Data Sharing in Digital Trade

Contents

Acronyms

ADB	Asian Development Bank
APEC	Asia-Pacific Economic Cooperation
API	Application Programming Interface
APPI	Act on the Protection of Personal Information
ASEAN	Association of Southeast Asian Nations
AU-SG DEA	Australia-Singapore Digital Economy Agreement
CASL	Canada's Anti-Spam Law
CBPR	Cross-Border Privacy Rules
CCTV	closed-circuit television
C-ITS	Cooperative Intelligent Transport System
COVID-19	coronavirus disease
CPTPP	Comprehensive and Progressive Trans-Pacific Partnership
CSV	comma-separated values
DEPA	Digital Economy Partnership Agreement
DOTC	Philippine Department of Transportation and Communications
DPWH	Department of Public Works and Highways
FDA	U.S. Food and Drug Administration
FTAs	free trade agreements
GDP	gross domestic product
GLOPID-R	Global Research Collaboration for Infectious Disease Preparedness and Response
GPS	Global Positioning System
HSL	Helsinki Public Transportation Authority
IATA	International Air Transport Association
ICA	Immigration and Checkpoint Authority
ICT	information and communications technology
IoT	Internet of Things
JR East	East Japan Railway Company
MaaS	Mobility-as-a-Service
MCCs	ASEAN Model Contractual Clauses
MMDA	Metro Manila Development Authority
MNO	Mobile Network Operators
MOH	Ministry of Health
NATS	North American Transportation Statistics
OECD	Organisation for Economic Co-operation and Development
PDF	portable document format
PDPA	Personal Data Protection Act
PIPA	Personal Information Protection Act
PPE	Personal protective equipment
PRP	Privacy Recognition for Processors
PSCN	Pandemic Supply Chain Network
RCEP	Regional Comprehensive Economic Partnership
STAN	Singapore Tourism Analytics Network
TAT	Tourism Authority of Thailand
TCT	Tourism Council of Thailand
TIH	Tourism Information & Services Hub
UKSDEA	UK-Singapore Digital Economy Agreement
UNICEF	United Nations Children's Fund

UNWTO	World Tourism Organization of the United Nations
WEF	World Economic Forum
WFP	World Food Program
WHO	World Health Organization
WTO	World Trade Organization

Executive Summary

Data consists of structured, and unstructured pieces of information generated and transmitted by people, devices, and organizations. Insights derived from data analysis can be a valuable tool to inform policy formulation by governments and decision-making in businesses and organizations.

The spread of coronavirus disease (COVID-19) has accelerated digitalization and the use of data as governments seek to better understand the impact of the pandemic on its people and businesses to support safe and sustainable economic recovery. Beyond common applications of data sharing in healthcare and research, data can be applied across all business sectors to improve decision-making, deepen customer relationship, reduce costs, and driving new product innovation.

Digitalization has also fostered introduction of technologies such as blockchain and cloud that can better facilitate multimodal exchange of data under more secured modes of transmission. Despite the value and potential of data that can be employed by the public and private sector, the widespread adoption of new technologies for data sharing is often hampered by concerns on technical and capacity issues, personal data privacy, cybersecurity issues and the extent to which data can be shared.

Cybercrimes and data breaches could also pose a security threat to individuals and organizations that may lack information and communications technology (ICT) skills and infrastructure to provide adequate protection to important data. Data sharing across jurisdictions is sometimes subject to localization laws that confine data storage or processing to local territories. Data collection, storage and manipulation also requires advanced technology and specialized skills, as well as strong data legislations and institutional frameworks, which may be lacking in several economies.

While recognizing value creation that is enabled by data sharing and utilization, the challenges and pitfalls to data sharing must be attended to for effective implementation of data sharing and open government initiatives. The paper provides the following policy recommendations to build awareness on the shared value of data, help bolster data interoperability and responsible data management. These are to:

1. Build awareness on value creation through data sharing/utilization
2. Encourage cross-sector collaboration between public, private and civil society to better identify useful data and opportunities for data exchange and innovation
3. Embrace data as infrastructure
4. Adopt data stewardship
5. Improve the capacity of stakeholders in applications of shared data

Beginning with improving the awareness and understanding of the importance of data sharing and utilization by the public and private sector, the policy recommendations provide a holistic approach to help economies head towards a common direction by addressing key bottlenecks to forging an enabling environment for public-private partnerships, and regional and global cooperation. It facilitates cooperation with local and regional partners to improve data sharing practices and data regulatory regimes and encourage governments to build and secure a stronghold of skilled expertise that can be critical resources in the digital age.

1. Introduction

Data is highly important in both economic and social fronts. It enables digital trade for businesses and consumers and allows governments to leverage data analytics in the formulation of policies. Data can be used in many aspects of business processes – decision-making, production, transaction and relationship management. It underpins digital services trade including new services supply models delivered through cloud computing, the Internet of Things (IoT), and additive manufacturing. Data is used by governments to inform decision-making across all policy aspects such as defense, public health, transportation, infrastructure, environment and utilities to improve societal welfare. Innovations in analysis of data through big data analytics is helping policymakers find solutions to previously intractable social or public health problems. Increasingly, open government data initiatives have grown in popularity to provide transparency and to encourage greater public-private dialogue.

Despite the enormous potential of advances like big data analytics, data held by individuals or entities may serve little value if there are only a few data points or if information is not processed to generate more insights. By pooling relevant pieces of data together for research and analysis, additional value can be created by generating new insights that support data-driven innovation. Examples of data sharing is evident in public health research, scientific research, and private sector collaboration in emerging technologies such as machine learning and big data analytics. All these have contributed to largely positive outcomes by providing more robust datasets to researchers, scientists, and engineers for analysis.

Data sharing and access also brings significant challenges to both public and private sector stakeholders. These include risks associated with data confidentiality and privacy and other legitimate interests including the commercial interests of businesses and national interests of governments. Such risks and challenges may pose a concern for businesses and public sector agencies and may deter data sharing. Thus, well-established data sharing procedures or policies may be required to build trust, allocate responsibilities, and offer protection to stakeholders to prevent data misuse and data disclosure without consent, particularly for confidential or personal information. With a need to balance data innovation while addressing the risks of data sharing, the onus of developing sound data policies is often assumed by governments.

The digital policy regulatory landscape is rather fragmented and may be less favorable to data sharing practices especially for cross-border transfer of data. In the Asia Pacific, national and regional initiatives have emerged to regulate the digital economy. Many Asia Pacific economies have introduced domestic laws including data protection or privacy laws, cybersecurity laws, and national initiatives to promote standards and ethical use of data. Regional initiatives include Asia-Pacific Economic Cooperation (APEC) and Association of Southeast Asian Nations (ASEAN) that have steered working groups on the digital economy by bringing together Asia Pacific economies to facilitate exchanges in technological innovation and policies, and to bridge digital gaps. However, the rise of data sovereignty and data protectionism have increased the cost of data sharing for both domestic and foreign businesses of which some of the costs are also passed to consumers.

There is a need to strike a balance between the national interests and welfare of citizens and also permit the ease of conduct of business and economic activities that are increasingly reliant on data transfer and data sharing. This paper explores the role of data, information sharing, and open

data in Asia Pacific economies to offer policy recommendations that could enhance data sharing and access to support economic growth and recovery after the COVID-19 pandemic while mitigating risk of data breeches or violations of commercial and national interests.

2. Data in Digital Trade and Its Applications

An estimated 2.5 quintillion bytes of data are created every day of which around 80 to 90 percent of global data are unstructured.[1][2] Unlike structured data which could be easily organized and analyzed, unstructured data e.g., images, videos and text cannot be placed in predefined formats and easily analyzed.

In recent years, advancement in computing and communication technologies has tremendously improved the technical and economic feasibility to harness value from different types of data, allowing more unstructured data which forms that majority of data created to be analyzed through new data analytical techniques such as machine learning. Hence, businesses and governments can utilize new technologies and data analytical techniques to derive useful analysis and uncover new patterns or relationships.

2.1 Types of Data in Digital Trade

Data in statistical terms is the physical representation of information in a manner suitable for communication, interpretation, or processing by human beings or by automatic means whereas information refers to knowledge concerning objects, such as facts, events, things, processes, or ideas, including concepts that within a certain context have a particular meaning.[3]

Digital trade is accompanied by data, whether it is digital content which is data produced and supplied in digital form as a merchandise, raw data that are gathered to generate insights, or meta data that describes a dataset and functions like labels.[4] These data are gathered and utilized in different ways.

Table 1: Examples of How Data from Digital Trade are Used

Data Types in Digital Trade	Applications
Digital content as merchandise	Digital products or services that can be traded and monetized e.g. software, audio recordings
Data to be gathered and analyzed for new insights with various origins, such as personal, industrial, and public	Datasets or data content to be used for further analysis, these can be analyzed by itself or combined with other datasets.

[1] Bernard Marr. "How Much Data Do We Create Every Day? The Mind-Blowing Stats Everyone Should Read," May 21, 2018. https://www.forbes.com/sites/bernardmarr/2018/05/21/how-much-data-do-we-create-every-day-the-mind-blowing-stats-everyone-should-read/?sh=710151fd60ba

[2] Tam Harbert. "Tapping the power of unstructured data," February 1, 2021. https://mitsloan.mit.edu/ideas-made-to-matter/tapping-power-unstructured-data

[3] ISO/IEC 2382-1; 1992 - Economic Commission for Europe of the United Nations (UNECE), "Terminology on Statistical Metadata", Conference of European Statisticians Statistical Standards and Studies, No. 53, Geneva, 2000.

[4] Jenn Riley. "Understanding Metadata What Is Metadata, and What Is It For?" National Information Standards Organization (NISO), 2017. https://groups.niso.org/higherlogic/ws/public/download/17446/Understanding%20Metadata.pdf

Meta-data accompanied with traded goods	Meta data from traded goods could be data explanatory notes, data variables, data source, data estimation method etc. They are used to better understand goods trade datasets and assess the quality of the data.
Meta-data accompanied with people	Meta data from datasets associated with people or users could be the users' attributes, digital activities of the user, the settings/access permissions provided by users etc. These could be linked to the profile data of users and could be used to support user analytics and improve user experience e.g., derive insights on consumer characteristics, browsing or shopping behavior, and provide more personalized content or experience.

Table 1 highlights ways that digital data can be used. Regulating data and information sharing can be further complicated by categorization and when it includes data types that are regarded as personal information or includes intellectual property. Such types of data require regulatory caution as the potential impact of data breech can be consequential. The cross-cutting nature of such data or information may be essential for trade or for promoting innovation which requires thoughtful policy responses.

2.2 Value of Data in Digital Trade and Digital Governance.

Open data can generate significant economic value. McKinsey estimated that open data can create an annual value of 3 trillion in seven areas of the global economy.[5] A review conducted by the OECD suggests that data access and sharing can help generate social and economic benefits worth between 0.1 and 1.5 percent of gross domestic product (GDP) for public sector data, and between 1 and 2.5 percent of GDP if private sector data is also included.[6]

The use of data has largely transformed digital trade or e-commerce. E-commerce platforms leverage data to determine the characteristics of its users and analyze their browsing behavior. Such data help to predict which products and services are in demand. Data or information sharing is sometimes necessary and can be used to help sellers/manufacturers determine production quantities, advise on product development, or enable more dynamic pricing.

Certain types of data, such as contact details of users (name, address, contact number etc.), obtained by e-commerce marketplaces or sellers must be shared with logistics services providers for the delivery of goods. Other data obtained by e-commerce platforms such as sales data may

[5] McKinsey Global Institute. "Open data: Unlocking innovation and performance with liquid information," October 1, 2013. https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/open-data-unlocking-innovation-and-performance-with-liquid-information

[6] OECD. "Enhancing Access to and Sharing of Data : Reconciling Risks and Benefits for Data Re-use across Societies," 2019. https://www.oecd-ilibrary.org/sites/276aaca8-en/1/2/3/index.html?itemId=/content/publication/276aaca8-en&_csp_=a1e9fa54d39998ecc1d83f19b8b0fc34&itemIGO=oecd&itemContentType=book#chapter-d1e5926

be voluntarily shared with consumers or sellers to assist decision making which could improve product development efficiency of firms/sellers.[7]

Cross-platform or interorganizational data sharing helps to fill data gaps and provides opportunities for collaboration to develop new solutions or services/products.[8]

There are several benefits to data sharing including:

i. Promote innovation e.g., product/services development
ii. Increase security e.g., real-time monitoring and detection of crimes and fraudulent activities
iii. Increase competitiveness for small companies with limited research/data collection capabilities
iv. Better user experience[9] e.g., customization for user, pre-filled responses for forms across platforms with shared data
v. Reduce costs or duplication of efforts

Apart from academic research, the use of datasets on a large scale or big data are also increasingly applied by businesses and governments to discover new patterns and insights that help make informed decisions, improve services delivery, and enable new value propositions. Big data is applied by industries including telecommunications, healthcare, manufacturing, travel and tourism.

2.2.1 Big Data Analytics in Telecommunications

The telecommunications sector collects data from its (typically) larger subscriber base and generates large volumes of data through calls, internet usage, transmission of text messages and electronic mails. These data are leveraged for multiple uses through big data analytics. Big data analytics could be used to improve network efficiencies, for troubleshooting network performance issues, in targeted marketing, and to address security issues and cybercrimes.

Globe Telecom in the Philippines, for example, adopted big data analytics to perform customer segmentation and optimize marketing campaigns to increase sales.[10] Big data analytics also allows telecommunication companies to detect and analyze fraud activities in real-time. The partnership between Vodafone and Argyle Data in the use of big data resulted in solutions to detect fraud that could not be detected previously.[11]

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[7] Baozhuang Niu, Jian Dong, Zhipeng Dai, Yaoqi Liu. "Sales data sharing to improve product development efficiency in cross-border e-commerce," Electronic Commerce Research and Applications, Volume 51, 2022, 101112, ISSN 1567-4223. https://doi.org/10.1016/j.elerap.2021.101112.

[8] Barbara H. Wixom, Ina M. Sebastian, And Robert W. Gregory. "Data Sharing 2.0: New Data Sharing, New Value Creation," MIT CISR, 2020. https://cisr.mit.edu/publication/2020_1001_DataSharing_WixomSebastianGregory

[9] https://towardsdatascience.com/4-benefits-you-receive-by-sharing-your-data-to-companies-70ca58e11989s

[10] Cloudera. "Globe Telecom is enhancing customers' mobile experiences, delivering relevant advertising with a modern analytic environment based on Cloudera." https://www.cloudera.com/about/customers/globe-telecom.html

[11] Kelly Hill. "Telco Case Study: Vodafone and Argyle Data on using big data to combat fraud," RCR Wireless News, 2014. https://www.rcrwireless.com/20141014/big-data-analytics/telco-case-study-vodafone-argyle-data-tag6

2.2.2 Open Government Data Initiatives

Governments and government-related agencies and institutions gather large amounts of data from businesses, citizens, and even meteorological and geographical data which could be harnessed for research and other applications. To promote transparency and enable value creation, open data governance initiatives have taken root in many Asia Pacific economies where government agencies are encouraged to make datasets publicly available for download and use.

There are several open data benchmarks or indicators that have been developed to measure or compare governments' progress in open government data initiatives. The Organisation for Economic Co-operation and Development (OECD) Open Government Data project developed an index to assess governments' efforts to implement open data in the three areas - openness, usefulness, and re-usability of government data. Asia Pacific economies including Korea, Japan and Australia have retained good scoring and rankings amongst OECD members.[12] [13] The Open Data Inventory 2020 compiled by Open Data Watch monitors the coverage and openness of official statistics in 187 countries. In the overall score for Asia Pacific economies, Singapore, Hong Kong, Korea, and the Philippines are amongst the better performers.[14]

[12] Korea is ranked first, Japan is ranked fourth and Australia is ranked 6th in the OECD 2019 OURdata Index.

[13] Organisation for Economic Co-operation and Development (OECD). "OECD Open, Useful and Re-usable data (OURdata) Index: 2019. " https://www.oecd.org/governance/digital-government/ourdata-index-policy-paper-2020.pdf

[14] Open Data Watch. "Open Data Inventory." https://odin.opendatawatch.com/Report/regionalProfile

Example: South Korea's Open Government Data Policies

One APEC economy, South Korea, introduced foundational legislation in 2013 to promote open government data policy. Through the "Act on Promotion of the Provision and Use of Public Data," public agencies have been encouraged to provide public data for citizen's access and promote utilization of public data by the private sector. The Act also institutionalized the establishment of a Public Data Strategy Committee to coordinate government policies on public data and its implementation and require each public institution to appoint officers to take responsibilities in overseeing the provision and use of public data and support coordination in public data policies and address quality control issues of public data.[1]

The Act helped to advance a concept that data sharing or data openness should be the default rule while other legislation accords protection to certain types of data including personal information, business confidential information and intellectual property.

Following the enforcement of the "Act on Promotion of the Provision and Use of Public Data", Korea also introduced strategic plans and policies on open government data. Such policies include the Open Data Master Plan (2013-2017) and (2017-2019), National Core Data Release Plan (2015-2017) and (2017-2019) and the Government-wide Data Release Plan (2019-2021).[1]

These policy plans have contributed to the launch of Korea's open data portal,[1] provision of data based on users' demand,[1] better data management and quality control, enabling Korea to emerge as one of the leading countries in global open data rankings.[1]

Despite the value of data sharing, it has been underapplied in both public and private sectors due to various challenges and associated risks. Furthermore, data may not be as easily shareable as it seems; the plethora of data sharing platforms could provide data in different formats that may not be interoperable for use in different applications.

3. Challenges to Data Sharing

Challenges to data sharing could take many forms. They primarily include lack of motivation to share data; risks perceived by businesses, individuals, and government stakeholders; and a lack of data-related skills and competences.

Most businesses are motivated by profit and data held by businesses can be valuable, providing businesses a competitive edge over their competitors. Sharing business data to a third party will need to be paired with incentives or reasons to do so. However, many businesses either do not understand how to unleash the value of data that they hold, or do not wish to disclose data that could benefit their competitors or give away their data for free.

Business could be challenged by their ability to monetize through data. Traditional business models focus on monetizing through sales of goods and services, but new business models have emerged in data and information trade as well as exchange of data without monetary transactions. Contrary to a traditional business model, business executives could find themselves struggling to develop a new business model that allows incentivization based on shared data. Furthermore,

such processes also take time to develop and a switch to a new business model may involve radical changes in resource and capital requirement, inflicting high implementation cost. These implementation challenges often result in stored data that is inadequately utilized by organizations and businesses.

Data sharing also comes with risks of data security, potential data breeches or violations of privacy rights. Businesses also need to be mindful of existing legal and regulatory frameworks that may limit one's ability to freely share data and transfer data across the border.

As cross-border transfer of data is ever more important to facilitate digital trade. It is crucial to examine some of the key bottlenecks to cross-border data sharing. These include the following:[15]

i. **Lack of data-related skills and data management capabilities**
Data will need to be managed, processed, and stored and this may require specialized skills or data infrastructures to handle more complex datasets or to hold large amounts of data.

ii. **Data interoperability**
Data shared by the owner or data controller may need to be interoperable for use by a third party to help ensure that value of data could be harnessed or reused in other applications. This will often require data to be well structured and in machine readable formats.

iii. **Addressing privacy and personal data protection laws**
Data privacy laws and personal data protection laws, while offering added security to personal data of individuals, may sometimes create barriers to data sharing particularly if sharing of such information is necessary to facilitate transactions.

iv. **Mitigate cybersecurity risks and ensure data security**
Hosting of data entails risks of potential cyber-attacks and data theft. There may also be a need to offer protection in the transmission of data to ensure that data cannot be intercepted or, if intercepted, cannot be decrypted or made readable by hackers. It is also common for countries to regulate critical information infrastructures through cybersecurity laws.

v. **Dealing with data sovereignty and data protectionism**
Countries could potentially seek greater control of data sourced from its territories and limit its use and transfer offshore.

vi. **Need to establish responsible mechanism for data and information sharing**
Oftentimes, there could be a lack of clear boundaries as to whether certain data can or should be shared. Thus, there is need for good data sharing mechanism and procedures in place e.g., data sharing agreements, contractual provisions, data sharing guidelines

[15] OECD. "Enhancing Access to and Sharing of Data : Reconciling Risks and Benefits for Data Re-use across Societies," 2019. https://www.oecd-ilibrary.org/sites/15c62f9c-en/index.html?itemId=/content/component/15c62f9c-en

and standard procedures which sets expectations and data protocols to be followed to mitigate the risk of mishandling by data controllers and personnel.

These challenges are common to businesses engaging in cross-border data sharing activities. Some of these challenges could be addressed by employing skilled data personnel to manage datasets, taking security measures to protect data against malicious threats and data thefts, and have proper procedures in place to share data with a third party. However, it is often beyond the means of businesses to address legislation that impedes or prohibits cross-border data transfers.

4. Overview of Data Governance in the APEC region

4.1 Domestic Regulations on Data Governance/ Cross-border Data Flows in Selected APEC Economies

APEC economies have different regulatory approaches and institutional requirements in data governance and the transfer of data. While most APEC economies have more comprehensive legislative frameworks for data protection, there are a few APEC economies that have yet to enact or develop more comprehensive personal data protection and/or cybersecurity laws.

Table 2: Overview of Data Governance Policies in Selected APEC Economies

APEC Economies	Personal data protection/ Privacy law	Cybersecurity law	Data storage and cross-border data transfer policies	Open government data initiative	APEC's CBPR system
Australia	✓	✓		✓	✓
Canada	✓	✓		✓	✓
China	✓	✓	✓	✓	
Indonesia			✓	✓	
Japan	✓	✓		✓	✓
Korea	✓	✓	✓	✓	✓
Malaysia	✓			✓	
Philippines	✓	✓		✓	✓
Singapore	✓	✓		✓	✓
Chinese Taipei	✓	✓	✓	✓	✓
Thailand	✓	✓		✓	
United States				✓	✓

Viet Nam		✓	✓	✓	

As Table 2 shows, most APEC economies have in place sector-wide legislation to regulate and protect data and information and the transfer of these data. There also economies that impose requirements on data storage and cross-border transfer of data such as China, Indonesia, Korea, and Viet Nam where certain data may not be allowed to be transferred freely across the border due to concerns on privacy and national security.

Table 3: Data Protection Legislations in Selected APEC Economies

	Personal data protection/ Privacy law	Cybersecurity law	Data storage and cross-border data transfer policies
Australia	• Privacy Act 1988	• Security of Critical Infrastructure Act 2018 • Telecommunications (Interception and Access) Act 1979	No data localization requirement; cross-border transfer of personal data is regulated by the Privacy Act
Canada	• Digital Privacy Act (2018)[16]	• Canada's Anti-Spam Law (CASL) • Telecommunications Act[17]	No data localization requirement including personal information, but this depends on provincial requirements
China	• Personal Information Protection Law (2021)	• Cybersecurity Law (2016)	• Data Security Law China's Cybersecurity Law and Data Security Law requires personal information and important business data collected and produced by critical information infrastructure operators during their activities within the territory; where due to business requirements it is truly necessary provide it outside the mainland, a security assessment shall be conducted according to the measures jointly formulated

[16] Applies to personal information held by private sector organizations in Canadian provinces excluding Alberta, British Columbia and Québec. These provinces may apply variations of private sector privacy laws.

[17] Canada announced a proposed legislation "Act respecting cyber security" on 14 June 2022 that would amend the Telecommunications Act. See: https://www.parl.ca/DocumentViewer/en/44-1/bill/C-26/first-reading

			by the national cyberspace administration and the relevant departments of the State Council. Transfer of personal information including personal financial information is subjected to the Personal Information Protection Law.
Indonesia	No comprehensive personal data protection law.	No comprehensive cybersecurity law.	Indonesia's Government Regulation 71/2019 limit electronic system administrators of public data to manage, process and retain data in the territory of Indonesia. The financial services sector is also not permitted to store data offshore.
Japan	• Act on the Protection of Personal Information (APPI)	• Basic Cybersecurity Act	There are no data localization requirement across legislations; cross-border transfer of personal data is subjected to the APPI.
Korea	• Personal Information Protection Act (PIPA)	• Act on the Promotion of Information and Communications Network Utilization and Information Protection (2001) • E-government Act (2010) • Act on Informatization of National Defense (2011) • National Intelligence Service Act (2020)	There are data localization requirement for location information and spatial data under the Act on the Protection and Use of Location Information and the Act on the Establishment and Management of Spatial Data; cross-border transfer of personal data is subjected to the PIPA.
Malaysia	• Personal Data Protection Act 2010	No specific law on cybersecurity.	No data localization requirement; cross-border transfer of personal data is subjected to the Personal Data Protection Act.
Philippines	• Data Privacy Act of 2012 (Republic Act No. 10173)	• Cybercrime Prevention Act of 2012 (Republic Act No. 10175)	No data localization requirement; cross-border transfer of personal data is subjected to the Data Privacy Act.

Singapore	• Personal Data Protection Act 2012	• Cybersecurity Act 2018	No data localization requirement; cross-border transfer of personal data is subjected to the Personal Data Protection Act.
Chinese Taipei	• Personal Data Protection Act (2015)	• Cyber Security Management Act (2018)	Cross-border transfer of personal data is regulated by the Personal Data Protection Act; cross-border transfer of personal financial data is subjected to approval by financial regulators; transfer of users' personal data in telecommunications and broadcasting sector to China is prohibited under the order of the National Communications Commission.[18]
Thailand	• Personal Data Protection Act 2019[19]	• Cybersecurity Act 2019	No data localization requirement; cross-border transfer of personal data is subjected to the Personal Data Protection Act.
United States	No comprehensive privacy laws at the federal level; there are several sector specific federal data protection laws.	No comprehensive cybersecurity laws at the federal level.	No data localization requirement; sector-specific regulatory requirements may apply for the transfer of personal data outside of the local jurisdiction.
Viet Nam	No comprehensive personal data protection law.	• Law on Cybersecurity 2018 • Law on Network Information Security	Vietnam's Cybersecurity Law require data controllers or processors to store data about personal information, data about the service users' relationships, and data created by service users in Vietnam for a period specified by the government.

As there are no global rules on data protection in place, many APEC economies have enacted domestic legislation in the past decade to enhance data and information security and protection in the rise of digital trade. Some economies like Indonesia do not have an overarching personal data protection law and cybersecurity law, but there are several regulations in place to address some concerns on data privacy and protection of personal data, including Government Regulation

[18] See https://www.ncc.gov.tw/chinese/news_detail.aspx?site_content_sn=538&sn_f=26302
[19] Thailand's Personal Data Protection Act (PDPA) will be enforced from June 1, 2022.

No. 80/2019 regarding Trade through Electronic Systems, Government Regulation No. 71/2019 the Implementation of Electronic Systems and Transactions and Government Regulation No. 71 of 2019 on Organisation of Electronic Systems and Transactions. Other economies, such as Viet Nam, currently do not have an enforced comprehensive personal data protection law. Viet Nam's Draft Decree on Personal Data Protection is awaiting approval by its National Assembly.

While most APEC economies do not impose data storage or localization policies that prevent the cross-border transfer of data and information, some economies require certain types of data—such as personal information, financial information, or data collected from important information infrastructures—be stored within domestic territories or require approval from designated authorities for necessary information to be transferred offshore. This could result in greater compliance costs for businesses to adhere with the necessary administrative procedures or to locate their data storage within a particular economy.

The data governance landscape in the Asia Pacific is fragmented with different data policies and initiatives. As data becomes more important to trade and governance, it is anticipated that more Asia Pacific economies that have yet to implement similar data protection legislation will also follow suite. In the development of data governance frameworks and legislations, it is also critical to imbue good regulatory and data governance principles to create a more harmonized regulatory environment that facilitates data sharing.

4.2 Regional Policy Landscape on Data Governance

Recognizing the risks of a fragmented regulatory landscape for digital trade, regional bodies have been hard at work. APEC, the OECD and ASEAN, for example, have crafted approaches to better harmonize digital trade rules including cross-border data transfer mechanisms to build trust and facilitate cross-border transfer of data. Some of these regional initiatives are the APEC Privacy Framework; OECD Privacy Guidelines; ASEAN Framework on Personal Data Protection (2016) and the ASEAN Model Contractual Clauses (MCCs) for Cross Border Data Flows. Each is considered in turn.

APEC Privacy Framework, CBPR and PRP System

The APEC Privacy Framework (2015) provides a set of definitions and guiding principles that encourage the development of appropriate information privacy protection mechanism while ensuring the free flow of information in the Asia Pacific region.[20] The Framework was endorsed by APEC economies in 2011 and was adopted in the APEC Cross-Border Privacy Rules (CBPR) system which is a voluntary system that enables organizations to be CBPR certified on nine privacy principles in the APEC Privacy Framework.[21] The APEC CBPR system is recognized by nine APEC economies: Australia, Canada, Japan, the Republic of Korea, Mexico, the Philippines, Singapore, Chinese Taipei and the United States of America.[22]

CBPR is a cooperative mechanism incubated and developed under the APEC framework. Its development and achievements over the years come from the trust and support of APEC member

[20] APEC. "APEC Privacy Framework." https://www.apec.org/docs/default-source/publications/2005/12/apec-privacy-framework/05_ecsg_privacyframewk.pdf?sfvrsn=d3de361d_1
[21] The APEC CBPR is guided by the OECD Privacy Guidelines.
[22] Cross-Border Privacy Rules System. http://cbprs.org/

economies by the principle of consensus building. CBPR cooperates in accordance with APEC rules and principles and within its member economies.

Another system – the Privacy Recognition for Processors (PRP) – was developed to complement the CBPR system by recognizing personal information processors that have implemented privacy policies and practices consistent with the PRP system requirements for all personal information that they process on behalf of data controllers.

As personal data is identified to be an important dataset that is highly regulated across APEC economies, both the CBPR and PRP system help to establish more harmonized data protection standards across APEC economies by facilitating transfer of personal data amongst certified organisations in participating economies.

ASEAN Framework on Personal Data Protection (2016) and ASEAN Model Contractual Clauses (MCCs) for Cross Border Data Flows

The ASEAN Framework on Personal Data Protection was endorsed by ASEAN in 2016. It takes into account the APEC Privacy Framework and the OECD Privacy Guidelines to recommend guidelines for ASEAN member states in the development of domestic laws and regulations on personal data protection.[23] There are seven key principles under the Framework including to address security safeguards, allow individuals to access and correct personal data, and to cease data retention where it is no longer necessary.

The ASEAN Model Contractual Clauses (MCCs) was developed based on the ASEAN Framework on Personal Data Protection for Cross Border Data Flows and provides contractual terms and language that can be inserted into legal agreements between parties transferring personal data across the border.[24] The MCCs are mainly designed to facilitate intra-ASEAN flow of personal data but could also be applied for data transfer to non-ASEAN members states whose legal regimes are in conformity with the APEC Privacy Framework or OECD Privacy Guidelines.

"Digital" Free Trade Agreements

Besides initiatives driven by institutional or governmental organizations, digital trade provisions in free trade agreements (FTAs) or digital-only trade agreements have also started to introduce enforceable binding commitments amongst signatories. Such digital trade provisions can be found in the e-commerce chapter of FTAs or in digital trade agreements that provide specific digital trade obligations and commitments on regulatory cooperation.

Trade agreements and regional agreements that are more comprehensive in scope and coverage also tend to embed digital trade provisions related to cross-border data flow, including commitments to not require location of computing facilities in the territories of a party and provide for personal data protection through legal frameworks. Regional trade agreements containing an e-commerce chapter or data related provisions include the Comprehensive and Progressive Trans-Pacific Partnership (CPTPP) and the Regional Comprehensive Economic Partnership (RCEP).

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[23] ASEAN. "ASEAN Framework on Personal Data Protection," 2016. https://asean.org/wp-content/uploads/2012/05/10-ASEAN-Framework-on-PDP.pdf

[24] ASEAN. "ASEAN Model Contractual Clauses for Cross Border Data Flows," 2021. https://asean.org/wp-content/uploads/3-ASEAN-Model-Contractual-Clauses-for-Cross-Border-Data-Flows_Final.pdf

New digital trade agreements have also been concluded by several APEC economies such as Australia, Korea, Singapore and New Zealand. These agreements include the Digital Economy Partnership Agreement (DEPA)[25] between New Zealand, Chile and Singapore, the Australia-Singapore Digital Economy Agreement (AU-SG DEA), and the UK-Singapore Digital Economy Agreement (UKSDEA). Such digital trade agreements include a broader scope of digital trade issues and areas for cooperation e.g., open government data, digital identities, cybersecurity, and data innovation.

5. Case Studies on the Impact of Data Sharing

This section provides examples where data-sharing between both public and private stakeholders has been beneficial in addressing common challenges faced.

One highly relevant example can be seen in APEC member responses to the spread of COVID-19. Sharing of information during the pandemic has been crucial to addressing the challenges of a global threat. Data sharing formed the basis of rapid government regulatory responses in curtailing and tackling the spread of the virus. Information shared on the characteristics, variants, treatments, and equipment for treatment prompted key policy decisions by other countries and in developing a vaccine.[26]

5.1 Case Study on COVID-19

Pandemics and epidemics like Ebola and COVID-19 highlight the importance of shared information. Crucially, data shared on symptoms, viral genome and variants, types and effects of treatment can inform policy decisions and enhance regulatory responses from other economies to save precious lives. As concerted effort is required to combat contagious virus and diseases, a seamless exchange of data and information can improve communication and stimulate faster responses and actions taken to combat virus and diseases.

Digital technology and the reduction of bureaucracy related to public health data sharing between countries has spurred quicker policy responses to contain the spread of virus and diseases and to develop effective treatment and vaccines.[27] Governments in the APEC region have been forerunners on information sharing and open information with reliable information infrastructures built to achieve the concepts of “smart nations” or “smart cities.” In so doing, they have improved their capacity to collect, process, and share public data openly. The use of public data was exemplified in three key areas during the COVID-19 pandemic: management of Personal protective equipment (PPE) supply chains, information on the illness and its variants, and development of vaccines.

5.1.1 Data Sharing on PPE Production

Personal Protective Equipment (PPE) is clothing, apparatus or equipment made for the protection of the wearer from injury or spread of infection such as masks, goggles, and sanitizers. Protective equipment was one of the foremost concerns early-on in the COVID-19 pandemic. Alongside

[25] DEPA accession talks are underway for Korea and Canada and China have applied to join.
[26] https://ec.europa.eu/research-and-innovation/en/horizon-magazine/coronavirus-accelerates-drive-share-health-data-across-borders
[27] Richard Grey. “Coronavirus accelerates drive to share health data across borders,” September 10, 2020. https://ec.europa.eu/research-and-innovation/en/horizon-magazine/coronavirus-accelerates-drive-share-health-data-across-borders

stay-at-home orders which were instituted in various parts of the world, attention focused on protecting individuals from further spread of the virus, particularly for health workers and first responders. Production of PPEs became critical, as shortages and embargoes on exportation of PPEs became prevalent. Many countries sought to develop capacity in PPE production in order to be less reliant on PPE imports. Information was also sought on the volume produced, quality and effectiveness of various protective equipment.

Governments and businesses shared data in the early days of the pandemic to figure out how key PPE items were made, which countries had them and in what quantities. It was important to establish credible data on the supply chain of PPEs, national capacity for production and nationwide demand in order to accurately scale PPE production, estimate costs for health-care facilities, and equitably distribute resources nationally. [28]

Lack of information on the supply chain and specific locations of the production process could leave governments vulnerable to shortages and possible embargoes on PPEs. Sharing data equipped countries to evaluate their supplies and capacity in order to better negotiate access to supplies and with concentrated effort.

Government Data-Sharing Examples

Data sharing helped countries maintain supplies of personal protective equipment. For example, the government of Chinese Taipei were able to maintain and provide real-time data of the mask stockpiles of more than 6000 pharmacies informing citizens of where PPEs were available and in what quantities. This avoided long waiting queues and equipped citizens with knowledge of the closest available resources to them.

Increased shortages of PPE, especially face masks and sanitizers, during the pandemic caused panic and long queues outside of pharmacies and outlet stores. To address the issue, the Chinese Taipei government made publicly available information on each location's stock levels and launched a platform where every vendor could update their stock numbers to deliver real-time information. This led Civil Society Organizations to develop digital applications with this information to create "mask maps," where individuals could locate the nearest supplier to them and determine what quantity was available.

Chinese Taipei has increasingly made efforts towards a creating more efficient state by promoting open sharing of information with its citizens and private stakeholders, having ranked first on the Global Open data index in 2017. Open data-sharing, in this instance, created a platform maintaining accurate, real-time inventory data held in locations managed by distributors. It also aided effective distribution of products amongst health care professionals and the general populace.

New Zealand also maintained a database of manufacturers producing COVID-19 related PPE. Information was voluntarily provided by individual companies and assisted health care providers and residents in sourcing necessary protective equipment.

In addition, institutional organizations such as the Asian Development Bank (ADB) played an instrumental role in policy research by pooling data from private and public institutions on supply chains for PPE. The ADB conducted an early, critical, in-depth study on the supply chain network

[28] He, Shuhan & Bala, Ram & Anupindi, Ravi & Ranney, Megan. (2021). "Effective supply chain surveillance for PPE." The Lancet. 397. 1706-1707. 10.1016/S0140-6736(21)00783-2. https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(21)00783-2/fulltext

of PPE products such as surgical masks, surgical gowns, protective suits, goggles, and surgical gloves, showing their geographic and national concentration in the PPE supply chain.[29] The study highlighted Asian countries which had a center role in the supply of PPE products world-wide and identified sources of significant bottlenecks in the supply chain. This information was used to propose recommendations to alleviate specific bottlenecks in critical PPE supply chains.

Private Sector Collaborations

Outside of APEC, the Pandemic Supply Chain Network (PSCN), was originally created in response to supply chain failures during the 2014 West African Ebola epidemic. PSCN is a public-private sector partnership to foster data sharing on the overall supply and demand of critical health products. The PSCN brought together the private sector and global organizations such as the World Health Organization (WHO), World Economic Forum (WEF), the World Bank, United Nations Children's Fund (UNICEF), the World Food Program (WFP), and other global partners to develop a transparent framework for pandemic preparedness and response by encouraging partners to share information on production and logistics of PPE and medical equipment. It aimed to obtain information on where such supplies were manufactured, where they were available, what supply chain capabilities existed, what logistics existed, and figured out ways to deal with issues of shortages. It also aimed to drive the emergency supply chain by assessing the global demand and global supply and developing market capacity to meet demand.

Institutions such as the World Trade Organization (WTO) have also contributed to tackling the pandemic as a data-sharing platform where aggregate data on COVID-19 related measures with relation to PPE were collated and published. WTO recently published a paper titled 'Improving Trade Data for Products Essential to Fight COVID-19: A Possible Way Forward'.[30] The paper argued that enhancing supply chain transparency through data sharing is a global public good and recommended public and private sector collaboration to provide improved data on supply chain for PPEs.

The World Health Organization (WHO) was another institution that facilitated data-sharing on PPE supplies by pooling resources and gathering information on producers of critical PPE products. Additionally, the WHO coordinated and liaising between UN agencies, donor governments, vendors, and NGOs to improve access to critical, lifesaving Covid-19 supplies via and efficient pandemic supply chains through the UN Covid-19 Supply Chain System Task Force.[31]

5.1.2 Data Sharing on COVID Virus and Variants

When a new disease or new variants of a bacteria or virus emerge, high frequency and reliable case reporting is critical in public health surveillance. Data sharing and management of COVID-19 information was also pertinent for governments, researchers, epidemiologists, pharmaceutical

[29] Asian Development Bank. https://www.adb.org/multimedia/scf/#/
[30] World Trade Organization. "Improving Trade Data For Products Essential To Fight COVID-19: A Possible Way Forward," July 1, 2021. https://www.wto.org/english/tratop_e/covid19_e/trade_data_report_e.pdf
[31] https://interagencystandingcommittee.org/system/files/2020-05/COVID-19%20SupplyChainTaskForce_28.04.2020.pdf

scientists and other stakeholders to work together not only in developing new vaccines and drugs, but also in designing interventions to contain fast-spreading diseases and infections.

Information on COVID-19 patient specimen resources, electronic patient records, hospitalization times, infection rates, symptoms, travel history and other information were essential to aid policymaking for governments and for researchers to better understand the virus. Given the fast-moving nature of the pandemic, governments rapidly adjusted responses and created tools, as shown below, to assist in driving improved public health outcomes. Some of these measures were adjusted or discontinued over the course of the pandemic, while others remain active today.

Government Data-Sharing Examples

Most governments maintained individual databases or routinely released official information on number of infected persons, deaths and hospitalized persons. Some economies also provided more detailed information on:

(a) Dates; including the date of travel, date of onset of symptoms, date of confirmation of infection, date of admission to hospital, and date of outcome of infected individuals;
(b) Demographic information including the age and gender of recorded cases;
(c) Geographic information on domicile and travel history at the highest resolution available down to the district level;
(d) Additional information such as symptoms and 'contact tracing data' (i.e., a record of exposure to infected individuals).[32]

Information was collected through government developed trackers and dashboards that reported close to real-time data. Such information was published and may have been made downloadable as Portable Document Format (PDF) reports, comma-separated values (CSV) files, or announced through official social media accounts of governmental or public health institutions, and government websites and platforms.

To improve early detection, notification and monitoring, many APEC economies developed digital applications and tools for the public to track population movements, assist the public to identify COVID-19 symptoms, traced close contacts of infected individuals, notified individuals with possible exposures to infected persons and monitored the effectiveness of containment measures.

At the start of the pandemic, countries shared detailed data sets including reports on the occurrence of symptoms, and dates of symptom onset and hospitalization. Economies like Singapore recorded data on occupations of infected individuals and the government of Korea maintained detailed data set that showed the whereabouts of a patient in the days prior to diagnosis and admission to a hospital, with specific time slots for each location they had visited. Such detailed datasets maintained by the governments were possible due to effective data sharing policies.

Singapore deployed the *Trace Together* application—a voluntary app that uses Bluetooth technology to detect proximity to other users activating this same app. When the app is downloaded, a random number is assigned to the user, and the data is stored on the phone itself

[32] OECD. "The territorial impact of COVID-19: Managing the crisis across levels of government," November 10, 2020. https://www.oecd.org/coronavirus/policy-responses/the-territorial-impact-of-covid-19-managing-the-crisis-across-levels-of-government-d3e314e1/

in an encrypted manner. Singapore's Ministry of Health (MOH) is the only entity that can decrypt this data, and it can request the users to share it if the user is diagnosed with COVID-19 to facilitate tracking of close contacts of infected persons and prevent further transmission.[33]

Japanese data showed the date of confirmation of virus, age, gender, residence, outbreak of surrounding patients, observation results of close contacts and special information concerning symptoms.[34] They also maintained information concerning government actions and policies to contain the virus such as specimen collection and transportation for patients suspected of infection, [35] guidelines for conducting epidemiological survey on patients with new coronavirus infection[36] and information on testing. All of this information was openly shared through the Japanese government's Ministry of Health's website.

In the Republic of Korea, the government developed and operated the COVID-19 Smart Management System to support epidemiological investigation. This system was based on the country's smart city data hub technologies for collecting and processing a large volume of urban data. Korea implemented this system for a wide range of statistics analysis to backtrack the movements of infected persons, identify transmission routes, or locate an infection source in a large-scale outbreak. The location data of the infected persons before they were diagnosed is collected from mobile base stations, credit card transactions, etc. within the permitted range under the Infectious Disease Control and Prevention Act. With full consideration of privacy, information deemed necessary is provided anonymously to the public so that people themselves can check whether they have crossed paths with the infected persons and get tested if necessary.

Additionally, an interactive and up-to-date webpage was created, mapping out COVID 19-cases within the country, as well as the places that patients reported having visited.[37] Authorities have easily identified high-priority cases and back-tracked the routes of infected persons due to artificial intelligence and data driven measures via location data collected from mobile base stations, credit card transactions and data-mining of closed-circuit television (CCTV) footage, to publish extremely detailed lists of their whereabouts.[38] Massive testing has also been the major strategy for combating the coronavirus.

Chinese Taipei centralized and integrated data of the national health insurance database and immigration and customs database, the government was able to create a detailed map of 14-day

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[33] TraceTogether Privacy Safeguards. https://www.tracetogether.gov.sg/common/privacystatement

[34] Richard Grey. "Coronavirus accelerates drive to share health data across borders," September 10, 2020. https://ec.europa.eu/research-and-innovation/en/horizon-magazine/coronavirus-accelerates-drive-share-health-data-across-borders

[35] He, Shuhan & Bala, Ram & Anupindi, Ravi & Ranney, Megan. (2021). "Effective supply chain surveillance for PPE."
The Lancet. 397. 1706-1707. 10.1016/S0140-6736(21)00783-2.
https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(21)00783-2/fulltext

[36] https://www.wto.org/english/tratop_e/covid19_e/trade_data_report_e.pdf

[37] Kim W, Jung TY, Roth S, Um W, Kim C. Management of the COVID-19 Pandemic in the Republic of Korea from the Perspective of Governance and Public-Private Partnership. Yonsei Med J. 2021 Sep;62(9):777-791. doi: 10.3349/ymj.2021.62.9.777. PMID: 34427063; PMCID: PMC8382722.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8382722/

[38] The World Bank. "Unraveling Data's Gordian Knot: Enablers and Safeguards for Trusted Data Sharing in the New Economy," February 15, 2020.
https://documents1.worldbank.org/curated/en/863831612427670947/pdf/Unraveling-Data-s-Gordian-Knot-Enablers-and-Safeguards-for-Trusted-Data-Sharing-in-the-New-Economy.pdf

travel histories and symptoms of its citizens and travelers. This pooled data enabled real-time alerts for hospitals and clinics assisting them in diagnoses and treatment and also allowed early identification of potential cases. The Taiwanese government also developed a geo-fence, or "electronic fence," which uses mobile phone location-tracking to ensure people who are quarantined stay in their homes. Those who are placed in high-risk groups or identified with COVID-19 are given government-issued mobile phones and monitored via location tracking.[39] This technology monitors phone location data and alerts authorities when quarantined individuals leave their designated shelter locations or turn off their mobile devices. It also provided real-time updates on high-risk zones and alerted the public to avoid the area.[40]

Private Sector Collaborations

Private Sector entities also formed collaborations with governments in which proprietary data held by a private sector entity was provided through partnerships or shared publicly to create new value. The World Bank, for instance, facilitated data sharing for pandemic response through the COVID-19 Mobility Task Force.[41] The task force was formed to establish partnerships and data sharing agreements with Mobile Network Operators (MNOs) and client country governments to support access to anonymized and aggregated mobility data for COVID-19 response and recovery efforts.

Private entities also made use of crowdsourced data to provide insights into the pandemic. For example, Metabiota's epidemic tracker service is monitoring incidence across 37 countries using 39 public data sources to produce high spatiotemporal resolution data. Through the available public data, Metabiota also created a forecasting model, which incorporates the known characteristics of the virus to provide forecasting of the spread of the COVID-19.[42]

5.1.3 Data Sharing on COVID Virus and Variants

Sharing of information on COVID-19--especially between researchers--was pertinent in developing a vaccine quickly. This information was not limited to research on developing a vaccine but included papers on the virus characteristics and the genome sequencing. In February 2020, the WHO in collaboration with the Global Research Collaboration for Infectious Disease Preparedness and Response (GLOPID-R), developed the Global Research Roadmap in response to the pandemic and identified priority research areas. Data from various groups have

[39] Melyssa Eigen, Flora Wang and Urs Gasser. "Country Spotlight: Taiwan's Digital Quarantine System," July 31, 2020. https://cyber.harvard.edu/story/2020-07/country-spotlight-taiwans-digital-quarantine-system

[40] The World Bank. "Unraveling Data's Gordian Knot: Enablers and Safeguards for Trusted Data Sharing in the New Economy," February 15, 2020. https://www.worldbank.org/en/topic/digitaldevelopment/publication/unraveling-data-gordian-knot-enablers-safeguards-trusted-data-sharing-new-economy#:~:text=mitigating%20associated%20risks.-,Unraveling%20Data's%20Gordian%20Knot%3A%20Enablers%20and%20Safeguards%20for%20Trusted%20Data,enhance%20individual%20agency%20and%20trust.

[41] World Bank. https://worldbank.github.io/COVID19-WBG-Mobility-Task-Force/

[42] Metabiota. "Monitoring and risk analytics for the 2019 novel coronavirus (COVID-19) epidemic," Metabiota Risk Report No. 3: February 25, 2020. https://metabiota.com/sites/default/files/inline-files/Metabiota_Risk_Report_No.3-25Feb2020-COVID-2019_0.pdf

informed more than 100,000 papers on COVID-19.[43] The information that has been disseminated through peer-reviewed journals and accompanying online data sets are vital for decision-makers.

Data sharing at the beginning of the pandemic allowed more and more researchers to have access to the virus's whole genome sequences, enabling vaccine development to start.[44] A key example is the early sequencing and sharing of the SARS CoV-2 viral genome by Chinese scientists on 8 January 2020 and subsequent sharing of the genomes of variants of concern.[45] The release of full viral genome sequences through a public access platform and the polymerase chain reaction assay protocols that were developed as a result made it possible to accurately diagnose infections early in the current emergency.[46]

Data sharing and global cooperation has also accelerated the development of vaccines which typically could take multiple years. The development of COVID-19 vaccine holds the record for the fastest vaccine development in history beating the creation of the mumps vaccine which took four years. The Pfizer and Moderna COVID-19 vaccines were granted full approval by the U.S. Food and Drug Administration (FDA) in less than a year.[47]

Open science and data sharing have increasingly become accepted norms of good research, allowing scientists to track the mode of transmission of diseases and viruses, enabling doctors to quickly learn how to spot the symptoms of a disease or viral infection, and give hospitals the ability to share effective treatment and prevention methods. Pharmaceutical companies and researchers have also been able to use the information about the virus and patient immune responses to rapidly develop potential vaccines and drug treatments.

5.2 Case Study on Travel and Tourism

Making better use of data in travel and tourism could introduce more opportunities for growth and development to this highly competitive market consisting of large numbers of small operators combined with larger tourism enterprises and airlines. Cooperation and partnerships have been fundamental to increase the influence of travel and tourism operators and provide them with access to external resources that have the effect of generating greater synergies. Technology and data play an important role to facilitate the establishment of cooperation mechanisms between relevant stakeholders that relies on information sharing between tour operators, transportation service providers, entertainment service providers, hospitality, and food and beverage service providers.

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[43] Pratt, B., & Bull, S. (2021). Equitable data sharing in epidemics and pandemics. BMC medical ethics, 22(1), 136. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8493940/

[44] Laura Lovett. "Cross-border collaborations lead to data sharing efforts during COVID-19," October 26, 2020. https://www.mobihealthnews.com/news/cross-border-collaborations-lead-data-sharing-efforts-during-covid-19

[45] Emma Yasinski. "Scientists Scrutinize New Coronavirus Genome for Answers," January 23, 2020. https://www.the-scientist.com/news-opinion/scientist-scrutinize-new-coronavirus-genome-for-answers-67006

[46] Moorthy, Vasee, Henao Restrepo, Ana Maria, Preziosi, Marie-Pierre & Swaminathan, Soumya. (2020). Data sharing for novel coronavirus (COVID-19). Bulletin of the World Health Organization, 98 (3), 150. World Health Organization. https://apps.who.int/iris/handle/10665/331380

[47] Philip Ball. "The lightning-fast quest for COVID vaccines — and what it means for other diseases," December 18, 2020. https://www.nature.com/articles/d41586-020-03626-1

Cooperation through data and information sharing could help to build a more resilient and sustainable tourism industry by identifying new business opportunities, new channels of engagement with clients, reduce the costs of finding new clients, and help preserve client loyalty.

5.2.1 Data Sharing to Improve Customer Experience and Maximize Revenue

Technology and the internet have enabled the trends of booking travel services, reviewing and sharing travel experiences, and allowing communication directly between customers and businesses to take place digitally. Such processes generate large amounts of structured and unstructured data. In the tourism and hospitality sector, effective use of data and information from internal customer feedback, online reviews, social media comments, and service usage data can improve service quality and overall customer experiences, which also contribute to customer loyalty and improved branding reputations.

Data mining and data analytics through machine learning, for instance, can be applied to large volumes of user generated data (e.g., travel reviews, blogs, or social media posts) which is unstructured and difficult to manually process.[48] Such data is often information rich and available in large volumes. It can provide insights such as levels of tourist satisfaction, inform perceptions of branding, and help to predict market demand. Content generated in from users has become an increasingly important and reliable source of information, acting as an "electronic word of mouth" spreading beyond personal acquaintances for other tourists as they prepare their travels, such user generated content may also influence perceptions and decision-making of potential clients.

The use of big data in the hospitality industry is not uncommon, especially for hotel chains that operate globally. For example, the InterContinental Hotels Group and Marriott International have applied data analytics to better understand and evaluate their customers opinions and preferences to improve or personalize customer experiences. Both internal and external data sources such as customer feedback, reservation data, personal data, real time data, third party demographic data, and location data can be used to forecast demand and improve the personalization of customer experiences.[49]

The hospitality industry can collect large amounts of data from hotel reservations and transactional activities during the customers' stay to develop strategies backed by data analytics. For example, data on duration, purpose of stay, and room types for a customer could be leveraged in his or her next visit to recommend similar rooms e.g., a non-smoking twin-bedroom with balcony. Data on customers' meal requests and dietary restrictions could also be used by hotel dining to redesign menus and create a more enjoyable and personalized hotel stay. At the same time, analytics on food preference could benefit the hotel by reducing ingredient and manpower costs and minimizing food wastage.

It is not only a hotel brand that could benefit from sharing travel data. Information shared or exchanged with a third party, such as travel agencies and tourist attractions, can help to forge strategic partnerships including the recommendations of specific itineraries of likely customer interest or to provide discounts for hotel guests if they visit certain attractions or venues. Tour

[48] Hailong Chen, Yi Liu and Kaiqi Chen. "Big Data in Tourism: General Issues and Challenges," 2021. Journal of Tourism & Hospitality. S4: 003. https://www.longdom.org/open-access/big-data-in-tourism-general-issues-and-challenges-83559.html

[49] Billy Turchin. How Hotels Are Using Big Data To Help Guests Feel At Home, December 15, 2014. https://www.forbes.com/sites/ibm/2014/12/15/how-hotels-are-using-big-data-to-help-guests-feel-at-home/?sh=37fe35b7fff4

packages booked through travel agencies can also recommend accommodations to partner hotels.

Shared data on tourist arrival and travel behaviors can be used by the hospitality industry as a whole to forecast demand, determine occupancy rates and manage room prices to maximize revenue.[50] Such external data could also be fed to a hotel's integrated management system that has the capability to forecast real-time optimal pricing to maximize room occupancy and profit. Although small hotels and accommodations may lack resources or capacity or do not require specialized analytical systems due to their scale limitations, the use of shared data on tourist arrivals, market insights and performance of hotels can still provide useful information and insights that can help the management of accommodation service providers make informed decisions.

Information can also be shared with local governments to better understand movement patterns of travel guests and to better provide, for example, transport options to and from key tourism locations or consider traffic flow adjustments to better account for tourism arrival and departure timings.

5.2.2 Data Sharing for Strategic Marketing

Data sharing facilitates collaboration between stakeholders in the tourism and hospitality sectors to launch coordinated marketing strategies and enables the formation of public-private partnerships to boost local tourism.

Governments and businesses have utilized shared data to analyze market trends and consumer preferences and identify the best marketing opportunities for their preferred demographics. This enables marketing messages to be sent, based on time, location and other data, allowing more targeted promotional content to be delivered to market local destinations and attract more tourists.

As an example, Thailand's tourism-reliant economy suffered a substantial decline in 2020 in the aftermath of the COVID-19 pandemic, prompting the Thai government to introduce new strategies and campaigns to boost domestic tourism and attract international tourists from more diverse economies. The decline in Chinese tourists, who were Thailand's largest source of international travelers pre-COVID, has contributed to emergence of marketing strategies and partnerships to attract new revenue streams.

The "We Travel Together" program was introduced in 2020 to stimulate Thailand's domestic travel and spending.[51] The program was extended to its fourth phase from May 31 to September 30, 2022.[52] This national program subsidizes domestic travel through a digital redemption platform (the Pao Tang app)[53] which has an estimated 40 million users. Data collected can be shared with government agencies and private entities. This has created an opportunity for domestic

[50] Datumize. "Why Is Marriott the Big Data Analytics Leader In Hospitality?" https://blog.datumize.com/big-data-analytics-in-hospitality-marriott-international-case-study

[51] Bangkok Post. "'We Travel Together' stimulus package launched," July 19, 2020. https://www.bangkokpost.com/business/1953632/we-travel-together-stimulus-package-launched

[52] Bangkok Post. "Cabinet approves 'We Travel Together' extension," May 24, 2022. https://www.bangkokpost.com/business/2315110/cabinet-approves-we-travel-together-tourism-scheme-extension

[53] The Pao Tang app developed by Krung Thai Bank is Thailand's biggest financial services mobile application with over 40 million users. It is also used to avail government financial support.

consumers' data to be collected and analyzed to provide more personalized tourism services and offerings.[54]

For instance, data collected from users could potentially be shared with tour operators, hotels, tourist attractions and shopping destinations to create an interlinked tourism ecosystem where users could be strategically engaged. Data on traveler preferences can also be tracked in real time to design more relevant offerings to target different customer segments.

With the gradual resumption of international travel, the Tourism Authority of Thailand (TAT) and Tourism Council of Thailand (TCT) have collaborated with other regional partners to gain a competitive edge over other popular travel destinations in the region. This includes TCT's partnership with the Singapore-based IsWhere to deploy a digital-marketing platform for tourism business operators to better connect and engage with a sizeable number of domestic and international travelers.[55] TAT's partnership with airlines such as AirAsia expand its reach in Southeast Asia and South Asian markets and have helped accelerate recovery for the travel industry.[56] Through such partnership, the tourism authorities of Thailand can gain access to first-hand information from partners such as flight schedules, number of bookings, popularity of travel destinations, to formulate strategic plans to target different markets across regions.

Travel companies and airlines can also devise targeted pricing strategies for different market segments. With the phased reopening of popular provinces in Thailand, and the inclusion of more visitors from selected economies on a quarantine-exemption list, travel companies and airlines could leverage data on traveler behaviors to optimize pricing and conduct targeted campaigns by country of origin and destination, particularly for visitors on a quarantine-exemption list.

The use of shared data for marketing is not limited to Thailand. In Singapore, the Tourism Board leveraged shared data to gather insights to help its network of retailers' design campaigns to market their products. In 2018, the Singapore Tourism Board developed a platform called Singapore Tourism Analytics Network (STAN) for relevant stakeholders to gain deeper insights into data obtained from internal sources, other government agencies, and partner industry big data providers.[57] Aggregated data from the STAN data analytics platform is available for public access and tourism stakeholders are provided additional features.[58] This platform allowed smaller businesses in the travel sector with limited data collection and analytical capabilities to make use of available data and analytics provided on the STAN platform to analyze key markets, forecast tourist arrival, frequency of stay, or tourism expenditure patterns.

Another platform launched by the Singapore Tourism Board, the Tourism Information & Services Hub (TIH), has allowed businesses to collaborate and share relevant information on Singapore's

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[54] McKinsey & Company. "Reimagining travel: Thailand tourism after the COVID-19 pandemic," November 30, 2021. https://www.mckinsey.com/industries/travel-logistics-and-infrastructure/our-insights/reimagining-travel-thailand-tourism-after-the-covid-19-pandemic

[55] Thaiger. "Rediscover Thailand with IsWhere – An easy-to-use travel recovery application," October 11, 2021. https://thethaiger.com/sponsored/rediscover-thailand-with-iswhere-an-easy-to-use-travel-recovery-application

[56] TAT News. "TAT and Thai AirAsia outline plans for cooperation to boost tourism to Thailand," April 4, 2022. https://www.tatnews.org/2022/04/tat-and-thai-airasia-outline-plans-for-cooperation-to-boost-tourism-to-thailand/

[57] Some of STB data partners include Sentosa Development Corporation, Gardens by the Bay and Expedia.

[58] Singapore Tourism Analytics Network. https://stan.stb.gov.sg/content/stan/en/home.html

tourism offerings and travel software services in real-time through an Application Programming Interface (API).[59] Such information may include business opening hours, latest tourism offerings and promotional events, and provides businesses in the tourism sector with increased marketing exposure and opportunity to connect with other tourism businesses to explore collaborative partnerships.

5.2.3 Regional Cooperation in Sharing of Travelers' Health Data

During the COVID-19 pandemic, economies worldwide implemented air travel restrictions and health-related travel requirements to prevent imported cases and contain infections. A substantial number of governments worldwide implemented temporary lockdowns measures at the onset of the pandemic in 2020 including China, India, Malaysia, and the Philippines.

Lockdowns and strict travel restrictions resulted in a steep decline in travel and tourism in 2020.[60] A swift resumption of international travel to pre-pandemic levels could be possible through cooperation in sharing of traveler health data and administering harmonized measures across borders for a safer and more streamlined travel experience.

An example of regional cooperation in sharing of travelers' health data is the CommonPass framework launched in October 2020. It is a collaboration between a non-government organization called the Commons Project, the World Economic Forum, and a broad coalition of public and private partners to restore confidence in air travel and accelerate reopening of borders by enabling individuals to document and present their COVID-19 status without revealing other personal health information for protection of individual privacy.[61]

The UNWTO–IATA Destination Tracker, developed collaboratively by International Air Transport Association (IATA) and the World Tourism Organization of the United Nations (UNWTO), is an important initiative to share information on air travel restrictions and health-related travel requirements.[62] This tracker leverages data from both organizations and public data sources, such as Our World in Data and the Oxford COVID-19 Government Response Tracker, to provide global information on COVID-19 related travel regulations for public access. This includes data and information on air travel regulations, destination-specific restrictions, COVID-19 notifications, and vaccination rate etc. Travelers can utilize this resource to identify any travel restrictions in destinations and plan before travelling.

The adoption of facial recognition and biometric data could also support the safe reopening of tourism by minimizing human contact. For example, since 2020, Singapore has progressively installed iris and facial scanners for air, sea and land checkpoints clearance.[63] This mode of clearance is also made available to international travelers on the Immigration and Checkpoint Authority's (ICA) Frequent Traveler Program who have enrolled their iris and facial biometric data

[59] Tourism Information & Services Hub. https://tih.stb.gov.sg/content/tih/en/about_tih/about-us.html
[60] World Tourism Organization (UNWTO). "2020: A year in review." https://www.unwto.org/covid-19-and-tourism-2020
[61] International House of Japan. "The Commons Project." https://www.i-house.or.jp/eng/programs/activities/tcp/
[62] UNWTO. "UNWTO/IATA Destination Tracker – Easy Travel." https://www.unwto.org/tourism-data/unwto-iata-destination-tracker-easy-travel
[63] Immigration and Checkpoint Authority Singapore. "Use Of Iris And Facial Biometrics As The Primary Biometric Identifiers For Immigration Clearance At All Checkpoints." https://www.ica.gov.sg/news-and-publications/newsroom/media-release/use-of-iris-and-facial-biometrics-as-the-primary-biometric-identifiers-for-immigration-clearance-at-all-checkpoints

with the ICA. Through shared iris and facial biometric data, this system enables a touch-free operation process to capture biometrics, contributing to a contactless, hygienic (compared to fingerprint scanning) and more efficient clearance process.

5.3 Case Study on Smart Cities Transportation

Public transportation is crucial for the movement of people. An efficient transport system could help to expand work opportunities by enabling greater mobility across cities and even the borders. The adoption of mass transit systems such as metro, light rail transit and bus rapid transit also contributes to more energy efficient and sustainable means of transportation in cities by reducing consumption of energy and fuel as well as carbon emissions.

Due to many daily commuters and high frequency of travel, large volumes of data can be collected from the transportation fleet and its users for transportation companies and vehicle manufacturers to improve management, efficiency, safety and maintenance of transportation in cities. The increased dissemination of data from public transport service providers can be used to improve the overall commuting experience and to encourage private mobility service providers to create new products/services to improve mobility and energy efficiency in cities.

5.3.1 Data Sharing for Traffic Management and Accident Prevention

More than 55 percent of the world's population lives in urban areas and this proportion is expected to increase to approximately 68 percent by 2050.[64] As the urban population increases, traffic congestion in cities could become increasingly problematic, particularly in already densely populated and congested cities in Asia like Tokyo and Manila.[65]

In Manila, the economic costs of traffic congestion were estimated at US$ 67 billion per day and this represents a toll on its citizens and businesses.[66] To better understand the congestion problem in Manila and find solutions to this issue, the Philippine Department of Transportation and Communications (DOTC) collaborated with the World Bank and ride-sharing companies in 2016 to make Global Positioning System (GPS) data obtained from an extensive fleet of drivers available for analysis of factors like travel time, average traffic speeds at different time of the day and on different roads. Anonymized traffic data were shared in real-time with agencies in the Philippines through an open-source software and big data partnerships with major ride-sharing companies.[67] The open transport partnership also enabled anonymized data from different fleets of public transport and private vehicles, companies, and city governments to be integrated for deeper analysis.

The shared data were made available for use by relevant Philippine government agencies including the Metro Manila Development Authority (MMDA), the Department of Public Works and

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[64] UN Department of Economic and Social Affairs (UN DESA). "68% of the world population projected to live in urban areas by 2050, says UN," May 16, 2018. https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html

[65] TomTom. "TOMTOM TRAFFIC INDEX Ranking 2021." https://www.tomtom.com/en_gb/traffic-index/ranking/?country=HK,IN,ID,IL,JP,KW,MY,PH,QA,SA,SG,TW,TH,AE

[66] CNN Philippines. "PH traffic may worsen, to cost ₱5.4 billion daily - JICA ," September 19, 2018. https://www.cnnphilippines.com/news/2018/09/19/JICA-study-traffic-5-billion.html

[67] The World Bank. "Open Traffic Data to Revolutionize Transport ," December 19, 2016. https://www.worldbank.org/en/news/feature/2016/12/19/open-traffic-data-to-revolutionize-transport#:~:text=The%20idea%20of%20the%20Open,iterate%20solutions%20to%20traffic%20challenges.

Highways (DPWH), and the Cebu City Transportation Office to identify congested roads at peak hours and make better decisions on traffic management using accurate, real-time data.[68]

Shared vehicle data and real-time traffic data could also prevent occurrence of traffic accidents in cities through the broadcast of real time traffic situations to alert drivers to unexpected situations on the road. In South Korea, the extensive coverage of 5G in cities like Seoul has permitted the rapid transmission of data across IoT enabled vehicles and infrastructure which allow the benefits of data sharing to be reaped in a larger scale.

The Cooperative Intelligent Transport System (C-ITS) project under Korea's Ministry of Land, Infrastructure and Transport is an initiative that aims to equip drivers with real-time information of traffic condition to prevent traffic accidents.[69] Under this initiative, the Seoul metropolitan government introduced new traffic safety services providing real-time updates to buses and taxis. These include information on detected jaywalkers and obstacles on the road, or countdowns to change in green light at road intersections to help drivers gain access to timely information and reduce accidents attributed to driver's carelessness or unexpected occurrences.[70] The real-time traffic safety services in Seoul are provided in navigation apps incorporating data collected from sensors on vehicles and roadside facilities.

5.3.2 Data Sharing for Conditioned-Based and Predictive Maintenance

Traditionally, time-based maintenance at regular intervals is adopted as a common preventive maintenance practice for vehicles. This practice, however, can be costly as it may lead to unnecessary labor costs and parts replacement and contribute to human error such as incorrect re-assembly and misalignment when many parts are disassembled and replaced on each occasion.

The adoption of smart maintenance mechanisms such as condition-based maintenance or predictive maintenance that relies on IoT technology can collect high frequency data to analyze the conditions of train tracks, wires, other components of the vehicle in real-time. This approach could provide greater efficiency and cost-savings than time-based maintenance through a data-driven approach to determine deteriorated components more accurately (condition-based maintenance) and even predict when in advance when maintenance is required before the condition of components display substantial deterioration (predictive maintenance). These mechanisms are often applied in industrial settings and are increasingly used to service public transportation to improve operational performance and reduce maintenance costs. Moreover, it makes taking public transportation a more reliable commuting option and this can help reduce the number of private vehicles in cities which is less energy efficient.

Japanese railways are renowned worldwide for their high levels of reliability and safety. Average delay of high-speed railway trains measures less than a minute every year. The Tokaido Shinkansen line that operates between Tokyo and Shin-Osaka runs 342 train services daily with

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[68] The World Bank. "Philippines: Real-Time Data Can Improve Traffic Management in Major Cities," April 5, 2016. https://www.worldbank.org/en/news/press-release/2016/04/05/philippines-real-time-data-can-improve-traffic-management-in

[69] Ministry of Land, Infrastructure and Transport Korea. "About C-TIS." https://www.c-its.kr/english/introduction.do

[70] The Korea Bizwire. "Seoul City Launches 5G Service to Provide Real-time Information to Buses and Taxis," December 3, 2020. http://koreabizwire.com/seoul-city-launches-5g-service-to-provide-real-time-information-to-buses-and-taxis/175961

174,000 passengers but recorded an average time delay of 0.5 minute per train in 2020.[71] The maintenance of high reliability and safety of train services has been highly prioritized by railway operators in Japan which introduced significant investments and costs to regularly service and maintain the condition of trains and train tracks via traditional maintenance at fixed intervals.

The East Japan Railway Company (JR East), the largest railway company in Japan (under the Japan Railways Group), started to introduce smart maintenance using IoT technology in 2016 to allow the collection and analysis of enormous amounts of data from trains and rails in real time when trains are in operation, making it possible to detect minor changes in equipment and to predict failures in advance. This shift from time-based maintenance to smart maintenance allowed JR East to maximize the potential capacity of its equipment and prolong the timespan between inspections without compromising on safety.

The use of big data sent in real-time from sensors and monitoring devices to monitor conditions of train tracks, power equipment and signaling system of trains, helped JR East identify signs of failure and act in advance to repair and replace worn out components and to accurately determine cause of train failures to reduce train down time.[72]

5.3.3 Data Sharing for Transport Research and Innovation

Both the public and private transportation operators collect enormous amounts of data, and these can be shared through open platforms to encourage research and innovation. An example is the North American Transportation Statistics (NATS) online database that provides transportation-related data available from the U.S., Canada, and Mexico. The database covers subject areas ranging from demographics to domestic and international freight activity, domestic and international passenger travel, and transportation infrastructure. This trilateral collaboration in data sharing is made possible by establishing a common set of statistics for publication and supporting technical documentation in three languages.[73]

Data sharing is key to enable implementation of innovative services such as Mobility-as-a-Service (MaaS) that provides integrated services across multiple transport modes. Due to legislative requirements for open transport data in Finland, transport services providers are obligated to share data on information on routes, stops, timetables, prices etc., in machine-readable format which laid the foundations for data exchange and encourage the government and private sector to provide more innovative services driven by data and digitalization.[74] The Helsinki Public Transportation Authority (HSL) utilizes data shared by the private sector to develop an app that can provide integrated payment and ticketing of all modes of public transportation including bike-sharing options, provide up-to-date information on the schedules of public transport, and help passengers find the best route options to get to their destinations.[75] The convenience and

[71] Central Japan Railway Company. “Integrated Report 2021.” https://global.jr-central.co.jp/en/company/ir/annualreport/_pdf/annualreport2021.pdf
[72] Kazushi Matsuura. “Prospects of “Smart Maintenance” Utilizing ICT,” JR East Technical Review No.34-2016. https://www.jreast.co.jp/e/development/tech/pdf_34/tec-34-05-08eng.pdf
[73] U.S. Department of Transportation. “North American Transportation Statistics Interchange.” https://www.bts.gov/browse-statistical-products-and-data/north-americantransportation-statistics-interchange
[74] See Chapter 2 Section 1 of Finland Act on Transport Services. https://www.finlex.fi/fi/laki/kaannokset/2017/en20170320_20180731.pdf
[75] American Public Transport Association. “Being Mobility-as-a-Service (MaaS) Ready,” 2019. https://www.apta.com/wp-content/uploads/MaaS_European_Study_Mission-Final-Report_10-2019.pdf

inclusion of multiple modes of public transportation including more environmentally friendly options such as bicycles is enabled by data sharing from different transport operators. This also contributes to more sustainable transportation in cities.

6. Recommendations

The following recommendations for future policy considerations are provided to recognize the shared value of data, help bolster interoperability of data and responsible data management where the personal data of individuals should be given adequate protection under the different jurisdictions.

6.1 Build awareness on value creation through data sharing/utilization

It is important for stakeholders to recognize the value and potential of data sharing and utilization to encourage data owners to share data and for data users to better leverage shared data. Data sharing is often driven by voluntary mechanism (except those mandated by law). Hence, there are considerable obstacles in accelerating the process of building a data sharing ecosystem if stakeholders do not participate actively in data sharing or effective utilization of data.

A strategy to build awareness of the value of data by individuals and the private sector is through the launch of awareness campaigns at a regional or domestic level that could educate the public and private sector audience on how data are used to improve consumer welfare and generate economic benefits. Such campaigns or initiatives could also help to address concerns on the risks of data sharing to enhance confidence and trust of data holders.

6.2 Encourage cross-sector collaboration between public, private and civil society to better identify useful data and opportunities for data exchange and innovation

There are large amounts of data held by different entities and stakeholders, but without opportunities for communication and collaboration, these data are often held inside the organization. This does not provide added value. Working in a collaborative manner and engaging a range of stakeholders across sectors and disciplines could enhance the efficiency and impact of shared data in creating new innovations.

Through platforms for dialogues and communication, the public sector could seek the feedback and opinions of the private sector and civil society to identify government data that could be made available to the public and establish data standards. Vice versa, the government could also identify data that could be utilized to analyze social and economic issues. For example, data obtained by transportation companies could be shared with the government to support analysis in time and frequency of commuting and to identify popular destinations and timings. These analyses could support decisions to improve transport connectivity to more popular destinations and resolve overcrowding issues.

Cross-sector collaboration is also necessary to promote innovation. Many Asia Pacific governments have established regulatory sandboxes by sectors which provide participating companies with a controlled environment to test new innovations.[76] These include the presence

[76] Participating companies in a regulatory sandbox are temporarily exempted from certain regulatory obligations to conducting testing of products and services.

of Fintech regulatory sandboxes in Australia, Brunei, Malaysia, Singapore and Thailand where participating companies need not require a financial service license or be in full compliance of financial regulations under defined conditions that are maintained by the financial regulators.

6.3 Embrace data as infrastructure

Governments must also be willing to adopt open data policies. Data should be viewed as infrastructure; they are important assets and may need to be integrated for wider applications by the public and private sector and even to the regional and global system. Data can be consumed without diminishing its value or availability to others, exhibiting the properties of a public good that could be propagated.

To foster greater use of data and collaborative data sharing, it is important to adopt the "open by default" principle where all data should be made available unless subject to exceptions due to personal privacy or security concerns. Data infrastructure that provides comprehensive data that is interoperable and accessible will need to be maintained to provide timely and quality data for public access. A culture of data sharing will also need to be forged in alignment with open data policies to cultivate practice in data and information sharing amongst public and private sector stakeholders.

6.4 Adopt data stewardship

It is likely that every organization will collect and make use of data. Hence, there should be at least one data steward appointed by each organization to oversee data management and issues related to personal data protection. Particularly for government agencies and organizations that are managing large amounts of personal data, financial data and confidential data that are sensitive and could result in severe repercussions if these data are exposed or stolen, the appointed data stewards will need to undergo training and be empowered to comply with data safety guidelines, data-related legislations and assist with identifying potential data risks.

There are similar initiatives adopted by APEC economies. For example, Singapore's PDPA requires each organization to designate at least one individual as a data protection officer to ensure that the organization's processes and practices in handling personal data are compliant with data protection legislations.[77]

In the application of data stewardship to smaller companies, governments should also ensure that data regulatory obligations are manageable, not too costly and provide for flexibility. For instance, regulators could permit small and medium-sized enterprises (SMEs) to leverage shared services for fulfilment of legal obligations by contracting the role of data stewards to specialized firms. Governments may also render assistance to help SMEs understand their legal obligations and approaches that they can take to meet new criteria in data regulations.

The role of data stewards should not be confined to ensuring data protection and compliance with regulations. Data stewards can also play an important role to support data collaboration efforts by advising a suitable approach for collaboration or partnership and ensuring that there are proper procedures in place to establish accountability e.g., data sharing agreement.

[77] Personal Data Protection Commission Singapore. https://www.pdpc.gov.sg/overview-of-pdpa/data-protection/business-owner/data-protection-officers

6.5 Improve the capacity of stakeholders in applications of shared data

Data sharing and open data initiatives could be constrained by the ability of stakeholders to make meaningful use of available data. There could be an abundance of data available, but it requires specialized skill and expertise to process and derive analysis from raw data. Organizations will need to employ skilled data engineers and data scientists or train individuals in data analytics to make data connections and identify relationships or reveal new patterns; and have data management specialists collect, organize and retrieve data in databases.

Hence, governments will also need to devote considerable resources to education, skilling and training of workers to provide a skilled workforce that can meet the demand of data analytics and data management in different sectors.

Conclusions

Data sharing is facilitated by advancement in technology, making communication and transfer of voluminous and complex datasets possible. The use of dynamic data that provides real-time information compared to static data has enabled the collection of quality and accurate data for analysis to support decision making in different applications. Across the private and public sectors, there were exemplary use cases and mechanisms for data sharing. As illustrated in the case studies, data sharing is used to combat public health crisis like COVID-19, build a more sustainable and resilient tourism sector, and contribute to safer and more energy and time efficient modes of transportation in cities.

Furthermore, real-time data sharing supports creation and development of innovation services and products (e.g., location-based services and MaaS) that would not have been made possible without the ability to collect, process, and share data through integrated systems. Hence, it is important for governments to raise public awareness of how data create value and expand a culture of data sharing to all sectors, facilitating different models of partnership and data collaboration to make meaningful use of available data.

Governments and businesses are increasingly collecting more data to improve their services and to make data driven decisions. Although technology enables data to be collected and stored on secure and encrypted platforms such as cloud, the collection and storage of personal data still pose a concern on how personal data collected should be handled and whether they can be shared with a third party.

To address such concerns, most APEC economies impose legislations to protect personal data and important infrastructure and stored data against cyber threats. These are integral to help build trust and responsible management of data. However, excessive restrictions particularly in the cross-border transfer of data could create unnecessary costs for businesses and the economy by limiting data and information flow and inhibiting cross-border trade.

There needs to be a fine balance between allowing data to be shared while addressing privacy and security concerns through more flexible policies. Some examples of policy responses by APEC governments include relaxing specific regulations under regulatory sandboxes, only permit sharing or publication of anonymized datasets through open data platforms, impose sector-

specific restrictions for sharing or transfer of more sensitive information and require appointment of persons responsible for overseeing data protection in organizations.

Governments can have different ways of regulating data sharing for the interest of the economy and society, but domestic data regulations and policies will need to consider how data sharing could create greater value to the businesses and avoid overburdening small businesses with complex and costly regulatory measures. As data is also transferred across the borders to facilitate cross-border trade and information exchange, governments should also work towards a more harmonized data regulatory framework under regional and global cooperation mechanisms to avoid a creating a more fragmented digital policy landscape which is inhibitive to cross-border data flow.