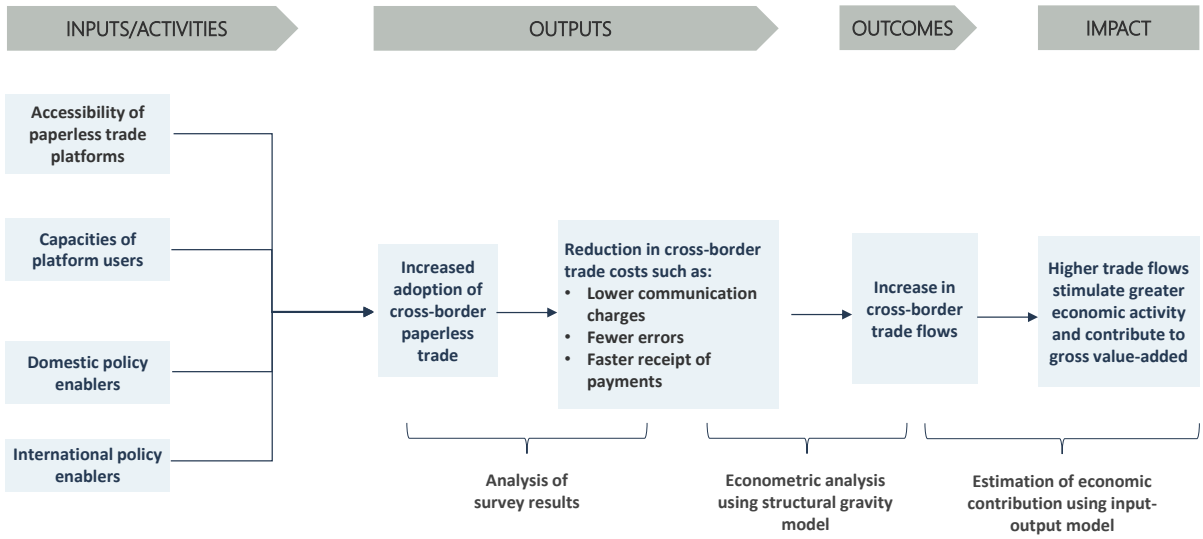
4. THE ECONOMIC VALUE OF PAPERLESS TRADE PLATFORMS

4.1 FRAMEWORK TO MEASURE THE ECONOMIC CONTRIBUTION OF PAPERLESS TRADE PLATFORMS

Beyond the individual performance of commercial paperless trade platforms, it is also useful to understand the benefits that both public and commercial paperless trade platforms generate at the economy-wide level. Existing studies, such as Arvis et al. (2013) and Roy and Huang (2020), have estimated that trade facilitation measures can boost trade volumes through lower cross-border trade costs. However, most studies take a top-down approach when looking at this impact, with few studies collecting empirical evidence of the impact of paperless trade platforms through the user's perspective.

The analysis in this study is based on a theory of change which links enablers for implementation of paperless trade platforms (inputs/activities) to their desired outputs and outcomes (Figure 4.1). The use of paperless trade platforms is expected to lower trade costs for exporters, which make it more favourable to engage in cross-border trade, increasing trade flows and stimulating greater economic activity.

Figure 4.1 Linkage of inputs/activities to desired outputs



Source: Literature review, Access Partnership analysis.

This section estimates the extent to which paperless trade adoption through public and commercial paperless trade platforms reduces costs, increases trade flows, and consequently the economic contribution to the eight in-scope economies.

- Section 4.2 discusses how the usage of paperless trade platforms provides cost savings to exporters;
- Section 4.3 discusses how reduction in trade costs from the use of paperless trade platforms increases trade flows to the eight in-scope economies, focusing on exports;
- Section 4.4 maps out how this impacts economic activity and contributes to economic growth.

The methodology for the results in Section 4.2 can be found in Annex A, while the methodology for the results in Sections 4.3 and 4.4 can be found in Annex C.

4.2 THE IMPACT OF PAPERLESS TRADE PLATFORMS ON TRADE COSTS

Both public and commercial paperless trade platforms simplify trade processes such as trade documentation, trade finance and customs filing, reducing the resources (e.g. postage, labour) that exporters require to undertake these trade processes. In addition, paperless trade can enhance security and traceability in supply chains, which could make it easier for exporters to arrange shipping and tracking, reducing the time spent on processes related to arranging shipping. The relationship between paperless trade use and cost savings is examined through a survey of exporters who use paperless trade platforms in each of the eight in-scope economies (see Annex A).[49]

These cost savings pertain to costs associated with border compliance and time in transit. Border compliance costs refer to time and costs associated with compliance with customs regulations, including relevant inspections for shipments to cross the border, as well as any relevant costs for handling of shipments that takes place at ports or borders. Transit time refers to the time that it takes for goods to be shipped from the export origin to the import destination. Additional time spent in transit can lead to unnecessary costs incurred, such as inventory holding costs, depreciation costs, or spoilage costs (for time-sensitive goods).

The analysis shows that adoption of paperless trade platforms, including public and commercial, led to average cost savings of 6.7 percent in border compliance processes for firms, translating to a 1.7 percent reduction in firm-level trade costs (Table 4.1).[50] At the aggregate level, the use of paperless trade platforms has simplified border compliance processes and led to time savings for exporting firms in the eight in-scope economies. On average, for firms that are currently using paperless trade platforms, the time taken (and hence costs incurred) to undertake the trade process would be 6.7 percent higher without the use of such platforms. As border compliance costs constitute around 21–33 percent of total trade costs for these economies, this leads to a 1.7 percent reduction in firm-level trade costs on average.[51]

---

[49] For each economy, the sample size of at least 97 exporters is statistically significant at the 95% confidence interval with a 10% margin of error.

[50] This is a weighted average for the eight in-scope economies.

[51] Our estimates acknowledge that the border compliance costs make up just a portion of total trade costs for firms. To estimate border compliance costs as a share of total costs, the labour costs from undertaking trade processes as a share of total labour costs was collected as part of the survey and used as a proxy. This was applied to the cost savings from undertaking trade processes to obtain the impact of paperless trade platforms on overall cost savings.

The analysis shows that adoption of paperless trade platforms, including public and commercial, also reduced time spent in transit for exported goods from the eight in-scope economies, leading to average reduction in trade costs of 2.1 percent. Hummels and Schaur (2013) estimated that each additional day that goods spend in transit incurs an ad-valorem equivalent cost of between 0.6 percent and 2.1 percent, depending on the time-sensitivity of the goods in question.[52] Based on the survey of exporters, at least 75 percent of goods exported from each of the eight in-scope economies were time-sensitive goods. Applying the relationship from Hummels and Schaur (2013) to the number of days in transit and weighting it by the share of time-sensitive goods in each economy,[53] the implied change in firm-level trade costs due to transit time savings in each economy was estimated (Table 4.1).

Taken together, firms reduced their total trade costs by 3.8 percent on average by using paperless trade platforms.

Table 4.1 Cost savings from adoption of paperless trade platforms

In-scope economy	Border compliance		Transit time	Total
	Cost savings	Reduction in firm-level trade costs	Reduction in firm-level trade costs	Reduction in firm-level trade costs
Canada	7.5%	2.0%	2.2%	**4.2%**
Chile	10.9%	2.9%	2.1%	**5.0%**
People's Republic of China	6.0%	1.3%	2.2%	**3.4%**
Republic of Korea	0.9%	0.3%	1.4%	**1.6%**
Mexico	10.3%	2.9%	2.4%	**5.3%**
Peru	15.5%	5.0%	2.9%	**8.0%**
Singapore	3.0%	0.8%	0.7%	**1.5%**
United States	9.2%	2.8%	2.5%	**5.3%**
Weighted average (8 economies)	**6.7%**	**1.7%**	**2.1%**	**3.8%**

Source: Access Partnership analysis from a survey of exporters across eight in-scope economies (Canada; Chile; People's Republic of China; Republic of Korea; Mexico; Peru; Singapore; and the United States).
Note: All figures are weighted averages of the cost savings when trading with economies of varying paperless trade implementation levels. Estimates may not sum due to rounding. Individual responses on cost savings were winsorised at the 10th and 90th percentile to manage the impact of extreme outliers.

The results in this study are broadly aligned with estimates from existing studies which suggest a positive relationship between paperless trade adoption and trade cost savings. Duval et al. (2015) examined the relationship between paperless trade implementation and trade costs via a trade cost model using panel regression, constructing an index for paperless trade implementation comprising various components such as the presence of an electronic customs system, electronic SW, and e-payment of customs duties and fees. The model estimates that a 10 percent increase in the paperless trade implementation index is associated with a 0.8 percent reduction in trade costs.[54] Duval et al. (2018) found similar results using the UN Global Survey

[52] Hummels, D.L. and Schaur, G. (2013) 'Time as a trade barrier.' *American Economic Review* 103(7), 2935–59.

[53] Our estimates assume that cost savings from every additional day saved when exporting time sensitive goods are 2.1 percent, while that of exporting non-time sensitive goods are 0.6 percent.

[54] Duval et al. (2015). Impact of Trade Facilitation and Paperless Trade on Trade Costs. In *Trade Facilitation and Paperless Trade: State of Play and The Way Forward for Asia and the Pacific (pp.1-77).*

on Trade Facilitation and Paperless Trade Implementation, estimating that a 10 percent increase in paperless and cross-border paperless trade measures across bilateral partners is associated with a 1.4 percent reduction in trade costs, with 0.9 percent reduction in trade cost arising from an economy's own implementation measures, and the remaining 0.5 percent arising from improvements in implementation measures of bilateral trading partners.[55] More recently, the Asia-Pacific Trade Facilitation Report 2024 prepared by UNESCAP and ADB also found a positive relationship between implementation of trade digitalisation measures and trade costs at an international level – partial implementation of trade digitalisation measures internationally can reduce international trade costs by 4.10 percent, while full implementation is estimated to lower trade costs by 6.95 percent.[56] The estimates in this study complement these existing analyses by providing empirical evidence based on a survey of exporters of actual cost savings arising from their use of paperless trade platforms.

4.3 THE IMPACT OF TRADE COSTS ON TRADE FLOWS

Lower trade costs make it more profitable for firms to engage in cross-border trade, increasing trade flows and stimulating economic activity. This study focuses on the impact of paperless trade platforms for exporters, as such this section of the analysis refers to export flows when discussing trade flows.

The gravity model, given its strong theoretical underpinnings, is widely used to study and quantify the effects of various determinants of international trade and conduct analysis of trade policies. A generalised method of moments (GMM) estimator, adapted from Arellano and Bond (2001), is used in this study. The specifications of the gravity model used can be found in Annex C. Prior to estimating the impact of reduced trade costs on trade flows, an additional step was required to decompose the trade cost variable to remove the components of trade costs associated with various geographic and trade variables included in the structural gravity model. This prevents the possibility of collinearity among independent variables. Details of the trade cost decomposition can be found in Annex C.

In 2021, the use of paperless trade platforms are estimated to have contributed to USD 236.2 billion in higher trade flows across the eight in-scope economies, equivalent to 3.4 percent of their total trade flows (Table 4.2).

An aggregate-level analysis using bilateral trade data from 1995 to 2021 found a statistically significant positive relationship ($p<.001$) between trade costs and trade flows. On average, a 1 percent reduction in trade cost is estimated to lead to a 2.57 percent increase in trade flows.[57]

Border compliance cost savings is estimated to lead to an overall reduction of trade costs at the firm level by an average of 1.7 percent across the eight in-scope economies,[58] while transit time savings reduces firm-level trade costs on average by an additional 2.1 percent (see Section 4.2). The cost savings estimates were then applied to the relationship between trade costs and trade

[55] Duval et al. (2018). Impact of implementation of digital trade facilitation on trade costs. Asia-Pacific Research and Training Network on Trade Working Paper No. 174.

[56] UNESCAP and ADB (2024). Asia-Pacific Trade Facilitation Report 2024.

[57] Refer to Table C.3 in Annex C.

[58] To estimate border compliance costs as a share of total costs, the labour costs from undertaking trade processes as a share of total labour costs was collected as part of the survey and used as a proxy. This was applied to the cost savings from undertaking trade processes to obtain the impact of paperless trade platforms on overall cost savings.

flows and adjusted for the share of export flows that are processed through paperless trade platforms.[59]

The adoption of paperless trade platforms is estimated to have contributed to USD 236.2 billion (3.4 percent) in trade flows in 2021 for the eight in-scope economies, through reducing border compliance costs and transit costs for exporters (Table 4.2).

Table 4.2 Impact of paperless trade platforms usage on trade flows (USD billion)

In-scope economy	Total trade flows (exports) in 2021	Trade flows contributed by paperless trade platforms	Percentage of total trade flows contributed by paperless trade platforms
Canada	494.9	18.3	3.7%
Chile	91.5	3.3	3.6%
People's Republic of China	3,110.5	96.9	3.1%
Republic of Korea	602.9	9.2	1.5%
Mexico	462.9	22.3	4.8%
Peru	54.6	4.2	7.6%
Singapore	422.0	4.4	1.0%
United States	1,660.5	77.7	4.7%
Total	**6,899.6**	**236.2**	**3.4%**

Source: Access Partnership analysis.

Similar studies examining the impact of paperless trade generally on trade flows have also suggested a positive relationship between the two, albeit focusing only on government measures and not platform usage. UNESCAP (2014) conducted simulations of different scenarios of government reforms related to paperless trade and their impact on trade times in APAC, which is then used to estimate the impact on trade flows in the region. The study found that partial paperless trade reforms can lead to a 9 percent gain in exports on average for APAC, while full reform can increase exports by about 15 percent.[60] UNESCAP and ADB (2024), through looking at the impact of paperless trade implementation measures of the exporter economy on bilateral trade flows concluded a similar positive relationship: a 1 percent improvement in trade digitalisation scores can increase bilateral exports by about 0.7 percent.[61] Looking at specific uses of paperless trade, OECD (2021) estimated that the implementation of Sanitary and Phytosanitary (SPS) e-certificates increased trade volumes of most agri-food products one year later, with increases of between 1.3 percent and 2.3 percent for specific products.[62] While the magnitude of the impact estimates from existing studies differ from this study, it is worth noting that this study's methodology focuses on the contribution of commercial paperless trade platforms on trade flows based on current usage, taking into account differences in extent of usage across different components of the trade processes. The results from this study would not be equivalent to existing studies, many of which examine the

[59] This was estimated using survey responses on both the share of exporters using paperless trade platforms and the share of sales done on paperless trade platforms for each exporter that uses such platforms.

[60] UNESCAP (2014). Estimating the Benefits of Cross-Border Paperless Trade. In support of implementation of ESCAP Resolution 68/3.

[61] UNESCAP and ADB (2024). Asia-Pacific Trade Facilitation Report 2024.

[62] OECD (2021). Digital opportunities for Sanitary and Phytosanitary (SPS) systems and the trade facilitation effects of SPS electronic certifications. OECD Food, Agriculture and Fisheries Paper *No. 152*.

extent to which trade flows could potentially benefit from yet to be realised implementation of government measures related to paperless trade. Nonetheless, evidence of a small to moderate positive relationship between paperless trade implementation and trade flows in other studies reaffirms the estimates from this study are likely reasonable.

4.4 THE ECONOMIC CONTRIBUTION OF PAPERLESS TRADE PLATFORMS

Increased trade flows are driven by increased external demand for an economy's goods and services that is met by increased domestic production of those goods and services. As such, when paperless trade adoption through platforms induces higher trade flows, this contributes to an economy through increased production activity that is induced across all industries in an economy (See Annex C).

In 2021, the export boost from paperless trade platforms contributed USD 383 billion to the eight in-scope economies, approximately 0.8 percent of their total GDP (Table 4.3). This includes the contribution from commercial and public platforms, including single windows.

- Around USD 105 billion of the economic contribution was from the direct effects of production activities undertaken by industries to produce the goods and services that were exported.
- More than USD 78 billion was attributed to the indirect effects from the production activities of industries along their supply chain. For example, for a given increase in output for Manufacturing, inputs from other industries such as Administrative and Support Services may be required, as well as from Manufacturing itself.
- Around USD 200 billion was attributed to the consumption induced effects from workers in those industries that increased their spending as their incomes rose.

Table 4.3 Breakdown of economic contribution (value added - USD billion, 2021)

	CDA	CHL	PRC	ROK	MEX	PE	SGP	USA	Total
Direct effects	8.5	1.4	36.6	3.7	11.3	2.1	1.5	39.7	104.9
Indirect effects	4.8	0.8	37.8	2.9	4.5	1.2	0.8	25.8	78.7
Consumption induced effects	14.8	1.9	74.1	5.5	7.5	1.8	1.6	92.2	199.6
Total	**28.1**	**4.1**	**148.6**	**12.1**	**23.4**	**5.1**	**4.0**	**157.7**	**383.2**
Nominal GDP	*2,000*	*316*	*17,820*	*1,818*	*1,313*	*224*	*424*	*23,320*	*47,235*
Total contribution as a share of nominal GDP	**1.4%**	**1.3%**	**0.8%**	**0.7%**	**1.8%**	**2.3%**	**0.9%**	**0.7%**	**0.8%**

Source: Access Partnership analysis.

This economic activity also supported more than 8.5 million jobs in the eight in-scope economies (Table 4.4).

Table 4.4 Breakdown of jobs supported (thousands of Full-time Equivalents or FTEs)

	CDA	CHL	PRC	ROK	MEX	PE	SGP	USA	Total
Direct effects	75	40	1,439	49	420	127	9	204	2,364
Indirect effects	44	25	1,749	41	185	73	5	139	2,262
Consumption induced effects	128	50	2,792	73	259	113	9	472	3,897
Total	**247**	**115**	**5,980**	**163**	**865**	**314**	**23**	**815**	**8,523**

Source: Access Partnership analysis.

5. ADVANCING THE UTILISATION OF PAPERLESS TRADE PLATFORMS

The evidence of an increase in economic contribution from the use of paperless trade platforms across the eight in-scope economies strengthens the case for the use of paperless trade platforms. This may also validate the case for continued public policy support for paperless trade as a channel to drive trade and economic growth.

Making further progress on adoption of paperless trade requires an understanding of the key enablers that drive successful implementation and motivate adoption in an economy. In addition to the survey of exporters, interviews were conducted with selected experts to understand the key barriers to adoption that need to be addressed, including among paperless trade platform providers, exporters with internally developed paperless trade systems, finance and logistics intermediaries, and port operators (Annex A).

5.1 ENABLERS FOR SUCCESSFUL IMPLEMENTATION OF PAPERLESS TRADE PLATFORMS

The analysis looks at the key enablers that affect i) the adoption of paperless trade platforms by exporting businesses; and ii) the benefits that exporting businesses derive from using paperless trade platforms, in the form of cost savings. The enablers for success are examined within four categories:

5.1.1 Cost of user switching to paperless trade platforms;
5.1.2 Digital capability of exporters to switch to paperless trade platforms;
5.1.3 Types of services available on paperless trade platforms; and
5.1.4 Variety of services conducted on paperless trade platforms.

5.1.1 Costs of user switching to paperless trade platforms

Exporters encounter various financial costs when deciding on whether to use paperless trade platforms. This includes a one-off cost of switching to paperless processes, such as the need to purchase compatible hardware and software or to train employees, as well as recurring costs of using paperless trade platforms including platform user fees and ensuring secure storage of electronic documents.

Survey respondents have indicated that initial switching costs incurred can be quite substantial – on average, switching costs are equivalent to 20 percent of an organisation's annual costs. More than a third of respondents also indicated that the initial switching costs affected their organization's decision to adopt paperless trade platforms to a moderate to large extent.[63] For exporters that do not use paperless trade, high monetary costs of switching to paperless trade platforms was stated as one of the top barriers. In addition, while recurring costs make up about 7–9 percent of exporters' annual costs on average, it could still affect exporters' decisions to adopt paperless trade platforms.

Financial costs might matter especially to SMEs. Platform managers and users that were interviewed expressed that the timing of cash flows matter for SMEs, and upfront support to

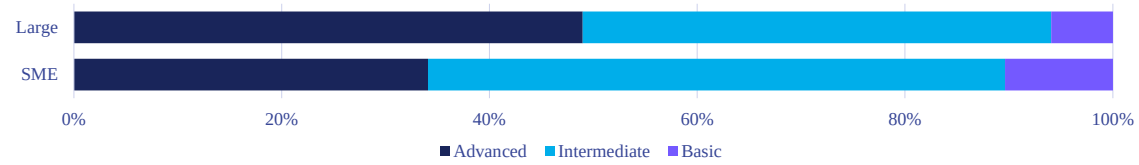
[63] Based on respondents who gave a rating of '6' or '7' on the Likert scale.

cover the one-off costs can help move the needle and push SMEs towards adoption. In addition, SMEs with limited resources might not be sufficiently incentivised to switch to paperless trade if the fees for platform usage are too high. From the importer's perspective, the improved presentation efficiency of eBLs can result in earlier payment. The additional capital cost will necessitate better cashflow management for the importer. To manage these cost implications, the exporter and importer may need to adopt mechanisms to negotiate mutually beneficial payment terms.

5.1.2 Digital capability of exporters to switch to paperless trade platforms

Aside from switching costs, the digital skills level of current employees is another top barrier to paperless trade adoption. Close to 40 percent of exporters who do not use paperless trade indicated that they lacked the right level of digital skills to use paperless trade platforms. Platform managers indicated the importance of possessing employees with the right skills to deal with change management – including having someone who understands how current projects and systems can be customised. Among exporters that use paperless trade platforms, the overall digital skill levels of employees who use paperless trade also tends to be lower for SMEs on average (Figure 5.1). This might affect the ability of smaller exporters to fully utilise all available features of paperless trade platforms.

Figure 5.1 Digital skills level of current employees who use paperless trade platforms (%, split by business size)

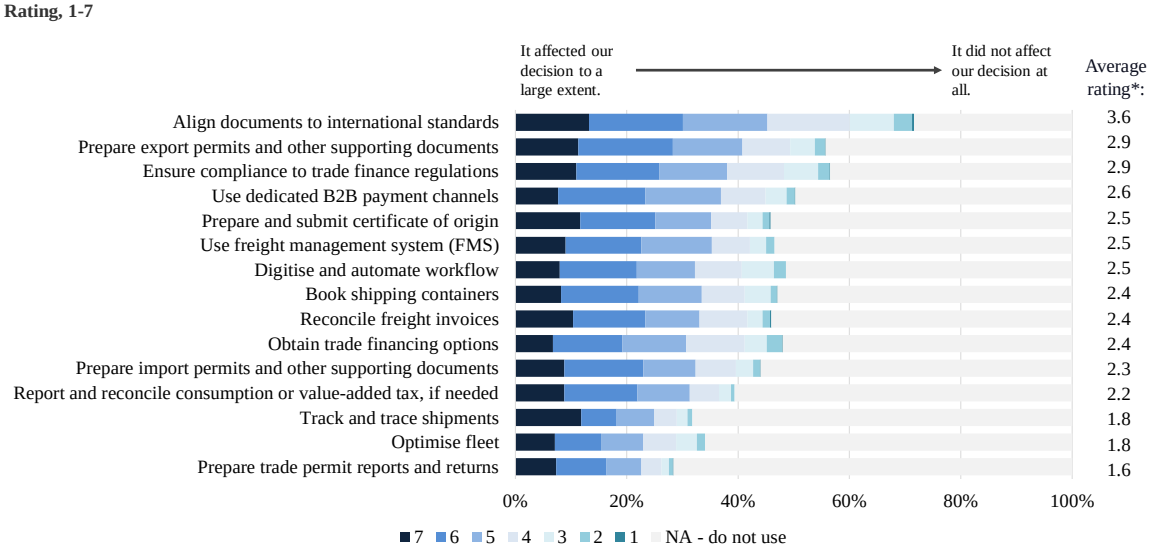


Source: Access Partnership analysis from a survey of exporters across eight in-scope economies (Canada; Chile; People's Republic of China; Republic of Korea; Mexico; Peru; Singapore; and the United States).
Notes: Basic skills refer to foundational skills for performing basic digital tasks covering hardware (computers), software (MS Office), online operations (search engines, social networks, etc.) and communication media (cellular and internet network). Intermediate skills refer to the ability to configure general digital tools to produce and consume digital content or enhance digital tools through basic programming skills (e.g., knowledge of programming, spreadsheet manipulation). Advanced skills involve design and programming of new digital tools and features, from knowledge acquired through advanced formal education; including those involving artificial intelligence (AI), big data, coding, cybersecurity, Internet of Things (IoT), and mobile app development usually needed by specialists in the ICT sector.

5.1.3 Types of services available on paperless trade platforms

The ability of paperless trade platforms to deliver value to exporters will depend on the types of services available on these platforms. For the eight in-scope economies, simplifying compliance processes for trade documents, export permits and trade finance were identified as the top factors that influenced their decisions to adopt paperless trade (Figure 5.2).

Figure 5.2 Level of importance of available services on paperless trade platforms that affected adoption



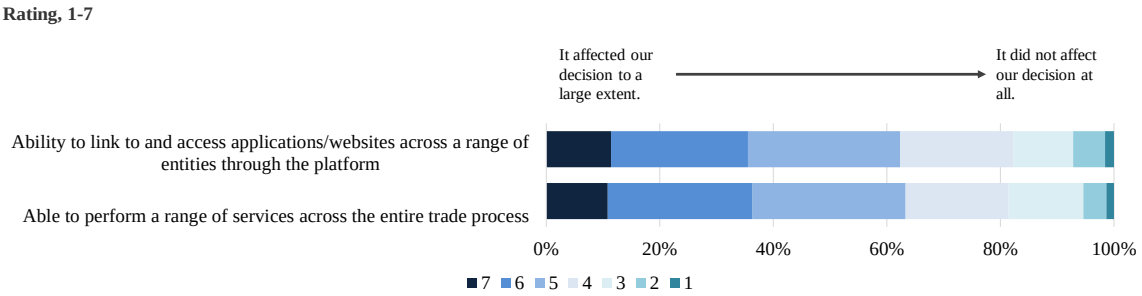
Source: Access Partnership analysis from a survey of exporters across eight in-scope economies (Canada; Chile; People's Republic of China; Republic of Korea; Mexico; Peru; Singapore; and the United States).
Note: Respondents were asked to indicate the level to which each of the following services affected their decision to adopt paperless trade across a scale of 1 to 7, where '1' indicates that it did not affect their decision at all, while '7' indicates that it affected their decision to a large extent. Average rating is calculated by taking the weighted average of scores indicated, where respondents who do not use these services are allocated a score of 0.

Consultation feedback from expert interviews with several paperless trade platform managers also acknowledged that document preparation as well as customs compliance and filings were the most impactful functionalities that motivated users' adoption and could have the greatest impacts on cost savings. Commercial platform providers indicated that onboarding regulatory authorities and offering Single Window linkage were key differentiators that successfully spurred user adoption. Nonetheless, they acknowledged that there are practical limitations as these linkages can be time- and cost-intensive to set up – linking platforms to a government system is a bespoke undertaking that can often take 6–12 months per customs system.

5.1.4 Variety of services conducted on paperless trade platforms

Respondents value platforms that allow them to conduct a greater variety of services, whether through in-built systems, or through providing greater interoperability to other platforms. 63 percent of respondents gave a rating of at least 5 out of a 7-point scale when asked if the ability to perform a range of services across the entire trade process affected their decision to adopt paperless trade platforms. Similarly, 62 percent of respondents rated at least 5 out of a 7-point scale when asked if greater interoperability, such as in the form of access to other applications and websites, affect their adoption decision (Figure 5.3).

Figure 5.3 Level of importance of having a variety of services on paperless trade platforms



Source: Access Partnership analysis from a survey of exporters across eight in-scope economies (Canada; Chile; People's Republic of China; Republic of Korea; Mexico; Peru; Singapore; and the United States).
Note: Respondents were asked to indicate the level to which each of the following functionalities affected their decision to adopt paperless trade across a scale of 1 to 7, where '1' indicates that it did not affect their decision at all, while '7' indicates that it affected their decision to a large extent.

The research also revealed that exporters who use paperless trade platforms across all five components of the trade process experience larger percentage border compliance cost savings on average, to the tune of 8–9 percent (Table 5.1). This was observed for both SMEs and larger firms, and regardless of whether exporters were exporting to destinations with higher or lower levels of paperless trade implementation, based on scores in the UN Global Survey on Digital and Sustainable Trade Facilitation (see Annex A for the classification of destinations by paperless trade implementation). Interestingly, adopting paperless trade for one more trade process component might not necessarily lead to higher cost savings, if some part of the trade process is still completely manual.

Table 5.1 Average cost savings by number of components that use paperless trade platforms

Number of components that use paperless trade	Percentage cost savings when exporting to economies with higher levels of paperless trade implementation		Percentage cost savings when exporting to economies with lower levels of paperless trade implementation	
	Large	SME	Large	SME
1	1%	2%	0%	2%
2	7%	3%	–7%	0%
3	1%	2%	2%	–3%
4	6%	3%	2%	5%
5	9%	8%	8%	8%

Source: Access Partnership analysis from a survey of exporters across eight in-scope economies (Canada; Chile; People's Republic of China; Republic of Korea; Mexico; Peru; Singapore; and the United States).
Note: Respondents were asked to estimate how time spent on each of the five components of the trade process will change without the use of paperless trade platforms, and this was then weighted by the number of hours they are currently spending on the trade process to obtain the percentage cost savings for each individual respondent. This information was collected for exports to destinations of two out of three implementation levels for each economy (see Table A.1 in Annex A). To avoid bias, respondents are allowed to indicate either an increase, decrease or no change in time taken for trade process. Thus, it is possible that negative values are observed. Individual responses on cost savings were winsorised at the 10th and 90th percentile to manage the impact of extreme outliers.

5.2 RECOMMENDATIONS FOR PROMOTING ADOPTION OF PAPERLESS TRADE PLATFORMS

Considering the insights of the research and ongoing policy developments in APEC, five recommendations were identified under two policy pillars for policymakers in APEC to promote greater adoption and fully harness the benefits of paperless trade platforms.

5.2.1 Pillar 1: Promote the business case for paperless trade adoption

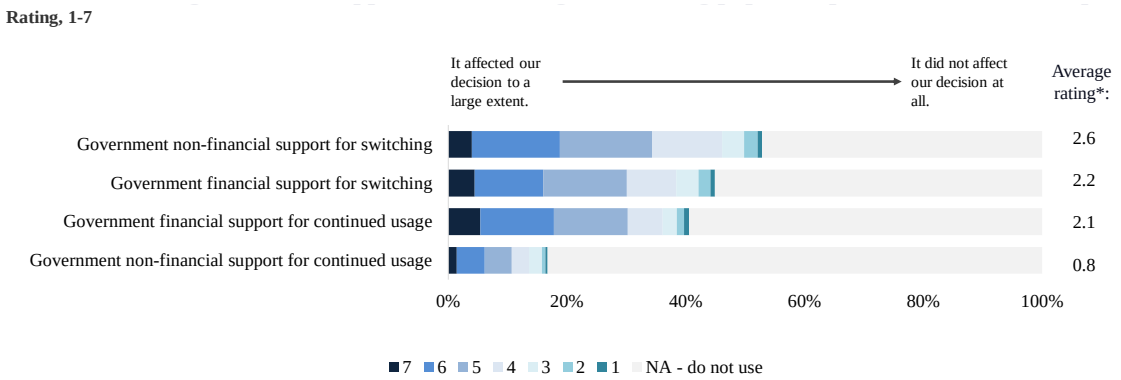
1. Provide government support for employee upskilling to facilitate paperless trade adoption

It should be acknowledged that the use of paperless trade platforms is only one way to participate and reap the benefits of paperless trade. Given the sophistication of the trade process, businesses also use commercial providers such as customs brokers to help assist with data submission. In that sense, the adoption of paperless trade platforms is subject to business preferences and hence is not necessarily the logical prescribed course of action for every business. Regardless of the mode chosen by businesses, it would be beneficial to remove specific barriers to adopting paperless trade, in a manner that is solution- and provider-agnostic.

The research found that the large initial investment required, such as to upgrade computer hardware and software and to reskill employees, form the main barriers to adoption for businesses, especially for SMEs with less resources. Even for SMEs that use paperless trade platforms, the relatively lower overall digital skills level of their employees also likely limits their ability to fully harness the benefits of paperless trade platforms.

Government support, particularly to encourage the initial switch to using a paperless trade platform, can play a role in reducing the barriers to adoption of paperless trade platforms. A larger share of survey respondents reported having accessed government support schemes for switching as compared to those provided for ongoing usage, and both financial and non-financial support for switching was deemed more impactful compared to similar forms of support for ongoing usage (Figure 5.4).

Figure 5.4 Extent to which government support for switching to and using paperless platforms affected adoption



Source: Access Partnership analysis from a survey of exporters across eight in-scope economies (Canada; Chile; People's Republic of China; Republic of Korea; Mexico; Peru; Singapore; and the United States).
Note: Respondents were asked to indicate the level to which each of the following types of government support affected their decision to adopt paperless trade across a scale of 1 to 7, where '1' indicates that it did not affect their decision at all, while '7' indicates that it affected their decision to a large extent. Average rating is calculated by taking the weighted average of scores indicated, where respondents who do not use these types of government support are allocated a score of 0.

With initial switching costs a key factor, governments and solution providers may consider prioritising training and upskilling workers to be able to fully utilise paperless trade platforms, and to choose the best one for their companies. Other recommendations include easier access to support in the forms of easier access to expert consultants, capacity training programmes for businesses and their employees (e.g., Certificate in Digital Trade Strategy by ICC), and organised exhibitions to help private sector companies showcase their solutions for paperless trade to prospective users.[64] These training and awareness programmes should remain solution- and provider-agnostic to enable free and competitive markets and for businesses to adopt the solution that best suits their operating models.

2. Demonstrate the financial benefits of paperless trade adoption for businesses

Better articulation of the cost savings and advantages of paperless trade adoption for businesses can allow businesses to better understand the full range of benefits from using paperless trade platforms and can help shift industry attitudes towards trade digitalisation. Some governments and multilateral organisations have initiated this in the past. The United Nations Network of Experts for Paperless Trade in Asia and the Pacific (UNNExT) and UNESCAP report a number of summary figures from single-economy studies (e.g., Hong Kong, China; Japan; Republic of Korea; Singapore; and Thailand).[65] More recently, it was estimated that paperless trade in the Republic of Korea reduced trade-related costs by USD 9.4 billion in 2021 through cost savings from labour hours, transportation, warehousing, and document processing.[66] Similarly, the UK government reported its Ecosystem of Trust pilot demonstrated that decision-making time for goods entering Britain could be reduced by 17 percent.[67] Such studies help businesses visualise their returns to investing in paperless trade implementation in tangible terms, especially in relation to the upfront and ongoing costs required to use paperless trade platforms.

3. Drive legal recognition of electronic documents

While the UNCITRAL's Model Law on Electronic Transferable Records (MLETR) sets out global principles and guidelines to treat electronic documents as equivalent to paper documents, only ten jurisdictions around the world have incorporated it as of June 2024.[68] While it should be acknowledged that some economies align to MLETR principles without having adopted the model law, the lack of full legal recognition for electronic trade documents in many cases generates uncertainty among exporters and other stakeholders that electronic records will be able to hold up in court in the event of disputes, and may hinder the switch towards paperless trade processes. Slower uptake of paperless trade processes reduces the value of paperless trade, which consequently reduces the incentive for traders to adopt it – close to a third of exporters that do not use paperless trade platforms indicated in the survey that they perceive the benefits to be low as their importing counterparties do not use paperless trade platforms.

---

64 UNESCAP (2024), "Demo Hours: Business Solutions for Paperless Trade". Available at: https://www.unescap.org/events/2024/demo-hours-business-solutions-paperless-trade

65 UNESCAP (2014), *Estimating the Benefits of Cross-Border Paperless Trade.* Available at: https://www.unescap.org/sites/default/files/Benefits%20of%20Cross-Border%20Paperless%20Trade.pdf

66 UNESCAP (2022), *Asia-Pacific Trade Facilitation Forum 2022. Available* at: https://www.unescap.org/sites/default/d8files/event-documents/APTFF%202022%20Session%201_panelists.pdf

67 IBM (2023), "UK Government tests frictionless trade models with Ecosystem of Trust pilots". Available at: https://www.ibm.com/blog/uk-government-tests-frictionless-trade-models-with-ecosystem-of-trust-pilots/

68 United Nations Commission on International Trade Law (n.d.,), "Status: UNCITRAL Model Law on Electronic Transferable Records (2017)." Available at: https://uncitral.un.org/en/texts/ecommerce/modellaw/electronic_transferable_records/status. It is acknowledged that some APEC economies align to the MLETR principles without having adopted the model law.

For exporters, financial and logistics intermediaries (e.g., banks and freight forwarders) to go paperless with confidence, governments need to adopt legislation that recognises electronic documents and transferable records as legally binding. Despite the slow progress on MLETR adoption, recent reforms in Singapore and the UK offer encouraging signs of progress. Even with broader legal reform, accompanying domestic policy initiatives could help drive further adoption, such as encouraging border agencies and banks to accept eBLs. In addition, supporting legal frameworks, such as laws to ensure legal validity of digital signatures or for data protection, need to be in place to facilitate trust in the paperless trade process among stakeholders.

5.2.2 Pillar 2: Fostering interoperability across the paperless trade ecosystem

1. Promote alignment of electronic formats, syntax, nomenclature and standards

Establishing compatible data formats, syntax, nomenclature and standards across different paperless trade systems would increase the efficiency of paperless trade, thereby further reducing costs. It would ensure that information submitted in one platform could be seamlessly transferred to another platform between the export origin and the import destination, hence reducing the need for duplication and re-entry. This would support greater interoperability between different paperless trade systems by facilitating the sharing and tracking of data across the entire supply chain. The lack of compatible data definitions across disparate organisations was an issue repeatedly raised by interviewees as a barrier to paperless trade.

Initiatives like the ICC Digital Standards Initiative (DSI) play a vital role in the data interoperability process, by promoting a shared understanding of data exchange practices across the supply chain. For instance, the Standards Toolkit for Cross-border Paperless Trade launched in collaboration with the World Trade Organization consolidates a list of foundational and identifier standards that can be adopted by platforms (both government and commercial), such as when specifying information required in data fields.[69] In April 2024, the DSI also launched a complete Key Trade Documents and Data Elements (KTDDE) framework for end-to-end supply chain digitalisation covering common data elements required for 36 key trade documents.[70]

To ensure the authenticity and verifiability of electronic documents, technological mechanisms to establish digital trust will also be essential. The ICC DSI and its Industry Advisory Board (IAB) have been examining technical mechanisms to establish and monitor trust in the digital environment. Much of it rests on the use of digital identities for transacting parties.[71] The trust and security standards for trade data should be included as part of work towards data interoperability to ensure that trusted data can be shared between different paperless trade systems.

---

69 World Trade Organization & ICC Digital Standards Initiative (2022), "Standards Toolkit for Cross-border Paperless Trade". Available at: https://www.wto.org/english/res_e/publications_e/standtoolkit22_e.htm

70 International Chamber of Commerce (2024), "ICC Digital Standards Initiative launches complete framework for supply chain digitalisation." Available at: https://iccwbo.org/news-publications/news/icc-digital-standards-initiative-launches-complete-framework-for-supply-chain-digitalisation/

71 International Chamber of Commerce (2023), *Trust in Trade: Verifiable Trust.* Available at: https://www.dsi.iccwbo.org/_files/ugd/8e49a6_5a75a77950d7474da772bf9cfc2d985b.pdf

2. Promoting interoperability across commercial platforms

Exporters that use paperless trade for a larger variety of services within the trade process enjoy greater benefits in the form of cost savings. On average, exporters also tend to use more than one commercial platform when digitalising their trade process. However, interviews with paperless trade platform managers have revealed that many paperless trade platforms are not interoperable with one another. This means that an exporter using multiple platforms might have to repeatedly enter the same data multiple times into different systems, lowering the productivity benefits from paperless trade adoption. One of the platform managers interviewed estimated that productivity could be three to five times higher if there were greater interoperability across paperless trade platforms. Despite this, commercial platforms might be reluctant to promote inter-platform interoperability due to strategic and operational reasons. For instance, some platforms might have invested in establishing a market leading position for themselves and could be hesitant about sharing the data and networks with other platforms as it might reduce their competitive advantage.

Effort should be made to ensure interoperability between platforms and applications without limiting their design or operation (technology neutrality), so as to allow for continued innovation. The aim should be to ensure systems can work together, not that they be exactly the same. Potential approaches to promote interoperability could rely on international standards developed through open and transparent processes. Other options could involve identifying and utilising trusted third-parties or intermediaries that are accepted by all stakeholders and can operate internationally. International scope is important when the goal is making global transactions seamless for traders. The following approaches, obtained in consultation with interviewed experts, could be considered:

- **Using technology-agnostic architecture:** Expert interviews brought up the potential of open, technology-agnostic systems or tools that enable trusted interoperability across different digital platforms. For example, TradeTrust allows any two users of a particular distributed ledger technology to exchange electronic trade documents, including transferable records like electronic bills of lading, without needing to subscribe to a common commercial paperless trade platform.[72]
- **Coordination by neutral third-party:** Paperless trade platforms that connect different parties together (e.g. commercial platforms that provide trade finance services), benefit from network effects, where a larger user base and a larger number of services providers increase the value provided by the platform. Therefore, it may make sense for an industry group to maximize network effects and connect the whole industry together with its clients through a single platform. When coming together as an industry group or consortium through a single platform, however, it is essential to ensure that objectives and interests are aligned across all participating players so as to establish trust and credibility required for stable and sustainable collaboration. The TradeLens case study in Box 3.1 sheds light on some issues that might arise if a single industry player is dominating the initiative. One possible solution could be for a neutral third party to play a leading role in managing the platform. The UN Food and Agriculture Organization (FAO) is a neutral third-party host of the e-Phyto hub and GeNS for the signatories to the

[72] Singapore Infocomm Media Development Authority (n.d.,), "TradeTrust". Available at: https://www.imda.gov.sg/how-we-can-help/international-trade-and-logistics/tradetrust

International Plant Protection Convention (IPPC) which allows them to successfully exchange electronic phytosanitary certificates successfully.[73]

- **Using trusted intermediaries to coordinate across different platforms:** In some cases, instead of promoting a large, centralised platform that consolidates the majority of trade processes, it might be more efficient to promote the use of trusted intermediaries. For example, the SWIFT network can enable seamless exchange of eBLs across multiple platforms, as demonstrated by their API-based eBL interoperability model developed in collaboration with its FIT Alliance partners and eBL platform providers.[74] Even partial interoperability can yield significant efficiency gains and foster network effects, reducing the risks of isolated 'digital islands'.

Additional opportunities are expected to develop as paperless trade becomes more prevalent. For instance, IQAX eBL has developed its Interoperable Addendum to allow for inter-platform transfers of eBLs with other system providers, as long as the transfer is to an International Group approved platform and the eBL is governed by the law of a jurisdiction that has accepted eBLs as equivalent to paper-based BLs.[75]

---

73 International Plant Protection Convention (IPPC), "ePhyto solution". Available at: https://www.ephytoexchange.org/landing/

74 SWIFT (2023), "Swift enables global trade interoperability in successful trials". Available at: https://www.swift.com/news-events/news/swift-enables-global-trade-interoperability-successful-trials

75 UK P&I Club (2025), "Circular 01/25: Electronic (Paperless) Trading - IQAX Limited - Approval by the IQAX eBL interoperable addendum". Available at: https://www.ukpandi.com/news-and-resources/circulars/article/circular-01/25-electronic-paperless-trading-iqax-limited-approval-by-the-iqax-ebl-interoperable-addendum/

ANNEX A: PRIMARY RESEARCH APPROACH

A.1 SURVEY COVERAGE

The survey sampled businesses from the eight in-scope economies that export and use cross-border paperless trade platforms. The survey aimed to: (i) gather insights on the enablers which are material to adopting paperless trade; and (ii) understand the extent to which adoption of paperless trade platforms reduces trade costs for exporters. The survey was estimated to take approximately 15–20 minutes to complete and was administered online. Respondents were given the option to answer in either English or their official business language (if this was not English).

The survey has a total qualified sample size of 831, with at least 97 respondents sampled in each economy. For each economy, this sample size is statistically significant at the 95% confidence interval with a 10% margin of error. To ensure sufficient coverage of respondents using both public and commercial platforms, a quota of 300 public platforms and 300 commercial platforms were also imposed at the overall level.

The following filters were applied as part of the survey screening process:

- Businesses were filtered based on whether they use paperless trade platforms to export to economy groups with different implementation levels of cross-border paperless trade measures assessed under UNESCAP's framework.
- Respondents were filtered based on their knowledge of their company's exporting activities, and knowledge of the company's trade processes and trade-related costs (e.g., border, compliance, transportation, and informal costs).
- Business size and industry coverage were based on natural fallout within each economy. However, the sample sizes are not statistically significant by business size or industry for each economy.

A.2 SURVEY SAMPLING DESIGN

The success of paperless trade platforms between economies depends on the extent to which electronic documents are recognised and exchangeable between the exporting and importing economies. This was proxied by the level of implementation of paperless trade measures and the implementation of cross-border paperless trade measures in each economy – economies with higher levels of implementation are more likely to have regulations and policies in place to issue, recognise and exchange electronic documents.

The UN Global Survey on Digital and Sustainable Trade Facilitation measures Trade Facilitation Implementation for each economy at the economy-wide level using a scoring system of 0–3 (0-Not implemented, 1-Pilot Stage, 2-Partially Implemented, 3-Fully Implemented).[76] The extent to which trade documents can be electronically exchanged with an economy's key trading partners is a key input to the determination of scores under the Paperless Trade and Cross-border Paperless Trade sub-groups.[77] For each sub-group, an aggregate

[76] United Nations (2023). *UN Global Survey on Digital and Sustainable Trade Facilitation.* Available at: https://www.untfsurvey.org/

[77] United Nations (2023). *United Nations Global Survey on Digital and Sustainable Trade Facilitation 2023.* Available at: https://www.untfsurvey.org/files/documents/2023-Survey-Questionnaire-English.pdf

implementation score between 0 percent and 100 percent can be computed for all economies, where 100 percent refers to an economy having a score of '3-Fully Implemented' across all measures within the sub-group. This provides a reasonable basis for grouping economies into three stylised implementation levels of paperless trade – Level 1, Level 2, Level 3 – based on pre-determined thresholds taking into account the general score distribution globally. The thresholds were set at below 75 percent for Level 1, between 75 percent and 85 percent for Level 2, and above 85 percent for Level 3 respectively. For example, the Republic of Korea, with an aggregate implementation score of 93.3 percent, would be classified as Level 3 (above 85 percent).

Requiring respondents to have experiences exporting to destinations in all three categories (Basic, Intermediate, or Advanced) would have resulted in low incidence rates. With this in consideration, the survey targeted respondents with two out of three implementation levels per in-scope economy. The allocation of export economies by implementation level was random by design and had been pre-assigned to ensure that sufficient data points are still collected to have generalisable conclusions about enablers, success metrics, and cost savings at an economy-wide level. Table A.1 provides an indicative picture of the sampling design and interpolation.

Table A.1 Sampling design and interpolation

Export destination / In-scope economy	**CDA**	**CHL**	**PRC**	**ROK**	**MEX**	**PE**	**SGP**	**USA**
	Intermediate	Intermediate	Advanced	Advanced	Advanced	Advanced	Advanced	Advanced
Advanced (implementation score of 85% and above)	✓	✓	Interpolated	✓	✓	Interpolated	✓	✓
Intermediate (implementation score of 75%–85%)	✓	Interpolated	✓	✓	Interpolated	✓	Interpolated	✓
Basic (implementation score of below 75%)	Interpolated	✓	✓	Interpolated	✓	✓	✓	Interpolated

Tick indicates that survey respondents (exporters from the in-scope economy) are surveyed on their experience of exporting to economies of that paperless trade implementation level.

When performed across all in-scope economies and analysis aggregated, this provides a complete picture of the differential impacts of paperless trade platforms, in accordance to varying levels of paperless trade implementation on both the exporter and importer side.

A.3 EXPERT INTERVIEWS

Selected expert interviews were conducted to help validate the findings, including with paperless trade platform providers, finance and logistics users, corporations with internal paperless trade systems, and port operators.

The interviews focused on several key areas of inquiry. Platform providers were asked about their onboarding and go-to-market strategies, market segmentation, the motivations and barriers to adoption for their users, as well as commercial viability. Users and corporates were asked to share about their organisation's specific needs and considerations and attitudes towards paperless trade. Both groups were also asked to share about the top success factors of paperless trade platforms, opinions about the failures of certain platforms, observations about

regional differences in implementing paperless trade, discussion of various enabling factors, and their vision and future outlook for paperless trade.

Table A.2 Interview profiles

Profile	Description
Platform Provider	Former Enterprise Product and Strategy Director for a regional paperless trade platform
Platform Provider	Former Commercial Manager for a global paperless trade platform
Platform Provider & User	Former Technology and Product Strategy Lead across multiple trade stakeholders (port terminal operators, paperless trade platforms and shipping lines)
Platform User	Former Finance Manager for a global construction firm
Platform User	Former Logistics Operator for a global oil major
Platform User	Former International Trade / Compliance Director for a global fast-moving consumer goods company
Technology Expert	Former Solution and Enterprise Architect for government and UN/CEFACT Project Lead

ANNEX B: SUMMARY STATISTICS – SURVEY

B.1 RESPONDENT PROFILE

A total of 7,866 respondents from the eight in-scope economies were sampled.

In order to ensure that we are sampling the right target group, filters were applied to only sample respondents from **exporting firms that use paperless trade in their export operations**. In addition, respondents should have a good knowledge of the firm's trade processes.

As a result, 4,264 responses were determined to be non-qualified samples as they were non-exporters, and a further 416 were determined non-qualified as they do not use paperless trade platforms. A remaining 2,355 responses were determined to be non-qualified due to other reasons (e.g. respondents do not have a good knowledge of firms' trade processes).

There was a total of 831 fully qualified samples, with at least 100 samples in each economy.

Table B.1 Qualified responses by economy

	CDA	CHL	PRC	ROK	MEX	PE	SGP	USA
Qualified responses	102	102	111	106	102	101	106	101

Figure B.1 Respondents by organisation size

Note: Based on qualified responses.

ANNEX C: ECONOMETRIC ANALYSIS – METHODOLOGY AND RESULTS

This section describes the detailed methodology and sources used for the research. There are six parts in this section:

C.1 Estimating reduction in trade costs from paperless trade adoption
C.2 Trade cost decomposition to estimate trade transaction costs
C.3 Reverse causality analysis in other trade studies
C.4 Main model specification and results
C.5 Robustness tests
C.6 Economic contribution from increased trade flows

C.1 ESTIMATING REDUCTION IN TRADE COSTS FROM PAPERLESS TRADE ADOPTION

The effect of paperless trade adoption on trade costs was estimated out-of-model using survey results as described in Annex A. These trade cost impacts comprise border compliance cost savings and transit cost savings.

Respondents were first asked to recall an actual scenario of the total person-hours that their organisation spends every month on activities along the trade process when exporting. ('Actual' Scenario). Respondents were then asked to consider a scenario where paperless trade platforms do not exist ('Counterfactual' Scenario). Respondents were asked to estimate the change in person-hours that could be expected under the 'Counterfactual' Scenario relative to the 'Actual' Scenario. Data points on the 'Counterfactual' Scenarios can be aggregated to estimate the time savings accrued to using paperless trade platforms, which is an indication of cost savings (henceforth referred to as 'border compliance cost savings').

Respondents were also asked if the adoption of paperless trade platforms had affected their transit time when exporting to economies in groups 1 and 2 respectively.[78] Data points were aggregated to estimate transit time savings from using paperless trade platforms, which is an indication of cost savings (henceforth referred to as 'transit cost savings').

While this approach is susceptible to hypothetical bias, the survey design has sought to minimise this by i) phrasing the questions in a neutral manner ('how would you expect it to change' rather than 'will you expect it to increase/decrease'); ii) prompting participants with what they indicated as their actual time spent while using paperless trade platforms for easier visualisation, and iii) providing options in the form of ranges to reduce the likelihood of false precision in respondents' stated responses. To manage the impact of outliers in individual responses on cost savings, responses were also winsorised at the 10^{th} and 90^{th} percentile.[79]

Border compliance cost savings

For each data point, responses were used to calculate a weighted average across all six components of the trade process to estimate an average percentage time savings per month

[78] Transit time is defined as the time taken for the goods to arrive to its final export destination (e.g. customers' doorsteps) after leaving the warehouse.

[79] The top 10% of values were replaced individually by the value at the 90^{th} percentile, and the bottom 10% of values were replaced individually by the value at the 10^{th} percentile. This statistical technique is well recognised and accepted for reducing the impact of potentially spurious outliers.

accrued to exporters from using paperless trade platforms. This was then further weighted by business size, to account for the fact that SMEs would likely differ in their paperless trade experience compared to larger enterprises. For each economy, the responses were then aggregated separately for each group of exporting destinations. Economy-specific gaps in the sampling design were interpolated linearly. Hence, each of the eight in-scope economies had three estimates of percentage time savings from using paperless trade platforms. These results provide an estimate of border compliance time savings. A ratio of border compliance costs (including time costs) to total trade costs was used to convert the average time savings results from the survey into a 'cost savings shock'. To estimate border compliance costs as a share of total costs, the labour costs from undertaking trade processes as a share of total labour costs was collected as part of the survey and used as a proxy. This was then applied to the relationship estimated from the gravity model.

Transit cost savings

For each economy, responses on paperless trade platforms' effect on transit time were aggregated for each group of exporting destinations. Economy-specific gaps in the sampling design were interpolated. Hence, each of the eight in-scope economies had three estimates of percentage transit time savings from using paperless trade platforms.

A seminal paper by Hummels and Schaur (2013) estimated that each additional day that goods spend in transit incurs an ad-valorem equivalent cost of between 0.6 percent and 2.1 percent, depending on the time-sensitivity of the goods in question.[80] This was applied to the estimated time savings to derive the ad-valorem transit cost savings from using paperless trade platforms. More recent studies, such as Ansón et al. (2017), examined the relationship between time spent in transit and trade flows more directly, and found a similar relationship, estimating that each additional day spent in international transit reduces bilateral trade by close to 1 percent.[81]

C.2 TRADE COST DECOMPOSITION TO ESTIMATE TRADE TRANSACTION COSTS

Before estimating the impact of reduced trade costs on trade flows, an additional step was required to decompose the trade cost variable to remove the components of trade costs associated with various geographic and trade variables included in the structural gravity model. This prevents the possibility of collinearity among independent variables.

The UNESCAP-World Bank Trade Cost database was used as the starting point for constructing the trade cost variable to be used in the model. The Trade Cost database is defined in Arvis et al. (2015) as the ad valorem equivalent bilateral trade costs associated with trading goods internationally with the bilateral partner relative to costs associated with trading goods domestically.[82] To exclude costs related to trade liberalisation such as tariffs,[83] only the non-tariff component of trade cost from the database was used for the main analysis.

---

80 Hummels, D.L. and Schaur, G. (2013) "Time as a trade barrier." *American Economic Review* 103(7), 2935–59.

81 Ansón, J., Arvis, J., Boffa, M., Helble, M. and Shepherd, B. (2017). "Time, Uncertainty and Trade Flows." *ADB Institute Working Paper* 673.

82 Arvis, J.F., Duval, Y., Shephard, B., Utokham, C. and Raj, A. (2016). Trade Costs in the Developing World: 1996-2010. *World Trade Review*, 15(3), 451-474. DOI: 10.1017/S147474561500052X.

83 This is consistent with the APEC endorsed definition of trade transaction costs. See APEC Policy Support Unit (2011). Facilitating Electronic Commerce in APEC: A Case Study of Electronic Certificate of Origin (e-CO). Available at: https://www.apec.org/publications/2011/11/facilitating-electronic-commerce-in-apec-a-case-study-of-electronic-certificate-of-origin

Column (1) in Table C.1 shows the results of the decomposition. All trade cost variables have expected signs and are reasonably similar in magnitude when compared to the regression coefficients to similar decompositions from past studies, such as in Arvis et al. (2015) (see Column 3). Similar results were obtained when testing the regression with total trade cost as the dependent variable (see Column 2).

Table C.1 Regression results of trade cost decomposition

	(1) Main specification	(2) Alternative specification	(3) Arvis et. al (2015)[84]
	Dependent variable: non-tariff trade cost	Dependent variable: total trade cost	Dependent variable: manufacturing trade cost
log(distance)	0.357***	0.347***	0.304***
	(0.006)	(0.005)	(0.000)
contig	-0.270***	-0.273***	-0.318***
	(0.028)	(0.025)	(0.000)
comlang_off	-0.166***	-0.173***	-0.156***
	(0.011)	(0.010)	(0.000)
comcol	-0.207***	-0.189***	-0.072**
	(0.015)	(0.014)	(0.028)
fta_wto	-0.086***	-0.127***	-0.128***
	(0.010)	(0.009)	(0.000)
Num.Obs.	168 950	198 063	2 519
R2 Within Adj.	0.528	0.536	0.594

* p < 0.1, ** p < 0.05, *** p < 0.01

The estimated coefficients from the main specification in (1) were then used to construct the bilateral trade cost associated with common geographic and trade policy variables (which include distance, common border, common official language, common coloniser, and the presence of free trade agreements) for each economy pair in each year. Subtracting these predicted trade costs from the non-tariff trade cost yielded a residual. The residual is the variable of interest to be used in the main gravity model, as it represents the unaccounted-for portion of non-tariff trade costs which could be further reduced by implementing paperless trade platforms.

C.3 REVERSE CAUSALITY ANALYSIS IN OTHER TRADE STUDIES

The impact of trade costs on trade flows has been historically well-documented in the trade literature. Within trade policy literature, policies such as preferential trade agreements and other non-tariff measures have been demonstrated to influence trade flows through trade costs. Hoekman and Nicita (2011) showed that the impact of policies that reduce transaction costs at and behind borders can result in greater impact on trade flows than measures such as tariffs or non-tariff measures;[85] Khan and Khalirajan's (2011) analysis of Pakistan's export growth

[84] The specifications in Arvis et. al (2016) differs slightly from our specification in the following ways: i) conducting a cross-sectional analysis rather than a panel analysis, ii) inclusion of other variables such as whether the economy is landlocked, and iii) regression on manufacturing trade costs.

[85] Hoekman, B., & Nicita, A. (2011). Trade policy, trade costs, and developing country trade. *World development*, *39*(12), 2069-2079.

between 1999–2004 reveals that exports grew primarily due to a reduction in beyond-the-border costs, generated by a transition in foreign policy orientation and improvement of orientation skills.[86] Within transport economics, the impact of transport costs on trade flows is also particularly salient in the transport economics literature, with Limao and Venables (2001) finding that a doubling of trade costs reduces trade flows by more than 80 percent.[87]

Existing literature acknowledges endogeneity issues associated with the structural gravity model – in particular, the possibility of reverse causality between trade costs and trade flows. In transport economics, the surge in trade volumes have been documented to lead to increased wait times and higher costs amounting from congested ports.[88] Alternatively, when trade volumes are higher, there might be a greater incentive for economies to engage in strategies to lower trade costs. For instance, higher volumes may incentivise the construction of newer infrastructure and the adoption of logistics technologies that may go into lowering trade costs in the subsequent time periods.[89] In trade policy, economies have been demonstrated to be more likely to enter into trade arrangements like FTAs with economies they have existing trade relationships with. Trefler (1993) finds that addressing the endogeneity of non-tariff barriers to trade (NTB) led to a decrease on US imports that is tenfold the coefficient estimated under the assumption of exogenous NTBs.[90] These considerations highlight concerns of reverse causality and simultaneity within the identified relationship between trade costs and trade flows.

Baier and Bergstrand (2002), in their analysis of the estimation bias resulting from endogeneity in the effect of FTAs on trade, discovered that accounting for endogeneity effects increases the impact of FTAs on trade by 69 percentage points.[91] In breaking down the endogeneity associated with transport costs, Brancaccio et.al (2019) models how various endogenous shocks occurring in the transportation sector have an lower impact on traded flows than exogenous shocks, reflecting an overestimation of the magnitude of impact; overall however, the relationship still remains – a decrease in trade costs leads to an increase in trade volumes.[92]

Furthermore, this relationship between trade costs and trade flows has been shown to persist particularly where endogeneity has been accounted for. Where researchers have sought to eliminate the endogeneity bias through instrumental variables, Donaldson (2009) tackles the challenge of endogenous trade costs resultant of transportation infrastructure projects by running estimations of placebo railroad lines, finding that the relationship between trade costs, trade flows, and income remain unchanged.[93] Rauche and Trindade (2002), in analysing the impact of having a substantial Chinese network on information costs, find that reducing

---

86 Khan, I. U., & Kalirajan, K. (2011). The impact of trade costs on exports: An empirical modeling. *Economic modelling*, *28*(3), 1341-1347.

87 Limao, N., & Venables, A. J. (2001). Infrastructure, geographical disadvantage, transport costs, and trade. *The world bank economic review*, 15(3), 451-479.

88 Behar, A., & Venables, A. J. (2011). Transport costs and international trade. In *A handbook of transport economics*. Edward Elgar Publishing.

89 Ibid.

90 Trefler, D. (1993). Trade Liberalization and the Theory of Endogenous Protection: An Econometric Study of U.S. Import Policy. *Journal of Political Economy* 101(1): 138–60.

91 Baier, S. L., & Bergstrand, J. H. (2002). *On the endogeneity of international trade flows and free trade agreements*. New York: mimeo.

92 Brancaccio, G., Kalouptsidi, M., & Papageorgiou, T. (2020). Geography, transportation, and endogenous trade costs. *Econometrica*, *88*(2), 657-691.

93 Baier, S. L., & Bergstrand, J. H. (2002). *On the endogeneity of international trade flows and free trade agreements*. New York: mimeo.

information costs in trade through having a substantial Chinese network can increase up to 47 percent increase in trade.[94]

C.4 MAIN MODEL SPECIFICATION AND RESULTS

If a static econometric model is estimated and the interaction between variables over time are ignored, significant information might be lost, resulting in poor estimation results with a likelihood of overestimation. Acknowledging the possibility of reverse causality between trade costs and trade flows, this analysis employs a generalised method of moments (GMM) estimator, specifically the first-differenced estimator popularised by Arellano and Bond (1991).[95] GMM estimators have featured in the trade literature – for instance, Martínez-Zarzoso et al. (2009) evaluate the effects of preferential agreements on trade between trade group members and non-members using both static and dynamic (GMM) estimators,[96] while Peridy (2005) finds that GMM is the most appropriate dynamic model to control for simultaneity bias.[97]

We estimate the gravity equation by adding an independent variable: the lagged value of the dependent variable of trade flows using the Arellano-Bond estimator. Although its coefficient of the lagged dependent variable is not of interest, dynamics are allowed for in the underlying processes, which might be essential for the recovery of consistent estimates of other parameters (Bond, 2002).[98] The inclusion of lagged quantities also lessens the problem of omitted variables.

The dynamic model is then specified as:

$$log\, X_{ijt} = b_0 + b_1\, log\, tradecost_{ijt} + b_2\, log\, X_{ijt-1} + b_3\, log\, distance_{ij} + b_4 contig_{ij} + b_5 comlang\_off_{ij} + b_6 comcol_{ij} + b_7\, FTA_{ijt} + b_8\, r_{it} + b_9\, r_{jt} + U_{ijt}$$

where X_{ijt} and X_{ijt-1} are the bilateral trade flows from exporter economy *i* to importer economy *j* in year *t* and *t-1*, $tradecost_{ijt}$ is the non-tariff trade cost unaccounted for by costs arising from various geographic and trade policy variables specific to the bilateral pair *ij* in year *t*, $distance_{ij}$ is the geographical distance between economies *i* and *j* which reflects trade costs that are correlated to distance, $contig_{ij}$ is a dummy variable equal to unity if economies *i* and *j* share a common land border, $comlang\_off_{ij}$ is a dummy variable equal to unity if economies *i* and *j* share a common official language, $comcol_{ij}$ is a dummy variable equal to unity if economies *i* and *j* were colonised by the same power, FTA_{ijt} is a dummy variable equal to unity if there are any free trade agreements (FTAs) between economies *i* and *j* in year *t*, r_{it} and r_{jt} is the appreciation of the currency against the United States dollar for economies *i* and *j* in year *t*, and U_{ijt} is the error term. The coefficient of interest, b_1, measures the effect of

---

94 Brancaccio, G., Kalouptsidi, M., & Papageorgiou, T. (2020). Geography, transportation, and endogenous trade costs. *Econometrica*, *88*(2), 657-691.

95 Arellano and Bond (1991), Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. Available at: http://www.econ.uiuc.edu/~econ508/Papers/arellanobond91.pdf

96 Martínez-Zarzoso et al. (2009), Are regional trading agreements beneficial?: Static and dynamic panel gravity models. Available at: https://www.sciencedirect.com/science/article/abs/pii/S1062940808000661

97 Peridy (2005). Toward a Pan-Arab free trade area: assessing trade potential effects of the Agadir agreement. Available at: https://www.ide.go.jp/library/English/Publish/Periodicals/De/pdf/DE43_3_1.pdf

98 Bond (2002), Dynamic panel data models: A guide to micro data methods and practice. Available at: https://www.econstor.eu/bitstream/10419/79398/1/362533474.pdf

a change in non-tariff trade costs on trade flows, after controlling for other trade costs arising from various geographic and trade policy variables.

Table C.2 presents the results from three gravity model estimations. Column (1) reflects a standard model, while Column (2) uses real bilateral trade flows instead of nominal trade flows, as in this model, exports are not deflated by the two multilateral resistance terms which are special but unobserved price indices. Nominal trade flows were deflated by the seasonally adjusted Consumer Price Index (2010=100), retrieved from the World Bank. Column (3), the base specification, includes terms for year-on-year exchange rate fluctuations for both the exporter and importer, which are typically absorbed by exporter-time and importer-time fixed effects that are required to control for multilateral resistance but are not present here.

Table C.2 Arellano-Bond model estimates of the impact of trade costs on trade flows

	(1) Standard model	(2) Adjusted for inflation	(3) Base specification
	Dependent variable: log(bilateral trade flows)	Dependent variable: log(real bilateral trade flows)	Dependent variable: log(real bilateral trade flows)
log(unexplained trade cost)	-2.760***	-2.574***	-2.573***
	(0.057)	(0.065)	(0.064)
log(bilateral trade flows, t-1)	0.180***		
	(0.008)		
log(real bilateral trade flows, t-1)		0.187***	0.187***
		(0.009)	(0.009)
log(GDP of exporter)	0.409***	0.412***	0.415***
	(0.026)	(0.031)	(0.031)
log(GDP of importer)	0.403***	0.380***	0.383***
	(0.027)	(0.030)	(0.030)
log(distance)	-0.827***	-0.601	-0.600
	(0.404)	(0.477)	(0.487)
Change in exporter currency value (against USD)			0.014**
			(0.005)
Change in importer currency value (against USD)			-0.002
			(0.002)
Num.Obs.	245 382	189 540	189 540
Sargan test – p-value	0.000	0.000	0.000
Autocorrelation AR(1) – p-value	0.000	0.000	0.000
Autocorrelation AR(2) – p-value	0.000	0.000	0.000

* p < 0.1, ** p < 0.05, *** p < 0.01

Variables such as contiguity, common language, common coloniser, FTA were dropped due to an unbalanced trade dataset. Windmeijer correction is applied.

A key limitation is that under the Sargan test, the model is assessed to be overidentified and exhibits first and second-order autocorrelation in the first-differenced errors, which may suggest concerns about instrument validity. Nevertheless, a key rationale and outcome of adopting this approach, as opposed to a static structural gravity model (presented below), is to apply a coefficient estimate of the effect of trade costs on trade flows that is more conservative, especially considering the possibility of overestimation resulting from reverse causality.

C.5 ROBUSTNESS TESTS

Two alternative estimations were also conducted using the structural gravity model without controls for reverse causality.

Consistent to the approach used in an earlier paper adopted for the APEC Committee on Trade and Investment by Access Partnership (2023),[99] a log-log specification was used for an ordinary least squares (OLS) estimation. Fixed effects were used with standard errors clustered at the exporter-importer pair level. Exporter-time and importer-time fixed effects as defined in Baier and Bergstrand (2007) were also included, which can be seen as accounting for all sources of unobserved heterogeneity that are constant for a given exporter across all importers and constant for a given importer across all exporters. The OLS equation is laid out as follows:

$$log\, X_{ijt} = b_0 + b_1\, log\, tradecost_{ijt} + b_2 F_{it} + b_3 F_{jt} + b_4\, log\, distance_{ij} + b_5 contig_{ij} + b_6 comlang\_off_{ij} + + b_7 comcol_{ij} + b_8\, FTA_{ijt} + U_{ijt}$$

where X_{ijt} is the bilateral trade flows from exporter economy *i* to importer economy *j* in year *t*, $tradecost_{ijt}$ is the non-tariff trade cost unaccounted for by costs arising from various geographic and trade policy variables specific to the bilateral pair *ij* in year *t*, F_{it} is the full set of exporter-time fixed effects (a dummy variable equal to unity for exporter economy *i* in year *t* and 0 otherwise), F_{jt} is the full set of importer-time fixed effects (a dummy variable equal to unity for importer economy *j* in year t and 0 otherwise), $distance_{ij}$ is the geographical distance between economies *i* and *j* which reflects trade costs that are correlated to distance, $contig_{ij}$ is a dummy variable equal to unity if economies *i* and *j* share a common land border, $comlang\_off_{ij}$ is a dummy variable equal to unity if economies *i* and *j* share a common official language, $comcol_{ij}$ is a dummy variable equal to unity if economies *i* and *j* were colonised by the same power, FTA_{ijt} is a dummy variable equal to unity if there are any free trade agreements (FTAs) between economies *i* and *j* in year *t*, and U_{ijt} is the error term. The coefficient of interest, b_1, measures the effect of a change in non-tariff trade costs on trade flows, after controlling for other trade costs arising from various geographic and trade policy variables.

Table C.3 presents the results from three structural gravity model estimations. Column (1) reflects a standard specification, while Column (2) reflects the specification for this analysis with trade cost as the independent variable of interest. The coefficients of geographic and policy trade variables in (1) were similar to that in (2), validating that the variable of interest, the unexplained trade cost, is reasonably uncorrelated with the other trade variables included in the regression (i.e. there are no collinearity issues).

Table C.3 Structural gravity model estimates of the impact of trade costs on trade flows

	(1) Standard gravity model	(2) Base specification	(3) Alternative specification
	Dependent variable: log(bilateral trade flows)	Dependent variable: log(bilateral trade flows)	Dependent variable: log(bilateral trade flows)
log(unexplained trade cost)		-3.903***	
		(0.030)	
log(non-tariff trade cost)			-3.176***
			(0.041)
log(distance)	-1.565***	-1.571***	

[99] APEC (2023), *Economic Impact of Adopting Digital Trade Rules: Evidence from APEC Member Economies.* Available at: https://www.apec.org/docs/default-source/publications/2023/3/economic-impact-of-adopting-digital-trade-rules-evidence-from-apec-member-economies/223_cti_economic-impact-of-adopting-digital-trade-rules.pdf?sfvrsn=e1021415_2

	(1) Standard gravity model	(2) Base specification	(3) Alternative specification
	(0.022)	(0.014)	
contig	0.737***	0.739***	
	(0.099)	(0.060)	
comlang_off	0.785***	0.811***	
	(0.041)	(0.027)	
comcol	0.843***	0.845***	
	(0.056)	(0.036)	
fta_wto	0.454***	0.466***	0.069***
	(0.036)	(0.022)	(0.019)
Exporter-year FE	Y	Y	Y
Importer-year FE	Y	Y	Y
Exporter-importer pair FE			Y
Num.Obs.	300 547	300 537	300 537
R2 Within Adj.	0.381	0.642	0.229

* p < 0.1, ** p < 0.05, *** p < 0.01
All standard errors are clustered by exporter-importer pairs

An additional specification of the structural gravity model was also estimated and included in Column (3), which allows for the inclusion of exporter-importer pair fixed effects in addition to exporter-time and importer-time fixed effects. Pair fixed effects account for unobservable relationships between the trade cost variable and the error term, thus removing endogeneity due to omitted variable bias. However, since pair fixed effects will absorb bilateral time-invariant covariates, coefficients of time-invariant components of trade cost (e.g. bilateral distance) cannot be estimated. Hence, for this alternative specification, the trade cost from the UNESCAP-World Bank Trade Cost database will be used directly, instead of isolating out specific components.

The OLS equation is laid out as follows:

$$log\, X_{ijt} = b_0 + b_1\, log\, \tau_{ijt} + b_2 F_{it} + b_3 F_{jt} + b_4 F_{ij} + b_5\, FTA_{ijt} + U_{ijt}$$

where X_{ijt} is the bilateral trade flows from exporter economy *i* to importer economy *j* in year *t*, τ_{ijt} is the non-tariff trade cost specific to the bilateral pair *ij* in year *t* obtained from the UNESCAP-World Bank Trade Cost database, F_{it} is the full set of exporter-time fixed effects (a dummy variable equal to unity for exporter economy *i* in year *t* and 0 otherwise), F_{jt} is the full set of importer-time fixed effects (a dummy variable equal to unity for importer economy *j* in year t and 0 otherwise), F_{ij} is the full set of pair fixed effects (a dummy variable equal to unity for exporter economy *i* and importer economy *j*), FTA_{ijt} is a dummy variable equal to unity if there are any free trade agreements (FTAs) between economies *i* and *j* in year *t*, and U_{ijt} is the error term. The coefficient of interest, b_1, measures the effect of a change in non-tariff trade costs on trade flows.

C.6 ECONOMIC CONTRIBUTION FROM INCREASED TRADE FLOWS

Paperless trade adoption contributes to an economy through the increased production activity that it induces through increased trade flows, across all industries in an economy.

Economic contribution measures the value of production by a firm or industry. Value added is the most appropriate metric for economic contribution, as compared to other metrics such as

total revenue or total export value, as these other methods risk double-counting and thus overstating economic contributions. For instance, these latter metrics would also include contributions by other industries supplying inputs as well as imported inputs, which are then reflected in the value of the final good or service which is sold. Instead, value added (VA) represents the unique contribution that each factor of production (e.g., labour and capital) creates for the value of the product in each intermediate step of production, and this can be measured by the incomes earned by those who own these factors of production. The sum of VA in production across all entities at the economy-wide level, this is equivalent to the gross domestic product (GDP) of an economy. Gross output (GO), on the other hand, measures the total economic activity in the production of new goods and services.

Input-output (IO) tables provide a detailed dissection of intermediate transactions within sectors in an economy. The intra-industry production relationships described in IO tables are expressed as multipliers. Using these multipliers, it is possible to analyse the total impact on all industries in an economy where there is a change in the demand for the output of any one industry. The analysis considers three categories of impacts: direct effects, indirect effects, and consumption induced effects.

- **Direct effects:** Where there is an increase in final use for a particular industry output, there will be an equivalent increase in the output of that industry, as producers react to meet the increased demand. The direct multiplier is exactly equivalent to one.
- **Indirect effects:** As these producers in this industry increase their output, inputs from other industries may also be required, as well as other inputs from the same industry. The first-round output from all industries will induce extra output from all industries, and in turn, these will induce extra output, and so on. The induced output is the industrial support output and is added to the first-round output to give the indirect effect (otherwise known as production-induced effects).
- **Consumption-induced effects**: In the process of producing the initial and production-induced output, wage and salary earners will earn additional income, which they will in turn spend on commodities produced by all industries in the economy. This spending will induce further production by all industries and is therefore described as ‘consumption-induced’.

Across these three categories, multipliers for gross output and value added can be tabulated from the underlying gross output and VA multipliers, using corresponding ratios specific to each industry in each economy:

Table C.4 VA multipliers from IO model

	CDA	CHL	PRC	ROK	MEX	PE	SGP	USA
First round effect	0.16	0.15	0.17	0.17	0.15	0.17	0.11	0.19
Type I multiplier	0.73	0.68	0.77	0.72	0.71	0.79	0.53	0.84
Type II multiplier	1.54	1.26	1.53	1.31	1.05	1.23	0.90	2.03

The IO tables were drawn from the latest OECD Inter-Economy Input-Output Tables (ICIO) for 2020, which covers all eight in-scope economies in our study. Where contributions to exports by enterprise size was unavailable on the OECD platforms (Singapore; Chile),

alternative data sources such as APEC[100] and domestic databases were consulted to draw corresponding estimates. The IO tables map flows of production, consumption and investment within economies in a consistent manner over the same period, with data for 45 sectors in each economy, making it suitable for analysis across different economies.

The estimation of the consumption induced effect uses data on compensation of employees (COE) by sector as a proxy for inputs to the household sector. As the ICIO does not include information on COE, this was estimated by applying the ratio of COE to VA in economy-specific IO tables or Supply-Use tables (SUTs) to the VA reported in the ICIO for each sector in each economy.

[100] APEC Policy Support Unit (2020) *Overview of the SME Sector in the APEC Region: Key Issues on Market Access and Internationalization.* Available at: https://www.apec.org/docs/default-source/Publications/2020/4/Overview-of-the-SME-Sector-in-the-APEC-Region---Key-Issues-on-Market-Access-and-Internationalization/220_PSU_SME-Market-Access-and-Internalization.pdf

ANNEX D: STOCKTAKE INFORMATION

D.1 CROSS-BORDER PAPERLESS TRADE PROJECTS

The Cross-Border Paperless Trade Database,[101] a joint initiative from the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) and the International Chamber of Commerce (ICC), tracks collaborative projects managed by private and public stakeholders with the objective of reducing paper-based processes and developing new methods to exchange electronic data and documents. Table D.1 details the active projects that the eight in-scope economies are involved in, including collaborations with other economies outside of the scope. This was performed by accessing the project database (www.digitalizetrade.org/projects) and selecting the relevant filtering parameters: these include the desired economy, and project status (Operating/Pilot) in the respective dropdown lists. This database is further supplemented by additional relevant databases, as outlined in Section D.2.

Table D.1 List of operating and pilot projects by the eight in-scope economies on the Cross-Border Paperless Trade Database[102]

Economy	Projects – Operating	Projects – Pilot
Canada	• TRACES – Trade Control and Expert System • Asia-Pacific Model E-port Network (APMEN)	• Digitization of ATA Carnet: A Step Closer with the Launch of Pilot Project (Mercury II Pilot project)
Chile	• Regional Customs Cooperation in Latin America • Electronic Origin Data Exchange System, China (EODES) • e-SPS: The Netherlands • Asia-Pacific Model E-port Network (APMEN) • Interoperability of the Foreign Trade Single Windows in the Pacific Alliance • Pacific Alliance- Electronic exchange of customs information (Chile, Mexico, Peru, Columbia) • Electronic phytosanitary certification between Argentina and Chile	N/A
People's Republic of China	• GACC and Mongolia Customs Administration eManifest electronic data exchange • Electronic Origin Data Exchange System, China (EODES) • Electronic exchange of Certificate of Origin between New Zealand and People's Republic of China • e-SPS: The Netherlands	• Trade Financing Pilots to Promote Digital Trade between Singapore and People's Republic of China under Singapore – China (Shenzhen) Smart City Initiative (SCI) • Digitization of ATA Carnet: A Step Closer with the Launch of Pilot Project (Mercury II Pilot project)

[101] Access Partnership analysis. Accessed in June 2024. Available at: www.digitalizetrade.org/projects
[102] Ibid.

Economy	Projects – Operating	Projects – Pilot
	• Asia-Pacific Model E-port Network (APMEN) • China's International E-Cert Cooperation • PAA e-AWB • NEAL-NET • PAA Secure Cross-Border Transaction Service	• EU / China Smart and Secure Trade Lanes Pilot Project (SSTL)
Republic of Korea	• Korea-India Electronic Origin Data Exchange System (EODES) • Electronic Origin Data Exchange System, China (EODES) • Exchange electronic phytosanitary certificates (ePhytos) between the Republic of Korea and the United States • e-SPS: The Netherlands • PAA e-AWB • NEAL-NET • PAA Secure Cross-Border Transaction Service	• Electronic exchange of certificates of origin between the Republic of Korea and Viet Nam • Korea-Netherlands e-Phyto Certificate Project
Mexico	• TRACES –Trade Control and Expert System • Pacific Alliance- Electronic exchange of customs information (Chile; Mexico; Peru; Columbia) • Interoperability of the Foreign Trade Single Windows in the Pacific Alliance • Asia-Pacific Model E-port Network (APMEN)	• Interoperability of the Foreign Trade Single Windows MX-UY
Peru	• Regional Customs Cooperation in Latin America • TRACES –Trade Control and Expert System • Pacific Alliance- Electronic exchange of customs information (Chile; Mexico; Peru; Columbia) • Interoperability of the Foreign Trade Single Windows in the Pacific Alliance • Asia-Pacific Model E-port Network (APMEN)	N/A
Singapore	• Singapore and National Bank of Cambodia - Financial Transparency Corridor (FTC) • Electronic Origin Data Exchange System, China (EODES) • PAA e-AWB • PAA Secure Cross-Border Transaction Service	• The ASEAN Customs Transit System (ACTS) • Cross Border CO Exchange between Singapore and Belgium • Trade Financing Pilots to Promote Digital Trade between Singapore and People's Republic of China under

Economy	Projects – Operating	Projects – Pilot
	• ASEAN Single Window (ASW) pilot project	Singapore – China (Shenzhen) Smart City Initiative (SCI) • World's first digital trade financing pilot between MLETR harmonised jurisdictions • Thailand's JSCCIB pilots blockchain-based National Digital Trade Platform (NDTP)
United States	• e-SPS: The Netherlands • Exchange electronic phytosanitary certificates (ePhytos) between the Republic of Korea and the United States • EU – USA: Mutual recognition of AEO and C-TPAT	N/A

D.2 STOCKTAKE OF PAPERLESS TRADE PLATFORMS

Besides the eight public platforms from the in-scope economies, an additional 31 commercial platforms were shortlisted for importance using a combination of reference list scans, additional literature review, and insights from APEC stakeholders.

1. List of commercial paperless trade platforms approved by The International Group (IG) of Protection and Indemnity (P&I) Clubs,[103] which provides marine liability cover for 90 percent of the world's ocean-going tonnage.
2. List of projects performing the digitisation of trade documents and digitalisation of trade processes in the Trade Finance Global (TFG) and the World Trade Organization (WTO) report in 2020.[104]
3. List of commercial platforms in the UNESCAP Cross-Border Paperless Trade Database.[105]
4. List of commercial platforms in a Ministry of Economy, Trade and Industry, Japan (METI)-commissioned study of international trade platforms in 2021.[106]

The analysis involved a stocktake of the historical and present operations of public and commercial platforms of interest across multiple key elements, including the platform

[103] Before 2010, the IG Clubs specifically excluded liabilities in respect of the carriage of cargo under all electronic, i.e. paperless trading, systems to the extent that the liabilities under such systems would not have arisen under a paper system i.e., one using transferable paper documentation. After 2010, liabilities arising in respect of the carriage of cargo under such paperless trading systems were covered, provided that the system had first been approved by the Group. The most recent list of IG approved paperless trade platforms is available in this circular dated 20 December 2023: https://www.piclub.or.jp/en/news/38714

[104] The publication maps 44 projects related to trade finance, insurance, Know-Your-Customer (KYC), shipping/logistics and supply chain, digitisation of trade documents and digitalisation of trade processes, as well as other projects such as marketplaces. Among these, 12 are specifically performing digitisation of trade documents and digitalisation of trade processes. Available at: https://www.wto.org/english/res_e/booksp_e/blockchainanddlt_e.pdf

[105] The cross-border paperless trade (CBPT) database facilitates the sharing of knowledge and expertise gained from previous and on-going projects and services on cross-border trade digitalisation. The CBPT database contains information on project/service on cross-border trade digitalisation (including its focus and objectives, architecture and functionalities, challenges, benefits, and other aspects), as well as relevant legal and implementation instruments. Available at https://www.digitalizetrade.org/

[106] NTT Data Institute (2021), *International economic research project for the establishment of an integrated domestic and international economic growth strategy.* Available at: https://www.meti.go.jp/meti_lib/report/2020FY/000681.pdf

objective, product scope, governance and business model, functionalities, documents supported, scale of adoption, technology architecture and standards, interoperability and partnerships. Table D.2 provides a summary comparison of all 39 shortlisted platforms, categorised by public and commercial platforms and sorted by the amount of publicly available information and similarity in breadth of offerings to facilitate cross-platform comparisons. Links accessed for the stocktake are provided in the endnotes.

Table D.2 Summary of each paperless trade platform – public and commercial

Public platforms	Functional classification of offerings					Success					Interoperability		
	Preparing documents	Financing trade	Arranging shipment and tracking	Declaring customs	Reporting and payment	Mandatory usage?	Region of operation	Adoption	Year of establishment	Highlights	Linkages with economy-wide/ regional/ global trade systems	Linkages with related trade service providers /other trade platforms	Other relevant linkages (e.g. financial)
Singapore: TradeNet/Networked Trade Platform	✓	✓	✓	✓	✓	No	Singapore	9 million transactions a year.	1989	Highlighted as a best-case practice by UNNExT.	>40 agencies. Part of ASEAN Single Window Initiative.	Onboarded GUUD, GeTS (CrimsonLogic) Dltledgers on NTP.[107] Linked to E2OPEN.	Partners with value-added service providers on the NTP (digitalisation and productivity, supply chain and freight, trade services, trade finance, insurance and payments), e.g., Haulio, Mastercard.[108]
Republic of Korea: UNI-PASS/uTradeHub	✓	✓	✓	✓	✓	No	Republic of Korea	Connects 430,000 entities, e.g., trading companies, Customs brokers, shipping companies, airlines, delivery companies, and warehouses.	2006	Systems based on UNI-PASS established in over 10 economies with support from Korea Customs Service.	>39 agencies[109]		Links to government institutions, customs brokers, banks, logistics organisations through uTrade, uLogis, uBankers, uTrade Search.
United States: Automated Commercial Environment (ACE)	✓		✓	✓	✓	No	USA	Per day: processed 100,000 containers, USD 9 billion worth of imported goods,	2014	Estimated economic benefits of USD 6.5 billion.	>47 agencies[110]	Linked to E2OPEN, SAP.	

[107] "GUUD TFAP eGuarantee Solutions," GUUD, accessed January 6, 2025, https://guud.company/wp-content/uploads/2023/11/GUUD-TFAP-eGuarantee-Solutions.pdf.

[108] "Factsheet: Trade Facilitation Agreement," Singapore Customs, September 26, 2018, https://www.customs.gov.sg/news-and-media/media-releases/2018-09-26-mediarelease-factsheet.pdf.

[109] Hoon-Goo Cho and Sung-Hoon Nam, "UNI-PASS: Korea's Customs Modernization Tool," *World Customs Organization (WCO)*, February 14, 2016, https://www.wcoomd.org/-/media/wco/public/global/pdf/topics/wto-atf/dev/uni-pass-koreas-customs-modernization-tool-wco-news-february-2016.pdf?la=en.

[110] "Partner Government Agencies in Automated Commercial Environment," Shapiro, accessed January 6, 2025, https://www.shapiro.com/wp-content/uploads/Partner-Government-Agencies-in-Automated-Commercial-Environment.pdf.

Public platforms	Functional classification of offerings					Success					Interoperability		
	Preparing documents	Financing trade	Arranging shipment and tracking	Declaring customs	Reporting and payment	Mandatory usage?	Region of operation	Adoption	Year of establishment	Highlights	Linkages with economy-wide/ regional/ global trade systems	Linkages with related trade service providers /other trade platforms	Other relevant linkages (e.g. financial)
								100,000 entry summaries for assessing duty and compliance, and USD253 million in duties, taxes, and other fees.					
People's Republic of China: China International Trade Single Window[111]	✓			✓	✓	All overseas exporters must register w/ GACC.	People's Republic of China	2.3 million users	2016		>25 agencies.[112] Exploring linkage to Malaysia[113]	Linked to E2OPEN.[114]	Linked to banks for international trade financing products e.g., Postal Savings Bank of China.
Canada: Single Window Initiative[115]	✓			✓	✓	No	Canada		2006		>9 agencies		
Chile: Integrated Foreign Trade System (Sistema Integrado de Comercio Exterior de Chile, or SICEX)	✓			✓	✓	No	Chile	407,129 exports in 2022[116]	2013		>12 agencies. Exchange of electronic documents w/ Pacific Alliance Economies[117]		
Peru: Single Window for Foreign Trade (Ventanilla Única de	✓		✓	✓			Peru		2006	Training programme on various transactions available	>22 agencies.[119] Exchange of electronic documents w/		

111 "China: Trade Facilitation and Customs Modernization," World Customs Organization (WCO), accessed January 6, 2025, https://www.wcoomd.org/-/media/wco/public/global/pdf/topics/facilitation/activities-and-programmes/sw-initiatives/china/pm0482e1_annexii.pdf?la=en.

112 Zhou Jinping, "Developing the China National Single Window," *Central Asia Regional Economic Cooperation (CAREC)*, January 21, 2021, https://www.carecprogram.org/uploads/RIBS-PRC-Module-2.pdf.

113 Asila Jalil, "Malaysia and China Work Together to Establish Single Window System," *New Straits Times*, June 19, 2024, https://www.nst.com.my/business/economy/2024/06/1065639/malaysia-and-china-work-together-establish-single-window-system#google_vignette.

114 "Customs Filing," E2open, accessed January 6, 2025, https://www.e2open.com/global-trade/customs-filing/.

115 "Single Window Initiative," Canada Border Services Agency (CBSA), accessed January 6, 2025, https://www.cbsa-asfc.gc.ca/prog/sw-gu/menu-eng.html.

116 "Numero de Transacciones en Sicex," Observatorio Logístico, accessed January 6, 2025, https://datos.observatoriologistico.cl/dataviews/248781/numero-de-transacciones-en-sicex/.

117 "Qué Hacemos," SICEX Chile, accessed January 6, 2025, https://www.sicexchile.cl/que-hacemos.

119 "VUCE - Alianza Pacífico: Guidelines for the Single Window System," Alianza del Pacífico, December 2021, https://alianzapacifico.net/assetsCDNy00MmYxLTg1MTItZWU2024/2021/12/VUCE_AP.pdf.

Public platforms	Functional classification of offerings					Success					Interoperability		
	Preparing documents	Financing trade	Arranging shipment and tracking	Declaring customs	Reporting and payment	Mandatory usage?	Region of operation	Adoption	Year of establishment	Highlights	Linkages with economy-wide/ regional/ global trade systems	Linkages with related trade service providers /other trade platforms	Other relevant linkages (e.g. financial)
Comercio Exterior, or VUCE)[118]										through VUCE.	Pacific Alliance Economies		
Mexico: Single Window for Mexican Foreign Trade (Ventanilla Única de Comercio Exterior Mexicana, VUCEM)	✓	✓		✓		No	Mexico		2013		>10 agencies. Exchange of electronic documents w/ Pacific Alliance Economies.		

The above information has been sourced on a best-effort basis. Blank cells indicate a dearth of readily available information from the perspective of the researchers, but do not preclude such the possibility of procuring such information.

[118] "Resultados de la Ventanilla Única de Comercio Exterior (VUCE)," Ventanilla Única de Comercio Exterior (VUCE), accessed January 6, 2025, https://www.vuce.gob.pe/Paginas/Resultados.aspx.

Commercial platforms	Functional classification of offerings					Success					Interoperability		
	Preparing documents	Financing trade	Arranging shipment and tracking	Declaring customs	Reporting and payment	Business Model (Revenue)	Region of operation	Adoption	Year of establishment	Accreditation (recognised by IG P&I Clubs)	Linkages with domestic/ regional/ global trade systems	Linkages with related trade service providers /other trade platforms	Other relevant linkages (e.g. financial)
IG P&I-approved platforms – eBLs issued have the same standing as paper-based solutions in terms of indemnity coverage													
ICE Digital Trade (formerly essDOCs)[120]	✓	✓	✓	✓		Paid service	Global	>70,000 company users in 190 economies.	2005	Recognised by IG P&I Clubs	**Global** linkages with chambers of commerce in 21 economies for eCOO.[121]	Partnered with trade platforms TradeGo, MineHub to embed capabilities.	Partnered with trade finance platforms Contour, Infosys, and Finacle.
CargoX[122]	✓	✓	✓	✓		Paid service: transaction fees for MSMEs and subscription model for corporates	Global	> 100,000 registered companies, > 124,000 registered users, > 7 million trade documents processed, > 120,000 companies connected.	2018	Recognised by IG P&I Clubs	**Global** linkages with economy-wide container carriers, Egyptian customs, and the government of India. [123]	Partnered with Enigio, digital finance platforms (Contour), ConsolFreight etc.[124]	
edoxOnline (Global Share S.A.)[125]	✓		✓	✓	✓	Paid service: subscription fees	Global	> 223,914 digital documents, 98,000 vessels and 160,000 containers.	2008	Recognised by IG P&I Clubs	**Global** linkages with chambers, official authorities in USA, Argentina, and Brazil.[126]	Partnered mainly with shipping agencies, traders, etc.	Exploring linkages with trade finance platform providers.
Bolero (WiseTech Global)[127]	✓	✓	✓			Paid service	Global		1999	Recognised by IG P&I Clubs		Partnered with dltledgers, ICE Digital Trade	Partnered with trade finance platforms

[120] NTT DATA Management Institute, Inc., "International economic research project for the establishment of an integrated domestic and international economic growth strategy," *Ministry of Economy, Trade and Industry (METI)*, March 19, 2021, https://www.meti.go.jp/meti_lib/report/2020FY/000681.pdf.

[121] "How to eCertify: Countries and Chambers," ESSCert, accessed January 6, 2025, https://www.esscert.com/how-to-ecertify/countries-and-chambers.

[122] "Transfer Documents," CargoX, accessed January 6, 2025, https://cargox.io/transfer-documents.

[123] "Governments," CargoX, accessed January 6, 2025, https://cargox.io/governments.

[124] "Press releases," CargoX, accessed January 6, 2025, https://cargox.io/news?category=Press+release.

[125] Deepesh Patel, "12 Companies Tackling Trade Document Digitization Head-On," *Trade Finance Global*, November 2, 2020, https://www.tradefinanceglobal.com/posts/12-companies-tackling-trade-document-digitization-head-on/.

[126] "eDox Online: In Figures," eDox Online, accessed January 6, 2025, https://web.edoxonline.com/index.php/edoxonline-in-figures/.

[127] "Partners," Bolero, accessed January 6, 2025, https://www.bolero.net/partners/.

Commercial platforms	Functional classification of offerings					Success					Interoperability		
	Preparing documents	Financing trade	Arranging shipment and tracking	Declaring customs	Reporting and payment	Business Model (Revenue)	Region of operation	Adoption	Year of establishment	Accreditation (recognised by IG P&I Clubs)	Linkages with domestic/ regional/ global trade systems	Linkages with related trade service providers /other trade platforms	Other relevant linkages (e.g. financial)
													Mitigram, Trade Flow, Marco Polo, R3 Corda; as well as domestic banks.
Secro[128]	✓	✓	✓			Paid service	Global	Currently used by 4 major commodities companies.	2022	Recognised by IG P&I Clubs			Partnered mainly with shipping agencies, e.g. B&M Agencia Maritima S.A; DynaRep Shipping Consultants; Tricon Steamship Agency; Pharo Ship Agent-Colombia.
GSBN[129]	✓	✓	✓			Not for profit consortium with Tiered membership fees	Global	>300,000 eBLs issued, 24 ports covered, >1,500,000 shipments released, >20,000 companies.	2021	No	Connected with more than 24 Ports globally	Linkage with COSCO Shipping Lines, Hapag Lloyd, OOCL, CMA CGM, ONE, PSA, Hutchison Ports, SIPG, QDP, ICTSI, COSCO Shipping Ports, Portbase.	Linkage with Banks, Insurance Companies, and Accredited conformity assessment bodies.
IQAX[130]	✓	✓	✓			Free of Charge	Global	> 16,000 registered companies, > 70 economies covered. >300,000 eBLs processed.	2020	Recognised by IG P&I Clubs		Used by Container Carriers: (COSCO, OOCL, Hapag Lloyd) and Bulk Carriers (COSCO Bulk, COSCO Special	Established linkages with more than 10 regional banks within People's Republic of China and Greater China through GSBN

128 "Home Page," Secro, accessed January 6, 2025, https://secro.io/.
129 "eBL and Paperless Trade," GSBN, accessed January 6, 2025, https://www.gsbn.trade/ebl-and-paperless-trade.
130 "Home Page," IQAX, accessed January 6, 2025, https://www.iqax.com/en/.

Commercial platforms	Functional classification of offerings					Success					Interoperability		
	Preparing documents	Financing trade	Arranging shipment and tracking	Declaring customs	Reporting and payment	Business Model (Revenue)	Region of operation	Adoption	Year of establishment	Accreditation (recognised by IG P&I Clubs)	Linkages with domestic/ regional/ global trade systems	Linkages with related trade service providers /other trade platforms	Other relevant linkages (e.g. financial)
												Carrier) through GSBN infrastructure.	
Enigio[131]	✓	✓		✓		Paid service: one-time fee for each document created	Global		2019	Recognised by IG P&I Clubs		Partnered with CargoX, Surecomp.[132]	Partnered with Mitigram.
E-Title[133]	✓	✓		✓		Paid service			2004	Recognised by IG P&I Clubs		Partnered with HAKOVO (online freight platform) to deploy HAKOVO ASSURED eBL[134]	
WaveBL[135]	✓	✓				Paid service: subscription and pay-as-you-go services	Global	545,000 eBLs issued, 136 economies covered, 65% eBL market share.	2016	Recognised by IG P&I Clubs		Partnered with Surecomp, Contour.	Partners mainly with shipping lines (Pacific International Line, Asia Shipping).
eTEU eBL Platform[136]	✓		✓			Paid service: pay per use	Regional (Americas)		2023	Recognised by IG P&I Clubs			
TradeGo[137]	✓				✓	Paid service	Regional (People's Republic of China; Singapore)		2021	Recognised by IG P&I Clubs	**Regional** linkages with China Xiamen NSW	Partnered with SGTradeX, 66LogisTech, EffiTrade.[138]	Piloted digital currency payments with PlatON.
Non- IG P&I-approved platforms													

131 "Home Page," Enigio, accessed January 6, 2025, https://enigio.com.
132 "News," Enigio, accessed January 6, 2025, https://enigio.com/news/.
133 "Introduction," e-Title, accessed January 6, 2025, https://www.e-title.net/co_intro.php.
134 "Press Releases," Enigio, accessed January 6, 2025, https://www.e-title.net/co_press.php.
135 "Home Page," WaveBL, accessed January 6, 2025, https://wavebl.com/.
136 "Home Page," Eteu, accessed January 6, 2025, https://eteu.co.uk/.
137 "Company Overview," TradeGo, accessed January 6, 2025, https://tradego.com/en/aboutus/company-overview.
138 "TradeGo MoU Media Release," SG Tradex, September 6, 2023, https://sgtradex.com/images/pdf/SGTD_X_TradeGo_MoU_Media_Release-_FOR_DISSEMINATION_.pdf.

Commercial platforms	Functional classification of offerings					Success					Interoperability		
	Preparing documents	Financing trade	Arranging shipment and tracking	Declaring customs	Reporting and payment	Business Model (Revenue)	Region of operation	Adoption	Year of establishment	Accreditation (recognised by IG P&I Clubs)	Linkages with domestic/ regional/ global trade systems	Linkages with related trade service providers /other trade platforms	Other relevant linkages (e.g. financial)
GUUD[139]	✓	✓	✓	✓	✓	Paid service: transaction fee	Global (Asia, Africa)	16% of all trade declaration permits in Singapore.	2018	No	**Regional** linkages (Cambodia, East Africa, Djibouti, CAREC) with customs and port authorities.[140]		
CargoWise (WiseTech Global)[141]	✓	✓	✓	✓		Paid service: subscription fees	Global	> 17,000 logistics organizations.	2014	No	**Global** linkages with over 170 customs facilities in the world.	Partnered with trade finance platforms Infosys, and acquired Bolero (with existing partnership with TradeWaltz, dltledgers, ICE Digital Trade)[142].	
Infor Nexus[143]	✓	✓	✓	✓	✓	Paid service	Global	> 85,000 companies on its platform, > USD 90 billion in global payments managed.	2019	No			Partners mainly with banks (DBS Bank, Standard Chartered, LSQ).
VAKT[144]	✓	✓	✓			Paid service	Global		2018	No		Partnered with Komgo and ICE Digital Trade (formerly essDOCS).[145]	

139 "Camel One," Guud, accessed January 6, 2025, https://guud.company/camel-one/.
140 vCargo Cloud, "VCargo Cloud Launches Guud Trade Platform to Simplify Global Trade Processes," *PR Newswire*, September 24, 2020, https://en.prnasia.com/releases/apac/vcargo-cloud-launches-guud-trade-platform-to-simplify-global-trade-processes-292694.shtml.
141 "CargoWise eCommerce Solutions," accessed January 6, 2025, https://www.cargowise.com/solutions/cargowise-ecommerce/#features.
142 Eleanor Wragg, "WiseTech Buys Bolero," *Global Trade Review (GTR)*, July 1, 2022, https://www.gtreview.com/news/fintech/wisetech-buys-bolero/.
143 "Infor Nexus Supply Chain Solutions," Infor, accessed January 6, 2025, https://www.infor.com/en-sg/solutions/scm/infor-nexus.
144 "Home Page," VAKT, accessed January 6, 2025, https://www.vakt.com/.
145 "Enterprise Blockchain Cost," Ledger Insights, accessed January 6, 2025, https://www.ledgerinsights.com/enterprise-blockchain-cost/.

Commercial platforms	Functional classification of offerings					Success					Interoperability		
	Preparing documents	Financing trade	Arranging shipment and tracking	Declaring customs	Reporting and payment	Business Model (Revenue)	Region of operation	Adoption	Year of establishment	Accreditation (recognised by IG P&I Clubs)	Linkages with domestic/ regional/ global trade systems	Linkages with related trade service providers /other trade platforms	Other relevant linkages (e.g. financial)
MineHub[146]	✓	✓	✓			Paid service: tiered subscription model	Global	Customer base includes largest resource companies, e.g. Sumitomo Corp, BHP, Codelco, Southwire.	2020	No		Partnered with Surecomp, Contour, TradeGo, and ICE Digital Trade.[147]	Partners mainly with commodity businesses e.g. Sumitomo.
Komgo[148]	✓	✓			✓	Paid service: membership fee and professional services cost by task	Global	3000+ connections between firms on the network, with 300+ firms and financial institutions on the network.	2018	No		Partnered with VAKT and essDOCs (ICE Trade). Partnered with CargoX and Contour. Partnered with SGTraDex and BB Energy.[149]	
TradeFinex[150]	✓	✓			✓	Paid service: network utility fee	Domestic (Singapore)		2018	No		Partnered with XDC Trade Network, r3corda, and DocuTrade.	
CrimsonLogic (Globel eTrade Services - GeTS)[151]	✓		✓	✓		Paid service	Global	> 170,000 users, over 13 million declarations annually.	1989	No	**Global** linkages with government agencies to develop domestic single windows		

146 "Platform," MineHub, accessed January 6, 2025, https://minehub.com/platform/.
147 Eleanor Wragg, "MineHub Bridges into China with TradeGo," *Global Trade Review (GTR)*, May 25, 2022, https://www.gtreview.com/news/fintech/minehub-bridges-into-china-with-tradego/.
148 "Home Page," Komgo, accessed January 6, 2025, https://www.komgo.io/.
149 "BB Energy, Komgo and SGTraDex Enter into MoU to Collaborate on the Digitalisation of Borrowing Base Financing," SG Tradex, August 21, 2023, https://sgtradex.com/images/pdf/Media_Release-_Digitalisation_of_Borrowing_Base_Financing_-_FOR_DISSEMINATION.pdf.
150 "Empowering the Trade Finance Ecosystem through Smart Contract Standards." TradeFinex, accessed January 6, 2025, https://www.tradefinex.org/
151 "Single Window Solutions," CrimsonLogic, accessed January 6, 2025, https://www.crimsonlogic.com/products-services/single-window.

Commercial platforms	Functional classification of offerings					Success					Interoperability		
	Preparing documents	Financing trade	Arranging shipment and tracking	Declaring customs	Reporting and payment	Business Model (Revenue)	Region of operation	Adoption	Year of establishment	Accreditation (recognised by IG P&I Clubs)	Linkages with domestic/ regional/ global trade systems	Linkages with related trade service providers /other trade platforms	Other relevant linkages (e.g. financial)
E2OPEN[152]	✓		✓	✓		Paid service: subscription-based, depending on modules and features.[153]	Global	> 480,000 enterprises and trading partners, over 15.9 billion transactions annually.	2000	No	**Global** customs linkages with 28 economies worldwide.[154]		
Morpheus. Network[155]	✓			✓	✓	Paid service	Global	>100 integrations with industry leaders, including DHL, FedEx, UPS.	2019	No	**Global** linkage with TradeTrust.[156]		Partners mainly with blockchain platforms.[157]
SAP[158]	✓	✓	✓	✓		Paid service: Annual contract	Global		2003	No			
dltledgers[159]	✓	✓	✓		✓	Paid service: subscription fee	Global	>4,500 ecosystem partners.	2018	No		Partnered with Bolero, SAP, TradeTrust, TradeLens, and essDocs (ICE Digita Trade).[160]	Partnered with global banks.

152 "Global Trade Solutions," E2Open, accessed January 6, 2025, https://www.e2open.com/global-trade/.
153 "E2Open Supply Chain Management Software," SelectHub, accessed January 6, 2025, https://www.selecthub.com/p/supply-chain-management-software/e2open/#:~:text=E2open's%20pricing%20structure%20is%20typically,of%20the%20user's%20supply%20chain.
154 "Customs Filing Data Sheet," Brandfolder, accessed January 6, 2025, https://cdn.brandfolder.io/IDKCKNW5/at/3h9wwcm9nhfhb5m83f4r568/e2open_Customs_Filing_Data_Sheet.pdf.
155 "Home Page," Morpheus Network, accessed January 6, 2025, https://morpheus.network/.
156 James Lathan, "Morpheus.Network Partners with Singapore Government's IMDA — TradeTrust Framework," *Morpheus.Network*, May 31, 2023, https://news.morpheus.network/imda-tradetrust-partnership-fe7a83792932.
157 James Lathan, "Morpheus.Network and Geeq Reinforce Partnership for Tailored Blockchain Offering," *Morpheus.Network*, May 27, 2023, https://news.morpheus.network/morpheus-network-and-geeq-reinforce-partnership-30cb61479af9.
158 "Trade Automation & GTM Solutions: SAP GTS," KPMG, accessed January 6, 2025, https://kpmg.com/us/en/capabilities-services/tax-services/international-tax-trade-and-transfer-pricing/trade-customs/trade-automation-gtm-solutions/sap-gts.html.
159 "Proteus Platform," dltledgers, accessed January 6, 2025, https://dltledgers.com/proteus-platform/.
160 "Partners," dltledgers, accessed January 6, 2025, https://dltledgers.com/partners/.

Commercial platforms	Functional classification of offerings					Success					Interoperability		
	Preparing documents	Financing trade	Arranging shipment and tracking	Declaring customs	Reporting and payment	Business Model (Revenue)	Region of operation	Adoption	Year of establishment	Accreditation (recognised by IG P&I Clubs)	Linkages with domestic/ regional/ global trade systems	Linkages with related trade service providers /other trade platforms	Other relevant linkages (e.g. financial)
Surecomp[161]	✓	✓				Paid service: subscription model	Global	> 300 clients	1987	No		Partnered with MineHub, Enigio, GSBN, ICE Digital Trade, WAVE BL.[162]	
People's Bank of China Blockchain Trade Finance Platform[163]	✓	✓				Non-profit	Domestic (People's Republic of China)	> 50,000 business transaction, > 48 commercial banks.	2018	No			
EC3 (Skuchain)[164]	✓	✓				Paid service: subscription and transaction fees	Global	Anchor customers include 10 enterprises across the globe.	2020	No		Partnered with R3 Corda (trade finance platform).[165]	

161 "Home Page," Surecomp, accessed January 6, 2025, https://surecomp.com/.
162 "About Us - Partners," Surecomp, accessed January 6, 2025, https://surecomp.com/about-us/partners/.
163 "PBOC Research Arm Blockchain Platform Shortens Trade Finance Process," *CGTN's Global Business*, September 8, 2020, https://news.cgtn.com/news/2020-09-08/PBOC-research-arm-Blockchain-platform-shortens-trade-finance-process-TCOmdGaLug/index.html.
164 Maddy White, "Skuchain and Mitsubishi Launch Blockchain Platform ECO for Metals and Mining," *Global Trade Review (GTR)*, August 10, 2020, https://www.gtreview.com/news/fintech/skuchain-and-mitsubishi-launch-blockchain-platform-eco-for-metals-and-mining/
165 Emmanuelle Ganne, "12 Companies Using Blockchain to Rewire Trade and Trade Finance," *Trade Finance Global*, November 2, 2020, https://www.tradefinanceglobal.com/posts/12-companies-using-blockchain-to-rewire-trade-and-trade-finance/

Commercial platforms	Functional classification of offerings					Success					Interoperability		
	Preparing documents	Financing trade	Arranging shipment and tracking	Declaring customs	Reporting and payment	Business Model (Revenue)	Region of operation	Adoption	Year of establishment	Accreditation (recognised by IG P&I Clubs)	Linkages with domestic/ regional/ global trade systems	Linkages with related trade service providers /other trade platforms	Other relevant linkages (e.g. financial)
TradeWindow	✓		✓			Paid service: subscription and transaction fee	Regional (Oceania)	> 450 company users in 2022.[166]	2018	No	**Regional linkages** with Australian and New Zealand export councils; authorised to issue trade COOs with RCEP agreement partners.[167]	Partnered with Cube to form an integrated digital trade platform.	
Covantis[168]	✓		✓			Paid service	Regional (Americas)	44 agricultural groups, > 200 legal entities.[169]	2021	No			
TradeWaltz Inc[170]	✓			✓		Paid service	Domestic (Japan)		2020	No	**Economy-wide** linkage with NACCS to meet the needs of domestic shippers. **Regional** linkages with overseas trade platforms (Singapore Customs' NTP, Thailand JSCCIB NDTP) through	Have begun conversations with trade platforms such as Bolero, TradeGo.[171]	

166 James Lindsay, "The Front Line of Trade," *Forsyth Barr*, June 10, 2022, https://www.forsythbarr.co.nz/assets/publications/TWL-2022-06-10-The-Front-Line-of-Trade.pdf

167 "TradeWindow Announces Partnership with the Export Council of Australia," TradeWindow, May 26, 2023, http://nzx-prod-s7fsd7f98s.s3-website-ap-southeast-2.amazonaws.com/attachments/TWL/412130/395301.pdf

168 "Platform Overview," *Covantis*, accessed January 6, 2025, https://covantis.io/platform/.

169 "Covantis Expands Into New Markets and Commodities to Reduce Inefficiencies in Global Trade," *CTMR Center*, March 26, 2024, https://www.ctrmcenter.com/news/ags-softs/covantis-expands-into-new-markets-and-commodities-to-reduce-inefficiencies-in-global-trade/.

170 NTT DATA Management Institute, Inc., "International economic research project for the establishment of an integrated domestic and international economic growth strategy."

171 "The First eBL Service (TradeGO) Certified by the P&I Club Has Emerged in Asia," TradeWaltz, January 26, 2023, https://www.tradewaltz.com/en/news/1124/.

Commercial platforms	Functional classification of offerings					Success					Interoperability		
	Preparing documents	Financing trade	Arranging shipment and tracking	Declaring customs	Reporting and payment	Business Model (Revenue)	Region of operation	Adoption	Year of establishment	Accreditation (recognised by IG P&I Clubs)	Linkages with domestic/ regional/ global trade systems	Linkages with related trade service providers /other trade platforms	Other relevant linkages (e.g. financial)
											implementation of API linkages.		
Trusple[172]	✓	✓			✓	Partial paid services	Domestic (People's Republic of China)		2020	No			Established linkages with **global** banks (Standard Chartered, DBS Bank, BNP Paribas, Deutsche Bank).[173]

The above information has been sourced on a best-effort basis. Blank cells indicate a dearth of readily available information from the perspective of the researchers, but do not preclude such the possibility of procuring such information. The 12 commercial platforms approved by The International Group (IG) of Protection and Indemnity (P&I) Clubs for indemnity coverage are listed first.

[172] "Trusple Blockchain Platform Overview," Ant Group, accessed January 6, 2025, https://www.antchain.net/productsAndSolutions/productsDetail/Trusple.

[173] "DBS Bank Partners with AntChain in Digital International Trade and Financial Service Platform," *DBS*, September 25, 2020, https://www.dbs.com/newsroom/DBS_Bank_is_the_first_Asian_bank_to_partner_AntChain_in_digital_international_trade_and_financial_service_platform#:~:text=Developed%20using%20AntChain's%20blockchain%20technology,their%20products%20and%20access%20trade.

ANNEX E: A FRAMEWORK FOR COST-BENEFIT ANALYSIS (CBA)

E.1 OVERVIEW OF COST-BENEFIT ANALYSIS

If governments were to support the development and use of paperless trade platforms, investment of public resources is required. Developing an economic case for such investment can be done through a cost-benefit analysis (CBA) framework, which would help provide an assessment of whether the proposed government support would provide net gains in societal welfare.

This section develops a framework around what should be considered, should a CBA be of interest.

A CBA involves a systematic evaluation of the full range of impacts of a project or policy, on society and the economy. It emphasises, to the extent possible, valuing the gains and losses in monetary-equivalent terms. Its goal is to enhance societal decision-making and maximise social value or, in economic terms, improving allocative efficiency. Implicitly, the benefits, costs, and net social benefit of a project are assessed in comparison to a reference point. Typically, this reference point is the 'status quo' or the current state of affairs, representing the absence of change. Essentially, CBA measures incremental changes brought about by a project.

One specific type of CBA is known as *ex ante* or prospective CBA, which is conducted before the decision is made to undertake or implement a project or policy. This form of analysis helps inform resource allocation decisions by aiming to determine if the proposed policy or project would be beneficial to society, that is, if it would yield a positive net social benefit.

The lack of detailed publicly available information on paperless trade platform implementation (including single windows) makes ex-ante cost-benefit analysis more tedious and complex. It must be noted that the experience of different economies is extremely diverse. The literature notes significant variance on the benefit side and on the cost side. The economic contribution estimated in Section 4.3 may provide some inputs for the benefits calculation, but it may not be comprehensive due to the presence of other ancillary benefits. Furthermore, it will also be necessary to develop estimates of the cost inputs in consultation with experts and contractors.

The following sections seek to provide high-level guidelines for policymakers attempting to begin the process of quantifying benefits and costs as an analytical tool for deciding whether to advance paperless trade platform implementation. By quantifying the potential benefits and costs, policymakers can make informed decisions about whether and how to proceed with such initiatives.

E.2 SPECIFYING GOVERNMENT INVOLVEMENT

After outlining the intent to advance paperless trade platform implementation, the government needs to specify the set of alternative projects to consider. Some potential projects (non-exhaustive) include developing a government-operated platform, supporting an interoperability initiative, and providing non-financial assistance such as awareness campaigns and training workshops to encourage business adoption.

The benefits and costs of developing a government platform may serve as an illustrative example. This could be in the form of a single window, enabling stakeholders to electronically submit data, information and documents through a single point, fulfilling all regulatory requirements for import, export, and transit.[174] The SW can evolve into a domestic trade platform, offering value-added services like e-payments, logistics options, insurance options, and data insights.[175]

With the government having primary standing[176] in the CBA as the main stakeholder, the CBA will measure government costs and benefits. By extension, the government also holds a further interest in economy-wide impacts, hence these wider economic impacts should also be accounted for.

It is important to try to include the full range of consequences of each project. However, from a practical perspective, analysts can consider only a manageable number of important impacts. For a CBA of a paperless trade platform, assigning monetary values to these impacts is anticipated to be relatively straightforward, as the effects are primarily economic in nature. This contrasts with environmental or health-related impacts, which would necessitate less established assumptions regarding their valuation.

The project may be assumed to exist across two periods: an 'implementation period' phased over a set number of years to implement and operationalise the project, and an 'operating period' which follows after the project is fully operational.

For the implementation period, a one-off implementation cost would be phased over a set number of years. A recurrent benefit will be generated annually from the use of the platform, but this benefit is expected to be only phased in during the implementation period as not all functions of the platform are fully operational. For the operating period, a recurrent cost will be incurred annually as part of regular operations and maintenance once the project is fully operational. A recurrent benefit will be generated annually from the use of the platform.

The platform may also be assumed to be fully operated and financed by the government, such that its costs are fully internalised.

E.3 OUTLINING THE BENEFITS

In this vein, this study identifies five key benefits of paperless trade platform implementation. Namely, these are the economic contribution from increased trade flows, reduced trade financing costs, decreased government administrative costs, higher customs net revenue, and

---

[174] Single Window Compendium (2017). *Understanding Single Window Environment.* Available at: https://www.wcoomd.org/-/media/wco/public/global/pdf/topics/facilitation/instruments-and-tools/tools/single-window/compendium/swcompendiumvol1parti.pdf

[175] Bayhaqi and Singh (2018), *Study on Single Window Systems' International Interoperability: Key Issues for Its Implementation.* APEC Policy Support Unit. Available at: https://www.apec.org/docs/default-source/publications/2018/8/study-on-single-windows-systems/218psustudy-on-single-windows-systems.pdf?sfvrsn=d3347f05_1

[176] Standing involves the identification of whose benefit and whose costs should be accounted for in the analysis, by determining whose preference matters and which preferences should count. See Whittington and MacRae (1986).

increased tariff receipts due to higher trade volumes.[177] The benefits to users from value-added services are not included here for conservativeness.

Table E.1 provides a starting point for how these benefit items may be computed.

Table E.1 Computation of benefit items for paperless trade platforms

#	Item	Recommendations for computation	Illustrative examples
1	Value of increased trade flows	At the firm level, border compliance cost savings and transit time savings from paperless trade adoption can be estimated using survey data. These savings can then be applied to the relationship between trade costs and trade flows to determine the percentage increase in trade flows. At the economy-wide level, export flows for each economy may be projected using real GDP forecasts from the IMF. The percentage cost savings calculated at the firm level may be scaled by the share of exporting firms and applied to total export flows. Only direct and indirect effects are considered, in line with the cost-benefit analysis literature. Consumption-induced economic effects from increased trade flows are excluded.	In 2021, the usage of paperless trade platforms was estimated to have boosted exports by USD 236.2 billion in the eight in-scope economies. This led to a combined economic contribution of USD 183.6 billion from direct and indirect effects of increased exports.
2	Reduction in trade financing costs	The reduction in trade financing costs can be calculated based on the increase in trade finance coverage, considering the current share of rejected applications and the estimated reduction in the cost of credit. This should be done separately for SMEs and large companies due to their differing characteristics.	There are several methodological challenges, including no direct data on the size of the paperless trade finance market and little or no quantitative research into the role of digitisation in enabling trade finance.[178] Estimates on trade finance cost reductions will depend on calculations from semi-structured interviews with trade practitioners, banks and experts.

[177] Sources include: UNESCAP (2012). Single Window Planning and Implementation Guide. Available at: https://www.unescap.org/sites/default/files/0%20-%20Full%20Report_5.pdf; African Alliance for E-commerce (2017). Practical Implementation Guide of Single Windows for Foreign Trade. Available at: https://swguide.org/single_window/AACE_guidelines_Single_Window_en.pdf; Hong Kong Legislative Council (2022). Implementation of Phase 3 of the Trade Single Window System. Item for discussion for Finance Committee. Available at: https://www.legco.gov.hk/yr2022/english/fc/fc/papers/f22-22e.pdf; and UNECE (2005). Case Studies on Implementing a Single Window. Available at: https://unece.org/fileadmin/DAM/cefact/single_window/draft_160905.pdf.

[178] The Commonwealth (2022), *Quantitative Analysis of the Move to Paperless Trade.* Available at: https://production-new-commonwealth-files.s3.eu-west-2.amazonaws.com/s3fs-public/2022-04/Quantitative_Analysis_of_the_Move_to_Paperless_Trade_UPDF%20(3).pdf?VersionId=lavpVx8RNZqWF17D0XY5B0HfkvbrXMr4

#	Item	Recommendations for computation	Illustrative examples
3	Reduction in government administrative costs	The reduction in government administrative costs can be estimated by considering the number of public sector employees involved in clearing paper-based trade documentation, their average gross annual wage, and the expected percentage reduction in time spent on these tasks.	Hong Kong, China estimated that the implementation of Phase 2 of the Trade Single Window would bring about a maximum notional staff savings of HKD 7,793,000 per annum among participating government agencies by streamlining the manual processes related to the applications of the licences/ permits concerned.[179]
4	Increase in customs net revenue	The potential increase in customs revenue may be estimated in two steps. First, business-as-usual tariff losses may be calculated by multiplying the percentage of tariffs lost to evasion with tariff revenues. Second, this loss may be multiplied by the percentage of trade flowing through paperless trade platforms and the expected percentage improvement in reducing tariff evasion through paperless trade.	ESCAP research indicates that cross-border paperless trade could reduce tax revenue losses from illicit financial flows (trade misinvoicing) in Asia and the Pacific by USD 119–USD 183 billion per year.[180] The estimate above may be a reference point when calculating economy-level benefit.
5	Increase in tariff receipts due to higher trade volumes	Finally, the increase in tariff receipts due to higher trade flows may be calculated by multiplying the projected increase in trade flows by the ad valorem tariff and the effective tariff collection rates.	Assuming a hypothetical ad valorem tariff of 5% and an effective tariff collection rate of 75%, the USD 236.2 billion increase in exports computed in benefit item 1 would yield an increase of USD 8.6 billion in tariff receipts.

E.4 OUTLINING THE COSTS

On the cost side, non-recurrent and recurrent costs related to starting and operating the platform will also be incurred (Table E.2).

[179] Hong Kong, China (2022), *Item for Finance Committee*. Available at: https://www.legco.gov.hk/yr19-20/english/fc/fc/papers/f20-53e.pdf

[180] Kravchenko (2023), *Estimating the effect of trade facilitation implementation on trade misinvoicing-based illicit financial flows and tax revenue in Asia and the Pacific.* Available at: https://www.unescap.org/sites/default/d8files/event-documents/ESCAP_Effect_of_trade_facilitation_StatsCafe_26Sep2022.pdf

Table E.2 Computation of cost items for paperless trade platforms

#	Item	Recommendations for computation
1	Non-recurrent costs	Non-recurrent costs consist of one-time expenses for items like hardware, hosting services, software, communication networks, and implementation services. They also include the wages and time costs of contract staff, IT personnel, and staff from participating government agencies involved in the initial setup and implementation. These data should be obtained through contractor quotes and internal estimations.
2	Recurrent costs	Recurrent costs are the ongoing expenses for the continuous operation of the platform, including hardware and software maintenance, data safety and security, communication network fees, system upkeep, and consumables. They also cover the salaries and benefits of contract staff and operators who manage and support the platform daily. These data should also be obtained through contractor quotes and internal estimations.

At the overall level, previous United Nations estimations in 2009 have placed the cost of Single Window projects at between USD 11 million and 56 million for implementation alone, with operational costs ranging from USD 227,208 to 9.2 million per annum (not adjusted for inflation).[181] In Africa, the Single Window budget is between USD 5 and 10 million for 41.6 percent of the economies interviewed, between USD 2 and 5 million for 16.6 percent of respondents, more than USD 10 million for 16.6 percent and less than USD 2 million for 25 percent of the economies (not adjusted for inflation).[182] A separate World Trade Organization report in 2015 reports that the establishment of single window systems seem to be among the most costly trade facilitation measures, with inception costs ranging from USD 100,000 to USD 27 million.

It would be important to measure the cost to the users of the Single Window platform as well in terms of additional time and money required to adopt and use the new platform.

E.5 ADDITIONAL CONSIDERATIONS

To assess projects with impacts spanning multiple years, it is necessary to aggregate benefits and costs arising at different times. In CBA, this is achieved by discounting future benefits and costs to their present values (PV). This involves dividing a cost or benefit that occurs in year t by $(1 + s)^t$, where s represents the real (inflation-adjusted) social discount rate. The CBA must be tested for sensitivity to this assumed discount rate.[183]

The discount rate, reflecting the time value of money,[184] is a crucial parameter in CBA as it allows for the comparison of costs and benefits occurring at different times. In the context of a paperless trade platform, the benefits (such as increased trade flows and reduced costs) take time to materialise, while the costs (such as implementation and maintenance) are often incurred upfront. As minor changes in the discount rate can significantly alter the present value calculations and influence project viability, sensitivity analysis is essential to assess the

[181] UN/CEFACT (2009). UN/CEFACT Single Window Repository, Geneva.
[182] African Alliance for E-commerce (2017). Practical Implementation Guide of Single Windows for Foreign Trade. Available at: https://swguide.org/single_window/AACE_guidelines_Single_Window_en.pdf
[183] Conceptually, this social discount rate measures the rate at which a society would be willing to trade present consumption for future consumption (Social Time Preference Rate, or STPR) or reflects the opportunity cost of capital based on the rate to productive investments (Social Opportunity Cost of Capital, or SOC).
[184] A dollar received in the future is worth less than a dollar received today as money can be invested and earn a return over time.

robustness of the results. The real (inflation-adjusted) social discount rate is typically estimated between two percent and seven percent, aligning with current policy government practices and applied literature.[185] The Net Present Value (NPV) is the difference between the present values of these benefits and costs. A positive NPV indicates that a project's incremental benefits outweigh its incremental costs, thus justifying its adoption.

However, uncertainty around predicted impacts and their monetary valuations necessitates further sensitivity analysis. This involves examining how the NPV changes under different assumptions, such as varying discount rates, adoption rates of the platform, or the magnitude of expected benefits. This analysis helps policymakers gauge the robustness of CBA conclusions and identify key factors influencing results, ultimately aiding informed decision-making on project implementation and risk mitigation strategies.

While a CBA traditionally centres on the overall economic impacts of a project, it is also important to consider the distributional impacts. This entails examining how the costs and benefits are distributed across various groups. In the context of a paperless trade platform, the benefits might not be uniform. For instance, while exporters and importers could experience notable cost reductions and efficiency gains, there might be adverse effects on specific groups like customs brokers or freight forwarders due to decreased demand for their services. Moreover, small and medium-sized enterprises (SMEs) could face challenges in adopting the new technology due to limited resources. Therefore, it is crucial for policymakers to consider these distributional impacts and develop strategies to mitigate any negative effects and ensure a fair and equitable transition to paperless trade. This could involve providing targeted support and training to affected groups, as well as designing policies that encourage the participation of SMEs in the paperless trade ecosystem.

By evaluating the costs and benefits and adopting a strategic approach to encourage and facilitate implementation, governments can leverage the potential of paperless trade to boost trade efficiency, lower costs, and foster economic growth.

[185] Sources include White House, United States (2023). *Circular No. A-4.* Available at: https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-4.pdf; Boardman, A.E., Greenberg, D.H., Vining, A. and Weimer, D.L. (2018). *Cost-Benefit Analysis: concepts and practice*. Fifth edition, Cambridge University Press.; Abelson, P. (2020), *A Partial Review of Seven Official Guidelines for Cost-Benefit Analysis.* Journal of Benefit-Cost Analysis. Cambridge University Press.

BIBLIOGRAPHY

AA Access Partnership. "Economic Impact of Adopting Digital Trade Rules: Evidence from APEC Member Economies." *Singapore: Asia-Pacific Economic Cooperation*, 2023. https://www.apec.org/publications/2023/04/economic-impact-of-adopting-digital-trade-rules-evidence-from-apec-member-economies.

Abelson, Philip. "A Partial Review of Seven Official Guidelines for Cost-Benefit Analysis." *Journal of Benefit-Cost Analysis* 11, no. 2 (2020): 272–93. https://www.cambridge.org/core/journals/journal-of-benefit-cost-analysis/article/abs/partial-review-of-seven-official-guidelines-for-costbenefit-analysis/A4A7830178222CC00726B7BF311714A8

African Alliance for E-commerce (AACE). "Practical Implementation Guide of Single Windows for Foreign Trade." 2017. https://swguide.org/single_window/AACE_guidelines_Single_Window_en.pdf.

Alianza del Pacífico. "VUCE - Alianza Pacífico: Guidelines for the Single Window System." December 2021. https://alianzapacifico.net/assetsCDNy00MmYxLTg1MTItZWU2024/2021/12/VUCE_AP.pdf .

Ansón, José, Jean-François Arvis, Mauro Boffa, Matthias Helble, and Ben Shepherd. "Time, Uncertainty and Trade Flows." *Asian Development Bank Institute (ADBI)*, no. 673 (2017). https://www.adb.org/sites/default/files/publication/230106/adbi-wp673.pdf.

Ant Group. "Trusple Blockchain Platform Overview." Accessed January 6, 2025. https://www.antchain.net/productsAndSolutions/productsDetail/Trusple.

Arellano, Manuel, and Stephen Bond. "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations." *The Review of Economic Studies* 58, no. 2 (1991): 277–297. http://www.econ.uiuc.edu/~econ508/Papers/arellanobond91.pdf.

Arvis, Jean-François, Yann Duval, Ben Shepherd, Chorthip Utoktham, and Anasuya Raj. "Trade Costs in the Developing World: 1996-2010." *World Trade Review* 15, no. 3 (2016): 451–474. https://doi.org/10.1017/S147474561500052X.

Asia Pacific Economic Cooperation (APEC) Policy Support Unit. "Research Outcomes: Summary of Research Projects and COVID-19 Policy Briefs 2020." 2020. https://www.apec.org/docs/default-source/Publications/2021/7/Research-Outcomes-Summary-of-Research-Projects-and-COVID-19-Policy-Briefs-2020/221_PSU_Research-Outcomes-2020.pdf.

Asian Development Bank (ADB) and the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). "Asia-Pacific Trade Facilitation Report 2024: Promoting Sustainability and Resilience in Global Value Chains." *ESCAP*, 2024. https://www.unescap.org/kp/2024/asia-pacific-trade-facilitation-report-2024-promoting-sustainability-and-resilience-global.

Baier, Scott L., and Jeffrey H. Bergstrand. "On the Endogeneity of International Trade Flows and Free Trade Agreements." New York: Mimeo, 2002.

Bayhaqi, Akhmad, and Satvinderjit K. Singh. "Study on Single Window Systems' International Interoperability: Key Issues for Its Implementation." *Singapore: Asia-Pacific Economic Cooperation*, 2018. https://www.apec.org/docs/default-source/publications/2018/8/study-on-single-windows-systems/218psustudy-on-single-windows-systems.pdf?sfvrsn=d3347f05_1.

Behar, Alberto, and Anthony J. Venables. "Transport Costs and International Trade." In *A Handbook of Transport Economics*. Edward Elgar Publishing, 2011.

Boardman, Anthony E., David H. Greenberg, Aidan R. Vining, and David L. Weimer. "Cost-Benefit Analysis: Concepts and Practice." 5th ed. Cambridge: Cambridge University Press, 2018.

Bolero. "Partners." Accessed January 6, 2025. https://www.bolero.net/partners/.

Bond, Stephen R. "Dynamic Panel Data Models: A Guide to Micro Data Methods and Practice." *Centre for Microdata Methods and Practice (cemmap) working paper*, no. CWP09/02 (2002). https://www.econstor.eu/bitstream/10419/79398/1/362533474.pdf.

Brancaccio, Guilia, Myrto Kalouptsidi, and Theodore Papageorgiou. "Geography, Transportation, and Endogenous Trade Costs." *Econometrica*, 88 no. 2 (2020): 657–691. https://doi.org/10.3982/ECTA15455.

Brandfolder. "Customs Filing Data Sheet." Accessed January 6, 2025. https://cdn.brandfolder.io/IDKCKNW5/at/3h9wwcm9nhfhb5m83f4r568/e2open_Customs_Filing_Data_Sheet.pdf.

Canada Border Services Agency (CBSA). "Single Window Initiative." Accessed January 6, 2025. https://www.cbsa-asfc.gc.ca/prog/sw-gu/menu-eng.html.

CargoWise. "CargoWise eCommerce Solutions." Accessed January 6, 2025. https://www.cargowise.com/solutions/cargowise-ecommerce/#features.

CargoX. "Governments." Accessed January 6, 2025. https://cargox.io/governments.

——. "Press Releases." Accessed January 6, 2025. https://cargox.io/news?category=Press+release.

——. "Transfer Documents." Accessed January 6, 2025. https://cargox.io/transfer-documents.
CGTN's GlobalBusiness. "PBOC Research Arm Blockchain Platform Shortens Trade Finance Process." *CGTN*, September 8, 2020. https://news.cgtn.com/news/2020-09-08/PBOC-research-arm-Blockchain-platform-shortens-trade-finance-process-TCOmdGaLug/index.html.
Chiappini, Raphaël, and Cyrielle Gaglio. "Digital Intensity, Trade Costs and Exports' Quality Upgrading." *The World Economy* 47, no. 2 (2023). https://onlinelibrary.wiley.com/doi/full/10.1111/twec.13448.
Cho, Hoon-Goo and Nam, Sung-Hoon. "UNI-PASS: Korea's Customs Modernization Tool." *World Customs Organization (WCO)*, February 14, 2016. https://www.wcoomd.org/-/media/wco/public/global/pdf/topics/wto-atf/dev/uni-pass-koreas-customs-modernization-tool-wco-news-february-2016.pdf?la=en.
Covantis. "Covantis Expands Into New Markets and Commodities to Reduce Inefficiencies in Global Trade." *CTMR Center*, March 26, 2024. https://www.ctrmcenter.com/news/ags-softs/covantis-expands-into-new-markets-and-commodities-to-reduce-inefficiencies-in-global-trade/.
——. "Platform Overview." Accessed January 6, 2025. https://covantis.io/platform/.
CrimsonLogic. "Single Window Solutions." Accessed January 6, 2025. https://www.crimsonlogic.com/products-services/single-window.
CTRM Center. "Vakt Sees Trade Volumes Grow Significantly – Expects More Growth in 2024." 2024. https://www.ctrmcenter.com/blog/vakt-sees-trade-volumes-grow-significantly-expects-more-growth-in-2024/.
DBS. "DBS Bank Partners with AntChain in Digital International Trade and Financial Service Platform." September 25, 2020. https://www.dbs.com/newsroom/DBS_Bank_is_the_first_Asian_bank_to_partner_AntChain_in_digital_international_trade_and_financial_service_platform#:~:text=Developed%20using%20AntChain's%20blockchain%20technology,their%20products%20and%20access%20trade.
Digital Container Shipping Association (DCSA). "DCSA's Member Carriers Commit to a Fully Standardised, Electronic Bill of Lading by 2030." 2023. https://dcsa.org/newsroom/dcsas-member-carriers-commit-to-a-fully-standardised-electronic-bill-of-lading-by-2030.
dltledgers. "Partners." Accessed January 6, 2025. https://dltledgers.com/partners/.
——. "Proteus Platform." Accessed January 6, 2025. https://dltledgers.com/proteus-platform/.
Duval, Yann, Aman Saggu, and Chorthip Utoktham. "Impact of Trade Facilitation and Paperless Trade on Trade Costs." *United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), Studies in Trade and Investment* no. 85 (2016).
Duval, Yann, and Mengjing Kong. "Digital Trade Facilitation: Paperless Trade in Regional Trade Agreements." *Asian Development Bank Institute (ADBI)* Working Paper 747 (2017). https://www.adb.org/sites/default/files/publication/321851/adbi-wp747.pdf.
Duval, Yann, and Simon Hardy. "A Primer on Quantifying the Environmental Benefits of Cross-Border Paperless Trade Facilitation." 2021. *United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)*. https://www.unescap.org/kp/2021/primer-quantifying-environmental-benefits-cross-border-paperless-trade-facilitation.
Duval, Yann, Chorthip Utoktham, and Alexey Kravchenko. "Impact of Implementation of Digital Trade Facilitation on Trade Costs." *Asia-Pacific Research and Training Network on Trade Working Paper* no. 174 (2018). https://repository.unescap.org/bitstream/handle/20.500.12870/1513/ESCAP-2018-WP-Impact-of-implementation-digital-trade-facilitation-on-trade-costs.pdf?sequence=1.
Duval, Yann, Nolwen Prince, and Chorthip Utoktham. "Advancing Digital Transformation: Global Insights into the Digitalisation of Trade Procedures." *UN Trade and Development (UNCTAD)*, 2023. https://unctad.org/news/advancing-digital-transformation-global-insights-digitalization-trade-procedures.
E2open. "Customs Filing." Accessed January 6, 2025. https://www.e2open.com/global-trade/customs-filing/.
——. "E2open Announces Fiscal 2025 First Quarter Financial Results." 2024. https://investors.e2open.com/news/news-details/2024/E2open-Announces-Fiscal-2025-First-Quarter-Financial-Results/default.aspx.
——. "Global Trade Solutions." Accessed January 6, 2025. https://www.e2open.com/global-trade/.
eDox Online. "eDox Online: In Figures." Accessed January 6, 2025. https://web.edoxonline.com/index.php/edoxonline-in-figures/.
Enigio. "Home Page." Accessed January 6, 2025. https://enigio.com. https://enigio.com/news/.
essCert. "essCert Countries & Chambers." Accessed January 6, 2025. https://www.esscert.com/how-to-ecertify/countries-and-chambers.
——. "How to eCertify: Countries and Chambers." Accessed January 6, 2025. https://www.esscert.com/how-to-ecertify/countries-and-chambers.
ETEU. "Home Page." Accessed January 6, 2025. https://eteu.co.uk/.
e-Title. "Introduction." Accessed January 6, 2025. https://www.e-title.net/co_intro.php.

——. "Press Releases." Accessed January 6, 2025. https://www.e-title.net/co_press.php.
European Commission. "Digital Intensity Index." Accessed January 2025. https://ec.europa.eu/eurostat/cache/metadata/en/isoc_e_dii_esmsip2.htm.
Ganne, Emmanuelle, and Hannah Nguyen. "Standards Toolkit for Cross-Border Paperless Trade: Accelerating Trade Digitalisation through the Use of Standards." *World Trade Organisation (WTO)*, 2022. https://www.wto.org/english/res_e/booksp_e/standtoolkit22_e.pdf.
Ganne, Emmanuelle. "12 Companies Using Blockchain to Rewire Trade and Trade Finance." *Trade Finance Global*, November 2, 2020. https://www.tradefinanceglobal.com/posts/12-companies-using-blockchain-to-rewire-trade-and-trade-finance/.
GSBN. "eBL and Paperless Trade." Accessed January 6, 2025. https://www.gsbn.trade/ebl-and-paperless-trade.
GUUD. "Camel One." Accessed January 6, 2025. https://guud.company/camel-one/.
——. "GUUD TFAP eGuarantee Solutions." *GUUD, 2023*. https://guud.company/wp-content/uploads/2023/11/GUUD-TFAP-eGuarantee-Solutions.pdf.
Guy. "How the eBL is shaping the future of shipping". Accessed January 6, 2025. https://ship.nridigital.com/ship_sep24/ebl_shaping_future_shipping
Hoekman, Bernard, and Alessandro Nicita. "Trade Policy, Trade Costs, and Developing Country Trade." *World Development* 39, no. 12 (2011): 2069–2079. https://doi.org/10.1016/j.worlddev.2011.05.013.
Hredzak, Tammy L. "Overview of the SME Sector in the APEC Region: Key Issues on Market Access and Internationalization." *Singapore: Asia-Pacific Economic Cooperation Policy Support Unit*, April 2020. https://www.apec.org/docs/default-source/Publications/2020/4/Overview-of-the-SME-Sector-in-the-APEC-Region---Key-Issues-on-Market-Access-and-Internationalization/220_PSU_SME-Market-Access-and-Internalization.pdf.
Hummels, David L., and George Schaur. "Time as a Trade Barrier." *American Economic Review* 103, no. 7 (2013): 2935–59. https://www.aeaweb.org/articles?id=10.1257/aer.103.7.2935.
IBM. "UK Government Tests Frictionless Trade Models with Ecosystem of Trust Pilots." 2023. https://www.ibm.com/blog/uk-government-tests-frictionless-trade-models-with-ecosystem-of-trust-pilots/.
ICE Digital Trade (IDT). "Partners." Accessed January 6, 2025. https://www.essdocs.com/network/partners.
Infor. "Infor Nexus Supply Chain Solutions." Accessed January 6, 2025. https://www.infor.com/en-sg/solutions/scm/infor-nexus.
International Chamber of Commerce (ICC). "ICC Digital Standards Initiative Launches Expanded Recommendations for Trade Documents." 2023. https://iccwbo.org/news-publications/news/icc-digital-standards-initiative-launches-expanded-digitalisation-recommendations-for-14-key-trade-documents.
——. "ICC Digital Standards Initiative Launches Complete Framework for Supply Chain Digitalisation." 2024. https://iccwbo.org/news-publications/news/icc-digital-standards-initiative-launches-complete-framework-for-supply-chain-digitalisation/.
——. "Trust in Trade: Verifiable Trust." 2023. https://www.dsi.iccwbo.org/_files/ugd/8e49a6_5a75a77950d7474da772bf9cfc2d985b.pdf.
International Federation of Freight Forwarders Associations (FIATA). "FIT Alliance Launches eBL Declaration to Secure Commitment to Digitalisation." 2023. https://fiata.org/n/fit-alliance-launches-ebl-declaration-to-secure-commitment/.
International Plant Protection Convention (IPPC). "ePhyto solution." Accessed 13 January 2025. https://www.ephytoexchange.org/landing/.
IQAX. "Home Page." Accessed January 6, 2025. https://www.iqax.com/en/.
Jalil, Asila. "Malaysia and China Work Together to Establish Single Window System." *New Straits Times*, June 19, 2024. https://www.nst.com.my/business/economy/2024/06/1065639/malaysia-and-china-work-together-establish-single-window-system#google_vignette.
Japan P&I Club. "Circular: Electronic (Paperless) Trading－eTEU eBL Platform" 2023. https://www.piclub.or.jp/en/news/38714.
Khan, Imran Ullah, and Kaliappa Kalirajan. "The Impact of Trade Costs on Exports: An Empirical Modeling." *Economic Modelling* 28 no. 3 (2011): 1341–1347.
Komgo. "Home Page." Accessed January 6, 2025. https://www.komgo.io/.
KPMG. "Trade Automation & GTM Solutions: SAP GTS." Accessed January 6, 2025. https://kpmg.com/us/en/capabilities-services/tax-services/international-tax-trade-and-transfer-pricing/trade-customs/trade-automation-gtm-solutions/sap-gts.html.
Kravchenko, Sergei. "Estimating the Effect of Trade Facilitation Implementation on Trade Misinvoicing-Based Illicit Financial Flows and Tax Revenue in Asia and the Pacific." *ESCAP*, 2023. https://www.unescap.org/sites/default/d8files/event-documents/ESCAP_Effect_of_trade_facilitation_StatsCafe_26Sep2022.pdf.

Lathan, James. "Morpheus.Network and Geeq Reinforce Partnership for Tailored Blockchain Offering." *Morpheus.Network*, May 27, 2023. https://news.morpheus.network/morpheus-network-and-geeq-reinforce-partnership-30cb61479af9.

——. "Morpheus.Network Partners with Singapore Government's IMDA — TradeTrust Framework." *Morpheus.Network*, May 31, 2023. https://news.morpheus.network/imda-tradetrust-partnership-fe7a83792932.

Ledger Insights. "Enterprise Blockchain Cost." Accessed January 6, 2025. https://www.ledgerinsights.com/enterprise-blockchain-cost/.

——. "Gunvor, Total Execute First Physical Oil Trade Confirmation Using VAKT Blockchain." 2022. https://www.ledgerinsights.com/vakt-blockchain-gunvor-total-oil-trade-confirmation/.

Legislative Council of the Hong Kong Special Administrative Region of the People's Republic of China. "Implementation of Phase 3 of the Trade Single Window System: Item for Discussion for Finance Committee." 2022. https://www.legco.gov.hk/yr2022/english/fc/fc/papers/f22-22e.pdf.

——. "Item for Finance Committee." 2022. https://www.legco.gov.hk/yr19-20/english/fc/fc/papers/f20-53e.pdf.

Limão, Nuno, and Anthony J. Venables. "Infrastructure, Geographical Disadvantage, Transport Costs, and Trade." *The World Bank Economic Review* 15, no. 3 (2001): 451–479.

Lindsay, James. "The Front Line of Trade." *Forsyth Barr*, June 10, 2022. https://www.forsythbarr.co.nz/assets/publications/TWL-2022-06-10-The-Front-Line-of-Trade.pdf.

Liu, Huju, and Julien McDonald-Guimond. "Measuring Digital Intensity in the Canadian Economy." *Statistics Canada*, 2021. https://www150.statcan.gc.ca/n1/pub/36-28-0001/2021002/article/00003-eng.htm.

Martínez-Zarzoso, Immaculada, Nowak-Lehmann D. Felicitas, and Nicholas Horsewood. "Are Regional Trading Agreements Beneficial?: Static and Dynamic Panel Gravity Models." *The North American Journal of Economics and Finance* 20, no. 1 (2009): 46–65. https://www.sciencedirect.com/science/article/abs/pii/S1062940808000661.

MineHub. "Condensed Consolidated Interim Financial Statements for the Three Months Ended April 30, 2024 and 2023." 2024. https://minehub.com/wp-content/uploads/2024/06/Q1-2025-Financial-Statement.pdf.

——. "Platform." Accessed January 6, 2025. https://minehub.com/platform/.

Morpheus Network. "Home Page." Accessed January 6, 2025. https://morpheus.network/.

New Zealand Customs Service. "Analysis and Pathway for Paperless Trade Report." *Asia-Pacific Economic Cooperation (APEC) Sub-Committee on Customs Procedures*, 2022. https://www.apec.org/docs/default-source/publications/2022/3/analysis-and-pathway-for-paperless-trade-report/222_sccp_analysis-and-pathway-for-paperless-trade-report.pdf?sfvrsn=fdd43e59_2#:~:text=Paperless%20trade%20refers%20to%20the,lieu%20of%20paper%2Dbased%20documents.

——. "Guidelines for Paperless Trade." *Asia-Pacific Economic Cooperation (APEC) Sub-Committee on Customs Procedures*, 2021. https://www.apec.org/publications/2021/11/guidelines-for-paperless-trade.

NTT DATA Management Institute, Inc. "International economic research project for the establishment of an integrated domestic and international economic growth strategy." *Ministry of Economy, Trade and Industry (METI)*, March 19, 2021. https://www.meti.go.jp/meti_lib/report/2020FY/000681.pdf.

Observatorio Logístico. "Numero de Transacciones en Sicex." Accessed January 6, 2025. https://datos.observatoriologistico.cl/dataviews/248781/numero-de-transacciones-en-sicex/.

Organisation for Economic Cooperation and Development (OECD). "Digital Opportunities for Sanitary and Phytosanitary (SPS) Systems and the Trade Facilitation Effects of SPS Electronic Certifications." *OECD Food, Agriculture and Fisheries Paper* no. 152 (2021). https://doi.org/10.1787/cbb7d0f6-en.

——. "OECD Productivity Statistics Database: Methodological Notes." 2021. https://www.oecd.org/sdd/productivity-stats/OECD-Productivity-Statistics-Methodological-note.pdf.

Patel, Deepesh, and Emmanuelle Ganne. "Blockchain and Distributed Ledger Technology in Trade: Where Do We Stand?" *World Trade Organization (WTO)*, 2020. https://www.wto.org/english/res_e/booksp_e/blockchainanddlt_e.pdf.

Patel, Deepesh. "12 Companies Tackling Trade Document Digitization Head-On." *Trade Finance Global*, November 2, 2020. https://www.tradefinanceglobal.com/posts/12-companies-tackling-trade-document-digitization-head-on/.

Péridy, Nicholas. "Toward a Pan-Arab Free Trade Area: Assessing Trade Potential Effects of the Agadir Agreement." The Developing Economies, XLIII-3 (2005): 329–45. https://www.ide.go.jp/library/English/Publish/Periodicals/De/pdf/DE43_3_1.pdf.

Porto, Lutercia, Patrick Racioppi, and André Simha. "How To Navigate The Transition From Paper Bill Of Lading (BL) to eBL." *Mediterranean Shipping Company (MSC)*, 2023. https://www.msc.com/-/media/files/msc-cargo/msc-solutions/digital-solutions/ebl/msc-ebl-white-paper-2023.

Ramachandran, Sukand, Ravi Hanspal, Laura Fisher, and Huny Garg. "Digital Ecosystems in Trade Finance: Seeing Beyond the Technology." *Boston Consulting Group (BCG)*, 2019. https://web-assets.bcg.com/img-src/BCG_Digital_Ecosystems_in_Trade_Finance_tcm9-229964.pdf.

Say, Alicia, Jack Wu, and Peter Stokes. "Facilitating Electronic Commerce in APEC: A Case Study of Electronic Certificate of Origin (e-CO)." *Singapore: Asia-Pacific Economic Cooperation*, 2011. https://www.apec.org/publications/2011/11/facilitating-electronic-commerce-in-apec-a-case-study-of-electronic-certificate-of-origin.

Secro. "Home Page." Accessed January 6, 2025. https://secro.io/.

SelectHub. "E2Open Supply Chain Management Software." Accessed January 6, 2025. https://www.selecthub.com/p/supply-chain-management-software/e2open/#:~:text=E2open's%20pricing%20structure%20is%20typically,of%20the%20user's%20supply%20chain.

SG Tradex. "BB Energy, Komgo and SGTraDex enter into MoU to collaborate on the digitalisation of borrowing base financing." August 21, 2023. https://sgtradex.com/images/pdf/Media_Release-Digitalisation_of_Borrowing_Base_Financing-_FOR_DISSEMINATION.pdf.

——. "TradeGo MoU Media Release." September 6, 2023. https://sgtradex.com/images/pdf/SGTD_X_TradeGo_MoU_Media_Release-_FOR_DISSEMINATION_.pdf.

Shapiro. "Partner Government Agencies in Automated Commercial Environment." Accessed January 6, 2025. https://www.shapiro.com/wp-content/uploads/Partner-Government-Agencies-in-Automated-Commercial-Environment.pdf.

Shepherd, Ben, and Yann Duval. "Estimating the Benefits of Cross-Border Paperless Trade in Asia and the Pacific." *ESCAP*, 2015. https://www.unescap.org/sites/default/d8files/Part%20II_Chapter%20V_Estimating%20the%20benefits%20of%20cross-border%20paperless%20trade_0.pdf.

SICEX Chile. "Qué Hacemos." Accessed January 6, 2025. https://www.sicexchile.cl/que-hacemos.

Singapore Customs. "Factsheet: Trade Facilitation Agreement." 26 September 2018. https://www.customs.gov.sg/news-and-media/media-releases/2018-09-26-mediarelease-factsheet.pdf.

Singapore Infocomm Media Development Authority (IMDA). "TradeTrust." Accessed January 6, 2025. https://www.imda.gov.sg/how-we-can-help/international-trade-and-logistics/tradetrust.

Surecomp. "Home Page." Accessed January 6, 2025. https://surecomp.com/

——. "About Us - Partners." Accessed January 6, 2025. https://surecomp.com/about-us/partners/.

SWIFT. "SWIFT Enables Global Trade Interoperability in Successful Trials." 2023. https://www.swift.com/news-events/news/swift-enables-global-trade-interoperability-successful-trials.

The Commonwealth. "Quantitative Analysis of the Move to Paperless Trade." 2022. https://production-new-commonwealth-files.s3.eu-west-2.amazonaws.com/s3fs-public/2022-04/Quantitative_Analysis_of_the_Move_to_Paperless_Trade_UPDF%20(3).pdf?VersionId=lavpVx8RNZqWF17D0XY5B0HfkvbrXMr4.

Trade Finance Global and World Trade Organization (WTO). "Blockchain & DLT for trade finance." 2020. https://www.tradefinanceglobal.com/blockchain/.

TradeGo. "Company Overview." Accessed January 6, 2025. https://tradego.com/en/aboutus/company-overview.

TradeWaltz. "The first eBL service (TradeGO) certified by the P&I club has emerged in Asia." January 26, 2023. https://www.tradewaltz.com/en/news/1124/.

TradeWindow. "FY 2024 Financial Results Investor Presentation." 2024. https://tradewindow.io/wp-content/uploads/2024/05/TWL-FY24-Results-Presentation.pdf.

——. "TradeWindow announces partnership with the Export Council of Australia." May 26, 2023. http://nzx-prod-s7fsd7f98s.s3-website-ap-southeast-2.amazonaws.com/attachments/TWL/412130/395301.pdf.

Trefler, Daniel. "Trade Liberalization and the Theory of Endogenous Protection: An Econometric Study of U.S. Import Policy." *Journal of Political Economy* 101 no.1 (1993): 138–160.

UN Trade and Development (UNCTAD). "Digital Trade Facilitation for Women Cross-Border Traders." 2020. https://unctad.org/news/digital-trade-facilitation-women-cross-border-traders.

United Nations Commission on International Trade Law (UNCITRAL). "Status: UNCITRAL Model Law on Electronic Transferable Records (2017)." Accessed January 6, 2025. https://uncitral.un.org/en/texts/ecommerce/modellaw/electronic_transferable_records/status.

United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). "Legal Readiness Assessment Guide." 2022. https://readiness.digitalizetrade.org/legal-guide/iia-establishment-paperless-trade-system.

——. "Asia-Pacific Trade Facilitation Forum 2022." 2022. https://www.unescap.org/sites/default/d8files/event-documents/APTFF%202022%20Session%201_panelists.pdf.

——. "Cross-Border Paperless Trade Database." Accessed January 6, 2024. https://www.digitalizetrade.org/projects.
——. "Single Window Planning and Implementation Guide." 2012. https://www.unescap.org/sites/default/files/0%20-%20Full%20Report_5.pdf.
United Nations Economic Commission for Europe (UNECE). "Case Studies on Implementing a Single Window." 2005. https://unece.org/fileadmin/DAM/cefact/single_window/draft_160905.pdf.
——. "Demo Hours: Business Solutions for Paperless Trade." 2024. https://www.unescap.org/events/2024/demo-hours-business-solutions-paperless-trade.
——. "UN/CEFACT Single Window Repository." Geneva, 2009.
United Nations. "UN Global Survey on Digital and Sustainable Trade Facilitation." 2023. https://www.untfsurvey.org/.
——. "United Nations Global Survey on Digital and Sustainable Trade Facilitation 2023." 2023. https://www.untfsurvey.org/files/documents/2023-Survey-Questionnaire-English.pdf.
VAKT. "Home Page." Accessed January 6, 2025. https://www.vakt.com/.
vCargo Cloud. "VCargo Cloud Launches Guud Trade Platform to Simplify Global Trade Processes." *PR Newswire*, September 24, 2020. https://en.prnasia.com/releases/apac/vcargo-cloud-launches-guud-trade-platform-to-simplify-global-trade-processes-292694.shtml.
Ventanilla Única de Comercio Exterior (VUCE). "Resultados de la Ventanilla Única de Comercio Exterior (VUCE)." Accessed January 6, 2025. https://www.vuce.gob.pe/Paginas/Resultados.aspx.
Wafula, Clarke Sumbule. "BLOCKCHAIN'S WEAKEST LINKS: A Modified UTAUT Model Analysis of the TradeLens Case." (Master's thesis, European University Institute, 2023). https://cadmus.eui.eu/bitstream/handle/1814/76074/Wafula_2023_Master_STG.pdf?sequence=1&isAllowed=y.
WaveBL. "Home Page." Accessed January 6, 2025. https://wavebl.com/.
White House, United States. "Circular No. A-4." 2023. https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-4.pdf.
White, Maddy. "Skuchain and Mitsubishi Launch Blockchain Platform ECO for Metals and Mining." *Global Trade Review (GTR)*, August 10, 2020. https://www.gtreview.com/news/fintech/skuchain-and-mitsubishi-launch-blockchain-platform-eco-for-metals-and-mining/.
Whittington, Richard, and James MacRae. "The Dimensions of Corporate Strategy." *Journal of Business Research* 14, no. 1 (1986): 49-63. https://www.jstor.org/stable/3324877.
WiseTech Global. "WiseTech Delivers Strong Financial Performance and Outlook." 2024. https://www.wisetechglobal.com/media/qnypwlh0/wtc-1h24-asx-release.pdf.
Wong, Yi Wei. "Singapore State IT Group Forced to Intensify Focus Overseas." *Nikkei Asia*, 2017. https://asia.nikkei.com/Business/Singapore-state-IT-group-forced-to-intensify-focus-overseas.
World Customs Organization (WCO). "China: Trade Facilitation and Customs Modernization." Accessed January 6, 2025. https://www.wcoomd.org/-/media/wco/public/global/pdf/topics/facilitation/activities-and-programmes/sw-initiatives/china/pm0482e1_annexii.pdf?la=en.
——. "Single Window Compendium: Understanding Single Window Environment." 2017. https://www.wcoomd.org/-/media/wco/public/global/pdf/topics/facilitation/instruments-and-tools/tools/single-window/compendium/swcompendiumvol1parti.pdf.
Wragg, Eleanor. "WiseTech Buys Bolero." *Global Trade Review (GTR)*, July 1, 2022. https://www.gtreview.com/news/fintech/wisetech-buys-bolero/.
——. "MineHub Bridges into China with TradeGo." *Global Trade Review (GTR)*, May 25, 2022. https://www.gtreview.com/news/fintech/minehub-bridges-into-china-with-tradego/.
Yuan, Dave. "Excellence in Action: CargoWise." *TideMark*, accessed January 6, 2025. https://www.tidemarkcap.com/post/bootstrapped-legends-cargowise.
Zhou, Jinping. "Developing the China National Single Window." *Central Asia Regional Economic Cooperation (CAREC)*, January 21, 2021. https://www.carecprogram.org/uploads/RIBS-PRC-Module-2.pdf.