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Digital Trade Technology and Policy: Barriers and Opportunities

A scoping report for a Centre for Digital Trade and Innovation

Prepared for Her Majesty's Revenue and Customs

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Executive Summary

The United Kingdom (UK) currently stands in a unique position to determine its own path through a world disrupted by digitalisation and recovering from a global pandemic. It has made firm commitments to regulatory reform, to strengthen science, technology, and innovation, and to align these commitments with the goals of industry and society. This approach has worked to good effect in the UK's agile, science-led response to COVID-19.

The UK has recently become the first country to commit to achieving net zero emissions by 2050, and has set an ambitious goal to achieve the world's most resilient and future-facing border by 2025. It has laid out a high-level vision for digital trade, an agenda for freeports and has made commitments to strike ambitious new free trade deals, for infrastructure upgrades, and to level up the economy. The government, however, has yet to set a clear agenda and roadmap for maximising technology innovation to achieve its high-level digital trade vision. This report presents the results of an initial scoping study to begin to address this issue, investigating barriers and opportunities related to the use of digital technology and innovation in support of trade and border activities.

The report is split into seven sections, exploring digital trade from the UK policy context, analysing the state-of-the-art in digital trade technologies, setting out the international context, and summarising stakeholder consultations. The report also provides an initial short-term roadmap to help unlock and maximise the potential of the UK's digital trade activities through focused, co-ordinated actions. Proposed actions include the development of an inclusive ecosystem to facilitate stakeholder communication and co-ordination, harmonisation of standards, and the creation of an innovation environment to catalyse public-private partnerships and drive forward promising use cases for pilot trade technology deployments. The report also presents an initial supporting case for a Centre for Digital Trade and Innovation (C4DTI) to provide a physical presence and focus for these activities.

The principal and leading role for Her Majesty's Revenue and Customs (HMRC) in digital trade and border policy, and in actioning this roadmap, is made evident. The roadmap, if put in place, can begin to steer UK digital trade policy and practice along the correct trajectory to achieving the UK's ambitious border goals as part of a wider, ongoing strategic consultation.

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*"What I'm hoping will come out of this [study], and from [this]
report, is a clear sense of what the barriers are… the barriers have
created a very fragmented system and that's a big problem. Too many
different standards, too many different systems, none of it connects as
it should. And that means we can't drive technology solutions and
innovation, and digitalisation at scale…*

*… when we can connect port systems to customs, to finances and
insurers, and to overseas stakeholders as well, everybody's on the
same system and it's a complete game changer. It's the equivalent of
the container [standardisation] in shipping. That's how big it is. Then
we can drive innovation and digitalisation through the entire
ecosystem."*

Chris Southworth, Secretary General of the ICC (UK), March 2022

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Introduction

The world is in transition. Digitalisation, decentralisation, automation, and artificial intelligence (AI) are disrupting and transforming approaches to the design and operation of industry, business, and society across the globe, including in the UK (Makridakis, 2017[1]). This disruption has been accelerated significantly by the worldwide COVID-19 pandemic. As communities around the world recover from the pandemic, there is an opportunity to further implement global change.

Interconnectivity, process automation, and decision-making based on the analysis and exploitation of big data is leading to intensified, global competition among firms and even nations. Organisations and individuals are now capable of buying goods and obtaining services from almost anywhere in the world, provided there is ICT connectivity. This scoping report is concerned with UK innovation in digital trade in the context of a changing, increasingly competitive digital world. This section examines the UK policy context in the framework of digital trade.

A Changing UK in a Changing World

The United Nations (UN) recently urged all developed and developing nations to "prepare for a period of deep and rapid technological change that will profoundly affect markets and societies" in its Technology and Innovation Report 2021 (UNCTAD, 2021[2]).

All countries, especially developing ones, are encouraged by the UN to pursue science, technology, and innovation policies appropriate to their stage of development and their economic, social and environmental conditions. This requires strengthening and aligning science, technology and innovation systems and industrial policies, building digital skills in the populace, and closing digital divides.

As a founding member of the UN, and one of the largest financial contributors to the UN budget, the UK is committed to the pursuit and support of the UN's goals and remit. This includes UN Sustainable Development Goal 9, which aims to build resilient infrastructure,

promote inclusive and sustainable industrialisation and foster innovation. Closer to home, the UK government's Integrated Review of Security, Defence, Development and Foreign Policy in 2021 (Cabinet Office, 2021[3]) was concluded during an important period for the country, following its departure from the EU. The period from 2016 to 2021 has provided a unique opportunity to reconsider many aspects of UK domestic and foreign policy, building on existing relationships and looking further afield, while remaining aligned and engaged with UN strategy. The integrated review set out a vision for a Global Britain, with four overarching objectives:

(i)   Sustaining strategic advantage through science and technology
(ii)   Shaping the open international order of the future
(iii)   Strengthening security and defence at home and overseas
(iv)   Building resilience at home and overseas.

Making science and technology an integral element in both domestic and international policy will help the UK to exploit the freedom that comes with increased independence, such as the ability to forge new free-trade deals and to adapt to major changes in the world, including the growing importance of the Indo-Pacific region.

Although the UK has gone through a period of deep change in recent times, it remains strongly committed to the active pursuit of the UN's sustainable development goals, and to international cooperation on digital innovation. This includes building innovation capacities in developing countries, facilitating technology transfer, increasing women's participation in digital sectors, and promoting an inclusive debate on the impact of frontier technologies on sustainable development. The UK's departure from the EU offers a once-in-a-generation opportunity to redefine regulatory and standards frameworks and re-align policy to implement the vision of a Global Britain set out in the integrated review (Cabinet Office, 2021[3]), in order engage fully and lead the UN through this period of deep and rapid global technological change.

Central to achievement of these goals will be to make use of the UK's newfound regulatory independence to boost productivity, foster growth and increase competitiveness through technological innovation.

It has been recognised in policy and discussion documents since 2018/2019, well before the COVID-19 pandemic, that as technology advancement is creating new industries, changing existing ones and transforming the way things are made and operated, a more agile approach to regulation is required to support innovation while protecting citizens and the environment.

The Organization for Economic Cooperation and Development's (OECD) Regulatory Policy Outlook in 2018 recognised that the UK's regulatory system was second to none, however government has already accepted that action needs to be taken by the UK to realise the technological potential of the Fourth Industrial Revolution (BEIS, 2019[4]). The future-facing regulatory framework proposed for the UK intends to:

(i) Put the UK on the front foot in reforming regulation in response to technological innovation, and ensure the regulatory system is sufficiently flexible and outcome focused to enable innovation to thrive

(ii) Enable greater experimentation, testing and trialling of innovations under regulatory supervision

(iii) Support innovators to navigate the regulatory landscape, comply with regulation and build dialogue with society and industry on that regulation

(iv) Work with partners across the globe to reduce regulatory barriers to trade in innovative products and services.

These policy drivers and regulatory reform commitments have manifested in several ways since the UK's official exit from the EU. This includes the ability to deviate, when appropriate, from EU State Aid rules, and to inform, finance and critically review key aspects of UK government policy such as science, research and industrial strategy, border strategy and finance/trade strategy.

The industrial policy of the UK is defined well in the Ten-Point Plan for a Green Industrial Revolution and the associated net zero strategy (BEIS, 2020[5], BEIS 2021[6]). Both these plans, and the integrated review (Cabinet Office, 2021[3]), place British science, technology and innovation at the heart of policy to drive forwards new clean energy technologies such as offshore wind, electric vehicles and alternative fuels. Green shipping and zero-emissions coastal regions and ports are an integral part of the strategy and vision, along with a new research and innovation framework for net zero emissions. Digitalisation and connectivity will be key enablers of the drive to net zero.

The UK's border strategy (Cabinet Office, 2020[7]) makes it clear that as a sovereign nation, the UK border must be as efficient, smart, and responsive as possible. It should be primed to flex and adapt to changing circumstances. In line with the integrated review, it is seen as critical that the border makes the fullest use of advances in technology to help manage changes in circumstances and help maintain secure and efficient flow of goods and people.

The UK border clearly depends on many stakeholders who are independent of government. Careful co-operation and co-ordination is required to strengthen and align these government agencies and stakeholders in order to innovate and deploy the technologically advanced, long-term Target Operating Model (TOM) central to the UK border strategy. The transition plan to a new UK border involves six transformations:

(i) Co-ordinated user-centric government approach to border design and delivery, working in partnership with industry and enabling innovation

(ii) Collection and assimilation of data for comprehensive and holistic views of border activities

(iii) Future-facing, resilient ports at border crossings to facilitate secure, smooth operations for passengers and traders

(iv) Upstream compliance and movement of operations away from frontier points, where applicable

(v) Capacity building of staff and border industries to ensure delivery of processes in an increasingly automated environment

(vi) Shaping the future development of borders worldwide, in order to promote the UK's interests and facilitate end-to-end trade and travel.

To initiate this, the UK government has (among other actions) committed to the creation of up to 10 freeports around the UK (DLUHC, 2022[8]) as national hubs for global trade and hotbeds for innovation.

More than 80 per cent of cargo worldwide is transported by ship. As an island nation, it is not surprising that approximately 95 per cent of UK international trade is transported via ships and seaports (DfT 2019[9]). Moreover, levels of cargo transported by sea are envisioned to increase by up to 250 per cent by 2050 (DfT, 2019[9]). In this context, freeports potentially provide fertile ground for innovation activities and piloting/demonstrating use of digital technologies in support of UK trade and border activities.

The government's stated aim is also to use freeports to promote regeneration and job creation as part of the levelling-up agenda (DLUHC, 2022b[10]). Levelling-up is a mission to challenge and change unfairness in the UK in terms of equality of opportunity. The aims of the levelling-up agenda are to preserve and enhance economic, academic and cultural success stories from the UK's most productive counties, towns and cities, while simultaneously improving

productivity, boosting economic growth, and encouraging innovation, job creation and then enhancement of educational attainment in parts of the UK that have stalled.

For technology, sustainability, and digitisation, this has included: £26bn of public capital investment to support the green industrial revolution and the transition to net zero; £5bn to bring gigabit-capable broadband to 85 per cent of the UK by 2025; the £1bn Shared Rural Network deal for mobile operators to deliver 4G coverage to 95 per cent of the UK by the end of 2025; along with commitments to upskilling and digital literacy.

In summary, in the context of the previous discussions, the UK stands in a unique position with respect to its newfound regulatory independence, future-facing border strategy, net-zero strategy, new freeports, and the technical strengthening elements of the levelling-up agenda. If opportunities are taken in a timely fashion to strengthen and align science, technology and innovation systems with industrial policies – in the context of international trade and digitalisation – the UK can potentially deliver on its ambition of having the world's most effective border. This will create prosperity and enhance security for a global UK, allowing the country to align with UN guidance and take a world lead on digital trade and innovation activities.

Trade is integral to the UK economy and well-being, and before taking a closer look at digital trade and the role of innovation in this context, it is worth considering the nature of government's involvement in trade. Although – as will be discussed in later sections – many government departments play a direct or indirect role in domestic and/or international trade, the role of taxation and customs should not be understated. Every transaction in domestic or international trade involving the UK is required to be processed and administrated by Her Majesty's Revenue and Customs (HMRC). HMRC is hence the principal actor within government with respect to trade (and hence digital trade) and also border-related activities involving transfer of value. As such, HMRC is likely to evolve as an organisation central to the UK's national resilience and crisis response (OECD 2020[11]), and will be required to take a leading role on technology innovation, digitalisation and government trade strategy/policy.

Digital Trade

There are many overlapping and inter-related definitions of digital trade. The OECD has observed that while there is no single recognised and accepted definition, there is a growing consensus (López González, & Jouanjean, 2017[12]) that: *"[Digital Trade] encompasses digitally-enabled transactions of trade in goods and services that can either be digitally or physically delivered, and that involve consumers, firms, and governments."*

The OECD goes on to emphasise that while all forms of digital trade are enabled by digital technologies, not all digital trade is digitally delivered. For instance, digital trade also involves digitally enabled but physically delivered trade in goods and services, such as the purchase of

a book through an on-line marketplace or booking a stay in an apartment through a matching application.

Additionally, in an increasingly overlooked point, not all physical trade (whether facilitated or supported by digital means) is physically delivered. This is down to the use of additive manufacturing (AM), which is changing the way physical goods can be transferred, for example through 3D printing. It is now possible, for example, to electronically purchase virtual prototypes for goods as diverse as manufacturing components or food items (traditionally physically transferred from seller to buyer), which are subsequently instantiated into physical goods by the buyer, using locally sourced raw materials (Gibson et al., 2021[13]).

Cloud and Internet of Things (IoT) services are also blurring lines between physical and digital, for example in teleoperation with haptic feedback for robotic surgery and telepresence for offshore platform inspection using mobile robotics (López González, & Jouanjean, 2017[12]; Makridakis, 2017[1]). Therefore, for the purposes of this scoping report it will be useful to define digital trade in a future-facing and inclusive way, such that it is: The use of ICT to facilitate the transfer of value (physical or virtual) between a buyer and seller, encompassing all relevant stakeholders involved in the transaction.

The above definition reflects the large number of stakeholders outside of government who are involved in modern digital trade. It includes AM technologies as a potential end-point physical delivery mechanism, with the understanding that 'physical' and 'virtual' can be interchanged with 'goods' and 'services' for more traditional use of the definition. Figure 1.1 gives an outline of the main elements of digital trade transactions (reproduced from López González, & Jouanjean, 2017[12]):
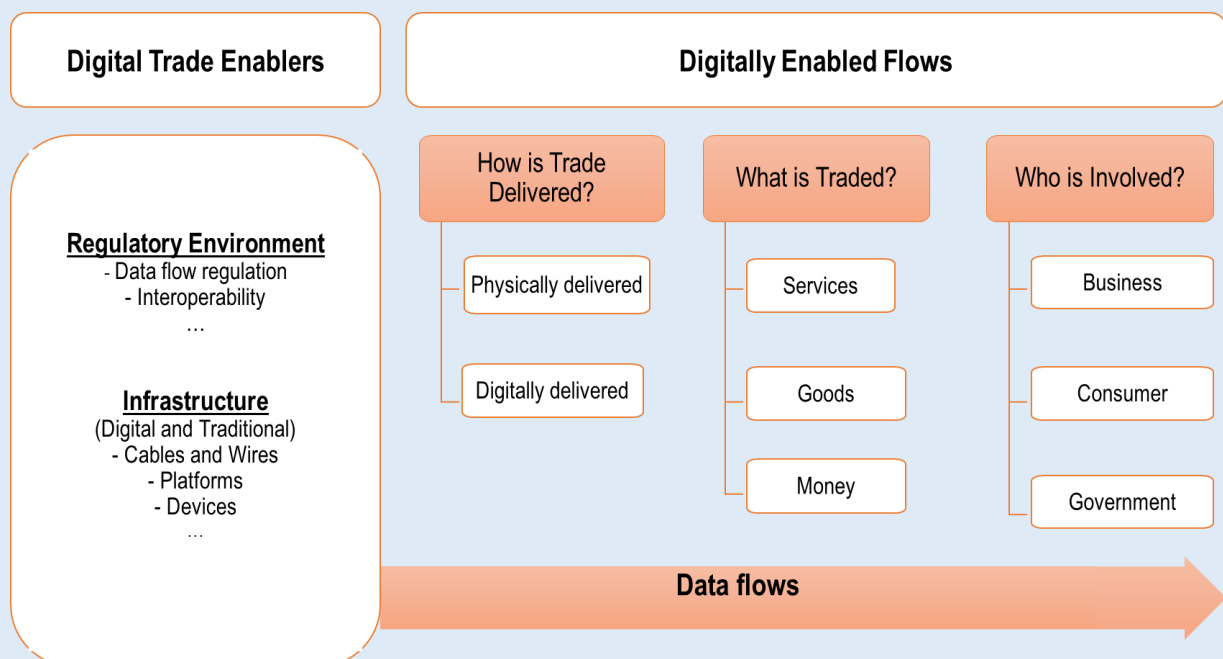

Figure 1.1: Digital trade enablers and data flows

It is worth emphasising at this point that 'going digital' does not necessarily just mean replacing digital copies of existing paper-based documentation – although that is clearly a part of the process – it is also (arguably more) related to how the use of digital technologies can better facilitate the desired end results (economic/commercial, clerical, policy-based, etc). Taking the digitalisation of paperwork as an example, of more concern in the context of this report is how aspects of digitalisation – such as robotic process automation (RPA) and interconnectivity, for example – can be used to make trade activities easier, cheaper, more efficient/streamlined and faster, for both buyers/sellers, government departments such as HMRC and industry (OECD 2020[11]; WTO/WCO 2021[14]).

Indeed, much of the focus on digitalisation (both for trade, and other activities) has been on the opportunities which can be leveraged: a deeper discussion on these points in the context of domestic and international trade is forthcoming in section 2 of the report. However, as HMRC is the principal actor within government with respect to trade and customs, it is worthwhile to note that advanced technologies have the potential to improve the efficiency of customs processes and to ease the flow of goods across borders (WTO/WCO 2021[14]). However, rethinking of strategy – and possibly legal and regulatory reform – is required, in addition to the basic deployment of technology: collaboration and standardisation that are required in order to leverage benefits and allow opportunities of digitalisation to be taken (WTO/WCO 2021[14]).

The potential benefits of digital trade for the UK economy are clearly stated in a recent Board of Trade report (UK Board of Trade, 2021[15]). The report suggests that by addressing digital protectionism on the global stage and championing a free, open, and competitive digital economy, huge economic benefits can be unlocked across multiple sectors. The report suggests that, in addition to pursuing new digital free trade deals and leveraging membership of organisations such as the G20, OECD, and WTO to advocate for an open, inclusive digital economy, digital trade policy should focus around five key goals:

(i)   Open digital markets
(ii)   Free and trusted data flows
(iii)   Consumer and business safeguards
(iv)   Digital trading systems
(v)   Partnerships to shape global rules, norms, and standards.

Aspects related to these areas of the high-level digital trade vision are discussed in sections two and three of this report. As acknowledged in the report, however, to achieve its high-level vision for digital trade over the long term, the government must continue to use all the levers of its trade and border policy to address the identified barriers to digital trade.

In the context of regulatory and legal reform for financial technology (fintech) aspects of digital trade, it has also been recognised in the recent Kalifa review (HM Treasury, 2021[16]) that, among other activities, there is a need to:

(i)   Create a forward-looking framework that delivers a digital finance package for emerging technology

(ii)   Implement the 'scale-box' that supports firms focusing on innovative technology to grow fintech

(iii) Secure fintech's position as an integral part of trade policy.

The report also emphasises the need to play to the UK's strengths on the global stage, for example by leading on concepts of 'smarter contracts', which leverage digital advantages through the fact that English law is the jurisdiction of choice for international arbitration. The need for reform around finance and banking in light of technology advancements discussed in the Kalifa report is also evident in stakeholder comments captured during this scoping exercise (see section 4). Also evident from this consultancy was the difficulty in coordinating trade activities involving multiple government departments: in some cases, more than 26 agencies and offices are involved in trade activities. The key role of HMRC in this respect has already been discussed; the need to provide a single point of access has already been recognised in the proposals for a Single Trade Window (STW) (Cabinet Office, 2022[17]), an integral part of the border strategy TOM, which acts to simplify traders' interactions with the border in line with World Customs Organization (WCO) recommendations. In 2021, government allocated £180m for the development of the STW as part of the border strategy (Cabinet Office, 2022[17]). Developments on the STW within central government are ongoing and involve multiple departments and agencies, with HMRC playing a crucial leading role, with ICT aspects supported by the Digital Cabinet Office.

In closely related developments, government is also seeking to leverage existing data pipelines to enable the direct ingestion of industry supply chain data into government systems, to streamline border processes and reduce compliance burdens on industry. Pilots of such a distributed Utilities Trade Platform (UTP) have already been successfully deployed, and along with the STW can potentially provide – if developed correctly – a useful solution for digital trade activities between business, industry, and government. As discussed in the border strategy, however, further work is required to be done between HMRC and industry/academia as part of a technology and innovation roadmap (Cabinet Office, 2020[7]).

In addition, the International Chambers of Commerce (ICC) has recently signalled (ICC, 2022[18]) that there is a need to:

(i)   Update national laws to reflect digitisation initiatives related to trade

(ii)   Align legal frameworks within the UK (and elsewhere) to support electronic documentation

(iii) Establish common, interoperable digital standards across the trading system and accelerate the adoption of open systems operating on international digital standards

(iv)   Support governments to update and modernise systems so they are better aligned to industry

(v)   Consider development of a 'Digital Trade Ecosystem', featuring a single point of contact in central governments to champion digital trade.

Common themes which emerge from multiple sources (e.g. UK Board of Trade, 2021[15]) are well-captured in the points stated above by the ICC. Standardisation and the need for openness in particular seem to be a priority themes, for good reason; in other areas of trade – for example the post Second World War standardisation of cargo containers to transport goods – is well-known to have had remarkable positive effects, such as allowing purpose-built ships and handing equipment to be constructed to freely available specifications and subsequently deployed. Parallels in the context of digitalisation are clear: standard message formats and data structures/operations, allowing purpose-built ICT interfaces and services to be created from open standards and subsequently deployed. Reform allows standardisation and openness, and requires collaboration and modernisation across multiple stakeholder groups: this is the central thread of the requirements and the salient points to be brought forward. Section 2 of the report takes a closer look at these and other related issues.

In light of these discussions, and in the context of a changing UK in a changing world, it is clear that the UK government – and in particular HMRC – has a crucial role to play in the delivery of trade digitalisation activities, the UK border strategy and other related aspects of policy (including, for example, carbon counting activities for net zero compliance). In many other jurisdictions across the globe (in many cases trading partners and competitors of the UK), governments are already undertaking key initiatives in these areas. There is a risk to the delivery of the UK's ambitions if the case for the establishment of similar initiatives in the UK is not developed for further consideration by senior stakeholders and decision-makers.

A Look Forward

As the discussion in this introductory section has demonstrated, a unique opportunity presents around use of the current global climate and UK policy context to take a lead on technology innovation for digital trade and other related border activities. This document outlines the concept and supporting case for a UK Centre for Digital Trade and Innovation (C4DTI) to help take this opportunity.

This document will set out a series of initial actions and describe the broad remit that a C4DTI may help to provide in order to steer UK digital trade and border policy and practice along the best trajectory to achieve the country's ambitious goals.

As will be developed throughout the report, the core theme of the C4DTI would be to deploy a specific ecosystem to foster and build collaborations between academia, technologists, central and local government, business/industry and other key stakeholders. This would enable the UK to successfully deploy and use world-leading infrastructure, processes and systems to become the global leader in digital trade innovation.

Section 2 of this scoping document presents a preliminary account of the current opportunity around digital trade technologies. Section 3 presents a review of the international context, while section 4 presents summarised results of consultation with stakeholders. Building upon this analysis, section 5 identifies the current gap with respect to digital trade in the UK context. Section 6 presents initial actions which may start to fill this gap and outlines an initial broad remit for a C4DTI. Conclusions and final summary are reported in section 7.

Section 2 Digital Trade Technology

Introduction

Between 2015 and 2017 there was significant worldwide discussion around the digitalisation of trade. Stakeholders understood what needed to be done, but there was a consciousness that the tools, the frameworks, the underpinning laws, and the standards to actually enable this were not yet in place. These discussions resulted in the development of the ICC Digital Trade Roadmap (ICC, 2022[18]) that acknowledged the barriers to digital trade and laid down the following concept: "*It's not about customs, it's not about e commerce platforms. It's not about trade finance, it's about the whole system operating in the same way that our consumer lives operate, with systems that talk to each other and technologies that enable us to get on with our jobs.*"

The ICC Digital Trade Roadmap set out three main pillars:

(i) **Digitalisation** of commercial trade documents and aligning legal frameworks to the UNCITRAL Model Law on Electronic Transferable Records (MLETR[19]). This is essential to enable solutions to scale across borders.

(ii) **Standardisation** to address the proliferation and fragmentation of standards across the trade ecosystem in the form of the ICC Digital Standards Initiative. The ICC provides a global convening body for standards bodies and international institutions, and a framework with a clear roadmap and structure for connecting platforms, systems and processes across industry and government.

(iii) **Mass adoption at scale,** enabled only by the alignment of frameworks and standards, and the legal reforms to implement them.

With the ICC standards map in place and the Electronic Trade Documents Bill (Law Commission, 2022[20]) moving through the legislative process, the next step is to explore open systems and interoperability. The goal is to be technology agnostic but to enable the market to thrive within the scalable model for frictionless digital trade.

The economic value of the legal reform has been quantified. It is expected that the Electronic Trade Documents Bill will deliver, for the UK alone, £225bn in efficiency savings, £25bn in small and medium-sized enterprise (SME) trade growth, £1bn in extra trade finance, halving the UK Trade Finance gap and cutting transaction costs by 80 per cent.

The ICC has learned from experience in the past five years while putting these key pillars in place and hopes that this can be cascaded to accelerate the process of trade reform for other economies worldwide. This section outlines the barriers and opportunities in global trade and the existing and emerging challenges to be addressed. It defines a technology stack for trade transformation and discusses the next steps in developing the necessary systems to crystallise this value-creation opportunity.

Global Deployment: Barriers and Opportunities

In a 2016 paper examining how trade policy institutions can mobilise to support the new digital economy of the 21st century, written for the International Centre for Trade and Sustainable Development (ICTSD) and World Economic Forum, Porges and Enders wrote:

"The alleged digital trade barriers, ranging from personal data protection to data localisation measures, and from data flow regulation to cybersecurity standards, from tariffs on digital products to digital tax, indicate that global governance of digital trade is more important to the international economic legal order than ever." (Porges & Enders, 2016[21])

Below we have summarised the barriers (Table 1), and opportunities (Table 2), identified in main global economies, and their consequences and benefits for the management of digital trade.

Barrier	Consequences
Data localisation (Weforum, 2022[22])	"…*restricts cross-border data flows*"
WTO rules (Jones et al., 2021[23])	Existing WTO rules were negotiated before the digital economy took off. *"Traditional WTO rules treat goods and services differently"*
Multilateral trade rules (Jones et al., 2021[23])	"…*do not cover areas such as cross-border data flows, which are central to the global digital economy*"
Management of cross border data flows (Meltzer, 2019[24])	Unintended consequences on the protection of privacy, cybersecurity, or the need to access data for law enforcement purposes.
Utilisation of big data flows is not sufficient (Meltzer, 2019[24])	The impact of data on growth and jobs are not maximised.
Conventional dichotomy between trade in goods and trade in services (Ahmed & Aldonas, 2015[25])	One major obstacle for the architecture of WTO, regional and bilateral free trade agreements. (Traditional barriers to trade in goods such as tariffs on devices)
Geo-blocking (Mitchell & Mishra, 2020[26])	"…*restricts access to internet based on the geographical location of the user*"

Data restrictions by other governments (Mitchell & Mishra, 2020[26])	"*...requiring digital service suppliers to comply with excessively burdensome administrative/certification requirements in domestic laws to conduct cross-border data transfers/processing.*"
Non-tariff or "behind the border" barriers (Mitchell & Mishra, 2020[26])	Majority of digital trade barriers are non-tariff measures or behind the border barriers. "…*Domestic laws and regulations often impose discriminatory and unreasonable requirements on foreign companies.*"
Differing cybersecurity laws (Peng, 2020[27])	For example, China's cybersecurity law restricts routine cross-border transfers of data; the digital services taxes adopted by a number of the EU member states, which levy an interim tax on revenues from digital services.
Differing domestic regulations (Peng, 2020[27])	"…*resulting in a complex domestic legal landscape for digital trade*"
Datafication (Ciuriak & Ptashkina, 2020[28])	The capture of truly astronomical amounts of information on the functioning of societies, economies and even the industrial processes of firms is yet to be realised.
OECD – restrictions on digital products and data flows (Casalini, González and Nemoto, 2021[29])	Restrictions on market access for digital products and companies

Restrictions on trusted data flows that are vital for digital trade |
| OECD – risks of digital trade (González and Sorescu, 2021[30]) | Insufficient safeguards for consumers and businesses engaged in digital trade – leading to risks both real and perceived |
| Infrastructure and global leadership issues OECD[31] | Insufficiently digitised trading systems, resulting from inadequate digital infrastructure and out-of-date regulation

A lack of global leadership, multilateral consensus, and effective cooperation on the governance of digital trade |
| OECD – information flows (Casalini, González and Nemoto, 2021[29]) | Imperfect information, particularly for SMEs, meaning that they are unable to take advantage of available opportunities |

Other issues: (Elms, 2020[32])	Digital services; digital taxation; cybersecurity and data protection; data or digital sovereignty; competition law and anti-trust polices; digital payments; effectively managing the rise of new technologies
(Meltzer, 2019[24])	Data transfer mechanisms, consumer protection, digital trade facilitation, emerging technologies and digital taxes are key areas of debate
(Porges & Enders, 2016[21])	Localisation requirements; trading rights; distribution rights; data privacy and protection; intellectual property rights; uncertain legal liability rules; censorship; unclear or overly complicated customs procedures.

Opportunities	Benefits
Reduce trade-based money laundering (Marzouk, 2021[33])	HM Treasury calls TBML "*the greatest area of risk to the UK economy.*" Transparent digital trade using blockchain and distributed ledger technology offers an opportunity to combat this by following transaction to source.
Digitalisation of trade (Ferracane et al., 2018[34])	"*...expands choice and allows them to access suppliers from all over the world, both official and unofficial*"
Digitalisation of trade (Ferracane et al., 2018[34])	"*lifts the constraints of the domestic/regional market, creating opportunities to sell to customers all over the world, or source inputs, products, or services from a myriad of new suppliers.*"
Digitalisation of trade (Ferracane et al., 2018[34])	"*emergence of online traders focusing on small orders, rather than the bulk orders that typically dominate business-to-business (B2B) supply chains*"
Digitalisation of trade (Ferracane et al., 2018[34])	"*(SMEs) producing niche products can find a critical mass of customers for their goods, services, or digital content online*"
Digitalisation of trade (Porges & Enders, 2016[21])	"*Expanded information sets about consumers (their data) can become a more focused driver of business strategy and innovation*"

	"*more big data applications*"
Digitalisation of trade (DIT, 2021[35])	Protect the UK's strong net neutrality principle; secure cheaper roaming when travelling; cheaper and ideally free roaming for consumers' calls, data and text messages when travelling in the trade deal partner country; ensure other consumer benefits from digital trade; prevent higher costs being transferred to consumers in the form of higher prices.
Gateway2Britain (Flanders Innovation & Entrepreneurship, 2022[36])	This initiative aims to establish a technology-enabled green digital corridor for efficient and frictionless trade between Flanders and the UK.

Meeting the Challenges of our Age

Challenges have increased with the pace of technological and global change. These represent both the evolution of established problems that have been plaguing traders for many years, and new issues that have arisen in global trading conditions. There are a number of existing initiatives that may be relevant as exemplars for future development.

Quantifying Scope 3 carbon emissions is a significant decarbonisation challenge that is being addressed by a number of companies active in distributed supply chain management. These include Circulor[37] whose Traceability-as-a-service platform monitors cobalt from the Democratic Republic of the Congo (DRC) used in electric vehicle batteries (Kshetri, 2021[38]). Traceability-as-a-service also offers transparency on the origins of goods. This has to be drilled down to component level with multiple touchpoints through the life of the product from raw material to finished article and recording passage backwards and forwards across borders.

The issue of counterfeiting has been addressed in several industries, particularly high-end luxury goods. Systems such as the LVMH Aura Luxury Blockchain[39] aim to authenticate goods for consumers. Everledger's diamond tracing initiative is also interesting here. The same technologies are addressing tracing and certification of goods in other supply chains, for example fruit, vegetables and flowers traced by DiMuto[40] and Agriledger[41]. Tools for transparency of supply and verification of authenticity are now being deployed at scale.

Digital identity is a long-held goal, giving individuals and legal entities access to resources and services in the increasingly digital world. Schemes are starting to mature and will be essential for the operation of frictionless digital trade systems. The Legal Entity Identifier (LEI)[42] scheme is an established database of trade identity. Personal digital identities are simple in theory but fraught with difficulty in practice due to political and privacy issues, although the technology is relatively straightforward. Every jurisdiction has its own plan, from the UK's

Digital ID to the established systems in the Nordic countries, the e-Estonia initiative, and UN work on self-sovereign identity for refugees: "*These cannot be standardised, as political, cultural and systematic barriers will always exist, but can their data be verified by a common ledger?*" (Cheesman, 2020[43])

Distributed ledger technology, machine learning and artificial intelligence combine to build ledgers of record and transparent, trusted systems, disrupting business models and innovating for improvement. An example is the work of DiMuto in Singapore whose global supply chains trace fruit from seed and small producers all the way to consumers. "*By on-chaining trade operations between multiple players, DiMuto produces a dynamic log of agreements, contracts, store locations, delivery times, and transfer points.*" (George et al 2020[44])

The consequences of Covid, Brexit, the war in Ukraine and sanctions against Russia have thrown the resilience of supply chains into sharp focus. Old incentives to use resources efficiently led to just-in-time supply and centralised production at large scale. There are now new incentives to hold stock and prioritise local manufacturing. Frictionless digital trade assists in releasing cash for stockholding and managing multiple local sources rather than single large suppliers. (SXSW 2022[45])

A Structure for Scalable Digital Trade

The UK government's Ecosystem of Trust pilot due to take place during 2022 (Cabinet Office, 2021[46]) suggests that automated assurance and reliability can help to assure movements across the border, building on technological capabilities, real time data and trusted relationships. The vision for this ecosystem is reproduced in Figure 2.1 below.
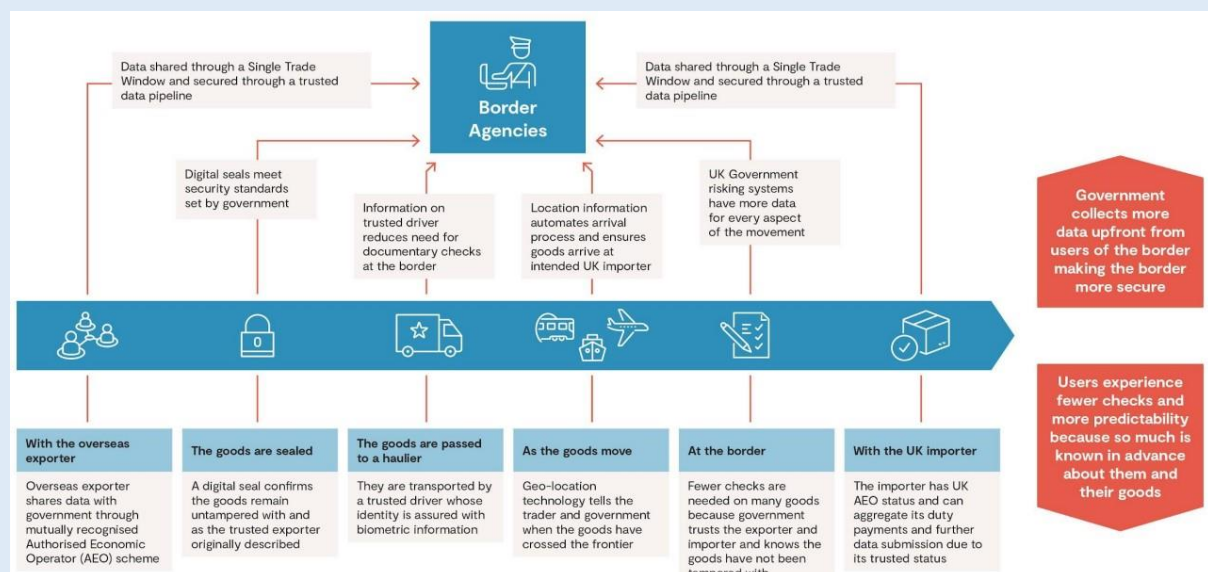

Figure 2.1 An ecosystem of trust (Reproduced from HM Government Ecosystem of Trust end-to-end pilot, 2021, under the terms of the Open Government Licence)

Technologies including digital identity, DLT ledgers of record, sensors, big data and AI will contribute towards the realisation of this ecosystem model. This model, alongside the current use of transparent ledgers of record by supply chain innovators around the world, inspires a model digital infrastructure for scalable digital trade.

The key elements of this include recording touchpoints in the movement of goods, using smart contracts to automate acceptance checks and payments, interfaces for interpretation of the ledger of record, establishing reliable oracles of data, digital identity of participants (both individuals and organisations), and good cybersecurity practices at all levels.

The touchpoints – transfer points – of commodities and components are crucial for the collection of metadata. They will be relevant to a number of different parties who record, variously, the origin of goods, the certifications, the allocated emissions, the identities of the entities with custody, and so on. Each touchpoint may accommodate a smart contract automating acceptance criteria. The result of acceptance may be a green light at border control, a payment authorisation to a supplier, a renewal of certification etc.

The ledger of record will be interpreted and used in different ways. Insurers will look for the chain of custody and proof of condition of goods in case of a claim. Providers of trade finance will look for an audit trail to mitigate risk, particularly with small producers who have no other reliable records. Public enquiries may delve into the origin of goods and decision making in case of disaster (for example., Hackett report on Grenfell). Statutory bodies will look for compliance with legislation, for example in Rules of Origin and economic entity rules.

The information added to the ledger at each touchpoint for every commodity or interaction may be drawn from disparate systems by API, from sensors (for example machine vision identification of vehicles), via algorithms (machine learning and AI application), from the output of smart contracts (automation), or by direct input by human operators. The use of oracles from reliable sources and the transparency of such oracles is part and parcel of establishing trust in the data and the overall system.

Security and simplicity are the twin goals for user experience and interaction. In terms of trust, digital identity is a significant part of achieving this. We have moved from username and password in Web 1.0 (the information economy) to single sign on technologies in Web 2.0 (the platform economy) and now to digital identity in Web 3.0, supported by thorough checks of humanity or legal entity and by global standards.

The security of a global system must be taken seriously and built into the solution from protype design onwards. There are a number of possible attack vectors and vulnerabilities to be addressed. Security of each connection is paramount, for all risks from inaccurate data through to exposure to malware and data breach from insecure third parties. Personal data should not be attached to the ledger of record. Despite encryption, it is possible to identify individuals from their activity on the ledger. EU privacy experts are leaning towards the side of caution,

and a global system must go with the tightest regulation. Consider zero knowledge proofs and or verification via intermediary databases such as LEI.

A distributed ledger structure reduces the risk of loss of records by providing full redundancy for nodes. It reduces (and may ultimately eliminate) the risk of any party amending existing records, by accident or by design. Smart contracts must be audited before deployment, preferably by more than one independent party, to ensure that there are no inadvertent loopholes. Attacks such as the 'The DAO' (2016)[47] and the more recent 'Pickle Finance' attack (2020)[48] are good examples of the problems that can arise. Smart contract deployment on a sprawling decentralised network also exposes risk. Cuckoo contracts ('evil' contracts) have been deployed by bad actors, for example diverting funds or data to third parties. This may be managed through the 'hub and spoke' structure discussed.

Algorithms used in acceptance criteria or prediction should be transparent, avoiding 'black box' decision making. The structure and scope of data must be carefully planned. Disaggregation is important to service the needs of multiple interested parties and to provide unbiased information.

User roles are to be defined. These will range from unrelated parties viewing the transparent audit trail on a browser representation of the underlying ledger, through granular permissions on the application, to hub-and-spoke roles.

HMRC can develop a broader and deeper model based on the Ecosystem of Trust that will encompass frictionless digital trade in a wider and global context. We propose a technology stack from which appropriate solutions can be drawn for trade transformation.

Technology Stack for Trade Transformation

Part of the journey of unlocking industry's digital potential involves moving towards Industry 4.0. This may seem a little daunting to most. However, this is seen as the way forward – a real paradigm shift for the sector – on a transformative journey that more purposefully engages new ways of thinking, where digital technologies converge to provide significant advantages. While the transition to Industry 4.0

Movement of goods:
- tracking progress
- chain of custody
- insurance proofs for liability
- quantify emissions
- ledgers proving participant activity, de-risking access to trade finance

Borders:
- Electronic Documentation
- Process Automation and Machine Learning
- Smart contracts and their legal counterpart

Governance
- Data visibility and control structure
- Digital Identity - LEI and individuals

Infrastructure
- The tetris of shipping containers
- IoT in shipping hulls

Technology Stack

may not be easy, it is encouraging to note that many entities have made significant progress to achieve this (Maskuriy et al., 2019[49]; Alaloul et al., 2020[50]). This paradigm shift is not only significant and transformative but is starting to open up many new revenue streams and divested services (Figure 2.2).

A caveat of caution needs to be raised at this juncture. This transition is not free; it comes at a cost. This 'cost' requires conjoined thinking, and a willingness (or acceptance) to embrace change, not just at individual or organisational level per se, but at a macro level (involving the whole sector and supply chain). In this respect, fragmentation and siloed positioning needs to be replaced by conjoined processes and 'digital coalition' (Rahimian et al., 2021[51]).

Figure 2.2 provides a high-level overview of potential interaction and exploitation possibilities between Industry 4.0 and the industries looking for a change. This not only highlights the need to become more connected, dynamic and customer centric, but more importantly, the mechanisms though which future business will need to operate. This includes the need to think about new business strategies and models – from design, through to procurement and delivery – and even the way goods are produced and delivered.

Figure 2.2: Industry 4.0 Transformational Opportunities
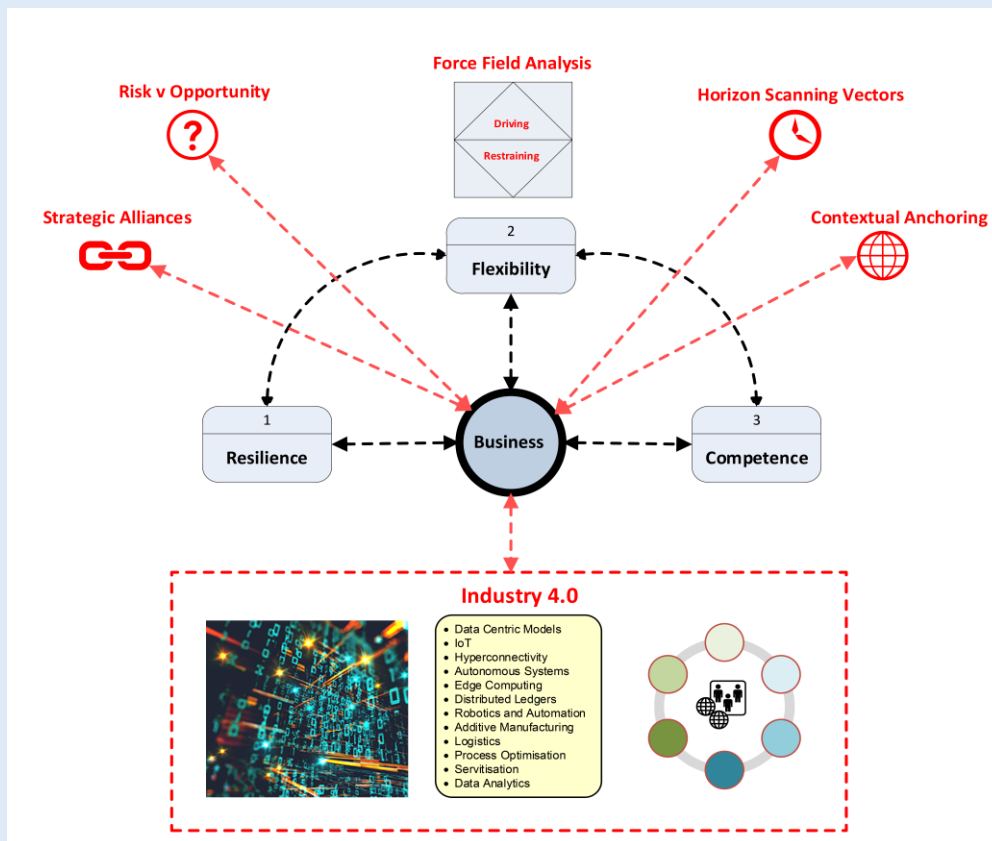
Successful companies will be those that unleash their true potential, using business models that drive innovation and deliver evidence-based value. Those that do not do this, will more than likely fall by the wayside. Therefore, organisations will need to be highly competitive, perhaps

more so than they are already, using factories and warehouses (physical and virtual) to leverage economies of scale and expertise to become much more streamlined, agile, and efficient. In doing so, they will be able to establish several new services and opportunities, especially through the deployment of cloud computing, big data, visualisation, AI, machine learning, the Internet of Things (IoT), blockchain and so on.

Data will undoubtedly be seen as the main asset; to not only inform decision-making, but to drive innovation and facilitate continuous improvement. This will also enhance customer-experience analytics, providing new end-to-end services and opportunities; where for example, significant growth-driven potential has already been evidenced in other sectors. In summary, the inertia underpinning Industry 4.0 provides the industry with many powerful opportunities to explore, nurture and exploit.

This scoping exercise offers a unique and timely opportunity to address a range of emerging challenges and to shape the future of digital trade innovation. We know the digital infrastructure must be ambitious and resilient, a solution that others aspire to use. It should accommodate existing national digital trade systems as oracles contributing to the full ledger, minimising disruption and maximising adoption. It should incorporate the following technologies:

- AI and machine learning to streamline and automate processes and deliver insights and trends based on the growing data corpora
- Blockchain to inspire trust, deliver transparency and enable the operation of smart contracts on a distributed ledger
- The IoT and well-chosen oracles to deliver reliable and trusted data to the ledger
- Digital identity both for access to appropriate functions according to role, and to add depth to metadata related to supply chain movements.

Internet of Things

The IoT is a collection of heterogeneous devices communicating over an internally or externally shared network. It entails an infrastructure of interconnected entities, people, systems, and information resources together with services which process and react to information from the physical and virtual world (BSI, 2021[52]).

We see IoT supporting digital trade in different ways including ensuring real time monitoring of products or items along a supply chain (Chen et al., 2019[53]) improving transportation efficiency, and supporting the tracking of goods (Pal and Kant, 2018[54]) and sharing and transmitting information to reduce supply chain uncertainty (Zhang and Gong, 2021[55]).

The use of IoT is particularly relevant for other government departments who would be interested in managing the physical rather than the fiscal risk at the border. The data gathered

offers opportunities for enhanced tactical and strategic decision making and insight generation for frictionless and efficient physical trade.

The potential benefits of integrating the IoT into digital trade are increasingly being embraced by industry players. Figure 2.3 highlights some real-life cases of the IoT playing a role in relation to movement of goods, infrastructure and borders. Although the benefits of the IoT have been highlighted, it has been observed that the IoT presents significant challenges with privacy and security, including deployment issues relating to standardisation and interoperability of different IoT systems (Hussain and Beg, 2019[56]).
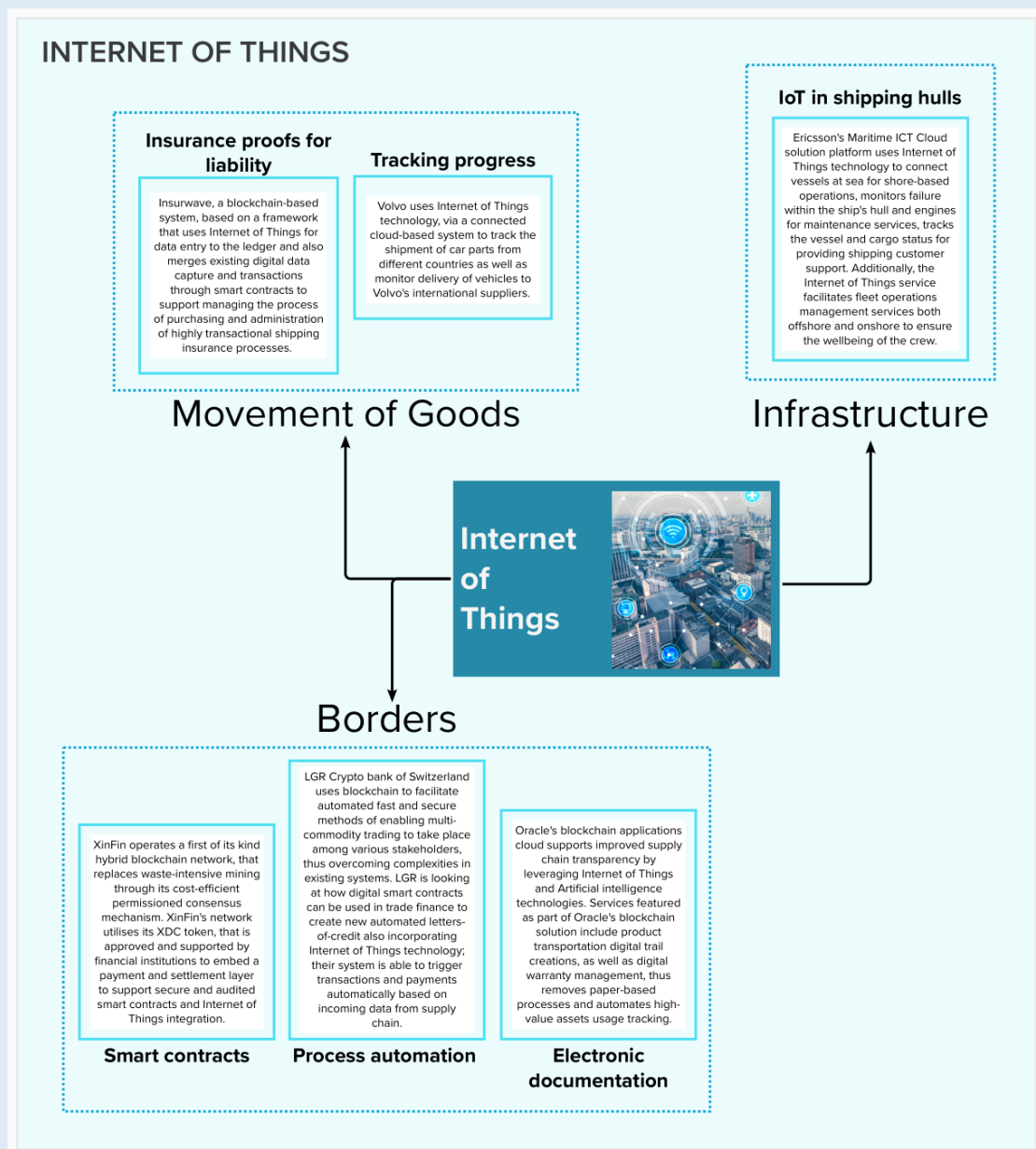
Figure 2.3: Examples of IoT deployment in digital trade

IoT Wireless Protocols

Communication and interoperability, particularly in physical locations, requires an uninterrupted flow of data from the connected things. There is a fragmented landscape of wireless protocols, summarised in Figure 2.4 below.
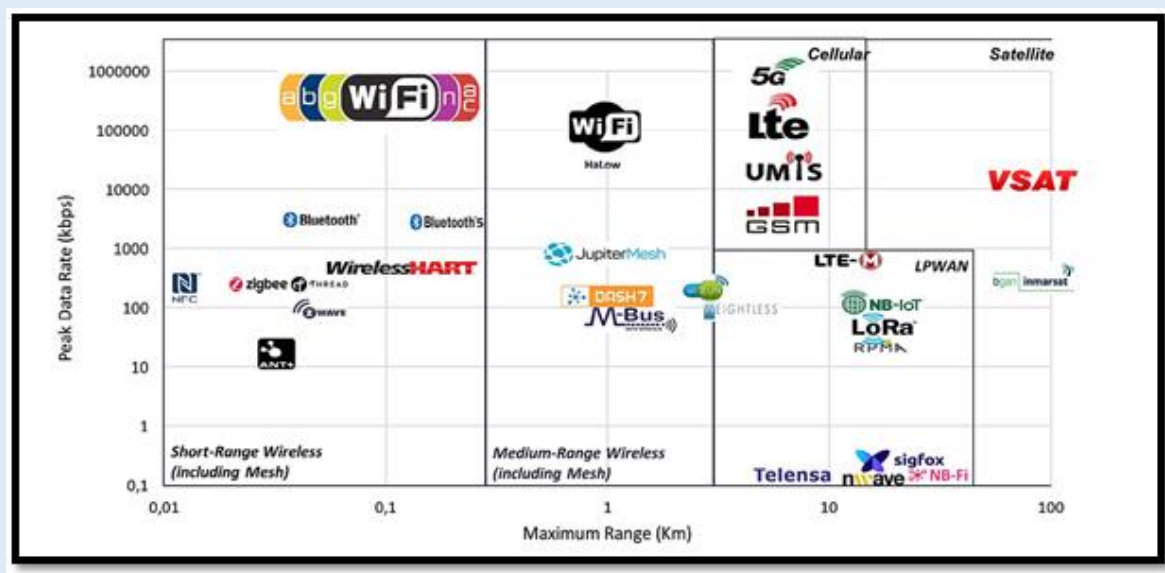
Figure 2.4: Comparison of main IoT wireless technologies

Wireless technology selection is use-case dependent and ultimately results from a multi-dimensional compromise that covers various aspects (e.g., scalability, range, coverage, deployment, battery lifetime, Quality of Service, up-link vs down-link, payload length, latency, cost efficiency for licensed protocols and protocols using frequencies under licensed spectrum). Therefore, a mindful selection of wireless technologies is vital to the implementation process.

There are specific risks to consider of technical lock-in, vendors imposing complex cost structures, and some legal and jurisdictional challenges. Technical challenges may include vendors designing a system incompatible with software developed by other vendors, by using proprietary standards or closed architectures that lack interoperability with other applications, licensing the software under exclusive conditions, or requiring expensive and time-consuming migration of application and data to alternative providers which deters organisations adopting cloud technology. (Bracke et al., 2021[57]).

Despite challenges, the importance of IoT in digital trade cannot be understated. Deriving reliable data from sensors reduces human error and exposes new data points for analysis.

A good example of this can be found in the Insurwave platform developed in May 2018 by a consortium including Ernst and Young, Microsoft, network security experts Guardtime, and insurers XL Catlin (now AXA XL, a division of AXA), MS Amlin and Willis Towers Watson. Sensors within shipping hulls reported location and other data to the application, enabling real-

time updates to the global asset register and removing annual reconciliation of assets for insurance premium calculations. Subsequently the data points that were exposed enabled integration with other systems including ports, real-time assessment of risk in conflict areas at sea and extended the records to include shipping machinery. (Baucherel, 2020[58])

IoT sensors and supply chain interactions should form one of the primary sources of supply chain and trade data for this application.

Blockchain

Blockchain is a collection of decentralised records that are distributed over a peer-to-peer network in accordance with an established consensus mechanism. Also, Blockchain is a distributed ledger with confirmed structured data comprising block data and a block header that are organised in an append-only, sequential chain using cryptographic links (BSI, 2020[59]).

The potential for the use of blockchain in cross-border trade was identified by UK Government as far back as 2016, and explored in detail in the Blackett review report, 'Distributed Ledger Technology: beyond block chain' (Government Office for Science, 2016[60]). This report identified opportunities for several applications of the technology, including reduced fraud and increased efficiency in trade finance, a linked Internet of Things, and the creation of "a single version of verifiable truth about [goods] for the industry, governments, consumer markets, border control and law enforcement agencies."

Blockchain supports digital trade in ways including sharing transaction information and simplifying complex processes (Fang et al. 2020[61]), enabling tracing and tracking of goods to ensure transparency (Westerkamp et al. 2020[62], Weng 2021[63]), facilitating smart contracts to avoid falsified information, database corruption, and external attacks (Sathya et al. 2021[64]), detecting counterfeit products as well as the authenticity of manufacturer for both end user and enterprise vendor (Jayaprasanna et al. 2021[65]).

Figure 2.5 highlights some examples of its application in relation to movement of goods, governance, and borders. Despite the potential posed by blockchain, the technology is still at an early stage of development, with its widespread adoption still farfetched (Dutta et al. 2020[66]). Its implementation also poses certain challenges that have been identified; for example, network issues, legal issues, mistrust in the technology, challenges with data entry and exchange as well as familiarisation with the technology are some of the issues that threaten its adoption (Rodrigues et al. 2021[67]).

BLOCKCHAIN

De-risking trade finance access

To address invoice inaccuracies, DHL Global Forwarding and Hewlett Packard have trialled a blockchain-backed shipment invoice system which links multiple entities for one-off order management. The use of this technology is to help ease the approval process and also to identify approved shipment quotes.

Insurance proofs for liability

Insurwave, a blockchain-based system for shipping insurance, was introduced to manage the process of purchasing and administration of highly transactional insurance processes. The solution is based on a framework that uses IoT for data entry to the ledger and also merges existing digital data capture and transactions through smart contracts.

Chain of custody

FedEx has integrated the blockchain into its chain of custody to improve traceability and provide a trustworthy record, helping to address customer disputes.

Tracking and monitoring

DeBeers' use of Tracr App, a blockchain tracking technology to monitor inventory and improve efficiency, The app documents the gemstones' journey along the entire value chain.

Movement of Goods

Blockchain

Borders

LiquidX launched an InBlock Digital Policy Management pilot which leverages Distributed Ledger Technology (DLT), smart contract technology, and AI, integrating trade credit insurance policies into financial workflows and automating critical policy management and compliance processes regardless of geography, product, or broker. InBlock creates a self-executing contract allowing brokers and their clients to confirm coverage eligibility at the invoice level, authenticate debtors, and automate the manual and resource-heavy day-to-day policy management and compliance processes.

Bolero employs blockchain technology to perform end-to-end trade process with clear trading transparency underpinned by legal certainty and authenticity of documentation. Bolero has a user enrolment process to ensure authenticity and a rule book to ensure legal certainty, it also has a matching engine to ensure that the key attributes of documentation presented match up. Bolero uses its rule book, experience and an established network of trade banks to speed up transactions via digital documentation

Smart contract

Electronic documentation

Governance

The potential of a blockchain scheme which involved the creation of a platform that combined blockchain with a homomorphic encryption solution has been studied. The proposed platform will allow users/companies to be aware of the transactional data being collected, how the data is being used and would not require to trust their transaction data in the hands of any, where they are susceptible to stealing and misuse.

Studies on a digital identity management mechanism that enable effective tracking in the supply chain management have been explored. The study highlights the potential of the proposed mechanism to accurately secure cargo information and generate efficiency gains in logistics handling.

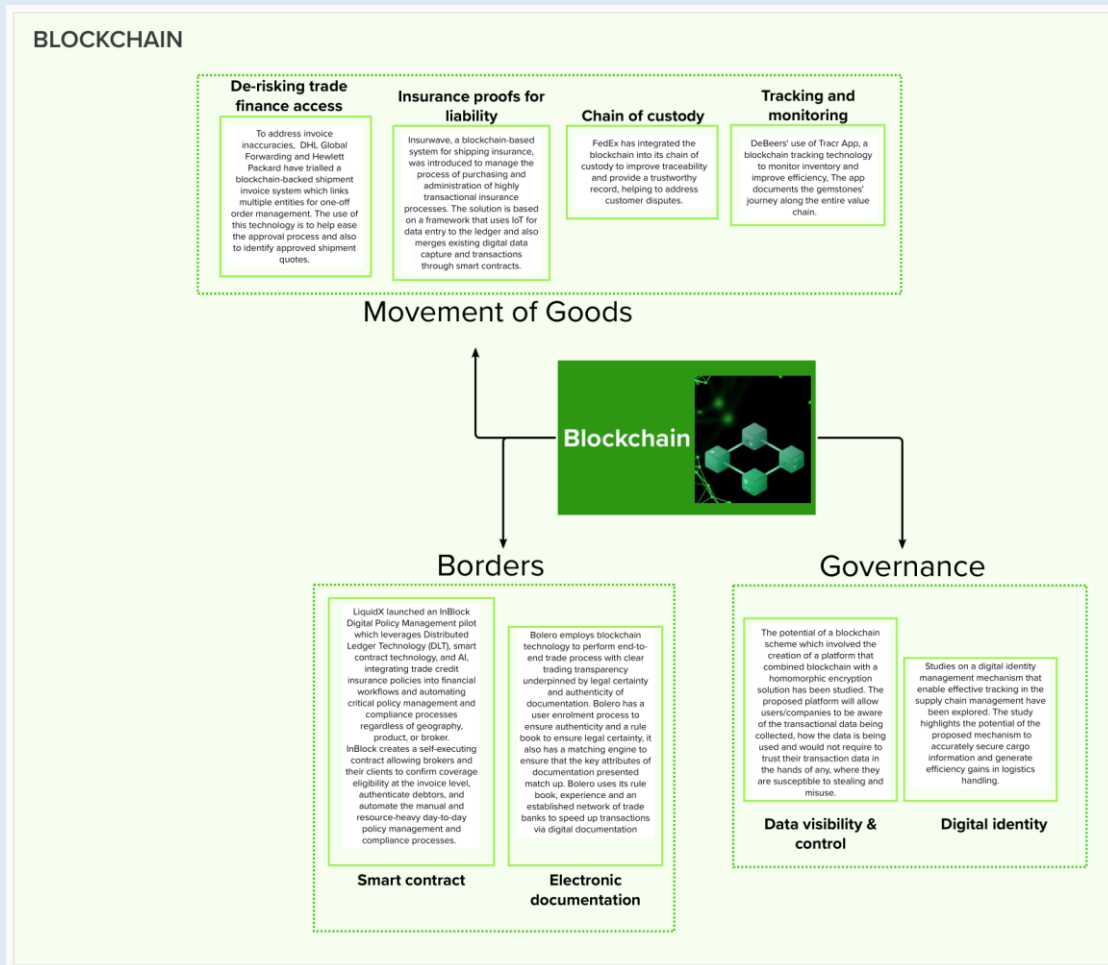**Data visibility & control**

Digital identity

Figure 2.5: Examples of Blockchain deployment in digital trade

There are a number of factors to consider in choosing an appropriate blockchain framework for both the prototype and the final scalable application. These include visibility and read/write access, transparency of the audit trail, cost of transactions, the carbon footprint of the blockchain, and the degree of centralisation versus decentralisation that is required to optimise the system for security, durability and independence. Applications exist on a spectrum of decentralisation. Any implementation must consider the trust/transparency trade-off and the required peer-to-peer structure, particularly where there are national hub-and-spoke networks.

With so many parties contributing data and extracting audit trails, the chain should be visible to all. This leans towards a public framework. However, the choice must be carefully considered. The largest public blockchain with complex Layer 2 (side chain) application capability, Ethereum, is at the time of this report a costly option for participants with high transaction fees and slow throughput.. A Layer 2 solution, as demonstrated by ledgers such as Polygon, can provide the same visibility with much faster processing and without prohibitive transaction costs, and other more efficient Layer 1 blockchains are emerging, notably Algorand, Tezos, Avalanche and Polkadot, among others.

Energy use by blockchain and cryptocurrencies is a recurring theme when considering the practicalities of this technology. It is extremely important not to conflate different distributed ledger frameworks and individual cryptocurrencies. The vast majority of crypto assets and blockchain frameworks are efficient and sustainable on a par with enterprise software systems, cloud computing and social media.

In short: 'bitcoin' is not 'blockchain'. Bitcoin is the original innovation upon which modern distributed ledger technology is based, Stephenson's Rocket to today's electric vehicles. It would not be used in a commercial trade ecosystem.

In the specific case of bitcoin and older cryptoassets the blockchain is secured through the use of CPU energy in the 'mining' process (Proof of Work). Miners expend energy to win the right to close the latest block in the chain and open the new one, earning substantial rewards while ensuring that the confirmation of each block is randomised and there can be no collusion to defraud or double spend assets. Bitcoin's current carbon emissions estimate per transaction is 1,216.91kg CO_2.

Ethereum is still currently reliant upon a Proof of Work consensus to secure the blockchain, but in the process of moving to a Proof of Stake consensus, due to complete in summer 2022. However, even with its current consensus its carbon emissions are a tenth of that of the bitcoin blockchain. A single transaction on the Ethereum blockchain has an estimated carbon footprint of 147.83 kg CO_2 (Digiconomist, 2022[68]).

By contrast, new Layer 1 and Layer 2 chains have fractional carbon emissions per transaction, much greater capacity for transactions, and rapid finality.

Polygon processes thousands of transactions per second, faster than the Visa network, with emissions per transaction of 0.0021kg CO_2 (Digiconomist, 2022[69]). Algorand, a Layer 1 blockchain employing Pure Proof of Stake as its consensus mechanism, processes 1,200 transactions per second with a one minute finality and carbon emissions per transaction of 0.0000004kg CO_2 (Algorand, 2021[70]).

Enterprise blockchains such as the Linux Foundation's Hyperledger Fabric also have a negligible carbon footprint as their consensus is achieved within the permissioned network, but if a publicly visible audit trail is required this would not be a suitable option. However, the control afforded by an enterprise blockchain, particularly in restricting write access, is attractive.

The prototype should explore public blockchain, Hyperledger, and R3 Corda's notary function, for example, for the control it gives over inputs into the ledger. The eventual solution is likely to be a hybrid approach with fast, efficient and sustainable processing, and smart contracts requiring specific credentials, that is digital identities, for users.

Big Data and Artificial Intelligence

Data is a reinterpretable representation of information in a formalised manner suitable for communication, interpretation, or processing. Big data is considered as an extensive dataset (that is an identifiable collection of data available for access or download in one or more formats) – primarily in the data characteristics of volume, variety, velocity, and/or variability – that requires a scalable technology for efficient storage, manipulation, management, and analysis (BSI, 2019[71]).

Meanwhile, AI is an engineered system comprising a set of methods or automated entities that together build, optimise and apply a model (physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, process or data) so that the system can, for a given set of predefined tasks (actions required to achieve a specific goal), compute predictions (output of a machine learning model when provided with input data), recommendations, or decisions (BSI, 2021[72]).

Thus, AI driven by big data can support digital trade in different ways. These include using data from consumer behavioural patterns, such as shopping habits, with intelligence algorithms to offer better personalised discounts on loyalty-card schemes to increase competition with other shopping brands (Willcox, 2015[73]), and harnessing system performance data of traded physical products to provide through-life support services (The Economist 2017[74]).

Structuring data collection is a vital step. There is a glut of data in existence, the volume collected doubling every two years. Despite this, AI has historically been trained on data sets that are "*riddled with data gaps*" (Criado-Perez, 2019[75]). Data collection should be more carefully planned to reduce the volume and give service users a more streamlined experience without the need to constantly replicate data entry. There is also data held in offline repositories that can be brought into the digital data set using edge computing and document scanning technologies. Ultimately, collecting only the raw data that needed and ensuring that it is disaggregated and trusted provides a more streamlined service and delivers unbiased and complete training data for effective AI decision-making.

AI and big data are currently being deployed in digital trade (see Figure 2.6). Several studies discuss different views on competition strategies, with some arguments of unfair competitive advantages for organisations that collect big data for AI processing to provide tailored services (Lambrecht and Tucker 2015[76]); however, there are counterarguments that the value resides in the organisation capability to make use of big data via technologies like AI and not just collecting the big data (Duch-Brown et al. 2017[77]).

Big data gathered from reliable sources provides training data, historical trends, and real time information for automation and machine learning. In this project, data collection must be carefully structured, with disaggregated, automated data provided through reliable oracles from IoT sensors to third party APIs.

Data derived from algorithms, particularly automated trend analysis and planning support, will create value for participants, enabling better data driven decision-making. We are living in a period where the only constant is change, and the agility afforded by AI and big data will be vital to the smooth conduct of global trade and growth of economies.
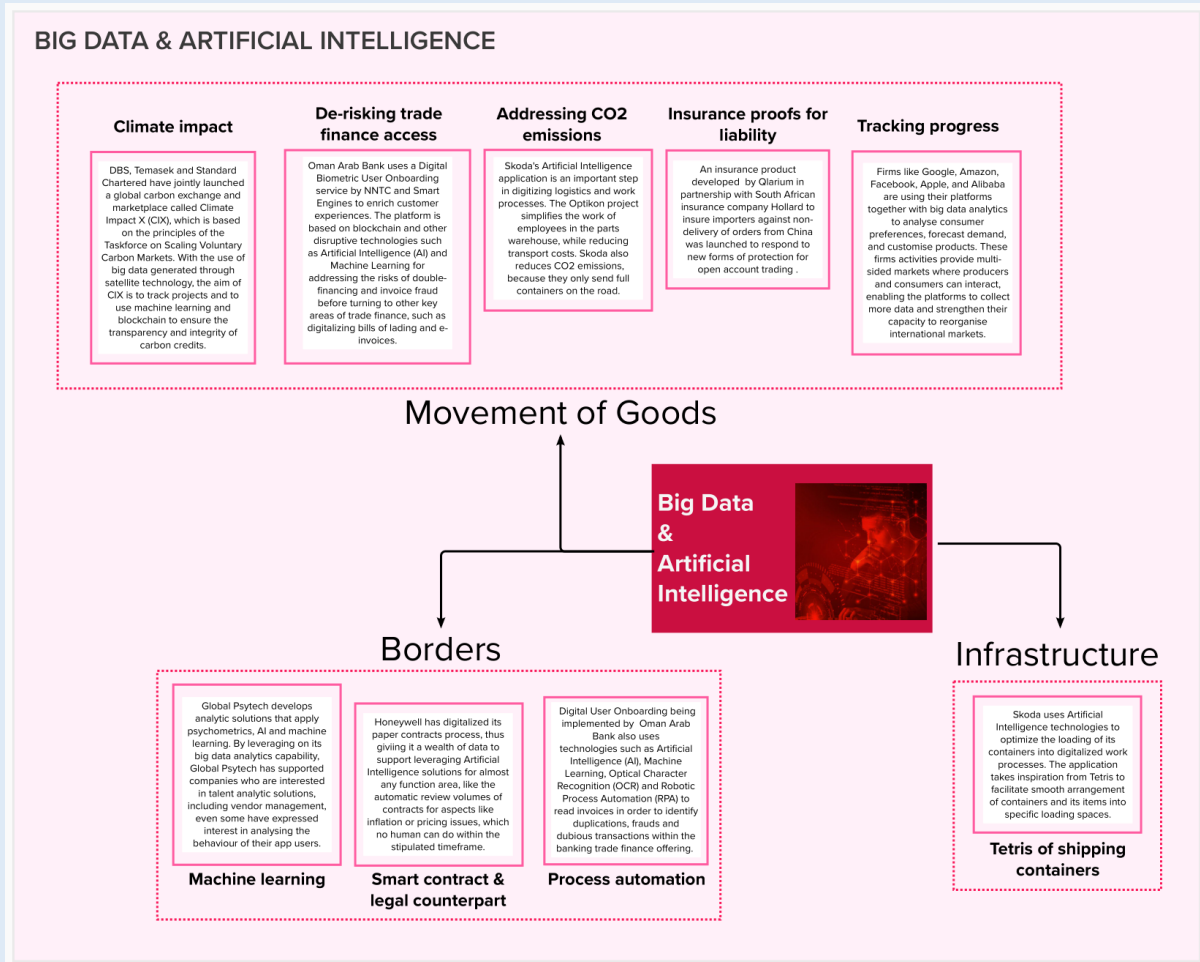
Figure 2.6: AI and big data deployment in digital trade

Digital Identity

Digital identity (DI) can simply be conceived as the digital counterpart of a real entity's identity; thus, it entails a set of identifiable attributes that can be used to verify the said entity (Buccafurri et al. 2018[78], Mir et al. 2020[79]).

Thus DI is critical to digital trade in different ways including providing a means of authorising, verifying and validating a person or entity involved in transactional activity (Mir et al. 2020[80]); accessing social benefits and healthcare services (Wang and De Filippi 2020[81]); facilitating simplified cargo goods tracking and inspection; deny or exclude malicious actors via digital rights management from e-commerce trade (Garba et al. 2020[82]).

Legal Entity Identifier (LEI), also a digital identifier, was initiated by the G20 intergovernmental forum in 2011 to enable the identification of legal entities/business involved in a financial transaction through a connection of key information that enables a clear and unique identification (Hartsink 2018[83]). Their use is supported by the Bank of England, who in 2018 became the first central bank to announce plans to make it mandatory for LEIs to be used in payment messages for certain transactions between financial institutions (Bank of England, 2020[84]).

LEI is a publicly available global directory that holds information on an "entity's ownership structure" which increases transparency in global trade. According to (Cleland and Hartsink 2020[85]) the establishment of LEI allows for easy identification and movement around the financial system has improved risk management and liquidity. However, despite the benefits to be derived from LEI, its adoption is threatened by barriers which include the lack of awareness LEI and its benefits and interoperability with existing identification systems (Cleland and Hartsink 2020[85]). Figure 2.7 highlights some use cases of DI in trade.
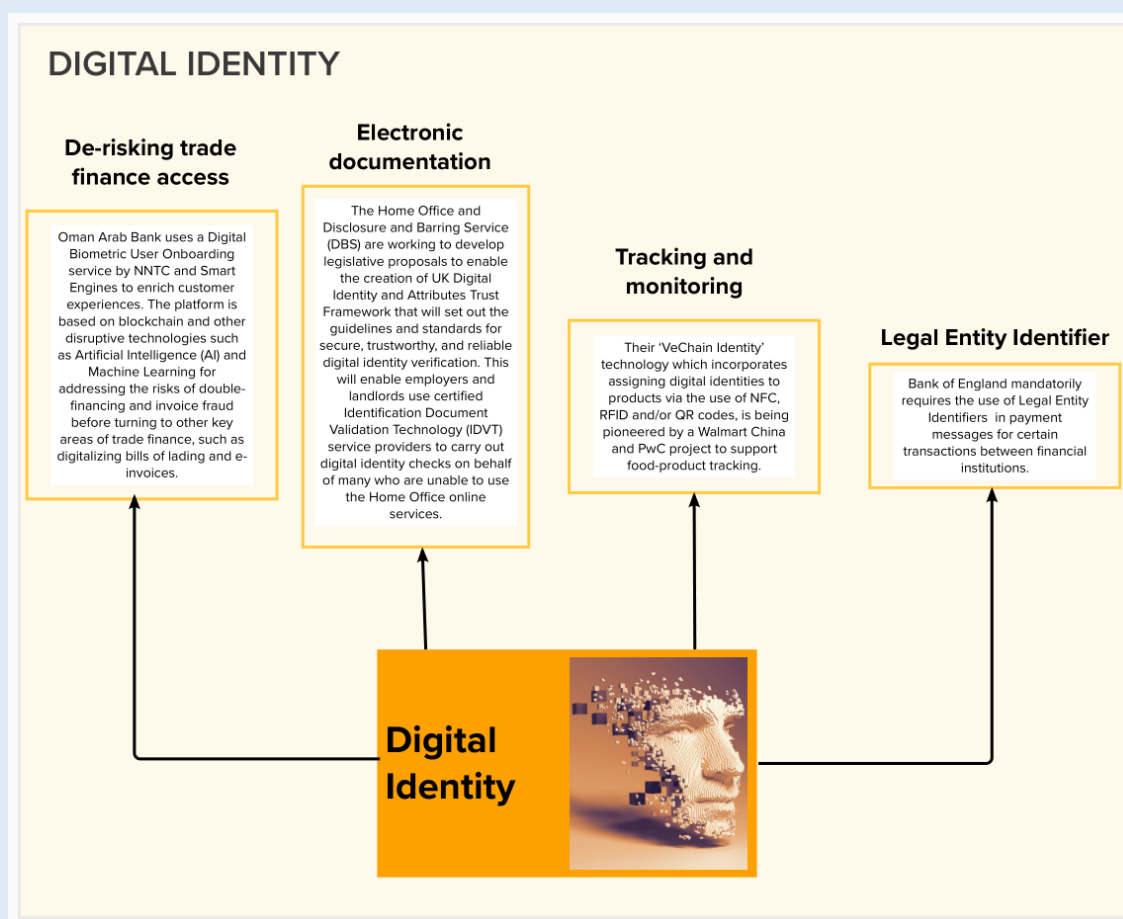

Figure 2.7: Use cases of Digital Identity

DI is a vital piece of the jigsaw for the prototype and scaled rollout of the digital trade application. It adds a layer of security at all levels of the system. Its use will include both access to functionality and recording of individuals and entities involved at each touchpoint in the

movement of a commodity. Thought must be given to the protection of personal data, for example, it should not be held on-chain. Instead, it is expected that zero knowledge proofs will provide suitable verification of authority to act.

Summary

This section has presented a review of digital technologies either currently in use or planned for future deployment in support of digital trade activities, along with their key use cases.

HMRC is in a unique position to develop systems and processes for frictionless digital and physical trade that will benefit multiple parties and meet the needs of the UK's border strategy. The maturing technologies outlined above form a strong technology stack from which to select the most appropriate tools for the task in hand.

In order to better understand how these technologies are current shaping the global trade picture, a review of the international context will follow in the next section.

Section 3 International Context and Comparators

Introduction

As industries and supply chains are being transformed across the world, the movement of data across borders is becoming central to the operation of the global economy. Provisions in trade agreements address many aspects of the digital economy; from cross-border data flows to the protection of citizens' personal data, and the regulation of the internet and new technologies such as AI and algorithmic decision-making.

Across the world, regulation of digital trade is a fast-evolving and contentious issue; and The most advanced borders in the world are leading the development of Single Windows[1] for trade to radically simplify traders interactions with the border (Cabinet Office, 2022[17]). The US, EU, and China have adopted different approaches. Following on from the integrated review (IR) 2021 and the Prime Minister's vision for the UK in 2030 (Cabinet Office, 2021[3]), the UK government's aim is for the UK to play a leading role in setting the international standards and regulations that govern the global digital economy. Now that the UK has left the EU, it will need to navigate across multiple and often conflicting digital realms. It needs to decide which policy objectives it will prioritise, how to regulate the domestic digital economy, and how best to achieve its priorities when negotiating international trade agreements.

To take full advantage of the digitalisation of the global economy and improve access to new markets, UK trade policy must become digital by default and provide a counterweight to growing trends towards digital protectionism. There is an urgent need to develop a robust, evidence-based approach to the UK's digital trade strategy that considers the perspectives of businesses, workers, and citizens, as well as the approaches of other countries in the global economy.

The UK is one of the world's most significant tech sectors, receiving £6.3bn of venture capital investment in 2018, and ranking fourth in the world for scaleup investment after US, China and India. To ensure this continued success the UK will need an effective international digital trade strategy.

Current Digital Trade Activities

It is useful to consider the current global landscape, pivoting around topics of adoption and implementation of AI, cross border data and cybersecurity. Digital transformation has reduced

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[1] The World Customs Organisation (WCO) defines such Single Windows as 'a facility that allows parties involved in trade and transport to lodge standardised information and documents with a single entry point to fulfil all import, export, and transit related regulatory requirements'.

the costs and complexities of engaging in international trade, but the adoption of new business models has given rise to more complex international trade transactions and policy issues.

Brexit, the transitional period leading up to it, the impact of the coronavirus (COVID-19) pandemic leading to global recession, and supply chain disruption have caused higher levels of volatility in trade statistics in the past two years. A Business Insights and Conditions Survey (BICS) reports that "*66 per cent of exporters and 79 per cent of importers faced challenges in late December 2021 to early January 2022*", with additional paperwork, change in transportation costs and customs duties or levels being the top challenges for traders.

It seems that the force of the fourth industrial revolution (I4.0) that brings the digital transformation has mainly affected physically delivered trade, although digitally delivered trade has also been affected to some extent. Since it is easier to physically deliver goods than services, it follows, that the digital transformation has had a greater impact on trade in manufactured goods (both final products and intermediate goods in global value chains) than on trade in services (mainly in global value chains), though some services have been impacted as well. The "*growth in the digital economy is creating new opportunities to grow international trade*", for example the Internet is providing new opportunities for those often marginalised from the international economy everywhere to become international traders (Meltzer, 2019[24]).

The global financial system has yet to display the fraying and fragmentation seen in the global trade system. But the "*trends of regionalisation and exclusive nationalism, now supercharged by great power competition, combined with digitisation and emerging technologies*" suggest that the status quo is unlikely to persist. "*The current economic downturn, the most severe since the 1930s, and attendant financial stresses that may exceed those experienced in 2008, promises to be a colossal challenge.*" (Manning, 2020[86]).

Failure to adequately mobilise a coordinated and cooperative economic response could leave major economies, particularly China and the EU, feeling an urgency to go their separate ways. Such a development could catalyse efforts to "*create rival reserve currencies to challenge the US dollar*" and trigger either the fragmentation or reordering of the global financial hierarchy (Manning, 2020[86]).

While debate continues about the viability of cryptocurrencies, with no nation's treasury backing them, why are they credible? Manning (2020) provides further context. "*Blockchain is becoming a mainstream cybersecurity tool with major US financial institutions investing hundreds of millions of dollars to have a more secure financial database*". IBM has created an entire division on blockchain; venture capital firms in Silicon Valley have invested more than $500bn since 2017; and some projections forecast a $2.3bn market for blockchain technology by 2023. There has also been a proliferation of cryptocurrencies for which there are no regulations or accountability. Further to the explanation given in section 2, the impact of blockchain cryptocurrencies on the global financial system is an issue of growing importance on which all international financial institutions need to assess and fashion appropriate regulation. Unlike the internet, which has governing institutions (e.g., the Internet Corporation

for Assigned Names and Numbers, ICANN), blockchain has no approved standards or norms. In the words of Atkinson and Cory (2021[87]): "*As the use of blockchain spreads, the need for shared norms, standards, and accountability becomes more imperative*".

Several of the world's central banks, including in the US, are actively studying the idea of digitising their currencies. China has filed 82 patents on the various aspects of digitising currencies, suggesting advance planning. Some fear that along with the "*Belt and Road Initiative (BRI) seeking to integrate Eurasia's infrastructure, including digital infrastructure, an attempt by China to digitise its currency might be a path for the RMB to rival the US dollar*" as a global reserve currency (Sen et al, 2019[105]).

Adoption and Implementation of AI

The use of AI technologies in the service industry has helped to drop capital costs significantly and decreased barriers to entry, which has been a game changer for start-ups. In services, the main impact of the next stage of the digital transformation will be to drastically reduce transportation and other transactional costs, rendering tradable many services that hitherto have been non-tradable.

The socio-economic impact of the new digital transformation was, and is, making more and more services digitally deliverable, will increase; as "*services tend to be highly labour intensive and those services that are becoming digitally tradable are typically intensive in medium to high-skilled labour, AI together with digital technologies, will vastly increase the potential to delocalise production from advanced countries to countries with relatively cheap skilled labour*" (Jones et al, 2021[23]).

Cross-border Data

Data is at the core of new and rapidly growing service supply models such as cloud computing, the IoT, and additive manufacturing. It also underpins trade by enabling the coordination of global value chains and the implementation of more efficient trade facilitation. (Jones et al, 2021[23]). Cross-border data flows, such as sharing information online, might not be international trade but are an important enabler of economic activity that can lead to international trade. (Meltzer, 2019[24]). At the same time, network effects and the value of collected data often leads to competition for the market instead of competition within the market.

Cybersecurity

As digital connectivity grows, so does exposure to the risks and costs of cyberattacks. The potential costs of cyberattack have underpinned a turn to conceiving cybersecurity risk as a national security threat. The scope of potential cybersecurity threats includes the digital space such as cybertheft of intellectual property (IP) and personal data and manipulation of online information, as well as the physical space, such as critical infrastructure (such as

telecommunications, transport, and health care) and IoT, which relies on software to network services (Meltzer, 2020[88]).

Digital Trade Partnership Priorities for the UK

In the context of digital trade and innovation, consideration of the UK's relations with other nations or groups and partnerships formed globally reveals the following geopolitical groupings as important to the UK's international trade priorities: Commonwealth countries, Nordic countries, the Gulf Cooperation Council (GCC), the US and friends and partners signatory to Digital Connectivity and Cybersecurity Partnership (DCCP) and ASEAN countries (Brunei, Darussalam, Myanmar/Burma, Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand, Vietnam) (see figure 3.1).

The UK's strategic choice of digital trade partners is not only political but also considers infrastructure readiness and potential. Commonwealth countries are an initial priority. Nordic and Benelux countries are advanced in digital adoption and, as societies with close culture ties based on mutual historical respect, could act as a gateway to the European market. Progress in this area is currently underway with the Gateway2Britain project[36].

The GCC countries, which are valuable investors in many UK industries, are keen to develop and work with the UK, and they understand and appreciate the importance of the UK close ties for their future of trade. During the Trump administration, the US and partners initiated DCCP which has many partners including India. The subsequent US administration seems to be following the same route to digital connectivity and cybersecurity partnerships.

The Digital Silk Road and Belt and Road Initiatives are just two of China's many ambitions for staying as a powerhouse of trade and the approach seems to work in hard-to-access places for the UK in the Central Asia region and Africa. As China is an ASEAN member, a prosperous friendly relationship with China brings the UK benefits throughout the region.

The Mercosur member countries have made extraordinary progress in the past decade, becoming Latin America's digital leaders. For example, Brazil's bCONNECT is proven to be a pioneer for the use of blockchain customs (Silva, 2020[89]; Pauletto, 2021[90]).

The Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) is a free trade agreement (FTA) between Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, Peru, New Zealand, Singapore and Vietnam. On 2 June 2021, the CPTPP Commission agreed to formally commence accession negotiations with the United Kingdom (Institute of Export and International Trade, 2019[91]; Department for International Trade, 2021[92]; Sanahuja and Rodríguez, 2022[93]).
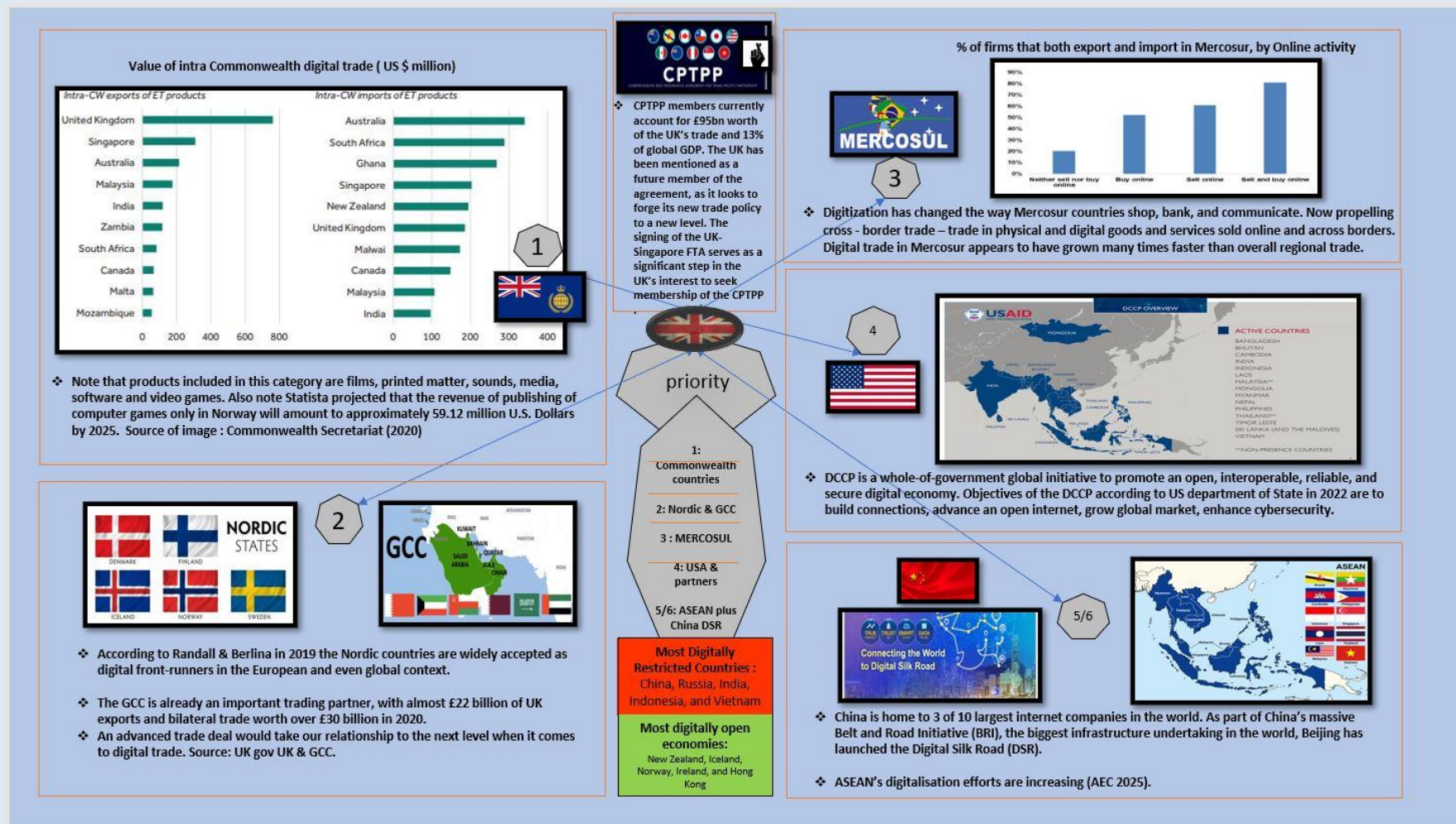
Figure 3.1: The UK's suggested international trade priorities

CPTPP & UK-Singapore FTA

Joining the CPTPP which is a £9tn partnership would deepen the UK's access to fast-growing markets and major economies, including Mexico, Malaysia, and Vietnam, for the benefit of UK business, which is aligned with 2025 UK Border Strategy and IR 2021.

The signing of the UK-Singapore Free Trade Agreement (FTA) serves as a significant step in the UK's interest to seek membership of the CPTPP. Singapore supports and welcomes the UK's intent to submit its application to accede to the CPTPP in early 2021. This will bring the UK closer to the CPTPP's vision of advancing economic integration and supporting the liberalisation of trade and investment globally. As vice-chair of the CPTPP Commission, Singapore will work with the chair and other CPTPP members to form an Accession Working Group for the UK as expeditiously as possible (Department for International Trade, 2021[92]).

Singapore is also the UK's largest trade and investment partner from ASEAN, while the UK is amongst Singapore's top three European trading partners and Singapore's top investment destination in Europe (Association of Southeast Asian Nations, 2022[94]; European Commission, 2022[95]).

Commonwealth countries

The Commonwealth is a voluntary association of countries with its roots in the British empire. Today, however, any country can join the modern Commonwealth: the last to join was Rwanda in 2009. It is home to 2.5 billion people and includes both advanced economies and developing countries. Thirty-two members are small states, including many island nations. Member governments have agreed to shared goals for development, democracy, and peace, expressed in the Commonwealth Charter.

According to Banga and Raga (2021[96]), COVID-19 and policy priorities for leveraging digital trade in economic recovery include expanding digital access in developing countries and least developed countries in the Commonwealth by targeting internet affordability. Policies encompass digital infrastructure development and sharing, and efficient spectrum allocation. Commonwealth African countries and small states also need to improve trade facilitation and logistics. COVID-19 has magnified challenges related to borders, customs, trade and automation and emphasised the need for digital solutions and automation, notably digital signatures and financial inclusion.

In addition, development of an appropriate legal framework around digital trade is seen as critical. Many of the African countries and small states have legislation in only one of four vital areas needed for digital trade (data protection and privacy, cybersecurity, e-transactions, and consumer protection). Developed countries in the Commonwealth have better regulatory environments and have addressed the adaptability of legal frameworks to digital technologies. This needs to be replicated in developing Commonwealth countries for cross border e-commerce in the Commonwealth.

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Nordic Countries

Solidifying our relationships with Nordic countries is the next opportunity. They are like-minded democracies and have good structure for digital trade in place already, ahead of most European countries. In the European Commission's Digital Economy and Society Index, Denmark, Sweden and Finland are at the top of the list in terms of the overall ranking, as well as performing well on individual indicators (see Figure 3.2)
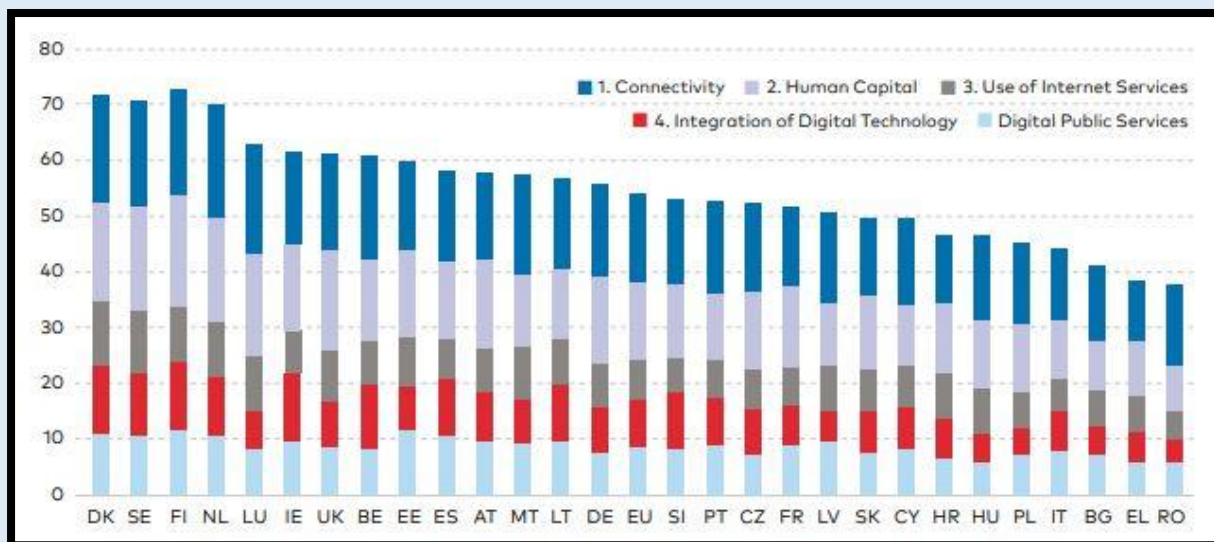
Figure 3.2: Digital economy and society index, 2018 ranking (European Commission,2017c[97])

The ranking is based on five aspects: connectivity (fixed broadband, mobile broadband, speed and affordability); human capital (digital skills); use of the Internet (content, communication and transactions); integration of digital technology (business digitisation and e-commerce); and digital public services (e-government). Finland leads the way on human capital and digital public services, Denmark on integration of digital technology and Norway on Internet use (Randall and Berlina, 2019[98]).

Gulf Cooperation Council

The Gulf Cooperation Council (GCC) is already an important trading partner of the UK. British business could seize new opportunities in areas such as renewable energy and, in line with UK targets for net zero emissions by 2050, play a key role in helping a region that wants to move away from a reliance on oil. Financial and digital services companies, along with education and healthcare providers could also strengthen their position in a region that holds UK expertise in high regard. The UK is already a top destination for investment from GCC members and a trade agreement is expected to attract even more into world-leading UK industries such as renewable energy, infrastructure, tech and life sciences.

The United Arab Emirates recently launched a blockchain-based digital trade platform, UAE Trade Connect (UTC) (UAE gov online, 2021[99]). This aims to help financial institutions fight fraud, invoice duplication and other crimes in the trade finance space, and to provide SMEs with better access to trade funding and supply chain-related finance by mitigating risk to finance providers. UTC will initially focus on fraud detection, later incorporating e-invoicing, bills of lading, letters of credit and bank guarantees.

Mercosur

Mercosur economies' digital transformation is in many ways a staggering for a region that has been known for its commodities for decades and, in the case of Brazil, heavy manufactures. Entrepreneurs and businesses in the region are building digital platforms on payments, logistics, and finance that in turn enable new volumes of trade in goods and services (Suominen, 2017[100]). The Internal Revenue Service of Brazil, a public body in charge of controlling the customs system of that nation, launched a platform called bConnect developed based on blockchain technology to connect its customs with the neighbouring countries Argentina, Paraguay, and Uruguay.

Use of blockchain technology in the bConnect project led to the reduction of administrative costs, lowering the time of procedures, the reliability of the data of licences, permits, certifier and free-trade agreement between member countries. bConnect does present a novelty in the fraud detection system including the detection of cryptocurrency laundering that unfortunately at the present time is a known issue in most Latin American countries. Meltzer highlights that the challenges and opportunity is to expand on what digital technologies provide to enhance digital trade in this region (Meltzer, 2018[101]).

United States

The US has long regarded itself as a champion of free trade and the leader in the global trading system. As the architect of the Bretton Woods System, the US has, until very recently, preferred to engage in rule-making efforts in the General Agreement on Tariffs and Trade (GATT) and its successor, the World Trade Organization (WTO). (Gao, 2018[102]). For the US, engagement on digital trade and economic issues is of high priority. Digital trade and economy agreements are relatively quickly achieved relative to comprehensive, traditional trade agreements (Cory, 2022[103]).

Digital Connectivity and Cybersecurity Partnership (DCCP) is a whole-of-government global initiative of USAID and the US Department of State to promote an open, interoperable, reliable, and secure digital economy. This initiative enables partners to realise the tremendous benefits of a vibrant and secure digital economy through investments in infrastructure, promoting best practices and regulatory reforms.

China

China is home to three of the ten largest internet companies in the world (Alibaba, Tencent and Baidu). While the largest US internet companies mainly provide online search, social network, or content services, two of the top Chinese companies mainly sell physical goods online. While the Chinese government has been wary of including commitments on digital trade in its trade agreements, this has started to shift as the largest Chinese companies have sought to expand internationally and since 2015, China has included digital trade provisions in trade agreements, including with Korea, Australia and Chile. It is now playing an active role in influencing international standards for new digital economy products. China's strategic proprieties reflect the interests of its largest internet companies. It opposes binding rules on data flows or language that limits digital protectionism and facilitates traditional trade in digitally enabled goods. China is a signatory to the Regional Comprehensive Economic Partnership (RCEP) agreement (2020), which includes the Association of Southeast Asian Nations (ASEAN), Australia, India, Japan, South Korea, and New Zealand (Liu, H.W, 2018[104]).

The Digital Silk Road

The Digital Silk Road aims to improve digital connectivity in participating countries, with China as the main driver of the process. It includes development and interoperability of critical digital infrastructure such as terrestrial and submarine data cables, 5G cellular networks, data-storage centres, and global satellite navigation systems.

A growing number of developing countries in Africa, Southeast Asia, and the Middle East have become engaged with the Chinese government and Chinese companies on digital initiatives. (Sen et al, 2019[105]). The Digital Silk Road is particularly suited to the needs of developing countries and lower-income groups (Li et al, 2018[106]). China is at the forefront of digital trade and technological power, therefore there is a need for the UK to maintain a cautious and friendly relationship.

Summary

The UK government must ensure that future trade deals enhance cross-border online consumer protections. Consumers need both transparency on the source of goods and access to redress and dispute resolution. Mechanisms for cooperation between authorities are needed to improve consumer protections for cross-border and online purchases.

The UK faces important decisions about how to regulate the digital economy now that it has left the EU, including identifying which policy objectives will be prioritised, the optimal regulatory measures for furthering these objectives, and how best to achieve them when negotiating international trade agreements. The next section provides an overview of the stakeholder mapping and consultation received over the period of this research, to further investigate these (and other related) issues.

Section 4 Stakeholder Mapping and Consultation

Introduction

Digital trade is now ubiquitous: almost every person on the planet with access to an ICT device such as smartphone, laptop, tablet or personal computer will have some experience of e-commerce. The number of actors involved in digital trade is vast and wide reaching, and encompasses multiple government departments such as customs and excise, and international trade. Transactions can be highly localised or may reach across continents.

This section provides an initial mapping exercise for the main stakeholder groups in the UK context. It is not intended to be all-encompassing, rather it is indicative of the main players. It also reports on preliminary consultation with specific representatives from groups involved in digital trade activities to gather initial evidence for the support case for a C4DTI.

Stakeholder Mapping

This exercise focuses upon road, rail, sea and air cargo transport. Figure 4.1 provides an indicative three-part summary of the main players. Having mapped the stakeholders identified as relevant to digital trade and innovation, an initial sample of their views on digital trade activities and the possible establishment of a UK centre for digital trade and innovation was sought, using both a workshop and individual interviews.

Type	Road	Rail	Sea	Air
Government (Principal Departments)	HMRC DIT DCMS BEIS DEFRA HO			
Trade Bodies / Associations	Road Haulage Association (RHA) International Road Transport Union (IRTU)	Rail Freight Group (RFG) European Rail Freight Association (ERFA)	British Ports Association (BPA) + Freeports Hub International Association of Ports and Harbours (IAPH)	Airlines UK International Air Transport Association (IATA – Cargo)
	Logistics UK (LUK) British International Freight Association (BIFA) Chartered Institute for Logistics and Transport (CILT) Chartered Institute of Procurement and Supply (CIPS) Institute of Export and International Trade (IEIT)			

Figure 4.1 (1 of 3): Non-exhaustive stakeholder map in the UK context

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Business and Commerce	Federation of Small Businesses (FSB) UK Chambers of Commerce (UKCC) International Chambers of Commerce (ICC) Trade Finance Bodies (WTO downwards) Association of Supply Chain Managers (ASCM) Institute of Supply Chain Managers (ISCM)			
Manufacturing/ Industry	Make UK Confederation of British Industry (CBI) Society of Motor Manufacturers and Traders (SMMT) North-East Automotive Alliance (NEAA) North-East Battery Alliance (NEBA)			
Insurance	RHA – Insurance Hub Lloyds Market Association (LMA) – Non Marine	Lloyds Market Association (LMA) – Non Marine	International Union of Marine Insurers (IUMI) Lloyds Market Association (LMA) - Marine Protecting & Indemnity Associations	International Union of Aerospace Insurers (IUAI) Lloyds Market Association (LMA) - Aviation
Standards and Governance	Building Smart International Global Legal Entity Identifier Association British Standards Institute (BSI Group)			

Figure 4.1 (2 of 3): Non-exhaustive stakeholder map in the UK context

Technology Groups/ Associations	British Blockchain Association (BBA) Hyperledger Foundation / IBM Blockchain (Permissioned chains) R3 Corda (push records – notarised chain) ConsenSys – Ethereum applications (public chain) UK Digital Business Association UK's technology trade association (TechUK) British Interactive Media Association (BIMA) Digital Catapult
Professional Bodies	Accounting (ICAEW, CIMA, ACCA etc) Law Society Other Finance (CIOT, ACT) Institute of Engineering and Technology (IET) International Telecommunications Union (ITU) OFCOM
Innovative existing tech examples	Circulor – Complex supply chain tracking (Cobalt ore etc including emissions). Partner with Oracle, working with Britishvolt Insurwave – was AXA (Catlin), E&Y and Guardtime, recently sold to US firm but their experience tracing shipping hulls is worth reviewing DiMuto Singapore – perishable supply chains, global, public ledger, releasing trade finance to small producers

Figure 4.1 (3 of 3): Non-exhaustive stakeholder map in the UK context

Stakeholder Consultation Workshop

In March 2022 a digital trade consultation workshop was organised by Teesside University. The exercise was designed to engage participants in the possible challenges and potential opportunities of developing a centre for digital trade and innovation. The aim of the workshop was to provide input into the independent scoping research that forms the basis of this report.

The workshop addressed the rationale for a possible UK centre for digital trade and innovation, testing and discussing models for the centre's operations and development, and consideration of next steps and support needed for the development of the centre.

Participants drawn from major stakeholders listed in Figure 4.1 (above) were asked to provide their insights. The main running question was: *"What would be your hopes and fears for a centre for digital trade and innovation?"*

The workshop exposed five key themes: technology; inclusivity; orchestration; ethics; and legislation, and trust.

Technology

Hopes	Fears
- a technology agnostic approach - a holistic technology roadmap - start with low-hanging fruits and digitisation of assets - going paperless	- being too technology-led; - excessive data controls and incompatible data interfaces; - cyber risk - vendor lock-in - data management complexity

Inclusivity

One of the key challenges mentioned by participants was on being inclusive. For instance, there is a need to identify 'real' stakeholders, such as management and people on the ground who work in ports. This community should have the opportunity to voice concerns. At higher level,

one of the main challenges seen is how to open the conversation with other centres and ports at the regional, national, and global level.

Orchestration

Hopes	Fears
- Developing a hub and spoke model to link up centres - Mapping and aligning disparate stakeholders and expertise - Synergy with freeports - A single pane of glass to unify and present data from multiple sources - Interoperability of databases, processes, and standards - Mapping the hard and soft systems - An underlying foundation for bringing various digital trade standards together	- Mindlessness in the face of bandwagons - Taking yet another digital initiative and creating unintended silos in terms of data, processes, standards, and mindsets - Mindfulness that previous attempts to create 'hub and spoke' models in UK innovation have had mixed success

Ethics and Legal

Participants hoped for an environment friendliness and public buy-in, deeper engagement on developing standards with the law society, and the simplification of standards. The main concern in this area was that the standards developed would be layered, redundant and therefore an unnecessary burden to the digital trade, contradictory and would not achieve the intended policy objectives.

Trust

Government buy-in, SME buy-in and public transparency were the trust-related concerns from some participants.

Stakeholder Consultation Interviews

Alongside the workshop a series of stakeholder interviews were designed and conducted. The main aim of the interviews was to gauge stakeholder viewpoints, thoughts, and experiences on questions regarding the involvement of their organisations in digital trade activities, barriers and opportunities to adopting digital trade, expectations of digital trade alliance and the nature of any support they could provide.

Participants interviewed represented 11 different organisations from government sector, trade bodies/associations, business and commerce, industry and technology firms. Participants engaged were mostly from executive management roles (7), followed by technology management roles (2) and policy management roles (2).

Digital Trade Definition

There was no consensus on what comprises a definition for digital trade; however, the popular views of participants were that digital trade deals with digital goods and services, as well as providing some form of digital facilitation via digital technologies for trade of digital goods and services. In addition, some participants said that digital trade is aligned to trade in bitcoin and some were of the view that digital trade is about data-enabled flows between organisations to create value that can be exchanged between organisations. Relating digital trade to IT, software and digital technology use was linked to the views that likened digital trade to an online business platform and marketplace solutions. The key definitions are highlighted in Figure 4.2.
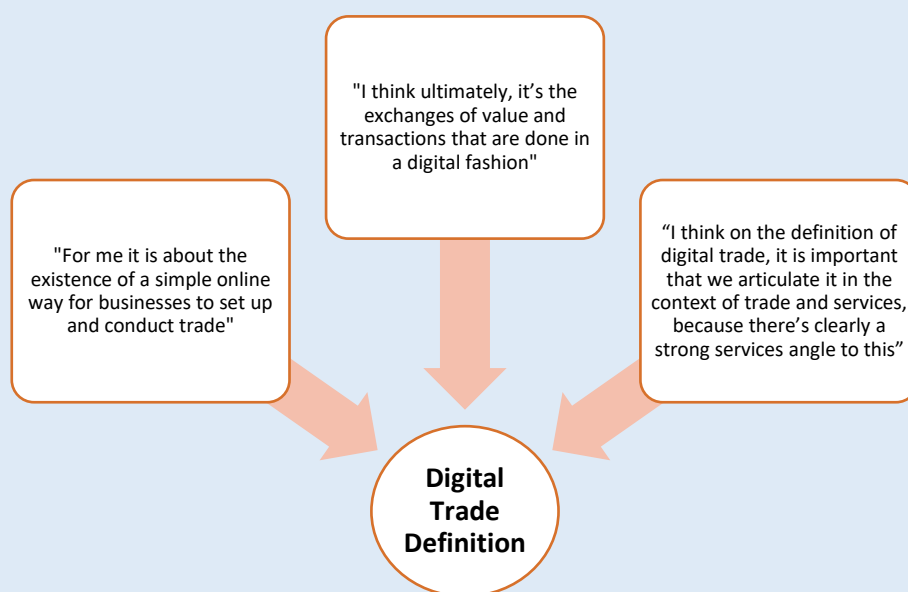
Figure 4.2 Varying definitions of Digital Trade

Organisational Involvement

Participants interviewed highlighted various activities that their organisations are involved in to support the growth of digital trade and its related activities; only a few indicated no direct involvement. The activities comprised: concept development; research and creating tech solutions to identified problems; information support and advisory services. The activities of these organisations are summarised below.

Stakeholder Category	Organisational Involvement in Digital Trade
Government	• Provision of essential information for businesses • Supporting businesses with advice and guidance • Standardisation of administration • Driving force for digitalisation
Trade Bodies/Associations	• No direct involvement, but individual members might be directly involved
Business and Commerce	• Creating a digital trade roadmap/Further develop the ICC digital trade roadmap • Support the electronic trade documents bill • Make a case for legal harmonisation and removal of barriers to digitalisation • Adopt cross border, interoperable digital standards (WTO/ICC Standards Toolkit) • Invest in digital skills training and innovation • Invest in testing and piloting new technology solutions
Manufacturing/Industry	• Creating a competitive supply chain via research, development, and innovation.
Fintech	• Tokenism of Financial Instruments for Ethical Trade • Developing the use of technology to provide a single set of data on trade goods, the entities involved, and enable verification • Developing Smart custom solutions • Running pilots for the ecosystem of trust • Protecting customers from financial crime
Local Authority	• Involved with a regenerative and innovative form of trading including movement of goods/services, innovation and technology, and global trading
Business Advisory	• Provision of professional services to support businesses in the use of digital technologies

Technology Barriers to Adoption of Digital Trade

When answering questions regarding the technology barriers to the adoption of digital trade, participants highlighted three main areas: inappropriate use of technology; lack of digital skills and knowledge by individuals or organisations resulting in a skills gap; and the lack of access to support technology and unstable infrastructure to sustain digital trade. Additionally, participants raised concerns about human errors feeding into digital process chains, thus supporting calls for wider education on digital trade and the need to simplify the experiences for users on its capability. On the other hand, some participants were of the view that technology barriers were not an issue, and the growth of technology should rather be seen as an enabler.

Interviewees raised concerns about the digital trade ecosystem being fragmented due to geo-political barriers and lack of strong regulatory guidance, which has led to the critical issue of how having to handle incoherent data interoperability reduces the value of digital trade. Clearly, government needs to lead on this issue of fragmentation, and in particular HMRC due its critical role in administration of trade and customs, as discussed in section 1. Key quotes on technology barriers are highlighted in Figure 4.3.

"...But in more traditional markets, like the UK, I think there still is a digital skills gap. That's the really biggest problem is people with the right skills to develop the technology. And then also to use the technology, how it's been implemented..."

"...I think technology is not a barrier to one.......There's plenty of technology in the in the system already. And there's a lot more in development. So technology is not the problem and never really has been the problem..."

"... even our closest neighbors, the European Union is pretty poor on its use of digital technology when it comes to trade and that's one of the biggest barriers . The legal frameworks don't feel like that much of a barrier..."

"At a very basic level, it's mistakes and human error that feed into the processes... so if there are errors on customs declaration, or if there are delays in submitting something, then those systems quite often can act with that subhuman pragmatism that you might find a conventional, 'I don't know' Border Force operator would be able to kind of wave something through as they used to..."

Technology Barriers

"...there's a big piece on Education. Effectively, we concentrate often about efficiency inside the box... So, we're not looking at innovating doing things differently. When we do digitise things, what we tend to do is take paper-based environments, and just create them, recreate them in a computer...So vehicles are much more user friendly, it's easy to drive a truck, you can have electrification, but actually utilising the trade mechanisms has been not being invested in for a long, long time, or under invested... We're probably 20 or 30 years behind where the rest of the world..."

Figure 4.3: Participant views on technology barriers to digital trade

Legal/Policy Barriers to Adoption of Digital Trade

Considering legal/policy or commerce barriers to the adoption of digital trade, participants generally highlighted: the absence of a legal framework for the digitalisation; non-harmonisation of standards and fragmentation of the existing technology systems; and the inability for trading entities to adopt the same standards and be able to operate in the same legal

environment. Participants further highlighted the lack of trust in a globally competitive trading environment, and also the lack of alignment and standardisation of global policies and legal frameworks. Resistance to change, lack of understanding to new requirements and the lack of investments in the digital resources were also mentioned as barriers to the adoption of digital trade.

A handful of participants revealed their unfamiliarity with the existing legislation on digital trade, hence they were unaware of any legal barriers to digital trade. Others were also of the view that legal barriers were not an issue. Again, this is an area where government can address through strong leadership and clear guidance from HMRC on the legal and pilocy barriers which need to be addressed. Key quotes on legal/policy or commerce barriers are highlighted in Figure 4.4.

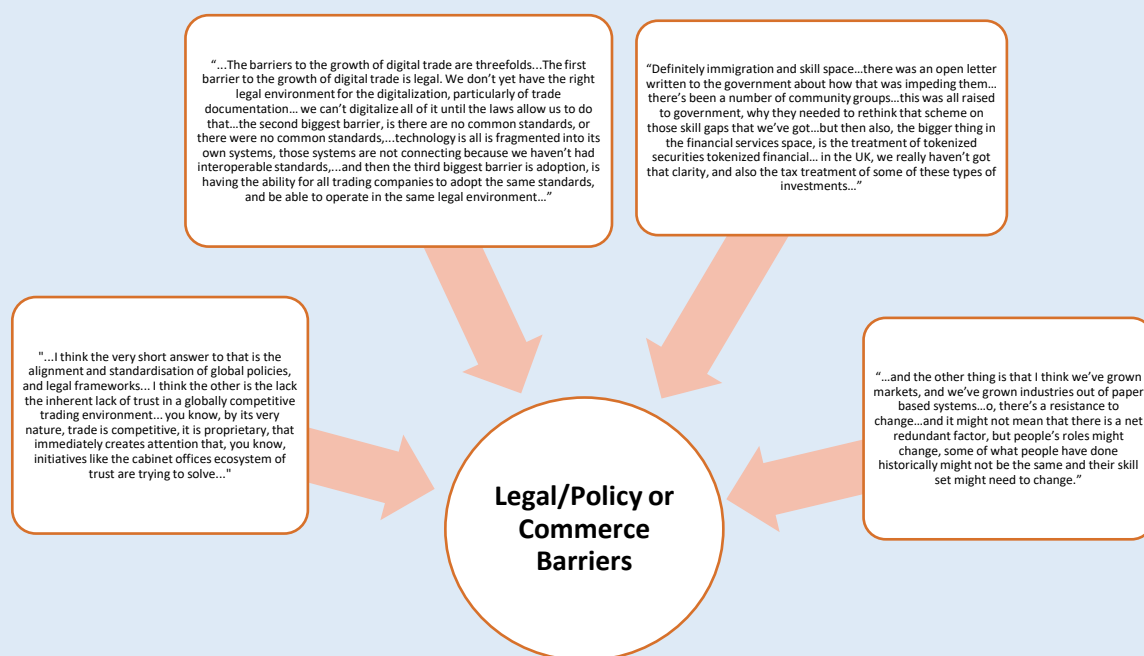"…The barriers to the growth of digital trade are threefolds…The first barrier to the growth of digital trade is legal. We don't yet have the right legal environment for the digitalization, particularly of trade documentation… we can't digitalize all of it until the laws allow us to do that…the second biggest barrier, is there are no common standards, or there were no common standards,…technology is all is fragmented into its own systems, those systems are not connecting because we haven't had interoperable standards,…and then the third biggest barrier is adoption, is having the ability for all trading companies to adopt the same standards, and be able to operate in the same legal environment…"

"Definitely immigration and skill space…there was an open letter written to the government about how that was impeding them… there's been a number of community groups…this was all raised to government, why they needed to rethink that scheme on those skill gaps that we've got…but then also, the bigger thing in the financial services space, is the treatment of tokenized securities tokenized financial… in the UK, we really haven't got that clarity, and also the tax treatment of some of these types of investments…"

"…I think the very short answer to that is the alignment and standardisation of global policies, and legal frameworks… I think the other is the lack the inherent lack of trust in a globally competitive trading environment… you know, by its very nature, trade is competitive, it is proprietary, that immediately creates attention that, you know, initiatives like the cabinet offices ecosystem of trust are trying to solve…"

"…and the other thing is that I think we've grown markets, and we've grown industries out of paper based systems…o, there's a resistance to change…and it might not mean that there is a net redundant factor, but people's roles might change, some of what people have done historically might not be the same and their skill set might need to change."

Legal/Policy or Commerce Barriers

Figure 4.4: Participant views on legal/policy and commerce barriers to digital trade

Short-term Opportunities

On the short-term opportunities in Digital Trade, several suggestions emerged which can generally be seen as providing perspectives about immediately closing identified gaps. To begin with, there were strong indications to digitise documents and audit trails as the foundation towards providing an improved oversight across the supply chain, and harmonising standards on using freeport levers. Additionally, there were indicators about funding, governance and regulation, where participants revealed the need in some cases to tighten regulations on trader and beneficiary identities to prevent fraud and provenance on funding; especially, through a multi government platform that supports trade and provides an appropriate regulatory framework. Action to review regulations around fintech were also expressed in the context of banking and transaction clearing, with a framework not designed for modern digital operations.

Urgent action was suggested in two cases related to physical trade associated with European import/export operations, in that couriers/hauliers and small businesses were not familiar with the paperwork introduced after EU exit, and that digitisation of customs forms would be beneficial and provide a lead to also simplifying these mechanisms for trading with the rest of the world. The selection and adoption of appropriate pilot schemes is an area in which government can lead on, and provide support (consultancy, infrastructure, funding, etc) to help deploy and energise priority pilots.

Examples of Best Practice

Despite the barriers identified, participants were able to provide a few generic and specific examples that the UK can emulate. There was mention of pilots and innovation hubs being capitalised upon by among others Canada, US, the Middle East, Germany, and Singapore. Singapore came up as a popular example for understudy, where participants shared that Singapore had implemented an automated port that uses digital technologies to help facilitate trade in goods and services. There was an allusion to promoted practice by World Customs Organisation's Trusted Trader, which may be adapted to fulfil digital trade, plus implementing a single trade window. With regards to specific companies: Fujitsu was cited as a good example due to its involvement in digital marketplaces. IBM and Maersk's collaboration on software solutions for trade, and Deloitte's CustomsClear software also were mentioned. A handful of participants revealed not being knowledgeable enough about best practice in digital trade to provide any recommendations; however, it can be seen from the above that there are different strands that can be understudied as best practice from the examples provided.

Support for a Digital Trade Alliance Group

When participants were asked about their interest in providing support for a UK digital trade alliance group or task force, the majority (9) supported the need for one. The answers revealed only two single instances of uncertainty and inability to support (see Figure 4.5). The need for a single access point to government on matters of trade has been well-established, and it is clear from discussion in section 1 that HMRC should be the key government component in a stakeholder alliance group.
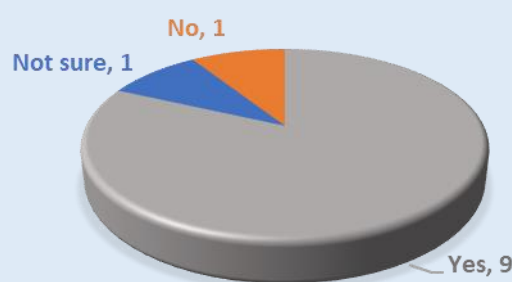

Figure 4.5 Support for alliance, response distribution

Priorities for a Digital Trade Alliance

Participants views on the remit or priorities of the alliance revealed a diversity of perspectives about creating relevant structures and an enabling environment that would support governance, innovation, funding, accountability, and coordination of stakeholders. In addition, participants indicated an interest for developing resources and technologies via value-creating experiments that would make the alliance a self-funding organisation. This connected with the perspectives of participants who indicated the need to identify quick-win projects to make it worthwhile and maintain interest.

There were also instances raised about addressing complexities in existing supply chains, with some participants indicating the need to simplify and automate import and export finance and duties by providing clarity for companies who are interested in digital trade via outward facing platform to market. Finally, prioritising education and information dissemination, fostering a peer network that helps establish links between industry and government needs were also highlighted.

Operating Model for Digital Trade Alliance

Options for an operating model logically include a central hub only, a central hub with regional spokes, or a fully decentralised virtual network. When participants were asked about their preferences, there was no clear consensus on a model however, the suggestion for a fully decentralised virtual network dominated the choices made. There were different combinations of models proposed that essentially mixed central hub with some degree of decentralisation at the regional or complete virtual level. Nevertheless, there were a few instances, where participants indicated no preference.

Involvement of Central or Local Government, Business and Industry

When asked what level of local government, central government, and business/industry involvement they considered suitable for the alliance; participants revealed strong sentiments to involve central government and business/industry as they were not clearly distinguished. With regards to the local government involvement, there was a relative consensus in favour of the local government for medium to high involvement (see Figure 4.6). Again, for reasons discussed in section 1 of the report, HMRC can clearly provide the central government support which has been expressed by stakeholders, through direct involvement an STW and UTP platforms.
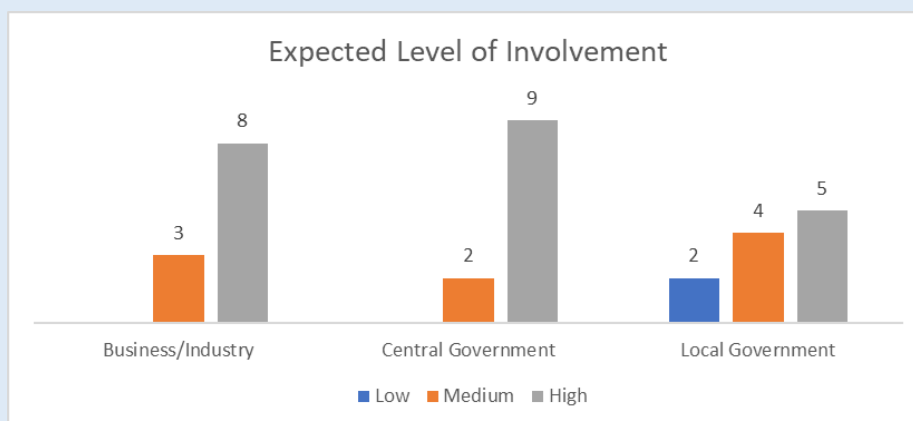
Figure 4.6 Level of involvement of business/industry, central government, local government

Contribution to Digital Trade Activities and an Alliance Group

When participants were asked about their intended contribution to digital trade activities and C4DTI alliance, the feedback was generally positive about their willingness to contribute in different ways. Participants were willing to contribute by providing: support to develop relevant skills; information dissemination via webinars; coordination of inputs from policymakers and lobby on government expectations; the voice within a target sector to obtain their industry-level requirements; and most importantly, to ensure financial support, safety from financial crime, and be compliant with UN's sustainability goals through ethical finance and provenance in the chain of goods.

Key Points from Stakeholders

Requirements and Aspirations

- There is an urgent need for action to maximise opportunities around UK digital trade activities.

- There is an urgent requirement for a holistic technology and policy roadmap for digital trade.

- For open sharing of data, there needs to be interoperability of standards and interfaces.

- An initial focus upon developing a hub and spoke model to link up activities into one national centre: with spokes to focus upon anther activates could happen organically, and possibly with a move to decentralised operations in future.

- It will be essential to fully map and align all disparate stakeholders and expertise within an inclusive ecosystem for digital trade.

- Single points of contact in government, academia, small business and other stakeholder bodies are needed for matters related to digital trade to be part of this ecosystem.

- HMRC provide the logical choice for the single point of contact in central government, and support industry-led, government supported initiatives in deployment of the border strategy, in line with commitments to work with industry to achieve the TOM.

- Digitalisation, AI and automation are also transforming many areas of industry in addition to trade (see, for example. Short & Twiddle (2019[107]) and Short et al. (2020[108]) for recent examples in UK water and energy industries), and the engineering community should be included in the stakeholder mapping as they are responsible for designing, implementing and maintaining large parts of the infrastructure required for physical and virtual trade (e.g. ICT, automation system for cargo handling) and there are close links to net zero activities;

- Freeports and other innovation hubs in fintech, manufacturing and digital technology should be a major focus area for initial activities, with input from government.

- There has to be public buy-in, and industry-led activities, supported by government, but with public transparency.

- The term 'Tradetech' should be used to describe technology developed and deployed to support physical and virtual trade.

Initial Priorities

- Further deployment of technology to support going paperless, in terms of financial and customs transactions to assist with both physical and virtual trade.

- Integration of Legal Entity Verification and Global Positioning with blockchain, focus on fraud detection and crime prevention and supporting rules-of-origin aspects of free trade deals.

- Deeper engagement on developing, reforming and simplifying trade, insurance, banking and logistics/customs standards and procedures/regulation in consultation with stakeholders such as the law society, fintech leaders and those involved in UK border activities and logistics.

- Setting up an initial physical and virtual presence to focus activities and initiate effective communications between stakeholder groups, central hub and spokes model.

- Develop a full governance structure and identify priority areas for pilots and innovation in conjunction with stakeholders.

- Concerted effort to increase awareness of the potential of digital trade, to make stakeholders fully aware of the problems it could solve and to energise and catalyse actions and planning[2].

Summary

The engagement with stakeholders carried out for this scoping report has revealed a number of key points that would facilitate the UK taking a leading role in the development of international digital trade and innovation. These key points will be brought forwards in the final sections and inform the design of a C4DTI.

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[2] The importance of this point cannot be understated: in many of the consulted stakeholders, they were not aware of the opportunities around digital trade for their sector. In face, it has previously been suggested that if 1 per cent of SMEs were educated regarding applied blockchains and smart contracts, global GDP would increase by $1.42tn (https://www.pwc.com/timefortrust)

Section 5 The Gap in Provision

Introduction

The worldwide trading system suffers from fragmented, unconnected platforms and systems, a lack of a standardised approach, and laws that require modernisation. The result is high trade costs, inaccessible trade finance and a system that is overly complex, bureaucratic, and inefficient, particularly for small businesses (SME). It also means that technology solutions cannot be scaled.

Digitalisation is a key enabler to delivering a more inclusive, sustainable and greener trading system; where more SMEs can participate in trade, where trade finance is cheaper and more accessible, and paper is no longer a pre-requisite. The UK's ambition is to set the global benchmark on how to trade digitally and to work with other, like-minded nations to help improve the international trading environment.

Other nations and regions such as Australia, China, Germany, Japan, the Netherlands, Singapore, Thailand, APEC, ASEAN, and Africa are moving quickly to capitalise on the benefits of digital trade. This is an opportunity for the ICC to develop the private-sector capability needed to be an exemplar of best practice working with others. An ICC Centre for Digital Trade and Innovation would have the opportunity to bring together stakeholders from government, academia and the private sector to deliver a leading digital trade initiative.

A UK Centre for Digital Trade and Innovation could be a global initiative led from the UK that promotes an open digital trade system based on common, internationally recognised digital standards. The centre could have the capability to engage industry of all sizes and sectors, identify policy barriers, test and pilot practical solutions and drive technology adoption and innovation at scale across the whole trading system.

This section analyses current initiatives that verge on the digital trade and innovation space.
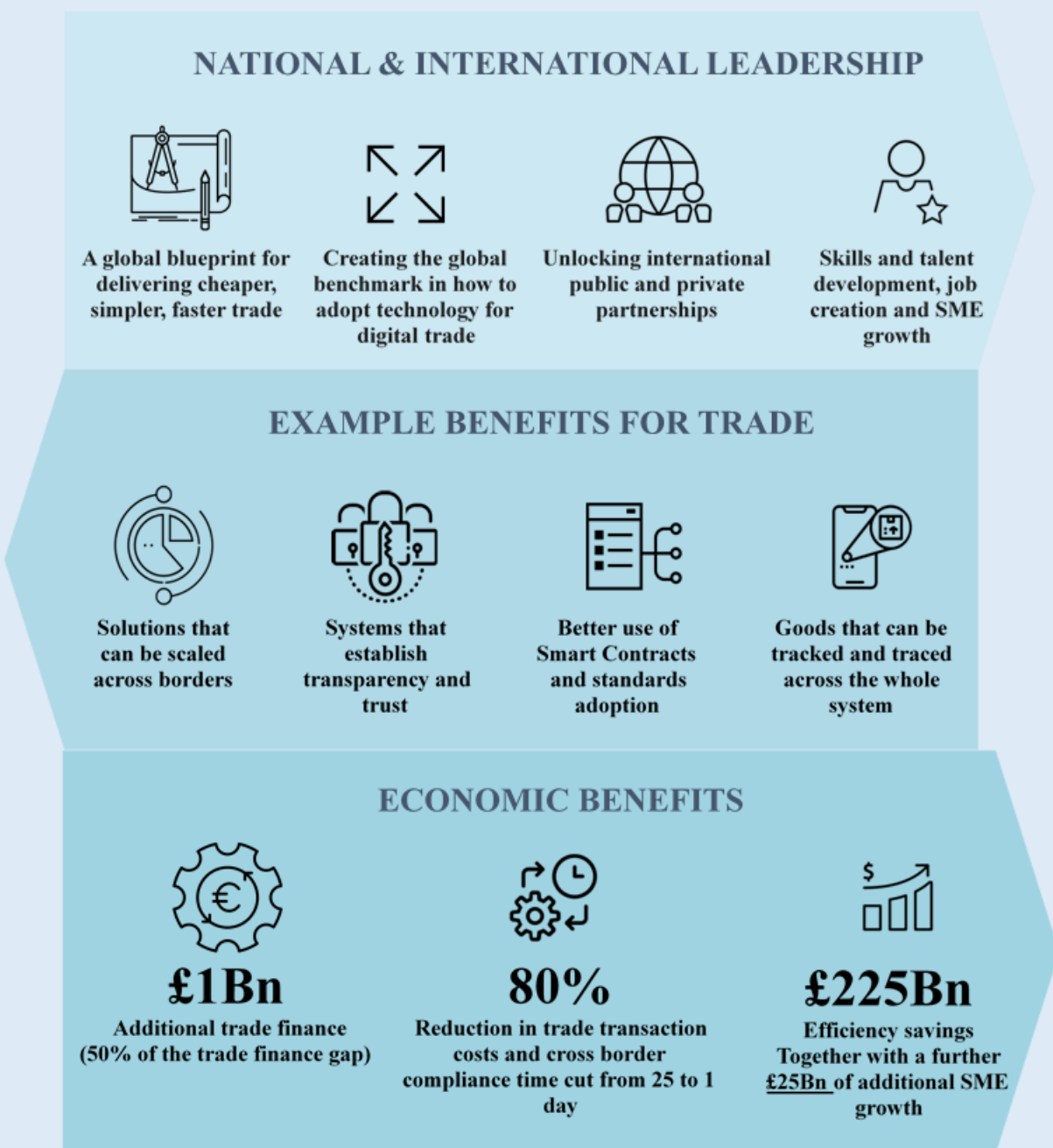
The Opportunity: Current State vs Target State

NATIONAL & INTERNATIONAL LEADERSHIP

A global blueprint for delivering cheaper, simpler, faster trade

Creating the global benchmark in how to adopt technology for digital trade

Unlocking international public and private partnerships

Skills and talent development, job creation and SME growth

EXAMPLE BENEFITS FOR TRADE

Solutions that can be scaled across borders

Systems that establish transparency and trust

Better use of Smart Contracts and standards adoption

Goods that can be tracked and traced across the whole system

ECONOMIC BENEFITS

£1Bn
Additional trade finance (50% of the trade finance gap)

80%
Reduction in trade transaction costs and cross border compliance time cut from 25 to 1 day

£225Bn
Efficiency savings Together with a further £25Bn of additional SME growth

Figure 5.1: Issues to be addressed in the UK's digital trade agenda and framework

There are four key issues present in the UK's current digital trade framework that need addressing in order for the opportunities described in the schema above (Figure 5.1) to be delivered. These focus on the current reliance of paper-based processes, limited access to finance, regulations slowing down the process and the lack of standards that would allow more seamless collaboration.

A comparison of the current state and the target state is described below in Figure 5.2, with a high-level summary of the actions required (taken from (ICC, 2022[18]).
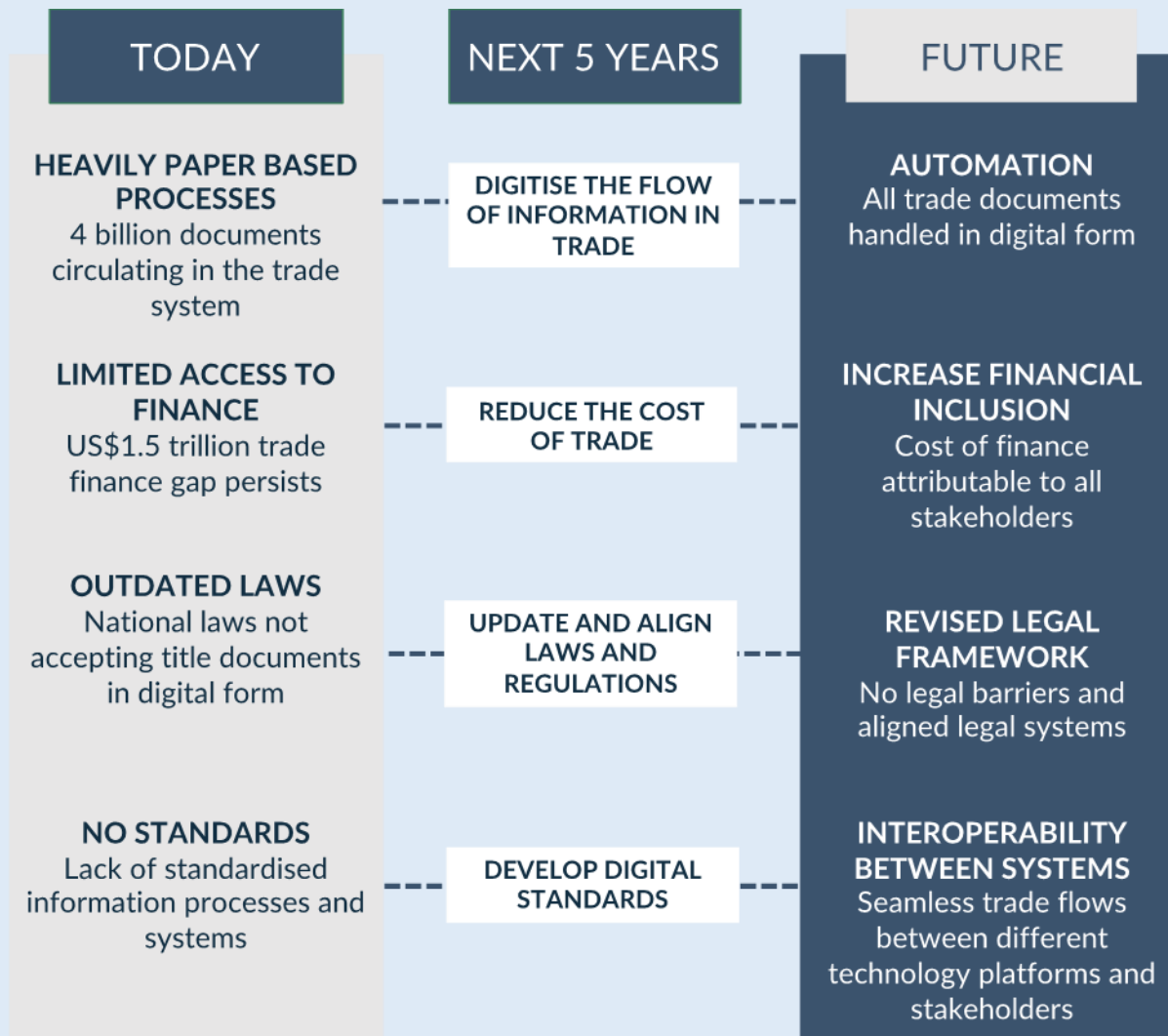
TODAY	NEXT 5 YEARS	FUTURE
HEAVILY PAPER BASED PROCESSES 4 billion documents circulating in the trade system	DIGITISE THE FLOW OF INFORMATION IN TRADE	**AUTOMATION** All trade documents handled in digital form
LIMITED ACCESS TO FINANCE US$1.5 trillion trade finance gap persists	REDUCE THE COST OF TRADE	**INCREASE FINANCIAL INCLUSION** Cost of finance attributable to all stakeholders
OUTDATED LAWS National laws not accepting title documents in digital form	UPDATE AND ALIGN LAWS AND REGULATIONS	**REVISED LEGAL FRAMEWORK** No legal barriers and aligned legal systems
NO STANDARDS Lack of standardised information processes and systems	DEVELOP DIGITAL STANDARDS	**INTEROPERABILITY BETWEEN SYSTEMS** Seamless trade flows between different technology platforms and stakeholders

Figure 5.2: Actions required to move from current state (left) to future desired state (right)

Relevant Trends and Recommended Focus Areas

Globally there is a clear trend towards the digitisation of trade and ensuring logistics are as frictionless as possible. This is largely driven by advances in technology, the acceleration of existing digital transformation process as a result of COVID-19, and the push towards increased efficiency as a result of global net-zero goals. These trends can be used to inform where HMRC should focus technical efforts with regards to the four previously identified workstreams: digitising the flow of information in trade; reducing the cost of trade; updating and aligning laws and regulations; and developing digital standards. Further details are given in the series of tables below.

Digitise the Flow of Information in Trade

Relevant Trends

AI/machine learning

Advances in AI/ML techniques have meant that the large amounts of data captured and at our disposal can be analysed autonomously. One of the key developments has been the contextualising of data by AI to support the decision-making of human operators.

Cloud computing

Increasingly, organisations are shifting from on-premise data storage solutions to cloud computing, which confers several advantages, enabling collaboration across geographies and providing a more easily scalable solution.

Distributed ledger technology

Aside from all the hype surrounding blockchain, DLT has proven to have several real-life use cases, particularly in the logistics sector. DLT can increase transparency and trust across partners and thereby allow for more efficient and automated process handover.

Recommendations

- Develop a sustainable flow for data capture, process, storage and multiparty use.
- Digitise existing records.
- Develop initial challenges for AI/ML, cloud-computing products and intermittent connectivity.

Barriers and Considerations

- Regulation around data processing/storage and interoperability can be cumbersome.
- Upskilling workforce to address the technical challenges associated with digitisation has a cost.

Reduce the Cost of Trade

Relevant Trends
Growing finance gap SMEs have seen large increase in rejected funding applications since COVID-19. This trend particularly affected SMEs led by women, who have seen 70 per cent of their applications being rejected in some capacity.
Limited investment flow Ninety per cent of trade finance is provided by just 13 banks, who therefore control the flow of investment in trade. This results in a concentrated investing landscape that is under minimal pressure to provide competitive rates to its customers.
Increased KYC requirements Ever-changing geopolitical challenges has resulted in greater compliance and know your customer (KYC) requirements. Unnecessarily slow or burdensome KYC requirements disproportionately affect SMEs seeking funding.

Recommendations
• Develop government-backed lending schemes for SMEs with a focus on under-represented groups. • Speed up the funding process while maintaining confidence in the process. • Conduct gap analysis and mapping of current KYC processes.

Barriers and Considerations
• Incumbent banks may be unhappy with the decentralisation of financial support. • Burdensome regulations can make gaining investment for SMEs harder. • Currently there is an over reliance on paper-based processes for KYC.

Update and Align Laws and Regulations

Relevant Trends

Public policy and border strategy

The UK's post-Brexit and 'levelling up' strategies have created an opportunity for the government to update its trade regulations, border strategy and single trade window to decrease the trade finance gap and build collaboration across the globe.

Shift to DI

Several countries have created their own forms of DI to allow digital access to key legal, citizen and government services. Regulations need to support this shift to help streamline traditionally slow tasks.

Agile approach to regulatory reform in freeports

Globally, freeports are being used by governments to take a new approach to regulatory changes. This is achieved by embracing agile ways of working to test and iterate new legislation.

Recommendations

- Continue to build free trade agreements, utilising freeports as possible trial sites.
- Develop regulations around the existence of digital identity and its use.
- Leverage freeport ecosystem to test legislation before scaling to wider areas.

Barriers and Considerations

- Free trade agreements are traditionally complex and involve many different governmental elements.
- Must ensure compliance with data protection regulations when creating digital identities.
- Cultural change will be required to adopt an agile regulatory approach.

Develop Digital Standards

Relevant Trends

Increase in bad actors and trade-related crime

In 2021, there was a reported approximately 20-fold[109] year-on-year increase in ransomware attacks worldwide. Likewise, the rise of global trade has meant it is harder to monitor the origin of transactions/funds. As such, there has been an increase in TBML with an estimated hundreds of billions of US dollars being processed each year. There is a clear need to improve resilience and response among UK organisations to both of the above challenges.

Increase in startups/SMEs in the sector

More and more businesses are becoming digitally native. Having a digital framework would provide SMEs with clear steps for securing their businesses and help them become on par with established firms.

Increase in APIs and desire for interoperability

APIs are now key components of any software built today. Their existence (particularly open APIs) has accelerated collaboration and improved interoperability across products. Increasing interoperability will result in improved efficiency of various processes, thereby, reducing cycle time, improving tax collection and enabling technological process across multiple industries.

Recommendations

- Bring together stakeholders from across sectors to align on a digital frameworks.
- Approach innovation with a 'secure by design' methodology.
- Encourage the use of open APIs across the innovation ecosystem.

Barriers and Considerations

- Most SMEs do not have a formal plan to deal with cyberattacks, there will be a need to support/up skill SMEs appropriately.
- Legacy systems/architecture may make interoperability difficult.

Potential Case Studies

Free Zones as Innovation Ecosystems

To accelerate innovation, governments around the world have been leveraging their free zones to encourage development of cutting-edge technologies.

One such example, is Shenzhen in China. Through reduced income tax, simplified processes for establishing businesses, and tax cuts for R&D investment, Shenzhen has been able to attract both foreign expertise, investment and local talent in the high-tech sector. Likewise, Shenzhen has used its strategic location (proximity to a major shipping hub and the international access Hong Kong provides) as a force multiplier for its free zone.

Shenzhen was designated a special economic zone in 1979 and since then its exports have grown from $9.3m to $244bn[110] (approximately a 26,000-fold increase).

Distributed Ledger Technology

Many countries are seeking to use DLT in a variety of applications. It gives organisations the opportunity to reduce errors, increase efficiency and increase trust. However, many of these applications are critical to national infrastructure. It is, therefore, the responsibility of government to ensure there is an open marketplace that promotes innovation while defining appropriate standards and creating protection for users.

Figure 5.3 below is a summary of the discrete distributed systems initiatives that are underway across the globe. This diagram clearly illustrates that there is a global push to implement DLT and to remain globally competitive the UK must develop a DLT innovation programme of it its own.
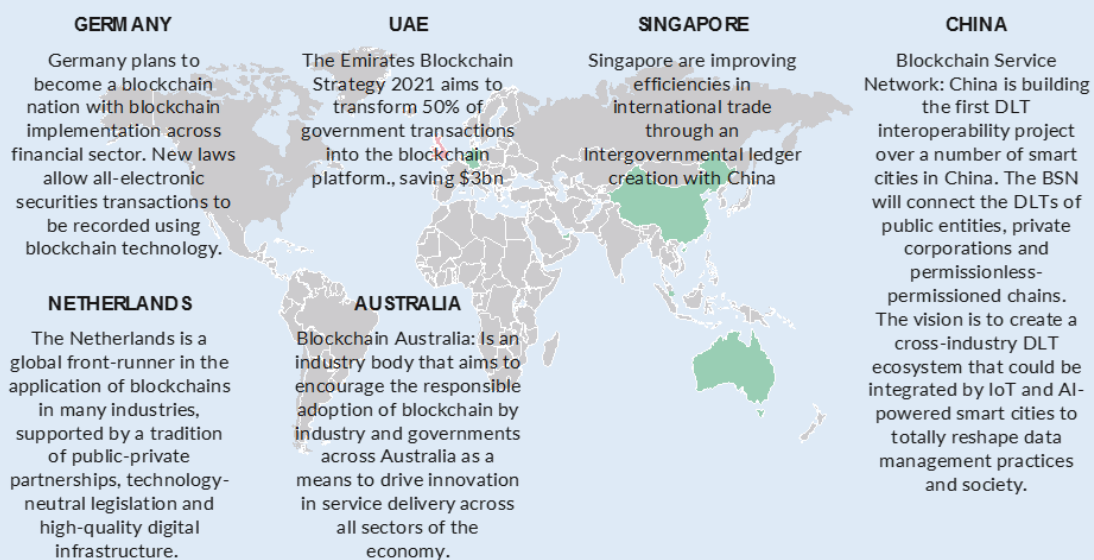

GERMANY
Germany plans to become a blockchain nation with blockchain implementation across financial sector. New laws allow all-electronic securities transactions to be recorded using blockchain technology.

UAE
The Emirates Blockchain Strategy 2021 aims to transform 50% of government transactions into the blockchain platform., saving $3bn

SINGAPORE
Singapore are improving efficiencies in international trade through an Intergovernmental ledger creation with China

CHINA
Blockchain Service Network: China is building the first DLT interoperability project over a number of smart cities in China. The BSN will connect the DLTs of public entities, private corporations and permissionless-permissioned chains. The vision is to create a cross-industry DLT ecosystem that could be integrated by IoT and AI-powered smart cities to totally reshape data management practices and society.

NETHERLANDS
The Netherlands is a global front-runner in the application of blockchains in many industries, supported by a tradition of public-private partnerships, technology-neutral legislation and high-quality digital infrastructure.

AUSTRALIA
Blockchain Australia: Is an industry body that aims to encourage the responsible adoption of blockchain by industry and governments across Australia as a means to drive innovation in service delivery across all sectors of the economy.

Figure 5.3: Worldwide distributed digital systems initiatives (C2021)

Public-Private Partnerships for Innovation and Sustainable Growth

Government-backed Innovation Programmes

The UK government has set the ambitious target of directing 33 per cent of central government procurement to start-ups by the end of 2022. To support with this goal, it has worked with a variety of organisations. This has created significant opportunity for start-ups/SMEs that are working on products that align with government strategy in sectors such as cybersecurity and telecommunications.

By collaborating with companies like Plexal, the UK government has backed initiatives such as LORCA (the London Office for Rapid Cybersecurity Advancement) and 5GTT (the 5G Testbed and Trials Programme).

The LORCA programme was supply and demand led and industry focused. The UK government provided £13m in funding over four years, which gave rise to a self-sustaining globally recognised programme. Likewise, Plexal's work to create public-private partnerships supported the companies in their growth journeys. Across the five cohorts, the start-ups have raised a combined £270m+ in equity, created 865 jobs and generated more than £37m in revenue since joining.

The 5GTT was a £200m investment made by the UK government in the future of wireless infrastructure, with the aim of fostering the development of the 5G ecosystem. It's stated purpose was to build quantifiable business cases for 5G connectivity and to lead the way in R&D investment in 5G technologies. With 5G still very much in its commercial infancy, the long-term benefits of the programme are still yet to be realised, but current estimates suggest that the uplift to the UK economy could be £2.58bn, or £15 for every £1 the UK government invested.

Freeports, though they have existed in the UK since the 1980s, have seen a renewed interest as a mechanism for decarbonisation, innovation and renewable energy projects . As a major policy strand for this administration there is a significant investment of £200m that has been earmarked for projects across the eight freeports announced in the March 2021 Budget. A strong strategy can result in tremendous growth (as demonstrated by the Shenzhen case study described in the previous section).

Commercial Sustainability

In the proposed operating model illustrated above, the assumed funding dynamics are as follows:

- Ecosystem: needs to be seed funded by (public or private) parties who believe in the high-level direction of the movement and want to catalyse it. This will likely be required to be

continued for up to three years, by which time it can then be sustainably funded by a membership fee and/or a commission from other revenue generated activities. It would not be unusual for this activity to be delivered by a not-for-profit entity from day one.

- Policy: there needs to be regular communication between policy makers and industry so that there is a clearer account of what innovative technology can deliver. This activity should complement policy and industry discussions surrounding the future of global trade.

- Innovation: intended to be funded on a project-by-project basis where the innovation consultancies (exclusive or otherwise) bid for work under the over-arching banner of the C4DTI. These projects are likely to be public sector (multi-geography) competitive tenders in the first instance, transitioning to private sector commissions within three years. It would be appropriate that there was a contribution from this income back into the funding for ecosystem and policy.

Summary

The scoping of a potential gap in provision, and what could be used to fill such a gap as has been reported in this section This information – together with knowledge about digital trade and innovation contained in previous sections – will be used to suggest a prototype design for a C4DTI in the next section. Likewise, the above information provides HMRC with an initial 'playbook' of potential activity that feeds into the end-to-end development of an innovation ecosystem (that is technology challenges, operational model transformation, forming of trade partnerships and so on).

Section 6 Prototype Design

Introduction

We have seen from the overview presented in section 1 that the UK stands in a unique position with respect to its regulatory and trade position due to its strengthening of science, technology and innovation sector, newfound regulatory independence, future-facing border and net-zero strategies, new freeports, and the technical strengthening elements of the levelling-up agenda.

It is also clear from the Kalifa review (HM Treasury, 2021[16]) and from the analysis and road mapping of the ICC, that there is a need to: examine and update laws to reflect digitalisation initiatives related to trade; align legal frameworks within the UK (and elsewhere) to support electronic documentation; establish common, interoperable digital standards across the trading system; accelerate the adoption of open systems operating on international digital standards, support governments to update and modernise trade systems and interface; and consider development of a Digital Trade Ecosystem.

Technical analysis (section 2) and international context setting (section 3), in conjunction with stakeholder consultations (section 4) have echoed many of these issues and opportunities.

Clearly action and positive reform are needed. In the medium to longer term, it would be prudent to carry out deeper analysis than has been possible in the context of this scoping report and develop a full Digital Trade Strategy document for discussion. However, in this section, a number of key recommendations for the prototype design of a C4DTI will be outlined. The design of a prototype for digital trade and innovation is suggested to be (initially) physically centred around the Tees Freeport. It will demonstrate the functions and interactions of individual actors, define the governance, membership and funding structures relevant to the network, and establish the appropriate technologies to take forward to a scalable, global model.

The C4DTI initiative offers a unique and timely opportunity to address a range of emerging challenges and to shape the future of digital global trade. It should be noted that a deeper consultation with stakeholders is required. This will be an ongoing iterative process as the prototype design takes shape.

A Digital Trade Alliance

The structure of a scalable digital trade alliance must consider governance at both national levels (government jurisdictions) and organisational levels (for example, ICC, regional government, business/industrial clusters, and others). It also should acknowledge the importance of a peer network for a trusted distributed ledger underpinning the alliance and safeguarding the audit trail of global trade.

The prototype proposed incorporates a principal hub-and-spoke cluster centred around a national presence, and with smaller, secondary hubs-and-spokes, as needed, to demonstrate expected connectivity and peer relationships. One primary and one secondary hub are initially suggested, as depicted in Figure 6.1, for reasons to be discussed in the next sub-section.

Each hub and spoke will be an equal node on the distributed ledger for validation of transactions and the flow of digital trade. The hubs will have a network relationship with their peers for governance, membership and funding purposes. Externally, unrelated parties will be able to view the activity on the ledger and extract publicly available information, and trusted oracles will deliver data (write only) to the network.
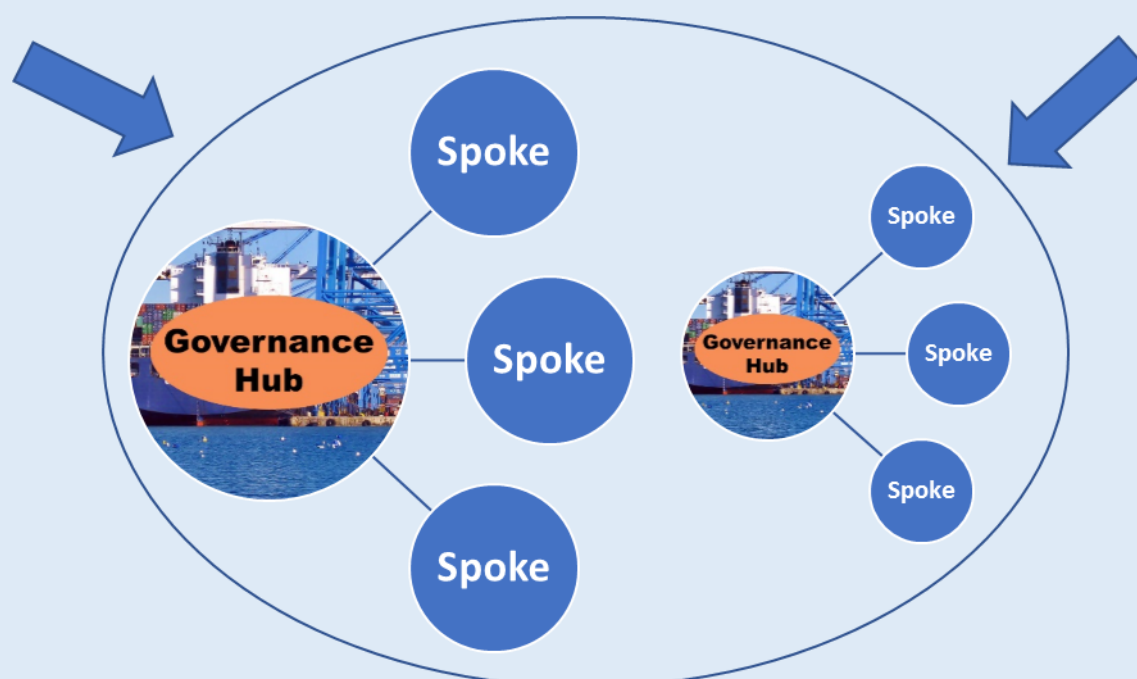
Figure 6.1: Hub/spokes governance model

Physical Presence

It is clear from stakeholder consultations that activities should, initially, be focused on innovation hubs and/or clusters in the main stakeholder groups related to digital trade, including cargo handling and import/export, fintech, banking/finance/insurance, manufacturing, logistics/warehousing, and research/academia. Central and regional government must also be considered when setting focus areas for physical presence.

In terms of cargo handling and import/export, more than 80 per cent of cargo worldwide is transported by ship. As discussed in section 1, as an island nation it is not surprising that approximately 95 per cent of UK international trade is transported via ships and seaports (DfT 2019[9]). Moreover, levels of cargo transported by sea are envisioned to increase two-and-a-half-fold by 2050 (DfT, 2019[9]). In this context, freeports potentially provide fertile ground for

innovation activities, piloting and demonstrating the use of digital technologies in support of UK trade and border activities.

Eight freeports in England were announced in the March 2021 Budget: East Midlands Airport, Felixstowe and Harwich, Humber, Liverpool City Region, Plymouth and South Devon, Solent, Teesside (see image, left), and Thames. The cargo-based Teesside freeport is the largest by surface area, and was also the first to open, beginning operations in November 2021. It is the only freeport to be wholly publicly owned and is located in an area of devolved governance under a single, regional combined authority (Tees Valley Combined Authority, TVCA).

The wider Tees Valley region also has an airport and is a hotbed for innovation related to net zero. Construction recently started on the Net Zero Industrial Innovation Centre[111] (see image, right). The region has also been the focus of 5G trials, both in the freeport and as part of a digital corridor test bed to the airport. Expansions in terms of 5G infrastructure deployment and increased coverage are expected soon.

The area also has excellent 3G/4G coverage and is embracing the digital economy. The Tees Valley is one of a number of key gateways to the wider north-east of England, which has a long history of manufacturing excellence with key industries such as automobile manufacturing (Port of Tyne being the other main gateway).

The North-east's automotive industry provides a useful and far-reaching exemplar for international trade activities related to manufacturing. Highly automated final assembly facilities and warehousing exist for some of the UK's largest automotive manufacturers: a large portion of the target market is the EU. Supply chains for OEM suppliers for raw materials (such as steel, plastics, fabrics, semiconductors), and also essential materials and minerals subject to supply challenges for component manufacture (such as cobalt), also span multiple continents.

Existing rules related to customs and border controls, in addition to planned incoming rules related to Rules-of-Origin clauses in the UK/EU Trade and Cooperation Agreement planned for 2026 make for interesting applications of digital technology related to trade. In the context of net zero efforts, much of the trade focus post-2026 will be upon electric vehicle (EV) export. The importance of battery manufacturing to the North-east's automotive industry is illustrated by the 2021 announcement of two Gigafactories in the area. Also the area has recently seen the

establishment of the first devolved office of the Faraday Institution outside of London to support battery manufacture[112], closely followed by the creation of the North East Battery Alliance (NEBA), which includes the Faraday Institution, the Centre for Process Industries (CPI), all five of the region's universities, and key industrials.

The universities of Teesside, Durham, Sunderland, Northumbria and Newcastle all are research active in areas related to engineering/technology, digitalisation, net zero and international business studies and trade. Teesside University is a modern, future-facing, digital and vibrant institution located in Middlesbrough, some two miles from Tees Freeport. It has a close working relationship both with the combined authority (TVCA) and with the freeport itself. The university is currently engaged in multiple innovation projects related to this scoping exercise; including funded projects to integrate cargo handing control and planning systems with industrial energy control and management systems and to produce a live digital twin of the PD Teesport site[113].

The fintech presence in the UK, on the other hand, is distributed quite sporadically, featuring a 'superhub' concentrated in Greater London/City of London but with other established and emerging clusters of note, including the Glasgow/Edinburgh corridor in Scotland and the Durham/Newcastle cluster and wider North-east of England respectively (HM Treasury, 2021[16]). Historically, much of the finance, banking and insurance presence in the UK is also concentrated in the City of London area, along with central government and key customs and trade-related departments such as HMRC and DIT. The ICC UK also has its headquarters in London.

Recent devolution of HM Treasury and Trade sub-departments to the North-east in Darlington does, however, provide unique potential in terms of devolved governance and links between London and Tees Valley, which is located centrally on mainland UK (see Figure 6.2). There is strong regional government support for digital trade and deployments of digital trade technologies in Tees Valley (Zangrandano & Chubb, 2021[114]), with specific focus on maritime trade. As such, there is a clear opportunity for additional links to be forged between Tees Valley and London, through HMRC regional involvement in testing of technology-driven international customs and other fiscal processes in the real-world setting of Tees Freeport.

These observations indicate that a combined physical presence for a C4DTI in both the City of London and the Tees Valley would be one way (of several) to neatly bring together the key required stakeholder groups in trade/finance/governance, actors and research/innovation hubs/clusters to focus on digital trade.
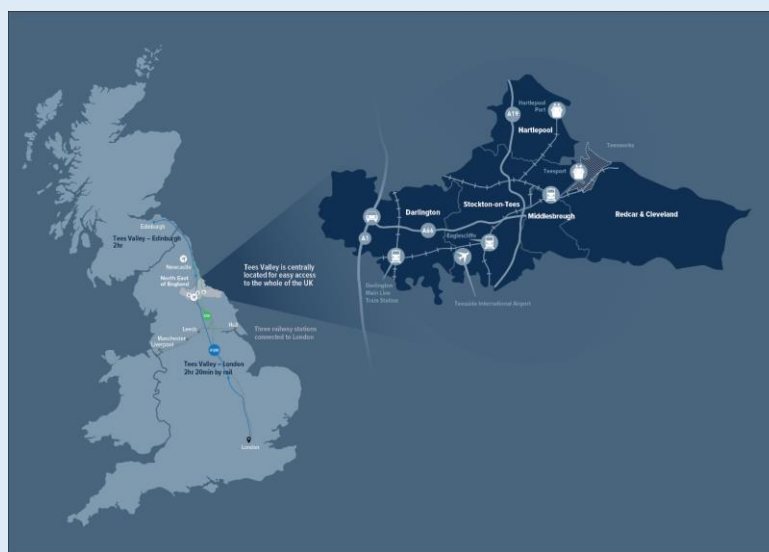
Figure 6.2: Central location of Tees Valley in the wider UK

Virtual Presence

The digital infrastructure for digital trade and innovation must be ambitious and resilient, a solution that others will aspire to use. It should accommodate existing national digital trade systems as oracles contributing to the full ledger, minimising disruption and maximising adoption. The prototype will seek to establish the most appropriate choices of technology, taking into account available development frameworks, security, ease of use, and reliability. It will incorporate elements of the following:

(i)   AI and machine learning to streamline and automate processes and deliver insights and trends based on the growing data corpora

(ii)   Blockchain to inspire trust, deliver transparency and enable the operation of smart contracts on a distributed ledger

(iii)   The IoT and well-chosen oracles to deliver reliable and trusted data to the ledger

(iv)   Digital identity, both for access to appropriate functions according to role and to add depth to metadata related to supply chain movements.

Establishing data structures is an essential part of the prototype stage. This will examine the use of digital identity (using Legal Entity Identifiers at this stage) and consider the different data points exposed by recording touchpoints in the movement of goods and using smart contracts to automate acceptance checks and payments.

The prototype will also consider the different stakeholders who may use publicly available information, including (but not limited to) insurers, providers of trade finance, HMRC and ONS.

Governance, Membership and Funding

Stakeholders across government, academia and industry will need to work closely together to successfully deliver on the above challenge. As such, there is a need to align on roles, responsibilities, and a clearly defined governance structure.

There will be five key roles that stakeholders might play within the context of this programme. They could be:

- problem solvers
- enablers
- convenors
- motivators
- integrators.

The definition of these roles and the indicative view of which stakeholders may fulfil those roles is shown in Figure 6.3.
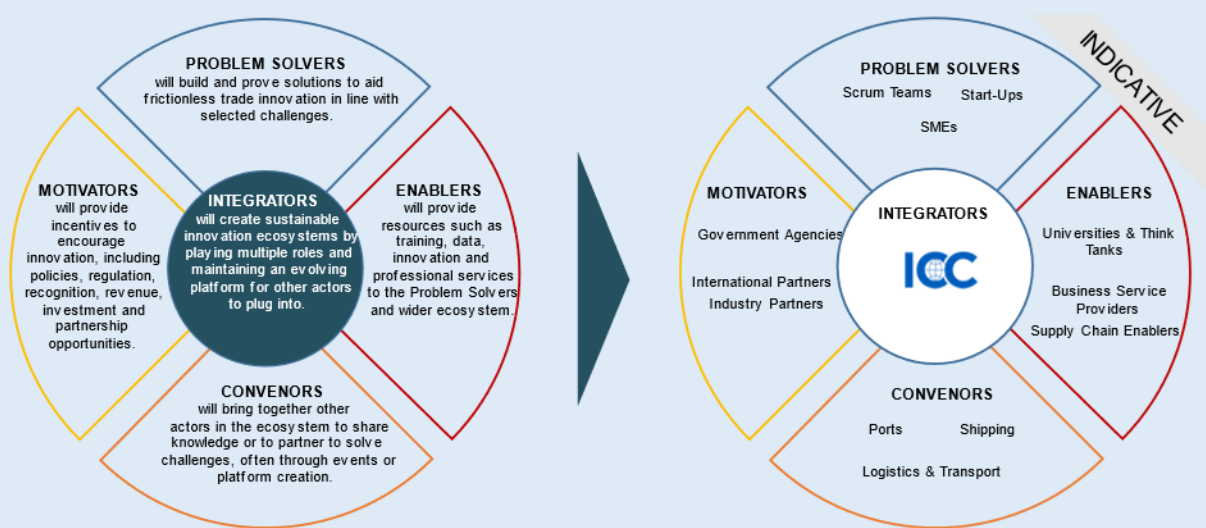
Figure 6.3: Stakeholder roles

As has been described in section five, an industry-led and government-backed approach ensures that any technology that is developed focuses on addressing key challenges in the sector. This means that promising start-ups/SMEs are able to partner with larger corporations to gain significant technical/operational support to accelerate their growth. In addition, industry can rely on government support for engaging these innovative companies. As such, the proposed operating model for the C4DTI challenge has been divided into three workstreams.

(i) **Ecosystem development**: Understanding the current state of the sector, capability gaps and providing the overall governance function for a C4DTI.

(ii) **Policy refinement**: Working closely with all workstreams to understand key policy blockers to leverage free ports as a testbed for regulations. In addition, this team will support innovation stakeholders by lobbying for policy change and evaluating the success of any changes for potential rollout beyond free trade zones.

(iii) **Driving innovation**: Working with start-ups and SMEs to support their development, focusing their efforts on relevant challenges, and facilitating partnerships, where appropriate, with larger corporations.

Figure 6.4 shows a high-level overview of the components that make up each workstream. Each workstream will contribute to driving innovation and funding. For the ecosystem and policy workstreams, funding is provided by partners and project specific requests. In the case of the innovation workstream, funding is obtained through a case-by-case basis for innovation projects. In addition, the stakeholders leading this stream will contribute 20 per cent of any funding received back into the 'core' funding pot.
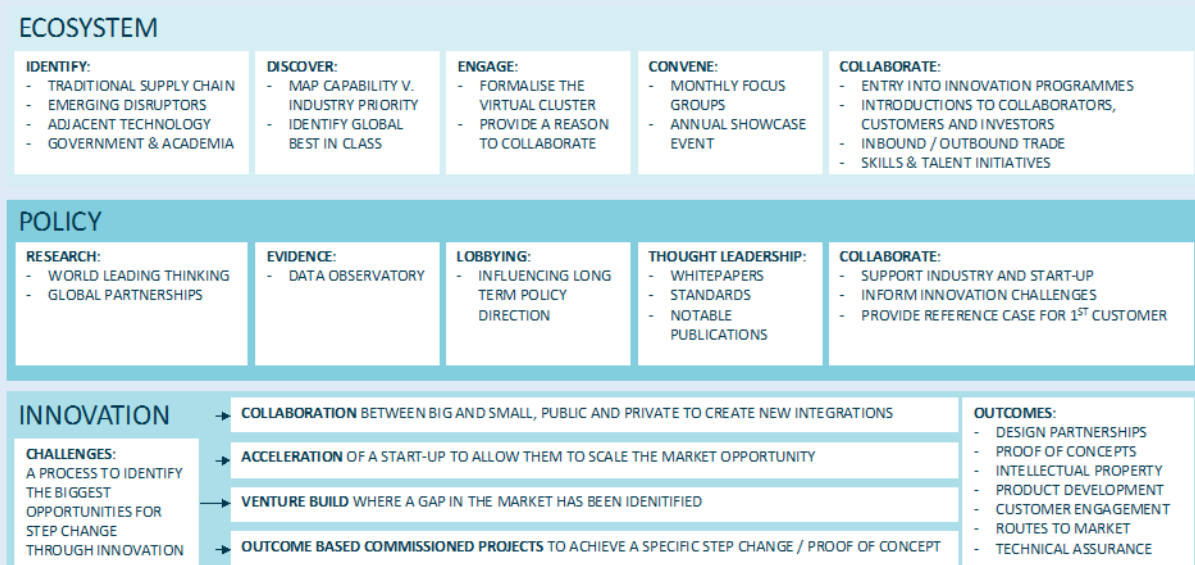

Figure 6.4: Ecosystem workstream components

Innovation

To maximise the probability of success when innovating, having a well-defined use case is key. This helps innovators focus their efforts and ensures that the output is applicable to existing challenges. Likewise, experience has shown that facilitating partnerships between industry, government and start-ups/SMEs provides innovators with a wide range of tools and expertise to support product development.

As such, each programme must begin with research into emerging themes across the sector, combining that with government strategy and industry challenges. This enables the bringing

together of cross-sector stakeholders to co-create an impactful challenge that addresses existing pain points.

Once the challenge is defined, the market is engaged to 'discover' leading start-ups/SMEs and assess them based on pre-defined criteria with the stakeholder group. Once a successful start-up/SME is chosen, government and industry support the acceleration of this company before adopting the solution and helping them scale beyond the engagement.

This approach has helped previous Plexal clients such as IBM, DCMS, FCDO and AWS identify leading SME/start-up partners to address key challenges for their end customers. The diagram below is a high-level summary of our innovation approach.
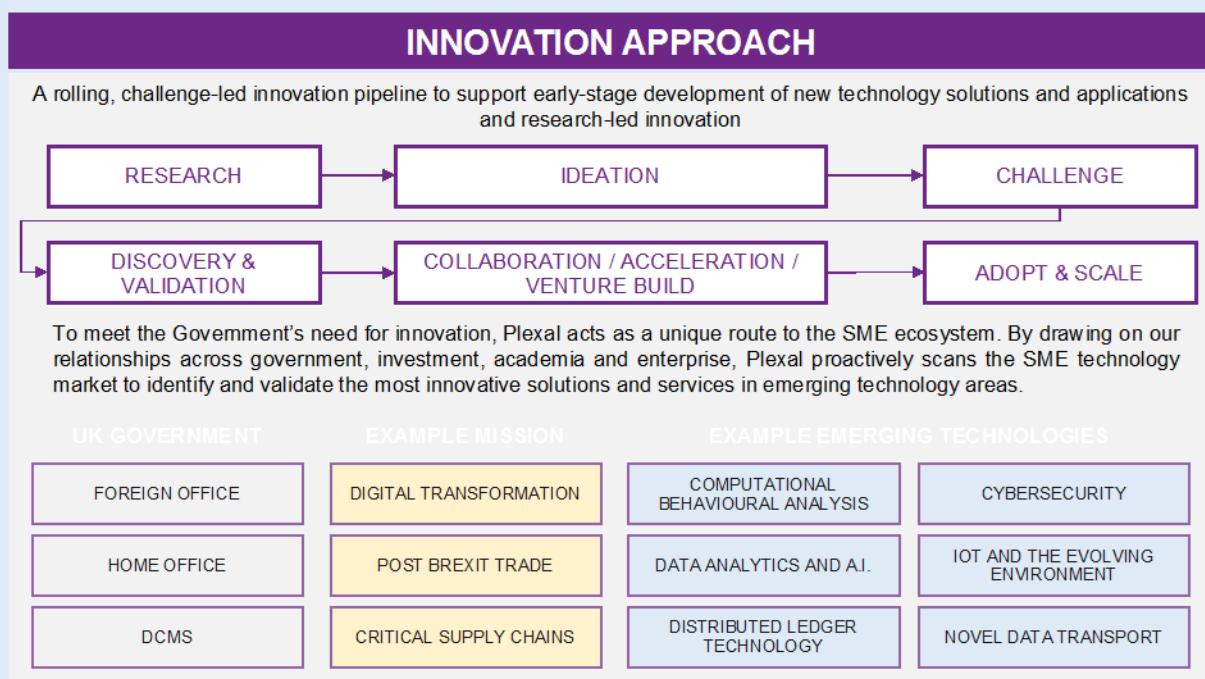
Figure 6.5: Innovation approach

Suggested Pilots

A series of pilots have been discussed with a series of stakeholders that are intended to:

  (i)   test the proposed methodology
  (ii)   drive stakeholder engagement to the intent of the centre
  (iii) prove out a longer-term business case that is fundable by public and private stakeholders.

The specific pilots considered to date for consideration in Tees Valley/North-east context are:

  (i)   Customs compliance using real-time provenance data for all supply chain stakeholders: The use of a cross-industry open-source data platform

(ii) Interoperability: Developing/upgrading the relevant systems and tools to simplify collaboration across operators, as well as agreeing on data governance and standards

(iii) Securing critical supply of minerals and elements subject to supply challenges: Ensuring critical supply chains are robust and secure, using technology for security and status monitoring, material and assembly tracking

(iv) Strengthening cross-border trade partnerships through frictionless port to port capability: harness this work to create a bi-lateral collaboration pilot between the UK and a third party port, perhaps stimulated by a free trade agreement

(v) Enabling cross-sector use of smart contracts: trialling the use of smart contracts focused on lowering barriers to trade for SMEs

(vi) Intra-freeport movement tracking/provenance: testing policy intent when a product is moved from one freeport area (say an airport) to another (say a seaport) while transiting non-freeport zones

(vii) Rules of origin: understanding the traceability aspects of the rules of origin legislation embedded in free trade agreements, required to drive the ambition of frictionless trade.

In particular, pilots one, two, four and seven are directly relevant to multiple sectors, including the Northeast Automotive manufacturing sectors, with pilots three relevant to procurement of materials for battery manufacture for EVs, seven being related to onwards sales of EVs in compliance with the UK-EU TCA, and two/three to enable frictionless movement of component parts between the UK and EU (e.g. application of engineering services such as electroplating of exhausts in Germany after forming from steel in UK).

Pilots one, two and four through six could be linked to an initiative such as the Gateway2Britain activities as described in section 2. Pilot six could provide a link to activities focused upon development of a digital corridor using 5G technology, for example to move goods without friction between Tees Freeport and Tees Airport. Alternatively, it could be linked to movement of goods into designated customs zones in other areas, for example in. warehousing/distribution facilities recently opened in Darlington.

All suggested pilots require co-ordination between multiple private/public sector stakeholders, including business/industry, academia, regional and central government. Key to successful deployment will be interworking on the STW and UTP components of the UK Border strategy as discussed in section 1 (Cabinet Office, 2020[7]), with the main actors from business/industry involved in the pilots, with support from academia. For reasons discussed in section 1, HMRC will be the lead actor from central government due to the close links to customs and taxation administration. The suggested pilots will provide opportunities for innovating, testing and validating solutions which provide the required integration of government and industry/business ICT systems in ways which have immediate benefits for UK digital trade activities.

Summary

Based upon the analysis of previous sections and the suggested gap in offerings, this section has discussed an initial prototype design for a C4DTI. The initiative, as suggested here, potentially offers a unique and timely opportunity to address a range of emerging challenges and to shape the future of frictionless digital global trade.

Deeper consultations with stakeholders are required, as development of the C4DTI and wider digital trade development in the UK will be an ongoing, iterative process that will see movement beyond a prototype design. This will involve development of a full TradeTech strategy, related full-scale (c.f. pilot) technology integration and deployment, and emergence of organic governance structures. Clearly, multiple actors from both public and private sectors (principally HMRC from public sector government) are required to come together and initiate action to begin to deliver the descried roadmap.

Section 7 Closing Remarks

The UK has made firm commitments to regulatory reform and to strengthen science, technology, and innovation, aligning these with industry and societal goals. Given the UK's ambition to achieve the world's most resilient and future-facing border by 2025, and with supporting infrastructure and policy in progress, there is an opportunity to maximise the use of digital trade to support current and new trade deals.

Trade is integral to the UK economy and although many government departments play a direct or indirect role in domestic and international trade, the role of taxation and customs is critical. HMRC will be the principal actor within government with respect to trade (and hence digital trade) and border-related activities involving transfer of value. There is a need for HMRC to evolve as an organisation central to the UK's national resilience and crisis response, and to take a leading role on technology innovation, digitalisation and the government's trade strategy/policy.

This report has presented the results of an initial scoping study investigating barriers and opportunities related to the use of digital technology in support of trade activities. It's content covers the UK policy context, digital trade technology, international comparators, and presents summaries of stakeholder consultations. An initial analysis of barriers related to digital trade has also led to the suggestion of several focused, short-term actions which can be taken to begin to leverage opportunities as part of wider, ongoing consultation and road mapping activities.

The potentially significant opportunities are to be leveraged through digitalisation and interoperability of trade-related ICT systems, including integration of customs and tax administration systems with a wider stakeholder network of business and industrial actors facilitating trade activities. As such, the suggested actions include development of an inclusive ecosystem to facilitate stakeholder communication and co-ordination, harmonisation of standards, creation of an innovation environment to catalyse public-private partnerships and selected use cases for innovative pilot trade technology deployments, and having HMRC take a lead on digitalisation of trade activities within government and progress the STW and UTP platforms.

The creation of hub-and-spoke models to initiate a physical presence for a C4DTI in both the Tees Valley region and in London is recommended. The C4DTI will provide focus for the suggested initial activities. The centre – if put in place – will quickly begin to steer UK digital trade policy and practice along the correct trajectory to achieving the UK's ambitious border goals, as part of a wider-ongoing stakeholder consultation and development of a wide-ranging digital trade strategy.

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