analysys mason

Final report

Data-driven innovation for emerging Asia–Pacific: supporting economic transformation, protecting consumers

6 September 2016

Ref: 2007317-372

www.analysysmason.com

Contents

Analysys Mason Limited
Bush House, North West Wing
Aldwych
London WC2B 4PJ
UK
Tel: +44 (0)20 7395 9000
london@analysysmason.com
www.analysysmason.com
Registered in England No. 5177472

This report was commissioned and sponsored by Google, and prepared independently by Analysys Mason, a global consultancy specialising in telecoms, media and technology.

The analysis contained in this document is the sole responsibility of Analysys Mason and does not necessarily reflect the views of Google or other contributors to the research. Lead authors were David Abecassis (Partner), Richard Morgan (Manager) and Hannah de Villiers, with additional input from Elena Korsukova, Paola Valenza and Oliver Kremer (Associate Consultants). The report was edited by Andrea Smith, with graphic design by Julie Bartram.

We would like to thank the following people for their time and valuable inputs during our research: Amit Bhatnagar (Managing Director, Accuster), Dana Blouin (Chief Data Scientist, DRVR), Subra Krishnan (SVP Products, Vizury), Vinay Nathan (CEO and co-Founder, Altizon), Reynazran Royono (Founder and CEO, Snapcart), Yeo Puay Lim (Regional manager SE Asia, Milvik / Bima) and all those who contributed anonymously through interviews. Thanks are also due to Ann Lavin, Emi Maeda, Goh Lih Shiun, Rahul Jain, Ross Young, Samantha Yorke and Toshiki Yano at Google for their comments and feedback during the preparation of this report.

1 Executive summary

Data-driven innovation (DDI) has an important role in realising the potential that data collected and processed through information and communication technologies has for creating significant economic and social benefits.

The scope and impact of DDI has been studied in some detail in the OECD and in Asia–Pacific specifically, through country-specific reports focusing on Australia, Japan, New Zealand and Singapore. This report broadens the scope of study to explore DDI in developing Asian countries, focusing on India, Indonesia, the Philippines, Thailand and Vietnam. Through a wide range of case studies, it shows how DDI is addressing specific needs and constraints in developing markets, such as by supporting an expansion of access to insurance, improving the efficiency of retail and logistics, and improving access to healthcare and disaster relief in remote areas.

Many of these innovations are linked to the increasing availability of mobile devices connected to the Internet, and continued growth in their number expected over the next few years. The analysis conducted as part of this study estimates that DDI's contribution to gross value added (GVA, a key measure of GDP) could grow from at least USD100 billion in 2015 to over USD300 billion in 2020 in Asia–Pacific as a whole (of which the five focus countries could make up 20% to 25%), representing around 2% of total GVA.

Indeed, the true impact of DDI in developing countries is likely to be even greater, as it can help reduce enduring barriers to development, such as difficulties in accessing financial services and healthcare. The challenges in reaping the full value of DDI are significant, however: data, as well as the skills to develop and use DDI services, remain scarce in these countries, requiring investment in machinery, software, training and education.

Governments have a role to play in overcoming these challenges, by making more of their own data available, and ensuring that the legal and regulatory environment surrounding DDI helps firms to develop, adopt and export DDI services. Governments should fulfil these roles in a way that protects consumer privacy and trust, through a clear understanding of the various policy options.

DDI holds substantial potential to help developing countries accelerate their economic and social development. Elsewhere in the world, this development has happened remarkably harmoniously, despite occasional disputes among privacy advocates, governments and businesses. These same economic and social benefits can also be realised in developing Asia–Pacific through clear outcome-oriented thinking, open sharing of expertise and international cooperation.

***

This report explores how data-driven innovation occurs in developing Asia-Pacific

Data-driven innovation (DDI) is playing an increasingly important role throughout the world. The OECD defines it as "the analysis of large volumes of data, from transactions, production and communication processes, that results in significant improvements of existing, or the development of new, products, processes, organisational methods and markets".[1]

Several recent studies have shown that its impact is already tangible in developed Asia–Pacific countries such as Australia, Japan, New Zealand and Singapore, which are all amongst the world's leading 'digital economies'. This report focuses on DDI services in developing countries, illustrating how it addresses specific issues in these markets and asking how it could flourish in the near future.

DDI takes many forms, from the real-time processing of vast amounts of traffic data to manage roads more efficiently, to the analysis of small amounts of data from individual vehicles for insurance or fleet management purposes. Whether big or small, DDI appears in nearly every sector of the economy.

In this report, we explore DDI services in insurance, e-commerce, fleet management, marketing, agriculture and healthcare sectors,[2] and look at five countries in particular (India, Indonesia, the Philippines, Thailand and Vietnam). Its findings are likely to be applicable to developing countries in Asia–Pacific more broadly, and complement the reports that have already been published on developed countries in the region.

DDI is helping to address important barriers to economic development in developing Asia-Pacific

Firms in developing Asia–Pacific use DDI for many of the same reasons as firms in developed countries: DDI increases operational efficiency, helping to reduce cost through reduced waste and better planning; it helps companies be more competitive domestically and internationally, improving growth prospects; and it supports new services for customers, from personalised products to more attentive, proactive customer service. For example, Lazada, South-East Asia's largest e-commerce platform, collects and analyses data to improve its sales through personalised recommendations, and to prevent or mitigate the impact of fraud.

The landscape of data-driven services in developing Asia–Pacific countries is extremely varied. Through interviews with stakeholders across the five focus countries (both people working in DDI start-ups and investment professionals from venture capital firms), we found that DDI services can enable firms and governments to overcome specific challenges that currently slow economic and social development in developing Asia–Pacific, such as skills shortages or inadequate information on which to build DDI services. For example, Bima offers life and health insurance, through

1 *Data-Driven Innovation: Big Data for Growth and Well-Being*, OECD Publishing, Paris, 2015; see http://dx.doi.org/10.1787/9789264229358-en.

2 These sectors account a significant proportion (typically over 50%) of gross value added (GVA) in the five focus countries; some of them are very large individual contributors to GDP, and others are important for future growth and are fertile ground for DDI.

mobile phones, to consumers who were previously completely excluded from the financial services market and on whom very little risk-related data was previously available.[3]. In the process, it collects real-life data on its customers, their risk profile and their behaviour, which enables it and its insurer partners to price risk more accurately and further expand the number of people who can be insured.

The way in which Bima delivers and improves its services exemplifies a common theme that is recurrent when looking at DDI in developing Asia–Pacific: the critical role of mobile technology in enabling advanced services. To sell insurance, Bima partners with mobile operators who enable it to collect premiums on a daily basis from customers' prepaid credit. Similarly, DRVR, a start-up in Thailand, provides detailed fleet management data and analytics to help improve the efficiency of transport and logistics fleet. In order to overcome skills limitations, which have hampered traditional data-driven fleet-management solutions, DRVR is developing a user experience that draws from mobile apps and video games.

Mobile phones are becoming ubiquitous and, increasingly, connected to the Internet: they are also highly personal (and personalised) devices, and therefore are a very important source of data. For example, in order to provide near-real-time retail trend data to major brands, Indonesia-based start-up Snapcart incentivises consumers to snap a picture of their supermarket receipts at least once a week and upload it to its cloud platform. Many other apps make use of location data to enable real-time applications, including for the public good: PetaJakarta and the Indonesian National Disaster Management Agency (BPBD) use real-time, location-specific information on floods from mobile social media to inform citizens and disaster relief efforts.

DDI could add over USD300 billion in Gross Value Added (GVA) in the region by 2020, up from at least USD100 billion in 2015, provided major challenges can be overcome

Quantifying the impact of DDI on developing and emerging economies is difficult, but we estimate that currently DDI contributes between 0.5% and 1.3% to gross value added (GVA), roughly between a third and half of estimates in developed countries. This is small but not insignificant: at current prices, in 2015 this contribution was over USD110–210 billion in developing Asia–Pacific, and USD20–40 billion in the five countries we focused on in this report (India, Indonesia, the Philippines, Thailand and Vietnam).

Bringing the DDI environment in developing countries up to the level of the most advanced markets in Asia–Pacific could create significant value: the contribution of DDI to the economy of developing countries in the region could reach USD300–560 billion in 2020.[4]

The challenges in achieving this growth are daunting: more innovation needs to take place, either through start-ups or accelerators within larger companies, to serve the specific needs of each market and country; much more data needs to be collected and processed to build the basis on

[3] Bima is currently present in Bangladesh, Cambodia, Indonesia, Pakistan, Papua New Guinea, the Philippines and Sri Lanka.

[4] USD75–140 billion in the five focus countries.

which these services can be developed; further investment needs to take place to upgrade systems to be properly instrumented to collect this data and act on it; governments and public sector organisations must contribute to the expansion of the amount of useful data available, through open data initiatives including real-time application programming interfaces (APIs); and many more people must be offered education and training that prepares them for jobs in a data-centric economy.

Policy-makers can help address barriers to DDI, through policies that encourage responsible and productive use of data

Policy-makers and governments have a fundamental role to play in overcoming these challenges and encouraging DDI. They are providers and users of data, but also can ensure that the legal and regulatory environment is designed in a way that encourages consumers and firms to adopt DDI services, and allows start-ups and larger companies to innovate with data, bring DDI services to market and grow their customer-base domestically and internationally. They also typically have a central role in education and are instrumental to ensuring the right skills are available for DDI to flourish.

Many countries in the region are embarking in fundamental reviews of their privacy and data protection regimes, which are the single most important component of how policy directly affects DDI. In doing so, they must be aware of the inherent tensions that can exist between protecting consumers' privacy, and enabling them to contribute data that is essential to the development of DDI services they and others will value. These tensions are often articulated as trade-offs, arguing that more innovation requires less privacy and vice-versa. This is not always the case: in some instances, solutions can be found that achieve the desired policy outcomes without harming innovation or competition.

In particular, the specific challenges highlighted in this study suggest the following:[5]

- Data already available in developing countries is relatively scarce, which limits the ability of firms to experiment and innovate specifically for these markets. Policy-makers should consider how to allow more data to be collected, while empowering end-users to make informed choices on how and with whom they share their personal data. In this regard

    — When considering consent regimes, it is important to ensure that they are effective: restrictive consent regimes to protect consumers have well-documented downsides, such as 'choice fatigue',[6] which defeats the purpose of the policy, and the risk of uninformed refusals to give consent (which may be a 'deadweight loss' where everyone is worse off).[7]

5 See Annex C.3.2 for further some examples

6 See, for example, Augenblick, Ned and Nicholson, Scott, *Choice Fatigue: The Effect of Making Previous Choices on Decision Making*, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.175.2560&rep=rep1&type=pdf

7 Additionally, there is a growing body of research suggesting that too much choice may be neither beneficial to society nor appreciated by consumers. See, for example, Schwartz, B, *The paradox of choice* (2005), and Botti, S.

— Clear and transparent information on how data is collected and used may be more appropriate than explicit consent regimes, to avoid the downsides mentioned above. Transparency can be combined with a large degree of control granted to consumers to help them make truly informed choices about their data. This approach should be carefully calibrated however, as it may not be suitable for some types of data (e.g. sensitive personal data) or to some types of processing (e.g. data transfers to third parties that cannot easily be reversed).

- DDI in developing countries is taking forms that differ from services prevalent in developed countries, as they address different needs and constraints. In this context, the ability to invent new approaches and techniques is essential. The greatest benefits from DDI can be obtained if data that is aggregated and anonymised, or pseudonymised,[8] can flow freely, with as few constraints on repurposing as possible, to allow 'serendipitous' innovation to take place. This is because a key aspect of DDI involves finding hidden patterns in data, and extracting value from these. This often happens by combining data from several sources and using it for a new purpose. In this regard:

  — Purpose limitation rules can hinder the combination and repurposing of datasets that are essential to experimentation and innovation with data. Wherever possible, the purpose for which data is collected should be determined freely between end users and firms, based on clear information. In some cases, this may need to be limited, in particular where the repurposing is manifestly against the interest of the end-user.

  — Again policy-makers may justifiably want to reduce the risk of certain harms occurring. A common concern is related to how the combination and repurposing of data could reduce anonymity and lead to re-identification of personal information. It is difficult to see how this could be wholly prevented while allowing innovation to unfold. Instead, data protection policy could seek to ensure that re-identified data is properly treated as personal data, which end-users can control, and limit the potential harms that could stem from re-identification.[9]

- DDI service providers in developing Asia−Pacific face constraints due to the relative scarcity of skills and infrastructure, which tend to be more plentiful in developed markets. Some DDI service providers also depend on customers based across the region and the world to gain scale. Finally, some firms in traditional verticals rely on DDI service providers based in other countries to gain access to the right expertise and innovative service inputs. In this regard:

and Iyengar, S. S., "The Dark Side of Choice: When Choice Impairs Social Welfare", *Journal of public policy and marketing* Vol 25(1), 2006.

8 That is, where specific identifiable information about an individual is removed, but where other characteristics remain associated with a single pseudonym.

9 This may involve strict limitations where sensitive personal data is involved.

— As they work to develop these skills and infrastructure, policy-makers should also ensure that international transfers of data be allowed to take place, subject to appropriate safeguards and enforcement, except in exceptional circumstances.

— Potential harm from international data transfers can be mitigated without banning or overly constraining such transfers. Multilateral agreements and international cooperation can significantly reduce concerns related to the adequacy of data protection overseas (including Privacy Shield, BCR, CBPR etc.). These may be more appropriate and less costly in terms of impact on data-driven innovation than country-specific limitations or outright bans on international data transfers.[10]

— In considering other rationales for limiting international transfers (e.g. national security, industrial policy), policy-makers should be aware of the potential detrimental impact on DDI, including how difficult it may be for domestic firms to access the skills and infrastructure required for a national sector to develop in isolation.

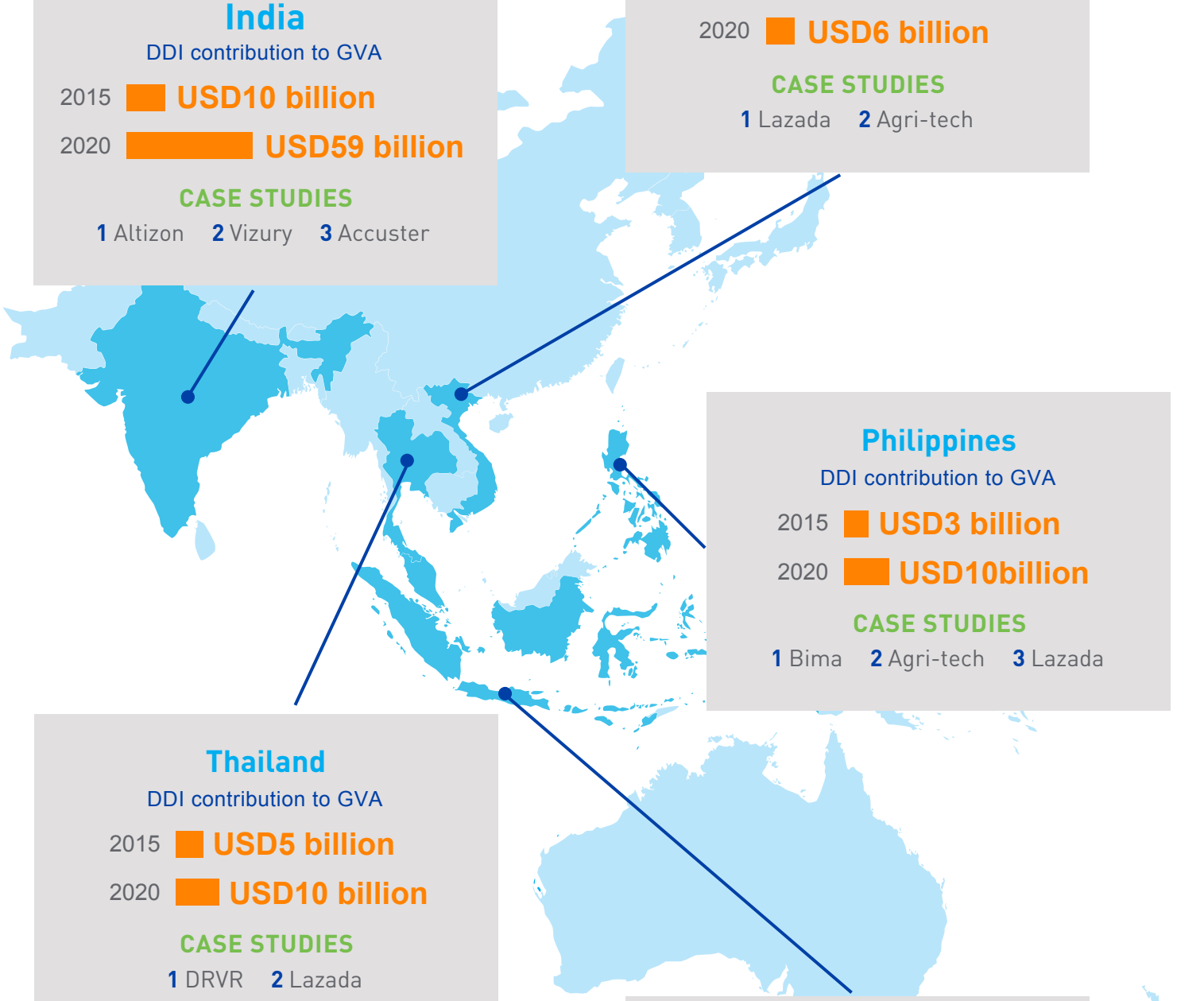
Conclusion

In this crucial period when nearly every government in the Asia–Pacific region is working on setting up modern data protection regimes, it is essential that these regimes are discussed openly and at length, with inputs from civil society and businesses. This will bring to the fore the progress that can be made without trade-offs, as well as informing the trade-offs between the legitimate interests of all parties when they are unavoidable. In turn, this will enable policy makers to make informed decisions that do not unnecessarily hinder DDI.

It is clear that DDI holds substantial potential to help developing countries accelerate their economic and social development. Elsewhere in the world, this development has happened remarkably harmoniously, despite occasional disputes between privacy advocates, governments and businesses. These same economic and social benefits can also be realised in developing Asia–Pacific through clear outcome-oriented thinking, open sharing of expertise and international cooperation.

10 Such schemes may explicitly aim at minimising harms (for example, this is the first principle in the APEC's Privacy Framework), and/or or they may involve provisions ensuring that data processing in general is carried out in a way that is compatible with different countries' provisions (e.g. the APEC's CBPR scheme or the EU's safe-harbour provisions.

DATA-DRIVEN INNOVATION IN DEVELOPING ASIA-PACIFIC: IMPACT ON GROSS VALUE ADDED (GVA) AND CASE STUDIES



India

DDI contribution to GVA

2015 **USD10 billion**

2020 **USD59 billion**

CASE STUDIES

1 Altizon **2** Vizury **3** Accuster

Vietnam

DDI contribution to GVA

2015 **USD1 billion**

2020 **USD6 billion**

CASE STUDIES

1 Lazada **2** Agri-tech

Philippines

DDI contribution to GVA

2015 **USD3 billion**

2020 **USD10billion**

CASE STUDIES

1 Bima **2** Agri-tech **3** Lazada

Thailand

DDI contribution to GVA

2015 **USD5 billion**

2020 **USD10 billion**

CASE STUDIES

1 DRVR **2** Lazada

Indonesia

DDI contribution to GVA

2015 **USD8 billion**

2020 **USD23 billion**

CASE STUDIES

1 Bima **2** Lazada **3** PetaJakart
4 Snapcart **5** Agri-tech **6** Medifi + Konsula

2 Introducing data-driven innovation

This report focuses on data-driven innovation in five developing countries in Asia–Pacific: India, Indonesia, the Philippines, Thailand and Vietnam. Its findings are, to some extent, applicable more broadly: we have tried to explain the current and potential future role of DDI in economies and societies that face fundamentally different challenges to developed countries.

This section sets out the context for this report, by introducing the value chain for DDI and the kinds of services it enables (Section 2.1). We then discuss existing literature on the impact of DDI in developed economies (Section 2.2), before outlining the role and impact of DDI in developing countries in Asia–Pacific (Section 2.3).

2.1 Data-driven innovation is a process through which digital data is analysed and used for economic and social gain

Data on its own is not necessarily valuable, but value can be created by using data in various ways: to innovate; to improve processes; and to make better decisions. In this report, the terms data-driven innovation (DDI) or 'DDI services' are used to refer to the innovative use of data, together with the technical and commercial arrangements that enable economic or social value to be created from this.

The OECD defines DDI as the analysis of large volumes of data, from transactions, production and communication processes, that results in significant improvements of existing, or the development of new, products, processes, organisational methods and markets.[11] DDI can thereby accelerate knowledge transfer and value creation across society.

There are a number of types of data which can all be collected, combined and processed to drive innovation. Data can be classified based on where it originated, whether from individuals, enterprises or government operations. A fourth category, metadata, refers to data which provides information about other data (e.g. when or where it was recorded). Metadata can relate to all the other types of data.

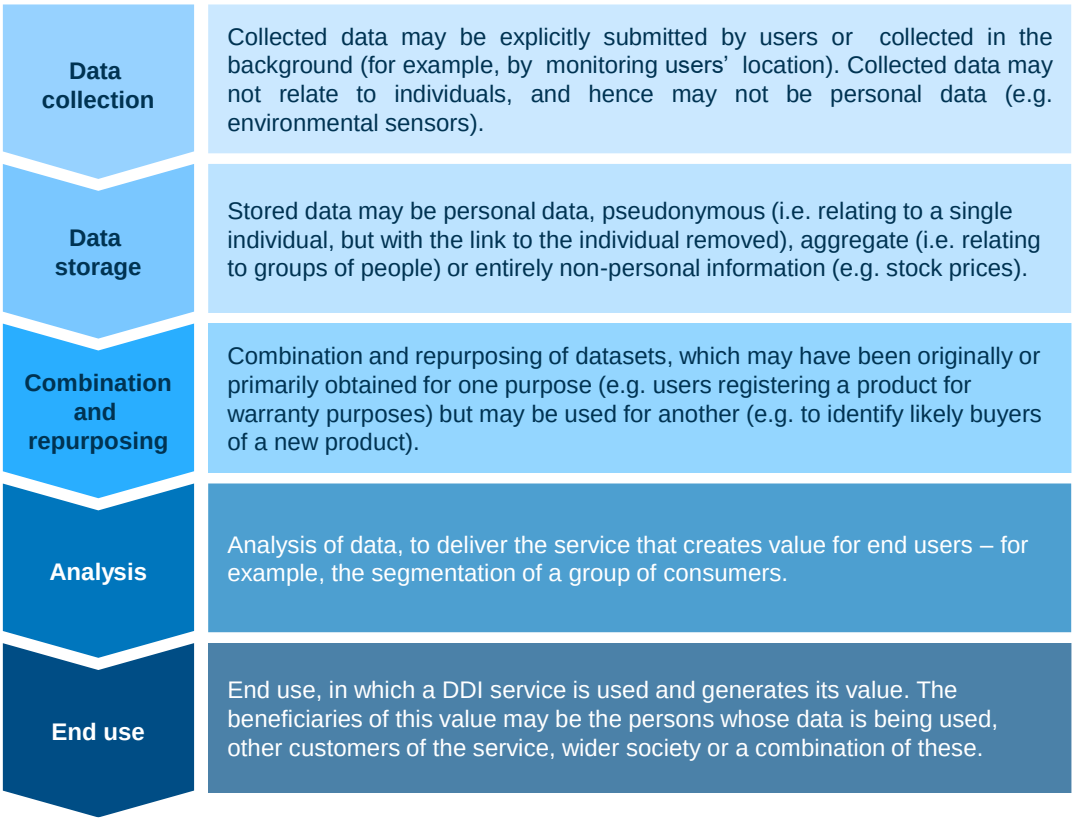
All four of these categories can contain sensitive personal data relating to individuals, Personal data can play a valuable role in DDI, by enabling services to be personalised and targeted more effectively, but it must be treated with care to ensure that individuals' privacy is protected appropriately. Policy makers are increasingly focusing on regulating the collection and use of personal data, with stricter controls on data from which individuals can be identified (sometimes called 'personally identifiable information'), or where the data is sensitive (e.g. relating to issues such as gender, sexual orientation, medical conditions, or political affiliations).

11 *Data-Driven Innovation: Big Data for Growth and Well-Being*, OECD Publishing, Paris, 2015; see http://dx.doi.org/10.1787/9789264229358-en.

Personal data is often aggregated and anonymised, particularly if it is transferred between various parties. Anonymisation techniques bring their own challenges, as they need to ensure personal data cannot be derived from anonymised datasets. This is particularly important in the case of pseudonymous data, where several attributes from a single individual are kept together in a record that is stripped of identifiable information.

Each data-driven innovation or DDI service will contain one or more of the following activities which make up the DDI value chain, shown in Figure 2.1. Various activities can happen in parallel, as for example many analytical techniques dynamically combine data from various sources.

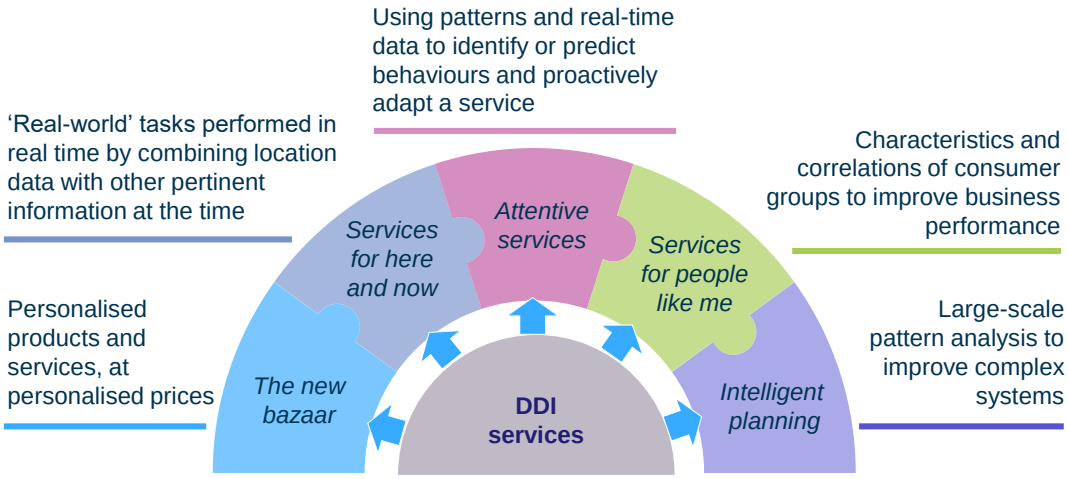
Figure 2.1: Activities in the DDI value chain [Source: Analysys Mason, 2016]



Data-driven innovation is a very varied landscape, with a wide range of applications across many organisations. Below we present an application-oriented taxonomy of DDI services, which categorises them in terms of the value propositions they enable (presented in Figure 2.2).[12]

12 For a more in-depth discussion of this taxonomy, see Analysys Mason: *Data-driven innovation in Japan: supporting economic transformation*; 31 October 2014

Figure 2.2: Taxonomy of DDI services [Source: Analysys Mason, 2016]



Examples of a number of these DDI service types deployed in developing Asia–Pacific are provided in case studies later in this report, as summarised in Figure 2.3 below.

Figure 2.3: DDI case studies index [Source: Analysys Mason, 2016]

Box	Organisation	Industry	DDI service type
Box 3-1	Lazada	e-Commerce	Services for people like me
Box 4–1	Bima	Micro-finance broker	The new bazaar
Box 4–2	Vizury	Big data analytics	Services for people like me
Box 4–3	Snapcart	Data collection	Services for people like me
Box 4–4	Ci-Agriculture, eFishery, Mimosa, CloudFarm, Vinteo	Agriculture	Attentive services
Box 4–5	Altizon	IoT, Big data analytics	Attentive services
Box 4–6	DRVR	Logistics	Services for here and now
Box 4–7	Accuster, Medifi, Konsula	Healthcare	The new bazaar
Box 5–1	PetaJakarta	NGO	Services for here and now
Box 5–2	Unique Identification Authority of India	Public services	The new bazaar
Box 5–3	Indonesia Corruption Watch, Solo Kota Kita	NGO	Intelligent planning

2.2 DDI already contributes materially to the economy of developed markets, enabling efficiencies and the emergence of new services and applications

The OECD's recent report on DDI examines the current state of the industry and the value that DDI unlocks for businesses and individuals, and in meeting broader social goals.[13] It finds, for example, that firms which use DDI have typically raised productivity around 5–10% faster than non-users.[14]

In Asia–Pacific specifically, in-depth research on DDI in a number of developed markets (Singapore, Japan, Australia, New Zealand) has confirmed its role in driving increased gross domestic product (GDP) and consumer welfare, through efficiency gains, increased productivity, lower prices and higher international competitiveness. DDI can provide consumers with better, more customised goods and services, and pricing can be adapted to their circumstances which may increase their willingness to spend. Furthermore, it has been shown that DDI has a wider social angle, in the form of healthcare and education benefits, as well as in delivering better evidence-based government.[15]

In Analysys Mason's study into DDI in Japan,[16] for example, we saw that around a third of companies surveyed used some form of innovative data-driven services, with DDI contributing over 3% of Japan's gross value added (GVA) in 2014. Around half of this impact was in the manufacturing sector, with the highest DDI value resulting from large-scale pattern analysis ("intelligent planning" in Figure 2.2) and services relying on real-time or location data ("services for here and now"). We also found that larger companies were more likely to use DDI than smaller companies.

The overall estimated impact of DDI on GDP in Japan is shown in Figure 2.4 below, along with the results of studies in other developed markets. A clear correlation is visible between the level of adoption of DDI services by businesses, and the impact of DDI on the economy.

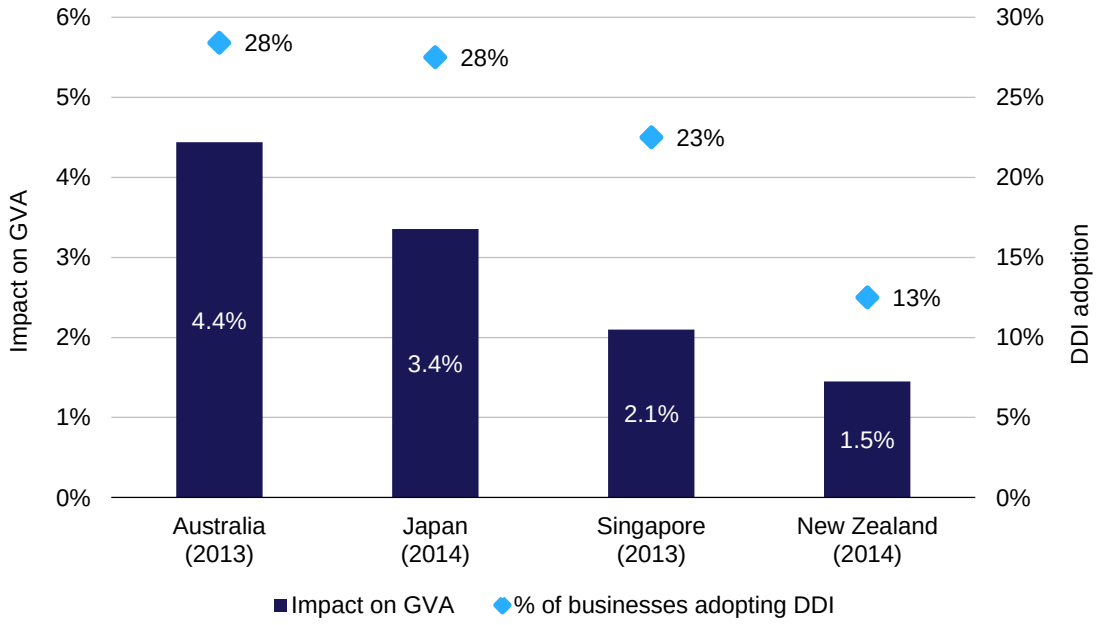
13 *Data-Driven Innovation: Big Data for Growth and Well-Being*, OECD Publishing, Paris, 2015; see http://dx.doi.org/10.1787/9789264229358-en.

14 Based on a literature review which includes a US study by Brynjolfsson, Hitt and Kim (2011), a UK study by Bakhshi, Bravo-Biosca and Mateos-Garcia (2014), and a study based on LinkedIn user profiles by Tambe (2013).

15 Analysys Mason: *Data-driven innovation in Japan: supporting economic transformation*; 31 October 2014. Analysys Mason: *Data-driven innovation in Singapore*, 28 January 2014. Sapere Research Group & Covec: *Data Driven Innovation in New Zealand*, 2015. PwC: *Deciding with data – How data-driven innovation is fuelling Australia's economic growth*, September 2014.

16 Analysys Mason: *Data-driven innovation in Japan – supporting economic transformation*; 31 October 2014.

Figure 2.4: DDI adoption and impact on GDP in developed APAC [Source: Analysys Mason (Japan, Singapore), PwC (Australia), Sapere Research Group and Covec (New Zealand), 2014-2016]



2.3 The focus of this report is the role and impact of DDI in addressing the economic and social challenges faced by developing countries in Asia–Pacific

Although data-driven innovation is increasingly being adopted in developing countries, the market is relatively nascent compared to the developed countries discussed above. At the time of writing we are not aware of studies which examine in detail the impact of DDI on developing countries, in Asia–Pacific or elsewhere in the world. Huge growth in digital technologies is forecast, however, and South-East Asia alone is expected to become a USD200 billion Internet economy by 2025, up from USD31 billion in 2015.[17] This growth will result in far more digital data becoming available, bringing new opportunities for DDI, and new digital businesses ready to exploit them.

Developing countries clearly have economic and social challenges to overcome, but beyond this there are a number of characteristics which make them inherently different from developed countries in terms of DDI and the related environment for information and communications technology (ICT). These include connectivity challenges (both for consumers and enterprises), the predominance of mobile as a means of access to ICT services, and the importance of foreign direct investment in supporting economic growth.

The benefits of DDI in these developing countries represent one way in which ICT and emerging technologies can help these markets to develop, both economically and socially.

17 Source: Google and TEMASEK presentation at *e-conomy SEA* event in May 2016. 'Internet economy' is defined as online retail spend for e-commerce, travel and online media. South-East Asia (SEA) is defined as Indonesia, Malaysia, the Philippines, Thailand, and Vietnam.

From an economic perspective, ICT can help developing countries to rebalance their economies away from subsistence agriculture and labour-intensive industries, to higher value-added activities and a much larger services sector offering employment opportunities to many more people. India's finance minister Arun Jaitley said of the Digital India initiative, "it will empower India by utilising the technology to the foremost […] new job creation will take place and it will probably take India to a much greater height.".

The social aspects are also very important. The UN's Sustainable Development Goals, agreed in September 2015, have a strong emphasis on gender equality, healthcare, education and strong, transparent institutional governance. Open data and innovative applications can support efforts to achieve these objectives and improve the efficiency and effectiveness of public services delivery.

2.4 Structure of this document

The remainder of this document is laid out as follows:

- Section 3 describes the social and economic context in developing Asia–Pacific countries, and highlights how ICT in general and DDI in particular can play a role in fostering more rapid economic development and social benefits.
- Section 4 describes the current landscape for DDI in developing Asia–Pacific through a number of case studies, explains their potential in driving economic and social development, and provides some quantified estimates of the current and potential economic impact of DDI.
- Section 5 discusses the role of the government and policy makers in fostering DDI, by providing openly available data to firms and consumers, using DDI effectively for public-sector activities, and fostering a legal and regulatory data protection environment that stimulates further investment and adoption of DDI.

The report includes a number of annexes containing supplementary material:

- Annex A highlights economic and social challenges common in developing Asia–Pacific.
- 0 includes more details on the methodology used to illustrate the potential economic impact of DDI, based on quantitative studies conducted in developed Asia–Pacific countries.
- Annex C provides a more detailed discussion on the nature of tensions between privacy protection and enabling the economic and social gains of DDI.[18]

[18] Adapted from Analysys Mason: *Data-driven innovation in Japan: supporting economic transformation*; 31 October 2014

3 Innovative uses of ICT, including DDI, can help developing countries' economies grow faster and more sustainably

This section describes the economic and social challenges faced by developing Asia–Pacific countries and governments' efforts to address them (Section 3.1), and discusses the important role that ICT and DDI can play in meeting the economic and social objectives of developing countries (Section 3.2).

3.1 Developing countries in Asia–Pacific all face related economic and social challenges

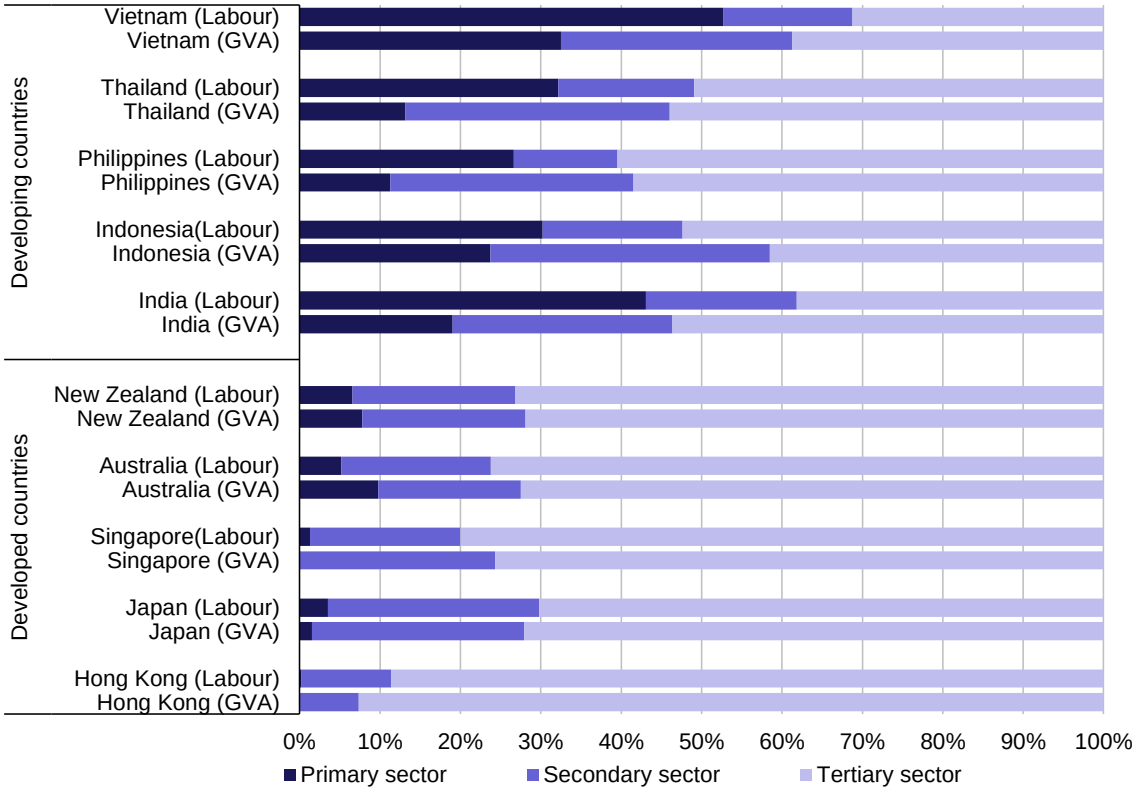
A high share of employment in developing Asia–Pacific countries is in primary and secondary sectors, which have relatively low economic productivity levels

An analysis of the structure of developing Asia–Pacific economies shows a high share of primary sectors (extraction of raw materials e.g. agriculture, mining, fishing) and secondary sectors (e.g. manufacturing or production of goods), with a lower contribution from the tertiary sector (e.g. services, retail and intangible products) than in developed markets. The relatively high dependency on basic industries results in much lower labour productivity than in developed economies, and can hinder the development of a knowledge-based economy.

Figure 3.1 below shows the contribution that the three sectors make to GVA and employment in the five focus countries, compared to that in developed Asia–Pacific countries. Agriculture is a large share of GVA in the focus countries (10–20% of the total), but less than 5% in developed Asia–Pacific economies, and the sector employs a disproportionately high number of people. Mining, another primary sector industry, represents almost 10% of GVA in Indonesia and Vietnam.

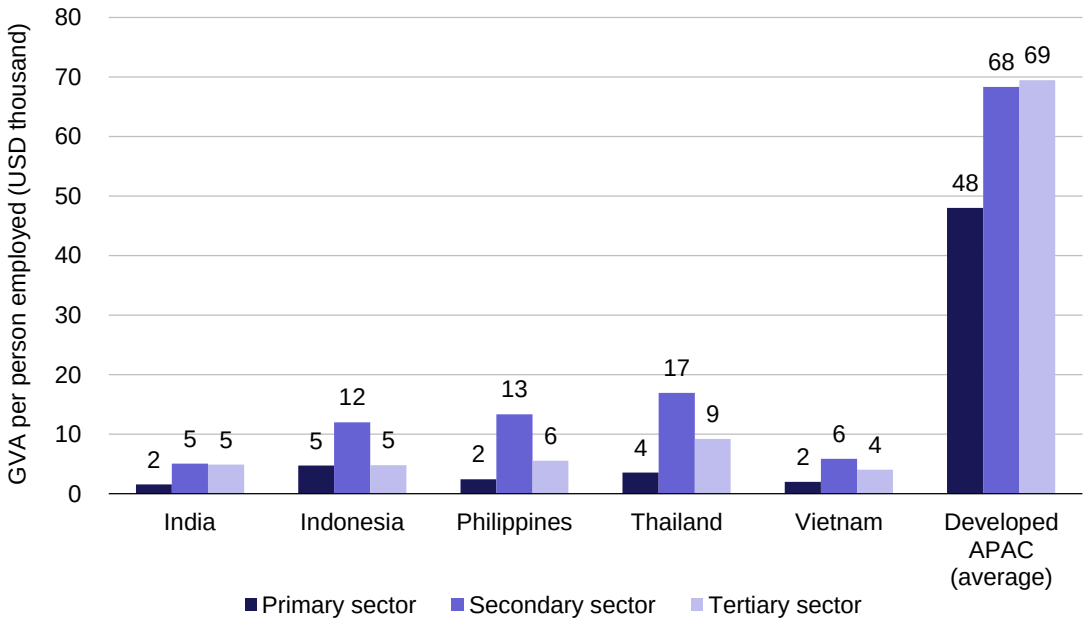
The secondary sector also represents a higher share of GVA than in developed Asia–Pacific, with the tertiary sector less well represented (40–60% of GVA in developing Asia–Pacific compared to 70–90% in developed Asia–Pacific).

Figure 3.1: GVA and employment (labour) breakdown by sector, 2015 [Source: Euromonitor, 2016]



As shown in Figure 3.2 below there is also a noticeable gap in productivity between developing and developed Asia–Pacific countries in most sectors, particularly the primary sector. This indicates an opportunity for potential economic development of the five focus countries, by boosting productivity across all three sectors.

Figure 3.2: Productivity breakdown by sector, 2015 [Source: Analysys Mason, Euromonitor, 2016]



Governments' economic plans rely on investment and skills development, including in the ICT sector, to improve growth through higher employment and productivity

Developing countries in Asia–Pacific face similar advantages and constraints: they are large markets, with low labour costs, extensive natural resources and relatively young populations,[19] but they also have high levels of unemployment and poverty relative to developed countries, limited reach or consistency of healthcare and education, relatively low investment levels and a limited base of skilled labour (see more detail in Annex C).

In planning for economic growth, governments in developing Asia–Pacific countries are therefore focusing on addressing the reasons behind low productivity and trying to rebalance jobs towards higher value-added sectors. This requires employment opportunities to be available, and people to have the right skills for these jobs. It also requires basic infrastructure to be in place, including for transports, utilities and financial services.[20]

As part of their efforts to address the drivers of economic growth, governments have launched several initiatives focusing on the role of ICT development and the digital economy, some of which are illustrated in Figure 3.3 below. The role of ICT, and within this of DDI, is explored further in Section 3.2 below.

19 The percentage of the population below 25 years of age is 46% in India, 43% in Indonesia, 53% in the Philippines, 41% in Vietnam and 32% in Thailand (compared to between 23% to 34% in developed Asia–Pacific countries). Sources: CIA World Factbook; Euromonitor; the World Bank; World Economic Forum (the Global Competitiveness Index).

20 According to the World Bank, over 60% of the population is 'unbanked' in Indonesia, the Philippines and Vietnam, nearly 50% in India and 22% in Thailand, compared to between 0% and 4% in developed Asia–Pacific countries (Source: World Bank Global Financial Inclusion Database, http://datatopics.worldbank.org/financialinclusion/)

Figure 3.3: Examples of government economic initiatives in developing Asia–Pacific countries [Source: Analysys Mason, based on official government policy documents from the markets of interest, 2016]

Country	Initiatives
India	• **Digital India** aims to improve digital infrastructure and connectivity in order to provide access to e-government services across the country, thereby creating new jobs, promoting entrepreneurship and improving the level of social welfare • The **Make in India** initiative encourages local and foreign companies to manufacture products in India • The Prime Minister's **People Money Scheme** aims to increase financial inclusion in the country • Other initiatives to promote entrepreneurship and improve skills include **Start-up India**, **Stand-Up India** and **Skill India**[21]
Indonesia	• The **2005–2025 Long-Term Plan** focuses on agriculture and mining serving as the basis of the economy and on manufacturing becoming globally competitive • The current **Medium-Term Plan** (covering 2015 to 2019) is part of the Long-Term Plan and emphasises competitiveness on the basis of natural and quality human resources • The **Masterplan for Acceleration and Expansion of Indonesia's Economic Development (MP3EI)** sets out a vision to 2025, calling for increases in value-adding, efficiency and productivity of production and distribution[22]
The Philippines	• **Philippine Digital Strategy** promotes the development of e-government, increased Internet accessibility, digital inclusion and education, as well as implementation of ICT in industry and business innovation • The **2011–2016 Development Plan** aims to achieve economic growth through investment in infrastructure, development of human resources, promotion of competition (leading to a boost in employment) and increased access to financial services[23]
Thailand	• Digital policy is set out in the **ICT2020 framework**, which aims to develop ICT infrastructure, promote ICT competence among the workforce and employ technology for government service • These goals are also reflected in the **2014–2018 Information and Communication Technology Master Plan**, which has a target of attaining economic growth through application of ICT[24]
Vietnam	• The **Industrial Development Strategy**, valid until 2025, emphasises the need for agricultural and industrial sectors to be boosted on the basis of skilled workforce, innovation and competition[25] • The **2010–2020 ICT plan** envisions an increase of approximately 10% in ICT's contribution to GDP by 2020[26] • Vietnam's **Master Plan on Information Technology** focuses on developing ICT-competent human resources and implementing information technology in industry[27]

21 See http://digitalindia.gov.in, http://makeinindia.com, http://pmjdy.gov.in, https://http://standupmitra.in, http:// startupindia.gov.in and http://skilldevelopment.gov.in.

22 See http://indonesia-investments.com.

23 See http://devplan.neda.gov.ph and http://icto.dost.gov.ph.

24 UNESCAP: *Asia–Pacific Trade and Investment Report 2015 – Supporting Participation in Value Chains*

25 See http://chinhphu.vn.

26 See http://vietnam-comm.com.

27 See http://moj.gov.vn.

3.2 ICT, including DDI, can have a significant impact on developing countries' economies, and on the delivery of government and social services

Increases in ICT use have been shown to deliver economic and social benefits

Many technology-related factors can play a role in accelerating socio-economic transformation, including increases in digitisation, adoption of ICT and emerging technologies, Internet connectivity, automation and related innovations. A by-product of these trends is a substantial increase in the amount of digital data being created, which creates opportunities for DDI, but also concerns related to privacy and cybercrime. Easier collection of data at scale is potentially important for DDI in developing countries, where data to develop DDI services has historically been scarce in many industries. The innovative processing and analysis of this data can in turn drive further economic or social development through DDI.

ICT and digitisation can have a significant impact on developing economies (see Figure 3.4), and can also support the role of government and other stakeholders in delivering essential social services (see Figure 3.5).

Figure 3.4: Examples of economic impact of ICT and digitisation [Source: Various studies,[28] Analysys Mason, 2016]

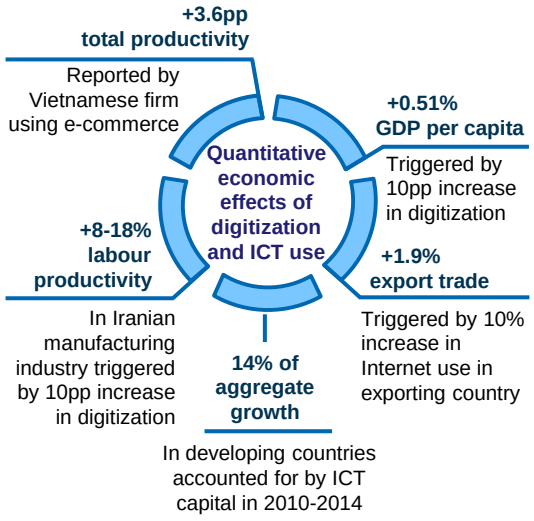
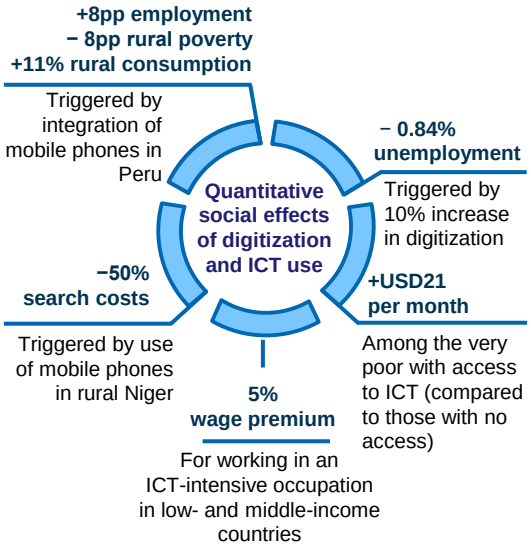


Figure 3.5: Examples of social impact of ICT and digitisation [Source: Various studies,[29] Analysys Mason, 2016]



28 World Bank: *World Development Report;* 2016. PwC: *Maximizing the Impact of Digitization;* 2012. Journal of Industrial Engineering International: *Impact of information technology on productivity and efficiency in Iranian manufacturing industries;* 17 December 2014

29 World Bank: *World Development Report;* 2016. PwC: *Maximizing the Impact of Digitization;* 2012.

ICT and data-driven innovation can accelerate economic transformation

ICT and related DDI impact an economy's GDP, through improvements in productivity, competition, employment and investment levels. These improvements primarily result from four drivers:

- **Increased volume and quality of data:** the availability of data is growing exponentially, driven by increasing Internet penetration (primarily through mobile connectivity in developing Asia−Pacific), digitisation of business processes, and the development of the Internet of things (IoT): an ever-increasing numbers of sensors and actuators connecting via networks to computing systems. This data in turn enables new DDI services, as discussed further in Section 4, and enables organisations to further boost productivity, for example by optimising inventory and supply-chain management, reducing equipment downtime and mitigating risk.[30] For instance, the city of Bangkok is using big data and sensor data to optimise transport systems and improve responses to emergencies.[31]

- **Reduced information asymmetries:** the increased availability of information can also reduce asymmetries in the market, as customers become better informed about prices, available products and services and as businesses increase their awareness of competitors' practices, boosting competition in the market. This also improves supply-chains: a reduction in information asymmetries between firms and their suppliers allows for more informed and efficient supplier choices, reducing costs and risks. For instance, farmers in Bangladesh have been able to cut their transport costs by using market information transmitted by mobile phone.[32]

- **Improved access to markets and new customer segments:** the proliferation of ICT has enabled many developing-market businesses to start trading online, both across borders and to new customer segments in their own markets. E-commerce platforms bring a far greater choice of goods and services within reach of many communities, especially given the relatively limited presence of retail stores in large parts of developing countries. DDI is being used to increase the efficiency of e-commerce businesses and to reach customers more effectively, as illustrated by the case of Lazada (see Box 3-1 below).

- **Greater automation:** the use of digital technologies allows resource-intensive and repetitive processes to be automated, leading to a shift of labour towards higher-value processes and increased productivity.[33] For example, Indonesian banks are focusing on automation of processes and ICT education of their staff to increase labour productivity.[34] Artificial

30 World Bank: *World Development Report 2016*.

31 Again this application is not only relevant in developing countries (Barcelona and other cities are using similar techniques). See Gesellschaft für Informatik: *Big data in logistics*; 18 November 2014. Teradata: *Siemens – Using big data and analytics to design a successful future*; 11 February 2015

32 David Grimshaw and Shalini Kala: *Strengthening Rural Livelihoods – The impact of information and communication technologies in Asia*; 1 January 2011

33 World Bank: *World Development Report 2016*.

34 PwC: Indonesian Banking Survey 2015; May 2015.

intelligence (AI) enables automation of highly complex processes and has potential to greatly increase efficiency. This is a benefit even in highly developed markets: the UK Robotics and Autonomous Systems Strategy references a potential global impact of between USD1.9 trillion and USD6.4 trillion per year by 2025 from advanced robotics.[35]

Box 3-1: Lazada uses ICT and DDI to expand the reach of its e-commerce business across South-East Asia, and to realise operational efficiencies

Lazada is South-East Asia's biggest online retailer, which sells a wide range of consumer goods in Indonesia, Malaysia, the Philippines, Singapore, Thailand and Vietnam. It has made online shopping far more accessible in these markets by offering mobile access and promoting financial inclusion by offering cash-on-delivery payment, thereby reaching new markets for its products.

The digital nature of Lazada's operations provides it with a wealth of data with which to streamline and expand its business. Data is aggregated from a number of sources, such as on operational processes, how customers use the website, deliveries, customer feedback, and customer service interactions. The company uses this data to drive improved sales and targeted marketing techniques such as personalised recommendations and search optimisation, thereby driving growth in sales.

The data is also used to realise cost efficiencies, for example as an input to machine-learning techniques to enable the automation of tasks and processes involved in managing over 15 million products, which were previously highly resource intensive. DDI has enabled Lazada to improve its approach to identifying and combatting fraud, and in future it hopes to use data to drive further efficiency gains in areas such as inventory management.

Emerging technologies and DDI can also support sustainable improvements in public and social services

The adoption of new technologies and DDI can help to address social challenges such as unemployment, poverty and health issues. These improved social outcomes can in turn help to drive further economic growth.

ICT adoption is having a profound impact in three areas:

- **Education:** software and applications can increase the variety and robustness of learning content that is available, and Internet connectivity provides extensive and easy access to it, even in rural areas.[36] Mobile learning projects in the Philippines, Mongolia, Thailand, India

35 UK Robotics and Autonomous Systems 2020 strategy.

36 World Bank: *World Development Report 2016*.

and Bangladesh have delivered positive results by extending access to education to previously unreached communities.[37]

- **Healthcare:** technological developments and data collection and analysis allow for better informed and more accurate preventive, diagnostic and treatment measures, while Internet connectivity establishes a communication network for healthcare specialists and patients.[38] Furthermore, the quality of health services can be improved as doctors save time through the automation of recording of patient information. In India, big data is used to identify patterns consistent with outbreaks of diseases, allowing the government to alert the population about expected epidemics.[39]

- **Government service provision:** digital technologies enable governments to overcome geographical, logistical and administrative hurdles to providing services to citizens. By reaching broader groups of the population it is possible to boost the participation and awareness of the population. ICT implementation can also contribute to the streamlining of government services and increased transparency of government and policy initiatives, though the use of process automation and data collection and analysis.[40] A World Bank study has confirmed the positive impact of ICT implementation in the public sector in India, in terms of travel time and cost savings, as well as an increase in governance and service quality scores.[41] Furthermore, the use of electronic records and digital identities can help governments to be more efficient in providing public services and collecting tax, thereby reducing waste and freeing up resources for investment in education and infrastructure.[42]

Aside from these main areas of social impact, ICT and DDI also have wide-reaching application across a range of issues, including environmental protection, sustainable development, poverty alleviation, natural disaster relief, as well as water, food and energy security.

37 The International Review of Research in Open and Distributed Learning: *Using Mobile Phones to Improve Educational Outcomes – An Analysis of Evidence from Asia*; March 2010

38 World Bank: *World Development Report 2016*.

39 Financial Express: *Big Data Analytics and Indian Healthcare*; 6 November 2015

40 World Bank: *World Development Report 2016*.

41 World Bank: *Impact Assessment Study of Computerized Services Delivery Projects from India and Chile*; November 2007

42 World Bank: *World Development Report 2016*.

4 Data-driven innovation in developing Asia–Pacific could contribute at least USD300 billion in GDP by 2020

What do the data-driven services described above look like in developing Asia–Pacific and what impact is it having? To answer this question, this section provides case studies of innovative services, many of them from small start-ups or 'accelerator'-type structures within larger firms, which are already gaining traction in the five focus countries (Section 4.1). We then propose a qualitative description of the levers through which DDI is having an impact in these countries (Section 4.2), before proposing a simple quantitative illustration of the impact of DDI (Section 4.3).

4.1 What does data-driven innovation look like in developing Asia–Pacific countries?

ICT and innovation are now very much the focus of attention for policy makers around the Asia–Pacific region, because of the potential that they hold for economic and social development. DDI sits at the intersection of these themes, and its development is closely interlinked with the adoption of technology that enables the collection and processing of electronic data.

Asia–Pacific as a whole is already recognised as a leading region for ICT-led innovation. With nearly half the world's population and 44% of the world's Internet users,[43] it is a huge market for technology companies, from telecoms operators to hardware manufacturers, online content and application providers. Many of the world's largest Internet platforms outside the USA originate from China, and they are expanding increasingly aggressively in the rest of Asia, as shown by Alibaba's recent acquisition of a controlling stake in Lazada (see Box 3-1). For investors, a very significant aspect of the region's attractiveness stems from the business growth potential in highly populated markets with large 'untapped' populations. Collectively, China, India and Indonesia represent 40% of the global population, with Vietnam, the Philippines and Thailand all among the top-20 countries in the world by population and all with relatively young populations.[44] There is strong growth potential due to low Internet penetration among the focus countries, especially India and Indonesia at 26% and 22% respectively in 2015.[45]

The landscape of data-driven services in developing Asia–Pacific countries is extremely varied. By interviewing stakeholders across the five focus countries (both people working in DDI start-ups and investment professionals from venture capital firms), we have been able to understand some of the dynamics of this diverse market.

43 International Telecommunication Union: *World Telecommunication/ICT Indicators Database*, 2015.

44 World DataBank: *World Development Indicators*, 2015.

45 International Telecommunication Union: *World Telecommunication/ICT Indicators Database*, 2016.

Figure 4.1 below outlines key drivers of technology adoption and DDI readiness, and illustrates areas in which developing countries face specific challenges. Technology adoption remains broadly constrained by a lack of infrastructure and skills, and a relative paucity of data to feed into DDI services. This last factor, in particular, has created barriers to development such as the difficulty for many people to open a bank account or get insurance, because of the risk for financial institutions associated with a lack of reliable data on people's identity and circumstances.

Mobile phones, and in particular smartphones with larger screens and more powerful software, are helping to overcome the barriers to technology adoption, and use of mobiles is growing rapidly. In fact, many people in developing Asia–Pacific countries rely entirely on their mobile devices to access the Internet, and have no access to computers. This has important implications for DDI:

- The main user interface that many people are used to is a mobile device, with a bias towards graphics rather than text. As a result, mass-market consumer applications must be designed as 'mobile first', and business-to-business applications are following suit, by offering native mobile interfaces to business users (e.g. the fleet management systems offered by DRVR, see Box 4–6).

- Smartphones are by their nature personal devices, with embedded sensors (accelerometers, GPS, etc.) that are well suited to generating a significant amount of data, in real time. This is a very positive driver for DDI given the lack of established databases and the relative paucity of data available to most businesses in developing countries.

In a lot of cases, mobile is the *only* way to obtain data on consumers: even utilities companies cannot provide personal information in semi-rural or rural areas due to lack of infrastructure, or sharing of common infrastructure or utilities meaning they do not have relationships with individual customers (e.g. shared solar panels, community water points). Where national identity schemes exist, they tend not to be mandatory (e.g. in Indonesia and Bangladesh less than 50% of the population is registered in the national ID scheme), and even if they are mandatory, a lot of people do not know their own national ID. Some countries in Asia have attempted to collect biometric and other information from mobile users by threatening disconnection if they do not register, in an effort to develop a more comprehensive picture of the consumer market.

Figure 4.1: Drivers of technology adoption and 'DDI readiness' in developing Asia–Pacific countries [Source: Analysys Mason, 2016]

Driver	Examples of status of drivers in focus countries
Digitisation	The recent World Bank's World Development Report clearly shows a strong correlation between Digital Adoption and GDP.[46]
Internet use	Less than half the population in developing countries in Asia–Pacific had used the Internet in the last three months (from 22% in Indonesia to 53% in Vietnam). In most developed countries, 80%-90% of people are online.[47]
Mobile use	These markets are 'mobile-first' or even 'mobile-only' when it comes to how people connect, and most people do not use large-screen devices such as laptops or PCs. Mobile unique subscriber penetration (removing the impact of multiple SIMs) in the focus countries is relatively high (up to 76% in Thailand but only 48% in India),[48] but still below developed markets where penetration is over 90%).
Connected businesses	The proportion of firms with fixed broadband Internet access is significantly lower than in developed Asia–Pacific countries. In developing Asia–Pacific countries, fixed broadband penetration among firms is typically 20–40%, compared to 85–100% in the region's developed countries.[49]
Network readiness	Thailand's development in terms of network readiness is highest (out of the five focus countries) at 67th position globally, and India has the lowest ranking of the five countries (89th position). Developed Asia–Pacific countries, on the other hand, are all in the top 20.[50]
E-government	Of the five focus countries, the Philippines is highest on the E-government development index (95th position), followed closely by the other markets, with India lowest at 118th position. The focus countries are well behind developed Asia–Pacific markets, some of which are in the top 10, but compare relatively well to other developing countries (e.g. in Africa and South / Central Asia).[51]
Innovation	India, Vietnam, and Thailand are recognised as having outperformed their economic peers (middle-income countries) in terms of innovation in 2015.[52]
Ease of doing business	The Ease of Doing Business Index ranks Thailand highest (49th position) and India lowest (130th position) among focus countries. In 2014, the government of India launched an ambitious programme of regulatory reform aimed at making it easier to do business (e.g. lower minimum capital requirements, simplifications to the procedures for starting a business).[53]

46 In a 2012 report classifying countries in four stages of digitisation (Constrained, Emerging, Transitional and Advanced), the Philippines was the only focus country classified as being in the 'Transitional' stage of digitisation, with others considered 'Constrained'; All developed countries are considered to be in the 'Advanced' stage of digitisation. See Strategy&: *Maximising Impact of Digitization*, 2012.

47 International Telecommunication Union: *World Telecommunication/ICT Indicators Database*, 2016.

48 Note that mobile SIM penetration (including multiple SIM ownership) is over 120% in all focus countries except India, according to GSMA Intelligence.

49 Source: Euromonitor, Vietnam ICT Index 2015 (Ministry of Information and Communications). Data on the percentage of firms with broadband Internet access for Vietnam was calculated from survey data, as a weighted average of province-level data, and equates to 88%. This statistic appears relatively high compared to other developing countries in Asia–Pacific, perhaps due to differences in survey methods.

50 World Economic Forum: *Network Readiness Index 2015*.

51 United Nations: *E-Government Survey 2014*, available at http://publicadministration.un.org/egovkb/en-us/Reports/UN-E-Government-Survey-2014.

52 GII Knowledge Partners: *Global Innovation Index*.

53 World Bank Group: *Doing Business 2016 Report*.

In the insurance sector, Bima (see Box 4–1) saw an opportunity to take advantage of mobile to collect and make use of good customer data to price risks and quote or close contracts in real time.

Box 4–1: Bima is a mobile-based micro-insurance broker which uses innovative approaches to collect and analyse risk data to bring insurance products to many more people

Bima is part of Swedish firm Milvik, which is active in developing countries around the world, including Indonesia, the Philippines, Bangladesh, Pakistan, Papua New Guinea and Cambodia. Its main focus is a pay-as-you-go life insurance product targeted at lower-income families, which allows policies to be registered through mobile phones and paid for with prepaid airtime credit.

As a broker, the company originates policies that are mostly underwritten by established insurers, to which it provides risk profile data to which they did not previously have access. As the customer base expands and policies mature, insurers are able to more accurately price risk and provide fair quotes to people who could not previously be insured, in large part because of a lack of reliable identity and risk-related data.

In addition to insurers, Bima also partners with mobile operators, which provide the payment gateway and a marketing channel, and also data that they have on consumers but are often unable to make use of themselves. Bima uses this data to progressively refine its own risk models, together with data that Bima itself collects (for example, on enquiries and claims). This enables Bima to gain an understanding of consumers based on demographic and geographical characteristics, how they use their mobile phones (e.g. how much they spend, how often they top up their credit) and their claims history.

Overall, the data Bima can get by operating its business has proved much more effective than third-party data that can be purchased or accessed today. Through this iterative approach to risk pricing, Bima has considerably widened access to insurance: 90% of its customers are insured for the first time through Bima.[54] Looking ahead, this approach could be expanded to offer health insurance (which Bima already offers on a small scale) or to offer credit scoring and other financial services to the vast majority of people who are currently unbanked and uninsured.

Once people are online and use the Internet, they can provide personal data to trusted companies in return for useful services. As process automation and machine learning is becoming more common, and as most online behaviour is automatically monitored, there is considerable scope for customisation of services. Consumers can benefit from services being tailored to their individual preferences, in exchange for sharing some personal data.

As in developed countries, the ability to understand the behaviour of consumers across online and offline channels is becoming increasingly important for large firms such as banks, airlines and multi-channel retailers. In developing Asia–Pacific countries, on the one hand the fact that they are mobile driven makes it easier to map individuals to a device (which can be tracked), but on the other hand most offline data is very unstructured and requires careful manipulation to be

54 See http://bimamobile.com/about-bima/about-us-new.

aggregated with online data. Vizury, an Indian company with customers across Asia, is offering these types of services to banks, airlines and other firms (see Box 4–2).

Box 4–2: Vizury applies data-driven techniques to growth marketing in India

Vizury is a start-up based in India, with offices across Asia and the Middle East and operations across the region (including India, Indonesia, the Philippines and Vietnam). The company offers multi-channel marketing insights to companies in four verticals: banking, insurance, airlines and e-commerce. Vizury's main product, 'Engage', is a platform which helps marketers integrate large volumes of data on customer interactions across channels, and derive insight from this data that can then be acted upon through promotion and customer service processes.

Vizury aggregates online data (e.g. information on people's behaviour on the Internet, either on the marketer's website or app, and third-party audience data) and offline data (e.g. customer transaction data not available in an online context). Its proposition for its customers is to improve new customer acquisitions or upselling of products, through this unified view of customer interactions.

As an example, Vizury works with a large Indian bank that has around 30 million customers, a third of whom are active online. The bank brought pseudonymised (i.e. individual records which exclude identifiable information) offline customer data onto Vizury's platform, including transactional data as well as a list of the pre-approved products for which individual customers are eligible (loans, interest rates, etc.). Personalised recommendations can then be offered to the bank's customer next time he/she visits the bank's website or app. Vizury's platform is omni-channel, meaning that the bank could also advertise on other platforms, such as Facebook. Vizury reported that implementing this approach led to a doubling in lead generation for the bank.

In developing Asia–Pacific countries, DDI and other technology-driven innovations cannot rely on the public and institutional funding that is often present in developed markets (e.g. through defence contracts and universities). Instead, innovation happens primarily in the private sector, either in start-ups or within 'accelerator' structures of larger firms. These structures often work closely with outside venture capital firms: for example, Nest[55] has developed an accelerator and outsourced research and development (R&D) model, whereby larger corporations can invest in and become customers for the start-ups it incubates.

Our interviews indicated that venture capital firms regard the ability to collect data as an important differentiator for start-ups, which is consistent with the view held by many DDI firms that there is a lack of available data in the region. Good-quality market research data based on large samples can be difficult to obtain for brands to inform their marketing strategies, but DDI is offering alternatives, as demonstrated by Snapcart in Indonesia (see Box 4–3).

55 See http://nest.vc.

Box 4–3: Snapcart collects real-time purchase data from smartphone users to develop large-scale purchase profile data and analytics for retailers and brands

Snapcart is an innovative, data-driven alternative to market research panels. It incentivises smartphone users to upload a photo of their shopping receipts on a regular basis, by offering small cash rewards.[56] Snapcart's system automatically logs each line of the receipt in its database, and so is able to provide a large database of purchases across its user base. This is complemented by profile data provided voluntarily by users, information from their device (e.g. location), and from third-party tools such as Facebook Connect.

Snapcart launched in Indonesia in September 2015, and since then its clients (brands and retailers) have been using data from 150 000 monthly active users (MAUs) to gain a better understanding of their customers. For comparison, Snapcart estimates that most offline market research panels only contain around 10 000 consumers, so the ability to reach people through their smartphones enables much greater scale.

Around 40% of Snapcart's MAUs upload receipts at least on a weekly basis. This data provides new insight into offline purchases (which make up 98% of total purchases in Indonesia) and real-time information about consumers that retailers and brands can act upon, for example by offering targeted promotions or pushing surveys and video content through Snapcart's app. The data in Snapcart's system is nearly real-time, as users typically upload their receipts on the day of purchase, whereas there can be a 30-day+ delay in obtaining data from traditional market research panels.

Snapcart sees a large potential for growth in Indonesia, which already has 52 million smartphone users and the number is rising quickly.[57] The company is now working with over 80 brands and has gained recognition through multiple awards (Campaign Innovate for Asia–Pacific,[58] Accenture's global Consumer Innovation Award,[59] and the Disrupt 100 list[60]). Snapcart is planning to expand to other countries in Asia, starting with the Philippines in July 2016.

Based on our discussions and interviews, investors consider that the relatively lower level of competition in DDI in developing countries is conducive to investments in this space. Start-ups in each country typically focus on the needs of their home market and challenges. For example, in developing Asia–Pacific countries, several firms are focusing on improving agricultural processes and productivity, which represent a major structural weakness in these countries (see Box 4–4).

56 See http://snapcart.co.id/, http://techcrunch.com/2015/09/02/indonesias-snapcart-turns-the-humble-receipt-into-big-data-for-brands-and-retailers and http://http://techinasia.com/indonesia-ardent-capital-snapcart.

57 As smartphones are becoming more affordable (from around USD50 for a new device) and accessible (via a growing second-hand market).

58 See http://campaignasia.com/article/snapcart-wins-campaign-innovate/404035.

59 See https://newsroom.accenture.com/news/four-companies-receive-inaugural-accenture-consumer-innovation-award.htm.

60 See http://disrupt100.com.

Box 4–4: Agri-tech is developing in Vietnam, the Philippines and Indonesia

In Indonesia, **Ci-Agriculture**[61] aims to improve productivity through DDI by using 'precision farming' (involving sensors, aerial imagery and data analytics). The company has a product which enables analysis of soil conditions, weather and growth progress to inform decisions on when to plant, fertilise or use pest control. Data from these platforms or systems can be used to make predictions about pricing and demand, provide early warnings related to pests or weather, and to determine the best insurance model based on the needs of farmers.

eFishery,[62] another Indonesian start-up, is focused on aquaculture and offers an integrated feeding solution for fish and shrimp farming. The machine is able to feed fish automatically, sense the fish's appetite and adjust the amount of food given to match the appetite. Fish feeding performance can be controlled remotely from a smartphone through the analytics platform, and the product is advertised as being capable of reducing the feeding cost by up to 21%, thereby improving both labour productivity and ultimately profits.

In Vietnam, **Mimosa**[63] focuses on precision farming using IoT technology. It claims to accurately measure the conditions and needs of crops and animals in real time, to improve predictability and increase yields, whilst minimising costs and risks. Data is available to be analysed on a smartphone at any time or place, allowing remote monitoring and control of various functions, which reduces the workload of farmers.

In the Philippines, **CloudFarm**[64] has developed a "Heat Stress Analyser", a sensor connected to a mobile app which measures temperature, light intensity, soil moisture and pH level in the ground. The sensor can help automate the activation of skylights, growing lights, exhaust fans, watering, and other farming components in a greenhouse and thus address the risk of crop heat stress, such as in the early stage of a drought. This technology is especially relevant for weather phenomena such as El Niño, when heat stress may pose a large threat. Research has shown that heat stress was an important reason why crop yields have declined in the Philippines, with over a third of farmers affected.

Other agricultural innovations in terms of automation are also prevalent in the region. For example, **Vinteo**,[65] has a product which automates the process of sampling and analysing the colour, size and shape of the seeds (coffee beans, rice, etc.) produced, in order to choose the best products.

61 See http://ci-agriculture.com.

62 See http://efishery.com/en.

63 See https://mimosatek.com.

64 See http://cloudfarm.cf.

65 See http://vinteoinc.com/seed-analyzer.

4.2 The benefits of data-driven innovation are primarily enabled by achieving efficiencies in business processes, improving productivity and enhancing competition

Due to the lower levels of digitisation and development of the ICT environment in developing Asia–Pacific countries compared to developed countries, there is an inherently lower adoption of DDI. There is therefore significant potential for growth in technology adoption, including DDI services, and over time this is likely to have a substantial economic impact, driving a reduction in poverty and unemployment and facilitating sustainable development.

From existing research in developed countries (particularly Australia, Japan, New Zealand and Singapore), and also by the OECD in its recent report,[66] it is clear that DDI services improve business processes, and in turn outcomes, in many commercial sectors as well as in education, healthcare and government. DDI services enable firms to sell more, and increase productivity and efficiency. These improved economics (wider addressable markets, lower costs) translate into higher profits for firms, better returns for investors, lower costs for governments, and lower prices for consumers.[67]

Manufacturing, transport and logistics are areas where DDI is already having a large impact in developed countries. These sectors are particularly important to developing countries in Asia–Pacific, but they tend to be underdeveloped, and availability of high-quality data is lacking. As a result, automation is limited and monitoring difficult.

There are many examples of data-driven approaches that increase efficiency in manufacturing, by companies around the world.[68] Developing Asia–Pacific countries stand to gain strongly from the development of more automated systems supported by DDI in many sectors because of the shortage of skills in many of these countries, and the global nature of competition. A particular challenge for DDI in manufacturing in developing markets is the relatively old machinery, which may not be appropriately equipped to collect data or act upon analysed data from the manufacturing process.

India is a good illustration of these challenges, as the government is pushing for a rapid increase in digitisation throughout the economy (via the Digital India initiative) and in parallel for more local manufacturing (via Make in India). This is in response to the widely accepted need for improved throughput and quality in the manufacturing sector, but it will require machines to be upgraded and new analytical systems to be established.

Altizon is an India-based company with customers around the world, which is working with manufacturers to implement DDI-driven systems (see Box 4–5). Another interesting example is Perpetuuiti, a company with offices in India, Singapore and the USA, which focuses on AI, machine learning and automation to improve productivity and efficiency in manufacturing.

---

66 *Data-Driven Innovation: Big Data for Growth and Well-Being*, OECD Publishing, Paris, 2015; see http://dx.doi.org/10.1787/9789264229358-en.

67 See in particular Sapere and Covec, *Data-driven innovation in New Zealand*, 2015, figure 1, p.7.

68 See, for example, Komatsu's KOMTRAX vehicle management system in Analysys Mason, *Data-driven innovation in Japan*, 2014, p.24.

Box 4–5: Altizon offers IoT solutions for industry in India and elsewhere to improve productivity, efficiency and quality

Altizon's headquarters are in India, where it launched the Datonis cloud-based platform in late 2013. Datonis allows enterprises equip their machines with 'connectivity kits' that send data to a device management system. This system is itself connected to a scalable real-time analytics engine with alerting and monitoring services. Altizon serves about 100 customers on the platform, 30% of which are outside India (mostly in developed markets such as the USA, Germany, Australia, Norway and Spain).

As an example, a leading auto-component manufacturer in India uses the Datonis platform to track its overall equipment effectiveness (OEE) automatically and in real time and to improve equipment utilisation. Before it used the Datonis platform, the manufacturer calculated OEE using costly manual and labour-intensive methods, which resulted in inaccurate, untimely data. This made it impossible for the manufacturer to react to efficiency trends in real time, and a lack of historical data meant that future throughput trends could not be predicted. Since using Datonis, machine utilisation has improved by 20%. The platform provides visibility of the top reasons for machine downtime and immediate correction of reduced production. In addition, OEE is now calculated automatically, which provides data on process-improvement initiatives on the assembly line and enables better decision-making.[69]

In India, Altizon reports rapid growth in interest in the offerings it provides, with firms starting pilots of automated data-driven systems and using Altizon solutions in multiple plants. Aside from manufacturing, firms active in logistics, asset management, field operations and supply-chain management are also evaluating and deploying solutions using the Datonis platform. These automated systems will ultimately replace labour-intensive solutions, which are significantly constrained by the scarcity of qualified manpower in high-growth industries. They will also set the foundation for advanced machine learning driven solutions that will benefit from the richer digital data.

Logistics and smart transport systems are equally well placed to benefit from DDI in developing Asia–Pacific countries. At present it is difficult for e-commerce firms (such as Lazada) to access and provide their customers with accurate or timely delivery information. This is changing progressively, albeit initially for larger companies, through the adoption of telemetrics and analytics systems (see Box 4–6).

69 See *Altizon Case Study: Machine Utilization and OEE in an Assembly Line Using Datonis™*, available at http://altizon.com/smart-manufacturing-improving-machine-utilization-in-assembly-line-using-datonis-iot-platform-real-time-oee/.

Box 4–6: DRVR makes fleet management accessible to organisations with limited in-house expertise, enabling improved fuel efficiency and vehicle monitoring

DRVR[70] is a fleet analytics platform with customers in Thailand and Myanmar and live pilots in Indonesia and Malaysia. It uses standard telemetric devices to collect data from vehicles, and analyses the data to improve the efficiency of fleets (vehicle performance, driver behaviour patterns, fuel efficiency) and deliver a holistic view of a fleet's performance (or underperformance). This helps to identify areas where costs can be reduced, prevent irregular activity (excessive personal use of vehicles, fuel theft) and pre-empt maintenance before breakdowns. Customers report 10–25% fuel savings for vehicles, based on the impact on driver behaviour alone.

Where DRVR differentiates itself from other fleet-management platforms is in its ability to present insights in a very intuitive way. Traditional fleet-management systems are seen as too complex by many companies which do not have the right skills to make full use of their capabilities. DRVR has therefore adjusted the way that data and insights are shown by taking inspiration from mobile games and other apps (e.g. Line), and hiring games developers. The fleet-management platform can be run entirely from a mobile handset.

Despite its success to date, DRVR faces difficulty in sourcing high-quality real-time traffic and road condition data. Commercial mapping software, including Google Maps, is relatively expensive and incomplete outside major cities, and is not sufficiently accurate or reliable for commercial purposes. At the moment, there are no government or private-sector initiatives on a large enough scale to address the commercial logistics barrier, although this would make a huge difference to the sector if implemented. In turn, the ability to access connected fleet data could enable governments to plan infrastructure projects more effectively and reduce road congestion.

As mentioned throughout this report, DDI can deliver both economic and social benefits in developing countries. Efficient service delivery is an important requirement when public funds are scarce; and better social outcomes, in terms of education, healthcare and financial engagement, can in turn help to drive economic growth. This is illustrated by the examples of Bima in the insurance sector (see Box 4–1 above) and by the many companies that are actively seeking to reduce the cost of accessing healthcare (see Box 4–7).

As such, the role of DDI goes beyond economic growth; it should be seen as a driver for all-encompassing, inclusive and sustainable development, as it has the potential to address poverty and health issues, pollution and energy provision.

70 See http://drvr.co.

Box 4–7: Revolutionising remote healthcare in the India, Indonesia and the Philippines

Developing Asia–Pacific countries are seeing strong interest in DDI applied to healthcare. Although this may seem more relevant to developed countries with ageing populations, in large countries such as India, and in archipelagos (Indonesia and the Philippines), remote monitoring and diagnostics are increasingly important in providing adequate and affordable healthcare to citizens who live in semi-rural/rural areas.

Accuster[71] is an Indian company which designs and manufactures innovative healthcare products, including mobile labs which can be used to provide more affordable diagnostics solutions to remote communities. The labs are typically operated by third party healthcare providers, however Accuster offers a service which collects data over a satellite connection and aggregates this data on a cloud-based patient management solution. This data can be accessed and analysed by healthcare providers and used to provide online health profiles for patients.

The data can be used to monitor the activity of the mobile labs and provides a range of opportunity for analytics and innovation. Accuster is already making aggregate, anonymised data available to external experts in the context of health screening programmes in certain districts of India, so that regional variations can be assessed. As diagnostic data is combined with accurate location data close to where people live, it is hoped it can be used in future to map health issues and healthcare profiles, so that regional abnormalities can be analysed in order to identify causes and inform mitigating actions. The availability of real-time data at scale will also enable local health issues to be tracked, enabling more efficient medical inventory management. Accuster also believes there is the potential for aggregated statistical data to be used by medical colleges and other firms to develop innovative new healthcare solutions.

Medifi,[72] launched in the Philippines in 2014, offers cloud-based health profile data management, two-way video consultations, medical imaging management and messaging services. This helps to address the major imbalance in the ratio of patients to doctors between urban and rural areas of the Philippines.[73] The company is also building in integration with personal health devices and emerging medical sensors (e.g. Fitbit, Jawbone UP, Withings, Apple Watch) to collect data on vital signs automatically and provide a more comprehensive diagnostic experience online. The company has plans to expand into other South-East Asian markets soon.

Konsula[74] is a similar venture based in Indonesia. It offers two products: an online doctor and hospital directory (including information on fees and online appointment bookings) and an online system for medical workers and health facility managers to manage appointments, online patient registration and data analysis. This can improve clinic efficiency, the quality of the service to patients, as well as physician utilisation.

71 See http://www.accuster.com/

72 See http://medifi.com.

73 See http://e27.co/philippines-medifi-enables-telehealth-consultation-doctors-patients-20151123.

74 See http://konsula.com.

4.3 The economic benefits of DDI in developing Asia–Pacific countries could already be USD 100–200 billion in 2015, with a much larger potential as their economies grow

Previous studies have sought to quantify the contribution of DDI to GVA in a number of developed countries. In Asia–Pacific, the studies mentioned in Section 2.2 for Australia, Japan, New Zealand and Singapore concluded that DDI was already used by around a third of firms, and that its impact on GVA, the main component of gross domestic product (GDP), was typically between 2% and 4%.

In developing countries, it is difficult to quantify the impact of DDI through economic research and modelling. Granular industry statistics are often not available in a timely and reliable manner, and most case studies showing a proven, quantified impact are from developed countries.

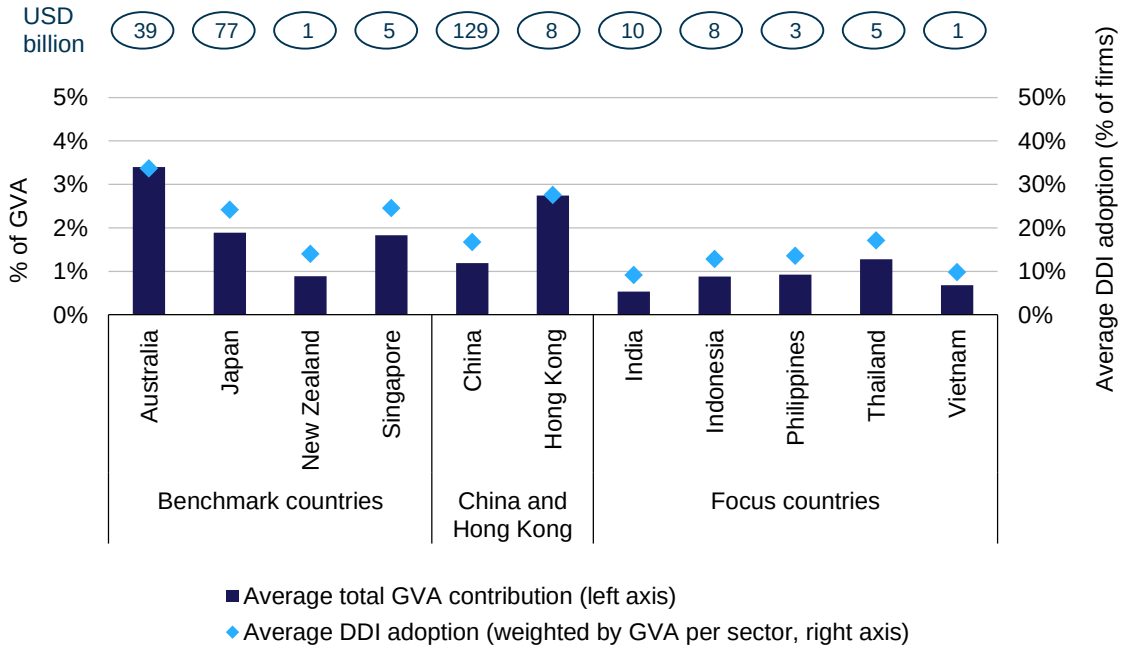
However, it is possible to estimate the size of the economic contribution from DDI on the basis of the benchmarks provided by studies in developed countries mentioned above. These benchmarks must be adjusted to account for the lower level of productivity in developing countries, as well as the relatively lower readiness to adopt and use DDI services compared to developed countries.

Our modelling approach, detailed in 0, looked at seven economic sectors (or 'verticals'): finance; ICT; manufacturing; primary industries; trade; transport & logistics; and health, education & social services. These sectors represent 60–80% of overall GVA in the economy of each focus country, and are those where DDI is likely to have the most impact in the short term.

Our conclusion is that DDI contributed around USD110–210 billion to GVA in 2015 (all values are in nominal USD), for the five focus countries (India, Indonesia, the Philippines, Thailand and Vietnam) plus China, which represent the vast majority of the population of developing Asia–Pacific. Most of the contribution is in China itself (USD90–170 billion), with the remainder (USD20–40 billion) in the five focus countries.

In most of the focus countries, this represents between 0.8% and 1.7% of GVA in the selected sectors (compared to developed-country benchmarks of 1.5% to 5.7%). The economic contribution of DDI in these sectors alone represents between 0.5% and 1.3% of the *total* GVA in these countries (compared to between 0.9% and 3.4% in the benchmark developed countries). In other words, DDI as a proportion of GVA (and therefore, broadly, GDP) in developing Asia–Pacific countries is about half what it is in the region's developed countries, as illustrated in Figure 4.2 below.

Figure 4.2: GVA contribution of DDI in 2015 [Source: Analysys Mason, 2016][75]



This figure also shows that the level of DDI adoption in developing countries is estimated at between 10% and 20% of firms, although this is difficult to gauge with confidence given the importance of the informal economy and independent labour in developing countries.

The difference in DDI impact is driven chiefly by lower adoption of DDI in developing countries, which we have estimated on the basis of the relative productivity in different sectors, with a higher productivity suggesting a higher adoption of digital services, including DDI.[76] This approach is described further in 0.

It is important to note that this lower impact of DDI as a percentage of GVA (and hence GDP) is compounded by the much lower GDP per capita in developing countries (GDP per capita in developed countries typically exceeds that in developing countries by a factor of 10 or more). As a result, the impact of DDI in Japan (estimated at between USD50 billion and 100 billion) was around two thirds of the impact in China, despite the vast difference in population between the two countries (127 million vs. 1.37 billion in 2015), and significantly higher than the combined impact in the five focus countries (with a combined population of 1.8 billion).

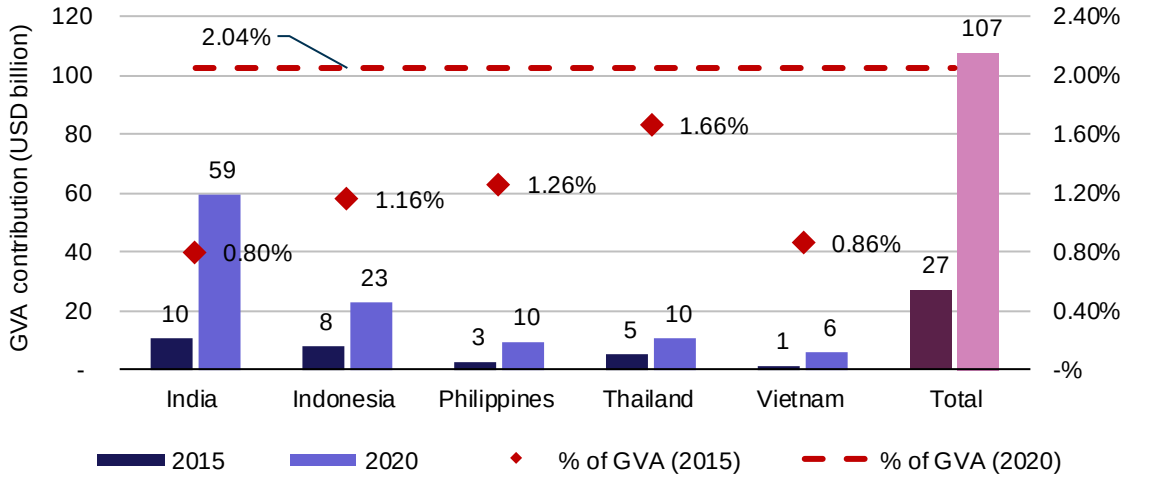
As developing economies in Asia–Pacific grow over the next few years, digitisation will increase and the impact of DDI will also grow significantly. For illustration, if developing countries in Asia–Pacific could reach the same level of DDI adoption in 2020 as that of developed countries in

75 Estimates for 2015 contribution in benchmark countries are based on the relevant reports sourced above and Analysys Mason's estimates of the evolution since the year of reference for each report.

76 We have used the relationship between GDP per capita and digital adoption by businesses documented in the recent World Bank World Development Report 2016, applied to a notional GDP per capita, corrected for the relative productivity in a given sector compared to the economy as a whole.

2015, based on their expected GDP growth,[77] the impact of DDI could reach USD300–560 billion in 2020,[78] of which USD75–140 billion would be attributable to the five focus countries.[79] Figure 4.3 below shows the average contribution made to GVA by DDI for each of the focus countries, and for the five focus countries as a whole. Arguably, these benefits significantly understate the potential benefits of DDI, because it can act as an accelerator of development that enables the emergence of 'multiplier effects'[80] throughout the rest of the economy.[81]

Figure 4.3: Potential growth in GVA contribution of DDI by 2020 [Source: Analysys Mason, 2016]



In order to fulfil this potential, many different elements must come together, of which some stand out from our research and interviews:

- DDI services must be developed or tailored to the needs and constraints of firms and consumers in developing countries (see for example how DRVR is adapting its interface to be 'mobile-first' and highly intuitive in Box 4–6).
- Much more data needs to be collected and processed. This requires machinery to be adequately instrumented with sensors and actuators (see what Altizon is doing in Box 4–5). It also requires reliable, high quality personal data to be available to firms (see for example Bima's approach in the insurance sector in Box 4–1).[82]

77 Based on projections by Euromonitor.

78 Average: USD427 billion.

79 Average: USD107 billion.

80 Defined by the Oxford Dictionaries as "A phenomenon whereby a given change in a particular input, such as government spending, causes a larger change in an output, such as gross domestic product".

81 For example, lower costs can be passed on to consumers, and the money saved can be allocated to other purchases and investments, which would drive economic growth further.

82 See also Box 5–2 in the next section for a discussion on digital identity in India

- Data that is already being collected by the public sector, including the government, public companies and (in some countries) the military (e.g. geographic and traffic data), should be made available as broadly and freely as possible to support innovation in the private sector.

- Many more people must be equipped with the skills to develop, deploy and operate DDI services in the medium term (as a result of deliberate investment in education and professional development).

- In the short term, it may be necessary to rely on skilled professionals and firms based elsewhere in the world (for example, several interviewees rely on cloud services based in Singapore and outside Asia for storage, processing capacity and analytics).

In the next section, we explore how all these drivers can be enabled by supportive, forward-looking government policies.

5 Policy makers in developing Asia–Pacific have a role to play in fostering DDI

Governments and policy makers should take an active role in ensuring that the potential of DDI is realised as far and as quickly as possible. Broadly speaking, governments can support DDI in three ways, which we explore in this section: they can use data to define, execute and monitor public policy and services (Section 5.1); they can provide data to other stakeholders (Section 5.2); and finally they can regulate how other stakeholders collect and process data in the context of DDI and ensure that education and skills develop to match the need of DDI (Section 5.3).

5.1 Governments and the public sector can use DDI to further their policy objectives

Delivering public services in an efficient and effective way is a challenge for all governments. It is particularly difficult in developing countries,[83] where tax revenues are typically relatively scarce and where public expenditure is often skewed towards subsidies for farming and basic necessities such as fuel.[84]

In this context, governments and public-sector organisations can benefit from DDI, by harnessing data from private-sector companies and individuals to supplement qualitative, statistical and geographical information they possess. This data can provide tangible insights that can be used to plan policy interventions or to support the efficient delivery of public services in areas such as disaster relief, education, healthcare, food and crop subsidies, among others.

Much has already been written about the potential for governments to use data, particularly in the OECD[85] and in developed Asia–Pacific countries.[86] Developing countries face great challenges in actually collecting useful data, but stand to benefit greatly if DDI enables them to respond more effectively to issues which they are exposed to, such as seismic and flooding risks (see Box 5–1 below for an example of real-time data-driven flood management in Indonesia).

83 See, for example, World Bank: *World Development Report: Making Services Work for Poor People*, 2004.

84 Fuel subsidies are not generally considered to be good policies, but they are still in place in several countries and are politically difficult to phase out. They cost nearly 15% of the state budget in Indonesia in 2014, before they were effectively abolished (see http://www.bloomberg.com/news/articles/2014-12-31/widodo-makes-biggest-change-to-indonesias-fuel-subsidy-system); in India, farming and fuel subsidies cost over USD55 billion, about 20% of total expenditure in 2014–15 (see https://india.gov.in/spotlight/union-budget-2014-2015, http://www.livemint.com/Politics/OQaYOOKMJcCNNliEV6SWTJ/India-to-spend-37-billion-on-major-subsidies-in-201516.html and http://www.wsj.com/articles/farm-subsidies-put-india-in-bind-1462121185).

85 *Data-Driven Innovation: Big Data for Growth and Well-Being*, OECD Publishing, Paris, 2015; particularly Chapter 10, *Governments Leading By Example With Public Sector Data*, p.407 and following (see http://dx.doi.org/10.1787/9789264229358-en).

86 See the already cited reports from Analysys Mason, PwC and Covec / Sapere

Box 5–1: Indonesia uses PetaJakarta as a platform for flood management

Launched in 2014, PetaJakarta maps real-time information about floods in Jakarta provided by members of the public and organises this information online to be used by communities and authorities to take appropriate action in the event of flooding.

Flood-management capabilities are necessary due to the city being subjected to severe and frequent life-threatening flooding. Flooding patterns can change by the hour, and accurate live data is therefore crucial for adjusting the disaster response.

PetaJakarta benefits from Jakarta's status as the 'Twitter capital' of the world, by soliciting information about location and severity of floods from the city's residents in the form of tweets. This information is then presented in the form of a map, which allows first responders and emergency services to plan city-wide action and helps citizens avoid flooded areas.

The National Disaster Management Agency (BPBD)[87] uses the social media information from PetaJakarta to augment government-produced population distribution data, as well as socio-economic, weather and topographical data. The result is a comprehensive visualisation of the situation, which is used to guide responders.[88]

Another important benefit of DDI for governments is its potential to increase transparency, reduce opportunities for corruption, enhance the personalisation of public services, and improve the targeting of welfare benefits and subsidies towards the intended recipients.[89] Being able to identify citizens is a precondition for delivering many of these benefits. In India, citizens are being identified using Aadhaar (see Box 5–2), which may well now be the largest-scale digital identity system in the world.

87 See http://www.bnpb.go.id/; the BNPB also has a data portal that reports statistics on natural disasters, http://dibi.bnpb.go.id/

88 www.petajakarta.org; 2015 World Disasters Report; The Economist – Mapping a flood of new data

89 See for example Pepper and Garrity: *ICTs, Income Inequality, and Ensuring Inclusive Growth*, in World Economic Forum, *Global Information Technology Report*, 2015

Box 5–2: The Aadhaar national digital identification system allows every citizen in India to have a secure digital proof of identity

Aadhaar is a unique ID number that the Unique Identification Authority of India (UIDAI) aims to assign to every Indian citizen. It is estimated that Aadhaar covered about 80% of Indian citizens by June 2016. Prior to the initiative, 400 million Indian citizens, mostly the very poor, were unable to participate directly in many parts of the economy and society due to lack of official identity records. Furthermore, the absence of a robust and comprehensive national identity system facilitated identity theft, as well as corruption and embezzlement within government, which was a drain on funds allocated for subsidies etc.

UIDAI lists the following uses for the Aadhaar system in relation to welfare and social benefits:[90]

- *Welfare and public distribution* – digital access to government services including food grains, cash subsidies, wages, education, health benefits, etc. Middlemen are eliminated, reducing theft and corruption within the service delivery.
- *Financial inclusion* – Aadhaars help credit checks and risk management and enable more people to open a bank account
- *National register of citizens* – Aadhaars can be used to issue passports, identify voters during elections and create a database of Indian citizens, which also helps control illegal migration

In addition, UIDAI envisages uses of Aadhaar in the private sector (e.g. for telecoms and eCommerce services). Despite the controversy that remains on these types of applications,[91] major telecoms operators (Vodafone and Bharti Airtel) reportedly started using Aadhaar for new mobile connections in August 2016.[92]

Our interviews suggest that companies in developing Asia–Pacific see the lack of reliable digital identity records as a barrier to DDI, and as a result consider that the Aadhaar initiative is helping to significantly reduce fraud and corruption, and resulting in significant efficiency improvements. There are legitimate concerns regarding protection of privacy in the process of collecting and processing Aadhaar data,[93] although these are common to all large-scale identity projects.

90 The South Asia Institute: Unique Identification Project for 1.2 billion People in India

91 See for example the following articles http://indianexpress.com/article/opinion/columns/why-supreme-court-judgment-on-aadhaar-calls-for-an-appeal/ and http://indianexpress.com/article/opinion/columns/aadhaar-rights-and-the-state/

92 See http://telecom.economictimes.indiatimes.com/news/bharti-airtel-vodafone-idea-to-issue-new-mobile-connections-using-aadhaar-ekyc/53725899

93 See for example http://www.thehindu.com/opinion/lead/lead-article-on-aadhaar-bill-by-chinmayi-arun-privacy-is-a-fundamental-right/article8366413.ece

5.2 Governments and the public sector have privileged access to a wealth of essential data, which could be made available to the private sector to support DDI

The Aadhaar project illustrates the role of governments as both users and providers of data. Governments and other public-sector organisations typically collect, store and process very large datasets as part of the services they run, for examples roads and transport, healthcare, education, policing and defence. The OECD lists 15 policy domains in which public-sector data is relevant, and many governments are developing the capabilities to share more and more data, both internally within government but also with the private sector and with citizens.[94]

This shared government data is often referred to as 'open data', which is machine-readable, freely available information that has the potential to unlock social and economic value. Examples abound, including: the use of data in Singapore to map dengue outbreaks; public records of government contracts in Slovakia to tackle corruption; a public–private partnership in Mexico to share school performance data; and a start-up in the USA providing detailed demographic and business statistics at a hyper-local level to improve information for businesses.[95]

Despite increases in the provision of open data, the OECD reports a number of challenges that many governments face in making more data available. Even in developed countries, institutional, organisational, policy, funding and technological challenges beset a majority of governments. These difficulties are typically even greater in developing countries, where funding and technical skills are relatively scarce.

In developing Asia–Pacific, and in the five focus countries in particular (see Figure 5.1), government open-data initiatives have gained some traction, helped by the availability of tools such as CKAN.[96]

Figure 5.1: Regulation of open-data initiatives in the focus countries [Source: government data portals, Analysys Mason assessment based on public statements, 2016][97]

Country	Entities involved in regulating open-data initiatives	Portal	Government support
India	Ministry of Science and Technology	https://data.gov.in/	Open data portal and open data policy
Indonesia	President's Delivery Unit for Development Monitoring and Oversight (UKP-PPP)	http://data.go.id	Open data portal but no specific policy

94 Economic and business information, geographical information, legal system information, meteorological and environmental information, social information, traffic and transport information, tourist and leisure information, agricultural, farming, forestry and fisheries information, natural resource information, scientific information and research data, educational information and content, public order and safety information, defence (including military), political information and content, cultural information and content; see OECD, 2015, op. cit.

95 See www.odimpact.org.

96 See http://ckan.org/.

97 High: open data portal and open data policy in place; Medium: open data portal in place; Low: no open data portal

Country	Entities involved in regulating open-data initiatives	Portal	Government support
Philippines	Task force: • Office of the Presidential Spokesperson • Presidential Communications Development and Strategic Planning Office • Department of Budget and Management	http://data.gov.ph/	Open data portal and open data policy
Thailand	Ministry of Information and Communication Technology Electronic Government Agency	https://data.go.th	Open data portal but no specific policy
Vietnam	No open data initiatives identified	N/A	No open data portal or policy

The open-data portals that are available in developing Asia–Pacific lag behind those in developed countries, but rapid progress is being made: the Philippines quickly improved its ranking across a variety of open-data metrics, and Indonesia was the biggest climber of the Open Data Barometer ranking in 2015, due in most part to development of an open data portal.[98] The Philippines and Indonesia are part of the Open Government Partnership, an international platform consisting of 69 countries which promotes making governments more open and accountable to citizens.[98]

Open data in itself can be difficult for individuals and firms to make use of, and therefore the existence of appropriate application programming interfaces (APIs) is an important factor in transforming open data into DDI. In the region, India has the most developed set of APIs (135 API-accessible datasets in the portal). Other countries have few or no APIs exposed on their portal, although they do make data available in a machine-readable format (e.g. XML and JSON).

Figure 5.2 shows the availability of data published in the five countries across multiple categories. Despite the widespread availability of data on almost all of the surveyed topics, not all of it is available free of charge and very little of it is licensed to be used and reused freely. It shows that the restrictions still in place on the usage of government data seem to be a persisting obstacle to realising the full potential of using public data for DDI.

Figure 5.2: Open-data characteristics [Source: Analysys Mason, Open Data Barometer (ODB), 2016]

	India	Indonesia	Philippines	Thailand	Vietnam
ODB rank (out of 92)	38	40	36	62	57
Crime	○ ⊘ ●	○ ⊘	○	○	
Education	○ ⊘	○ ⊘ ●	○ ⊘		○ ⊘
Elections	○	○	○	○	○
Environment	○ ⊘	○ ⊘ ●	○ ⊘	○	○ ⊘
Health	○ ⊘	○	○	○ ⊘	

98 Open Data Barometer; see www.data.gov.in, www.data.go.id, www.data.gov.ph and www.data.go.th.

	India	Indonesia	Philippines	Thailand	Vietnam
ODB rank (out of 92)	38	40	36	62	57
Trade	○ ⊘	○ ⊘	○	○ ⊘	○ ⊘
Census	○ ⊘	○ ⊘	○	○ ⊘ ●	○ ⊘
Corp. registry	○	○ ⊘ ●	○	○	○
Gov't budget	○ ⊘	○	○ ⊘ ●	○	○ ⊘
Gov't spend					
Land ownership	○	○			
Legislation	○	○	○	○	○
Map data	○ ⊘	○	○ ⊘		
Public contracts	○	○	○ ⊘ ●	○	
Transport	○ ⊘	○ ⊘	○ ⊘	○	○

Key: ○ = data available; ⊘ = data available free of charge; ● = data openly licensed (anyone can use it)

There are few high-profile instances of government data use for commercial purposes, and indeed interviewees suggested that governments in developing Asia–Pacific must do more to make data available, particularly in real time and through APIs. Examples of open data being provided to non-governmental organisations (NGOs) and directly to the public are shown in Box 5–3, demonstrating that facilitating public–private partnerships in respect of data could be beneficial for the economy and society.

Box 5–3: Use of government data by civil society organisations and citizens in Indonesia

Uncovering cases of corruption – the Indonesia Corruption Watch (ICW) consolidates data from the Indonesian procurement agency, LKPP, on an open website, allowing users to view and analyse data on procurement contracts. ICW has also developed an algorithm that can be applied to procurement contracts to identify those which are likely to be fraudulent. This information is used by CSOs, media and members of the public to conduct further investigations and draw attention to government units involved in corrupt practices.[99]

Developing tools for citizen planning and advocacy – Solo Kota Kita (SKK) is a non-profit project aiming to provide information to residents of Surakarta, Indonesia ahead of the annual participatory budgeting process. The main tool developed by the project team is the "mini atlas", a poster created using government-provided data, which provides a visualisation of demographic, social and economic patterns and explores metrics such as water supply, sanitation, health, poverty and housing status in individual neighbourhoods. SKK supplements government data with data from an SMS survey of residents, and then uses the combined information to engage with local government, for example during budgeting discussions.[100]

5.3 A balance must be struck between protecting the protecting end-users' privacy and encouraging the development of DDI

Motivated by the significant potential that DDI offers for economic value creation, policy makers around the world have been taking steps to ensure that DDI can reach its full potential. With the emergence of more IoT sensors and applications, and the prevalence of personal mobile devices in Asia–Pacific, the potential for DDI is increasing, but so are consumer concerns about privacy.

Government action with regard to data is often motivated not by a desire to encourage DDI, but in response to concerns about risks related to privacy, crime prevention or national security. These concerns are important and cannot be ignored.

The challenge is thus to reconcile the tensions between an ambition to foster DDI, and the need to continue protecting important public interests. The broad aims and desired outcomes of both objectives are not fundamentally in conflict with one another. This means that it should be possible to design policy regimes that reconcile these two aims. In previous reports on DDI, we have provided a detailed framework for considering the impact that policy decisions will have on the data value chain, and hence indirectly on DDI.[101]

In developing countries, governments must be mindful of the specific drivers and needs of DDI, and also of the impact of compliance costs for smaller firms (SMEs, start-ups) in a complex

99 See *Reboot – Open data does not equal open government (available at* www.antikorupsi.org).

100 See www.solokotakita.org.

101 For ease of reference, this discussion is replicated in Annex C, which is a slightly revised version of Section 5 from Analysys Mason's report on *Data-driven innovation in Japan*, 2014.

regulatory regime. 'Light-touch' mechanisms, such as self- and co-regulation, transparency and market forces, can help achieve desirable outcomes at an acceptable cost. This is particularly relevant in developing countries, where data protection regimes are very recent or not yet place, and regulatory capability are necessarily limited.[102] In these countries, light-touch, market-driven mechanisms also help avoid high compliance costs and regulatory risk, which would compound business risk[103] that is already typically higher than in developed countries.

'Enabling' and 'constraining' policies work together to foster trust in the collection and processing of data, protect consumers and encourage innovation

Some policies, including open data and APIs and funding for innovation, are 'enablers' of DDI, whereas others could constrain it.

The broad principles that data protection regulation, laid out in documents such as the OECD's *Guidelines on the Protection of Privacy and Transborder Flows of Personal Data*,[104] include requirements that personal data be collected for specific purposes, and that this data should be obtained lawfully and with the knowledge or consent of end users. The guidelines also specify that personal data should be held securely and that the organisations collecting and processing the data ('data controllers') be accountable for complying with these principles. A key principle relates to 'individual participation', which implies the ability for an end user to access the data that is held about them, and to have a degree of control over this data.[105]

These principles are implemented in details in the various data protection laws and regulations that prevail. Internationally, the European data protection regime is regarded as one of the most sophisticated and comprehensive in the world today. The European General Data Protection Regulation (GDPR) was enacted on 24 May 2016 but comes into force on 25 May 2018. Importantly, the EU regime has evolved over a period of 20 years, in tandem with rapid growth of the Internet and online services in Europe as well as other forms of direct marketing.

In many other countries outside the EU, governments have opted to apply lighter-touch regulation. These countries have agreed that fewer restrictions on the processing and use of data are more

102 In developed markets, light-touch regulation also plays a role in limiting the extent to which explicit enforcement action needs to be taken by data protection authorities, given the very large amount of data processing that is happening.

103 Defined as a combination of financial, legal and operational risks; risk is higher in developing countries because of uncertainties about the size and growth of the market, potential weaknesses in the currency, governance issues, etc. See for example World Bank: *Doing Business reports*, http://www.doingbusiness.org/reports/global-reports/doing-business-2016.

104 See http://www.oecd.org/sti/ieconomy/oecdguidelinesontheprotectionofprivacyandtransborderflowsofpersonaldata.htm

105 For example, Google offers a range of services that comply with this principle, such as My Activity, or https://aboutme.google.com for example, as well as the ability to download and port personal data to other providers

beneficial for encouraging innovation. These include developed countries such as Singapore, Japan, the USA, and the vast majority of other developing countries.[106]

Governments in developing Asia–Pacific are mindful of the importance of an adequate data protection framework, but much remains to be done

In developing Asia–Pacific countries, the legislative and regulatory landscape is still nascent: several countries have no so-called 'horizontal', or general, data protection law, others have consulted on legislative instruments that have not yet been finalised, and the Philippines is currently consulting on secondary legislation after the recently appointed National Privacy Commission started work in March 2016. In total, Conventus Law reports that 11 countries in the region have recently adopted new regulations.[107] This demonstrates that many governments in the region are aware of the need to ensure a suitable data protection regime is in place and are acting to ensure this.

Government action addresses two distinct issues. First, government must respond to concerns among consumers and civil society (including but not limited to privacy and human rights advocates) regarding the protection of personal data, and the risk that individuals could be exposed to crime involving data (e.g. identity theft and financial fraud). Second, and equally importantly, they see a need to bring their legal framework in line with international practice,[108] to provide clarity to firms already operating domestically, as well as an adequate environment to support fast-increasing cross-border data flows. So far, the data protection regimes in many developing Asia–Pacific countries are relatively basic, but a number of them are in the process of establishing more comprehensive arrangements:

- **India** amended its Information Technology Act in 2008 to include a new set of rules, the "Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules", which came into force in 2011. Although regulators and ministry such as the Reserve Bank of India (RBI) and the Department of Telecommunications (DoT) have published sector-specific guidelines, there is currently no national regulatory authority for data protection or specific legislation regarding data protection. Since 2014, a draft 'Right to Privacy' bill has been in development based on recommendations from the Group of Experts on Privacy led by Justice A.P. Shah.[109] The Indian government has proposed or enacted regulations that appear to some commentators to be relatively restrictive, including on the use of geospatial data, which is essential to many DDI services.[110] The government's

106 Two notable exceptions are Uruguay and Argentina, whose data protection regimes are judged 'adequate' by the EU; that is, the processing of EU personal data can be carried out without restrictions under the laws of these countries.

107 See http://www.conventuslaw.com/report/2016-data-protection-and-cyber-security-regulation/.

108 As evidenced by the provisions in the draft regulations currently being consulted on in the Philippines, for example.

109 See http://planningcommission.nic.in/reports/genrep/rep_privacy.pdf and http://cis-india.org/internet-governance/blog/leaked-privacy-bill-2014-v-2011

110 See the Geospatial Information Regulation Bill, 2016, and The Geospatial Information Regulation Bill, 2016, available at http://www.prsindia.org/uploads/media/draft/Draft%20Geospatial%20Bill,%202016.pdf

Aadhaar initiative (discussed in Box 5–2) brought privacy discussions to the fore, and the Aadhaar Law contains provisions to protect the privacy and integrity of Aadhaar data.

- **Indonesia** published the "Draft Data Protection Law" in July 2015, and there are plans to submit this to the House of Representatives for discussion in 2016, with the pre-existing Central Information Commission responsible for enforcing the law.

- The **Philippines'** first data privacy law, the Data Privacy Act, came into effect in September 2012 and is concerned with protection of personal information. The Act mandates the creation of a National Privacy Commission (NPC), which is to draw up "Implementing Rules and Regulations" necessary to implement the law; the Commission was reportedly appointed only in March 2016. We understand that the NPC and the government are currently consulting on secondary legislation that would bring the Philippines' legal framework into line with OECD recommendations and perhaps even the EU privacy regime.

- **Thailand's** current legal framework for data protection is fragmented, as there are only sector-specific rules and regulations and no consolidated legal framework or authority for data protection. The draft "Personal Information Protection Act" (January 2015), restricts the collection, usage, alteration and disclosure of personal data without the subject's consent.

- Although **Vietnam** does not have a unified data privacy law, it recently enacted the "Law on Cyber Information Security", which will come into effect in July 2016, setting out principles and requirements for online data protection.

An overview of current data protection regimes in the five focus countries and their potential impact on DDI is shown in Figure 5.3 below.

Figure 5.3: Data protection regimes in the five focus countries [Source: Analysys Mason, Practical Law, 2016]

Country	Type of data regulated	Collection	Storage	Use and repurposing	Transfer and disclosure
India	Sensitive personal data or information (SPDI) – *passwords, financial and medical information, etc.*[111]	○ Requirement to have a privacy policy, obtain consent and state purpose	◑ SPDI cannot be stored longer than is required for the purpose stated	◑ SPDI can only be used for the purpose for which it was collected	○ Disclosure and transfer of SPDI to third parties is possible if consent is provided or if it is necessary for compliance with a legal obligation. Third party must ensure same level of data protection
Indonesia	Personal data – *no definition of the scope of data*	○ Consent and a data protection policy are required, but there are no specific conditions for collection and processing of personal data	◑ A data centre and disaster recovery centre must be set up	○ Use has to be in line with objectives explained to the data owner at the time of collection	● International transfers of personal data are restricted ○ Disclosure needs to be conducted with consent and in line with objectives
Philippines[112]	Personal data – *any information relating to a natural person*	○ Collection needs to be for specified purposes. Consent is not required if: the data processing results from a contract with a subject, is required by a data controller to fulfil its obligations or is necessary to protect the interests of the data subject	○ Data needs to be kept in a form which only allows identification of the data subjects for as long as is necessary for the specified purposes	○ No specific requirements	○ Disclosure is possible if in line with specified objectives, and safety measures are performed ○ There are currently no rules regulating transfer of data outside the Philippines

111 There are provisions for breaches of confidentiality and privacy, including disclosure of personal information in breach of a lawful contract, in section 72 and 72A of the IT Act 2000

112 In the Philippines, only non-binding data protection guidelines are currently in place. No comprehensive legislation on personal data protection or information privacy is available.

Country	Type of data regulated	Collection	Storage	Use and repurposing	Transfer and disclosure
Thailand	Personal data – *no current statutory definition*[113]	○ Consent is required for data collection, but the precise form of consent is not specified by law. The concept of implied consent is recognised	○ Currently no specific requirements beyond taking measures to prevent unauthorised access	○ No specific requirements	○ There is currently no distinction between local and international transfer. Both are possible with the subject's consent[114]
Vietnam	Personal data – *information that can identify the subject* Cyber-information – *information exchanged via telecoms or computer network*[115]	○ Subject's consent is required for data collection	◑ Intermediary service providers must employ malware-filtering systems when handling information ● Organisations which own information must classify it by level of secrecy, and classify their systems by level of security on a scale of 1 to 5[115]	○ Use of personal data must be in accordance with the purpose notified to the subject	○ No specific restrictions on transfer of personal data

Legend: ● = major hurdles for DDI; ◑ = some challenges for DDI; ○ = less-restrictive regulation

113 Under the Personal Information Protection Act that is currently being drafted, personal data is defined as any information relating to a natural person that can identify them

114 If the Draft is enacted, the subject's explicit consent will be required for an overseas transfer

115 According to the new Law on Cyber Information Security

Governments should focus on bringing clarity and balance to their data protection regimes to create an environment that protects privacy and encourages DDI

Despite advances in data protection regimes, there are still concerns about the safety of personal data online, which undermines trust in the Internet. For example, in Indonesia, over half (57%) of Internet users surveyed were unaware that free online services could sell personal data to governments and other companies in Indonesia (47% in India). In India and Indonesia, 80–90% of Internet users surveyed were concerned that their personal data could be bought or sold. 55–62% of Internet users thought that the government was not doing enough to keep personal information secure and safe from private companies. Furthermore, 89–93% of people had changed their online behaviour in an effort to control the personal data that is shared online.[116]

Overall, as data protection regimes are currently being considered and updated in developing Asia–Pacific countries, policy makers need to be aware of the economic potential of DDI and the constraints that certain regulations may impose on this potential. Tensions between these two objectives are often articulated as trade-offs, arguing that more innovation requires less privacy and vice-versa. This is not always the case: in some instances, solutions can be found that achieve the desired policy outcomes without harming innovation or competition.

In particular, the specific needs of DDI in developing Asia–Pacific countries (as laid out in Section 4.3) suggest that:[117]

- **Data already available in developing countries is relatively scarce**, which limits the ability of firms to experiment and innovate specifically for these markets. Policy-makers should consider how to allow more data to be collected, while empowering end-users to make informed choices on how and with whom they share their personal data. In this regard

    — When considering **consent regimes**, it is important to ensure that they are effective: restrictive consent regimes to protect consumers have well-documented downsides, such as 'choice fatigue',[118] which defeats the purpose of the policy, and the risk of uninformed refusals to give consent (which may be a loss to everyone, a kind of 'deadweight loss').[119]

116 CIGI Ipsos, *Global Survey on Internet Security and Trust*, 2016, available at https://www.cigionline.org/internet-survey-2016.

117 See Annex C.3.2 for further some examples

118 See, for example, Augenblick, Ned and Nicholson, Scott, *Choice Fatigue: The Effect of Making Previous Choices on Decision Making*, available at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.175.2560&rep=rep1&type=pdf

119 Additionally, there is a growing body of research suggesting that too much choice may be neither beneficial to society nor appreciated by consumers. See, for example, Schwartz, B, *The paradox of choice* (2005), and Botti, S. and Iyengar, S. S., "The Dark Side of Choice: When Choice Impairs Social Welfare", *Journal of public policy and marketing* Vol 25(1), 2006.

  - **Clear and transparent information** on how data is collected and used may be more appropriate than explicit consent regimes, to avoid the downsides mentioned above. Transparency can be combined with a large degree of control granted to consumers to help them make truly informed choices about their data. This approach should be carefully calibrated, however, as it may not be suitable for some types of data (e.g. sensitive personal data) or to some types of processing (e.g. data transfers to third parties that cannot easily be reversed).

- DDI in developing countries is taking forms that differ from services prevalent in developed countries, as they address different needs and constraints. In this context, **the ability to invent new approaches and techniques is essential**. The greatest benefits from DDI can be obtained if data that is aggregated and anonymised, or pseudonymised,[120] can flow freely, with as few constraints on repurposing as possible, to allow 'serendipitous' innovation to take place. This is because a key aspect of DDI involves finding hidden patterns in data, and extracting value from these. This often happens by combining data from several sources and using it for a new purpose. In this regard:

  - **Purpose limitation rules** can hinder the combination and repurposing of datasets that is key to the experimentation involved in innovation in this area. Wherever possible, the purpose for which this data is collected should be determined freely between end users and firms, based on clear information. In some cases, this may need to be limited, in particular in cases where the repurposing is manifestly against the interest of the end-user.

  - Again policy-makers may justifiably want to **reduce the risk of certain harms occurring**. A common concern related to how combination and repurposing could reduce anonymity and lead to re-identification of personal information. It is difficult to see how this could be wholly prevented while allowing innovation to unfold. Instead, data protection policy could seek to ensure that re-identified data is properly treated as personal data, which end-users can control, and limit the potential harms that could stem from re-identification.[121]

- DDI service providers in developing Asia−Pacific face constraints due to the **relative scarcity of skills and infrastructure** (see Box 5–4 for example), which tend to be more plentiful in developed markets. Some DDI service providers also depend on customers based across the region and the world to gain scale. Finally, some firms in traditional verticals rely on DDI service providers based in other countries to gain access to the right expertise and innovative service inputs. In this regard:

120 That is, where specific identifiable information about an individual is removed, but where other characteristics remain associated with a single pseudonym.

121 This may involve strict limitations where sensitive personal data is involved.

— As they work to develop these skills and infrastructures, policy-makers should also ensure that **international transfers of data** be allowed to take place, subject to appropriate safeguards and enforcement, except in exceptional circumstances.

— Potential harm from international data transfers can be mitigated without banning or overly constraining such transfers. Multilateral agreements and international cooperation can significantly reduce concerns related to the adequacy of data protection overseas (including Privacy Shield, BCR, CBPR etc.). These may be more appropriate and less costly in terms of impact on data-driven innovation than country-specific limitations or outright bans on international data transfers.[122]

— In considering other rationales for limiting international transfers (e.g. national security, industrial policy), policy-makers should be aware of the potential detrimental impact on DDI, including how difficult it may be for domestic firms to access the skills and infrastructure required for a national sector to develop in isolation. For example, there is no evidence that restricting cross-border data flows or forcing data localisation would achieve higher security for consumers or firms.[123] Such policies also have the potential to negatively impact other sectors such as the business process outsourcing (BPO) industry, which generates significant exports in India and the Philippines for example, and relies on the ability to transfer data in and out of the country.[124]

Each country's government will need to work towards a balance that is acceptable to its citizens, with the following principles in mind:

- Although there may be tensions between privacy and innovation, in some cases it may be possible to resolve them without trade-offs by **focusing on desired outcomes** and how they can be secured outside of data protection regulations.in other cases where difficult choices and trade-offs may be unavoidable, they should be informed by a careful consideration of the benefits at stake.

- Wherever possible, the emphasis should be on **self-regulation**, based on sound principles enhanced by **market forces** and the use of **privacy-enhancing technologies**. Our interviews suggest that firms see good business sense in protecting the trust their customers have placed in them by using their data responsibly, a dynamic that should be encouraged and harnessed through regulation.

122 Such schemes may explicitly aim at minimising harms (for example, this is the first principle in the APEC's Privacy Framework), and/or or they may involve provisions ensuring that data processing in general is carried out in a way that is compatible with different countries' provisions (e.g. the APEC's CBPR scheme or the EU's safe-harbour provisions.

123 See, for example, http://policybythenumbers.blogspot.co.uk/2015/06/the-price-of-data-localization.html and https://www.leviathansecurity.com/cloudsecurity.

124 'Adequateness' with EU rules is not necessary for this type of industry to flourish, as bilateral and contractual instruments are well suited for enabling firms established in these markets to process EU consumer data.

Box 5–4: Skills remain a major barrier to DDI, which policy can address explicitly

From our interviews, it is clear that DDI companies active in developing Asia–Pacific, even start-ups, tend to pre-empt upcoming regulations by looking at the models in other more developed countries (e.g. the EU, Singapore). All interviewees accept that regulations will become more restrictive, but also believe that it is good business practice to ensure their users' data is well protected. Restrictions on cross-border data transfer are most relevant to companies active across the region or with global operations. They can also be a concern for DDI companies that are mostly active in one national market if they prevent them from accessing the infrastructure and skills they may lack in their domestic market. In the short term, the main constraints on DDI growth are not regulatory, but are related to the availability of local skills, e.g. in analytics.

Investment in STEM (science, tech, engineering, maths) education is paramount in alleviating these skills shortages in the medium term. Immigration policies that encourage skilled people to come and settle locally would also have a positive impact on DDI in the short term. This is particularly important in relation to the need for experienced scientists and managers.

6 Conclusions

Our research, case studies, interviews and modelling all show that DDI is already the subject of much interest in developing Asia–Pacific. Governments are actively trying to improve the connectivity and business environment to stimulate such innovation, whilst large corporations, start-ups and financiers are contributing to the emergence of a variety of DDI applications that are well suited to opportunities presented in developing countries.

The potential of DDI in developing Asia–Pacific is large: from a current base of around 0.5%–1% of GVA (USD20–40 billion in the five focus countries), we estimate that DDI could contribute 1.5%–3% to GVA in 2020. Given the rapid economic growth in these economies, this could add USD50–100 billion to GVA in the focus countries, many times the current DDI impact.

To realise this potential, however, important obstacles must be overcome: limited availability of data, obsolescence of machinery,[125] shortages of skills and unclear policy environments all limit the potential to collect and act on data.

In this context, the role of governments is fairly clear, but complex. In the short term, they should actively encourage DDI by encouraging skilled people to come and work in their countries, building it into governmental service delivery, and openly collecting and sharing as much data as possible. In the longer term, they should ensure that the local workforce acquires the skills necessary for DDI, and should put in place appropriate, robust, forward-looking and future-proof policy environments around data protection, privacy and security.

From a policy perspective, governments must balance the legitimate interests of end users, in particular their right to privacy and redress in case of breach of their personal data, with a regulatory regime that encourages DDI and does not overly constrain innovation and risk-taking.

In this crucial period when nearly every government in the region is working on setting up modern data protection regimes, it is essential that they are discussed openly and at length, with inputs from civil society and businesses. This will bring to the fore the fundamental trade-offs between the legitimate interests of all parties, and enable policy makers to make informed decisions that do not unnecessarily hinder DDI.

It is clear that DDI holds substantial potential to help developing countries accelerate their economic and social development. Elsewhere in the world, this development has happened remarkably harmoniously, despite the occasional disputes between privacy advocates, governments and businesses. These same economic and social benefits can also be realised in developing Asia–Pacific countries through clear outcome-oriented thinking, open sharing of expertise and international cooperation.

125 In particular the lack of connectivity, sensors or actuators in older machines.

Annex A Economic and social challenge in developing Asia–Pacific

There are seven key areas of economic and social challenge for developing Asia–Pacific. We have summarised the broad themes below.

Figure A.1: Key economic and social challenges in developing Asia–Pacific [Source: Analysys Mason, 2016]

Pillar	Characteristics in developing Asia–Pacific
Productivity	Although there is evidence of growing productivity in all these markets, productivity levels are still low compared to developed Asia–Pacific.[126] This is especially true of agriculture, which employs major portions of the countries' population but does not make a proportionate contribution to GVA. There is a need for a shift towards higher value-added production and services, in order to drive GDP growth.
Infrastructure	Underdeveloped logistics and transport industries, as well as telecoms and energy networks, hinder economic development across these countries.[127] Government infrastructure programmes have an important impact, however many improvements will be driven by industry. For example the development of the modern retail sector (super- and hypermarkets, convenience stores, discounters, e-retail) is likely to help drive increased investment and infrastructure development for the logistics industry.[128]
Trade balance	Most of the focus countries regularly experience trade deficits.[129] These are not necessarily problematic, although in some cases they reflect deficiencies in high value-added industries: for example, Indonesia exports crude oil and imports refined petroleum products, which creates a deficit.
Investment	Foreign direct investment (FDI) is a key driver of the countries' development due to relatively limited local investment. FDI provides a source of additional capital, which can make labour more productive, allowing for higher wages and consumption.[130] Although the investment climate in developing Asia–Pacific countries is generally positive, a number of barriers to FDI still remain (e.g. restrictions on industries available for investment, protectionist measures on employment of foreigners, relatively high levels of corruption[131]). Most countries have seen increasing FDI in recent years, however investment in Thailand contracted in 2014.[132] FDI can be boosted through economic growth, political and financial stability, government initiatives (e.g. India's Make in India programme), technology adoption and improved access to skilled labour.

126 IMF: Structural transformation – how does Thailand compare?; McKinsey & Company: Improving productivity in Indonesia; Paths to shared prosperity for the Philippine economy; Sustaining Vietnam's growth: The productivity challenge.

127 Euromonitor, World Bank

128 Euromonitor; Spire Research and Consulting:

ASEAN Retail Strategies – Emerging Markets, in Search of Sustainable Growth

McKinsey & Company: Modern grocery and the emerging-market consumer: A complicated courtship

129 http://tradingeconomics.com

130 The Australian APEC Study Centre: Asia Pacific Foreign Direct Investment

131 See Transparency International's *Corruption by country*, https://www.transparency.org/country/

132 Decline in investment was reportedly caused by weak economic growth and political tensions.

Pillar	Characteristics in developing Asia–Pacific
Skills	Many developing countries suffer from skills shortages, with negative effects on employment and labour productivity.[133] In the Philippines for example, this has reportedly led to the lack of dynamic development in the manufacturing sector, which in turn further translated into lower demand for highly skilled workers.[134]
Education	Challenges in education are related to making high-quality education affordable and available throughout the country, and to increasing participation. Addressing these challenges is essential to reduce the skills gap and achieve higher labour productivity. Quality of education is important, as illustrated by the example of Thailand, where despite making great progress in expanding basic education, almost one third of 15-year old students are 'functionally illiterate', meaning they lack a level of literacy to be able to manage daily living and employment tasks.[135]
Healthcare	Challenges in healthcare in developing countries in Asia−Pacific primarily concern achieving universal coverage and consistency of healthcare services, to resolve inequity across regions and demographic segments. Although all five focus countries have made a commitment to provide universal healthcare, millions of people still remain without access to basic services. Furthermore, the quality of health services varies across the countries' territories, and many households cannot afford the healthcare they require.[136]

UNESCAP: Asia–Pacific Trade and Investment Report 2015

133 Skills For Employment (Global public-private knowledge sharing platform)

134 World Bank: Philippines Skills Report

135 UNESCO; *World Bank: Thailand Economic Monitor – June 2015*

136 World Bank; World Health Organization; OECD: Health at a Glance – Asia/Pacific 2014; McKinsey & Company: India Healthcare – Inspire possibilities, challenging journey; EY: Ripe for investment – the Indonesian health care industry post introduction of universal health coverage.

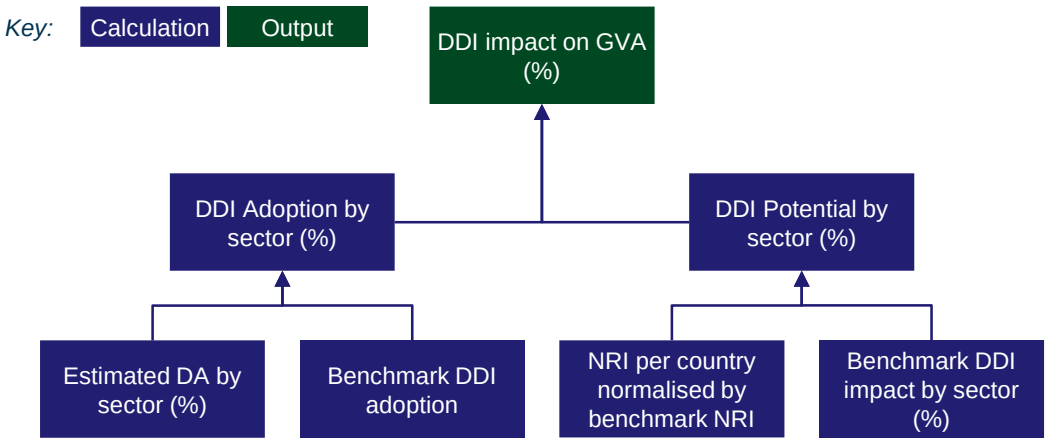
Annex B Methodology for quantification of economic benefits

This annex describes our approach to estimate the impact of DDI in the focus countries (India, Indonesia, Philippines, Thailand and Vietnam), plus China and Hong Kong as additional benchmarks. The impact of DDI is calculated here as the product of a DDI 'potential impact', measured as a percentage of Gross Value Added (GVA), and of a level of DDI adoption by firms, for a range of different sectors of the economy (measured as a percentage of firms).[137]

These factors are estimated for each of our focus countries as functions of existing DDI impact and adoption for benchmark countries (Australia, Japan, New Zealand and Singapore), scaled to reflect specific economic drivers in the focus countries.

The diagram below describes the approach used to estimate DDI impact on GVA. In the next sub-sections we describe the methodology and sources adopted to estimate DDI potential and DDI adoption.

Figure B.1: Methodology diagram for the calculation of DDI impact on GVA [Source: Analysys Mason, 2016]



Estimation of DDI potential by sector

We estimate DDI potential for each sector in each of the focus countries based on:

- average DDI potential by sector in four benchmark countries,
- average network readiness index (NRI) from the World Economic Forum in the benchmark countries,
- and NRI in the focus countries.

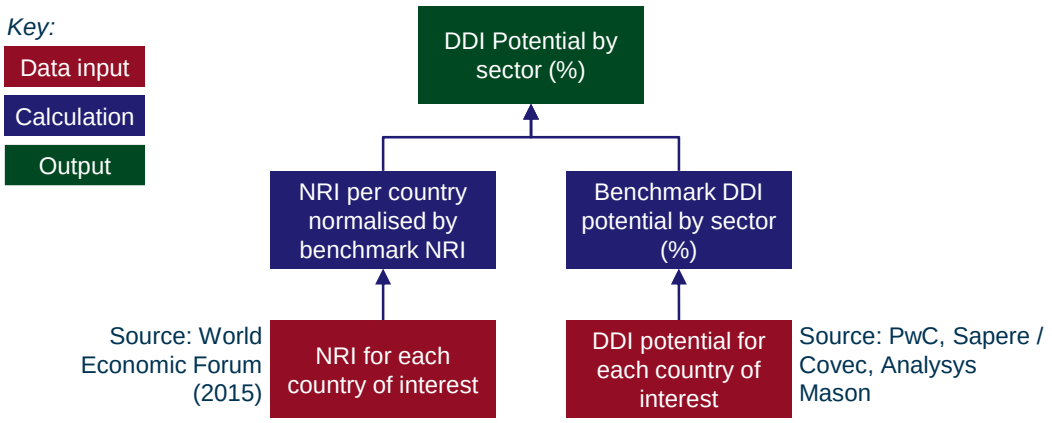
137 The sectors included are: health, education and social services; financial industry; manufacturing; trade; information and communications; transport and logistics; primary industries (agriculture, extractive industries).

The DDI potential by sector for the benchmark countries is calculated in existing reports from Analysys Mason (Japan and Singapore) and third parties (PwC for Australia and Sapere / Covec for New Zealand). The values of DDI potential in benchmark countries are aggregated using a simple average.

For each of the focus and benchmark countries, we use the NRI reported by the World Economic Forum in 2015. Average NRI in benchmark countries is calculated as a simple average of the country specific NRIs. We use the ratio between country-specific NRI and benchmark average as a scaling factor to convert average DDI potential in benchmark countries to our focus countries.

The below diagram summarises the flow of calculations performed to estimate DDI potential by sector.

Figure B.2: Methodology diagram for the estimation of DDI potential by sector [Source: Analysys Mason, 2016]



Estimation of DDI adoption by sector

For each of the analysed sectors, DDI adoption is estimated based on:

- average DDI adoption by sector in four benchmark countries
- average digital adoption (DA) by businesses in the benchmark countries
- and DA by sector in the focus countries.

DDI adoption for the benchmark countries is estimated by Analysys Mason based on the reported values in the aforementioned existing DDI reports. Average benchmark DDI adoption is calculated using a simple average.

Digital adoption at country level is reported in the World Development Report from the World Bank. The benchmark average used to estimate DDI by industry in the focus countries is calculated as a simple average of the value of digital adoption in the four benchmark countries.

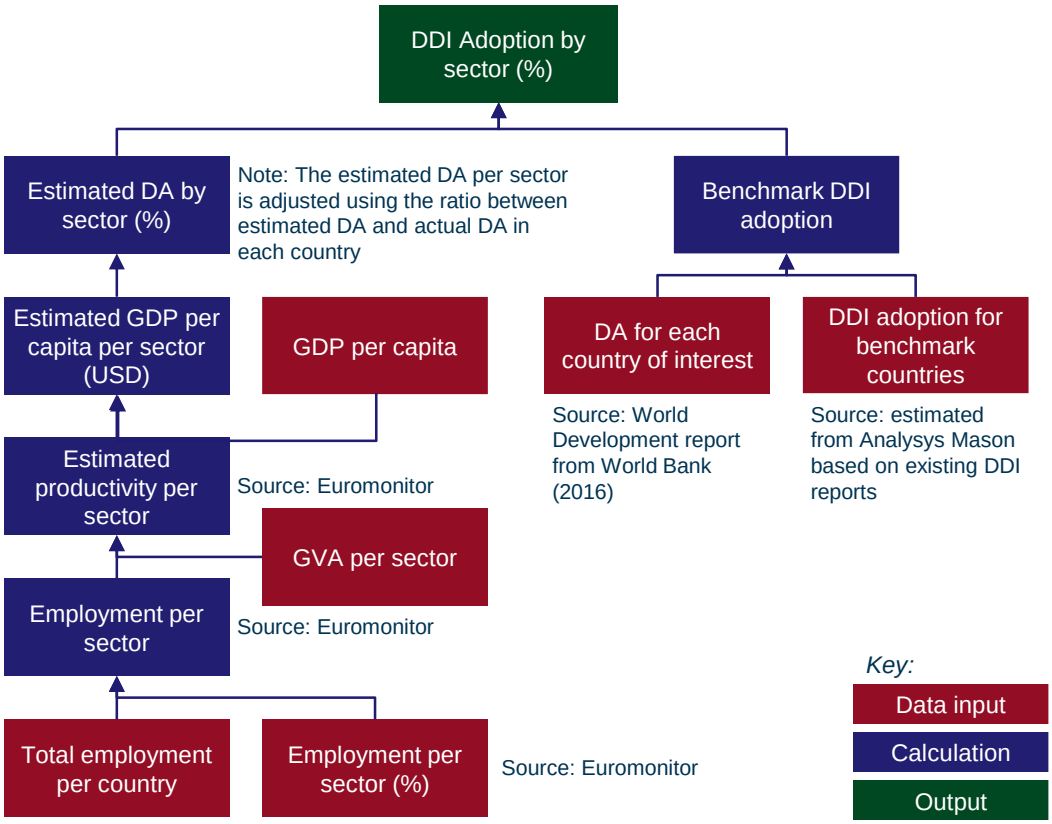
In order to scale digital adoption at country level to reflect adoption at sector level, we have used the relation existing between GDP per capita and digital adoption as described in the World

Development Report.[138] We calculate predicted digital adoption in benchmark and focus countries and we calculate a correction factor given by the ratio between the actual digital adoption and the predicted one. For each of the sectors we calculate the predicted sector digital adoption using sector-adjusted GDP per capita, and we adjust the predicted value using the correction factor calculated for each country.

GDP per capita per sector is estimated adjusting national blended GDP per capita as reported by Euromonitor with a scaling factor accounting for sector productivity premium or discount over country average productivity. For the scope of this calculation productivity is defined as the GVA per worker, at sector level and nationwide. Total employment per country and share of employment per sector are reported by Euromonitor.

The following diagram summarises the flow of calculations performed to estimate DDI adoption by sector.

Figure B.3: Methodology diagram for the estimation of DDI adoption by sector [Source: Analysys Mason, 2016]



[138] DA = 0.1085* ln(GDP) – 0.51 + ε, where ε is an error term with 0 average. R^2 = 0.80

Results summary

The table below shows the results of these calculations, which are estimated ranges of DDI adoption and impact in all the countries included in the analysis.

Figure B.4: Results of DDI impact estimation [Source: Analysys Mason; benchmarks values estimated on the basis of cited studies from Analysys Mason, Covec/Sapere and PwC]

All values as a % of annual 2015 GVA	*Average DDI adoption range*	*Average DDI potential range*	*Estimated DDI Impact range*
India	6.1%-15.1%	4.8%-15.1%	0.4%-1.6%
Indonesia	9.6%-16.3%	5.0%-16.3%	0.5%-1.8%
Philippines	9.0%-19.9%	5.2%-19.9%	0.7%-2.3%
Thailand	12.3%-24.8%	5.2%-24.8%	0.8%-2.8%
Vietnam	8.2%-15.5%	5.0%-15.5%	0.5%-1.7%
China	12.3%-19.5%	5.4%-13.1%	0.7%-2.3%
Hong Kong	23.4%-33.2%	7.1%-17.1%	2.3%-5.5%
Australia	25.0%-40.0%	17.0%-17.0%	4.3%-6.8%
Japan	19.6%-32.5%	3.8%-21.8%	0.8%-5.9%
New Zealand	9.2%-17.7%	5.7%-23.9%	0.6%-3.7%
Singapore	16.0%-32.5%	2.8%-16.5%	0.6%-3.8%

Annex C Policy considerations related to data-driven innovation

A version of this annex was provided in Analysys Mason: *Data-Driven Innovation in Japan*, 2014, available at: http://www.analysysmason.com/Research/Content/Reports/Data-driven-innovation-in-Japan/.

The purpose of this annex is to set out the issues relative to regulatory frameworks that balance consumer protection and innovation with data, in particular regarding personal data. We do this by first discussing the kinds of policy that affect DDI development (enabling policies that can help enable data-driven innovation in Section C.1.1 and data protection and other policies that may act as barriers to it in Section C.1.2). We also review how these various policies can affect DDI services, in terms of day-to-day operation, development, growth and international competitiveness (Section C.2).

In seeking to resolve this apparent tension between data-driven innovation and data protection, it may be constructive to focus on the outcomes sought through existing policies and to consider alternative ways in which these can be secured (we discuss this in Section C.3). However, this is not always possible: in such cases, difficult choices and trade-offs may be unavoidable, which should be informed by a careful consideration of the benefits at stake (we discuss these cases in Section C.4).

C.1 What kinds of policy affect DDI development?

Policy action related to data can either enable or potentially constrain the development of data-driven innovation, so that we can thus speak in terms of ‘enabling’ and ‘constraining’ policies. In this section we briefly discus the main examples of each type of policy.

Our classification of policies into ‘enabling’ and ‘constraining’ types is by no means intended to suggest that only ‘enabling’ policies are desirable while ‘constraining’ ones are always undesirable. Indeed, the importance for citizens of issues such as privacy protection means that some constraining policies may always be necessary. However, as we will see, policymakers can in some cases aim to address the intended outcomes of data protection through alternative policies that minimise potentially negative effects on innovation.

We address the relationship between enabling and constraining policies later in this section. First it is necessary to review the types of policy in question. The main types of policy are listed in Figure C.1 and discussed in more detail below.

Figure C.1: Selected enabling and constraining policies [Source: Analysys Mason, 2014-2016]

Enabling policies	*Constraining policies*
Positive policies: • Direct funding • Ecosystem development • Open data • Skills development • Technical standards	**Activity-specific – Constraints on:** • Collection • Storage • Combination/repurposing • Analysis • Use
Removal of barriers: • Regulatory clarity • Trust-enabling data protection • International regulatory interoperability	**Non activity-specific – Constraints on:** • Inter-company transfers • International transfers • Security

C.1.1 Enabling policies

Governments can rely on a broad range of policies to promote the development of data-driven innovation. These can be broken down into two broad groups: introducing positive policies aimed at helping data-driven innovation from a resources standpoint, and removing regulatory barriers (including absence of clarity in regulations). We discuss these in turn below.

Positive policies that help data-driven innovation from a resource standpoint

Key positive policies that governments can pursue include:

- *Direct funding* for innovation, for example through seed capital or competitions open to start-ups, established firms and/or academic groups.
- *Ecosystem development* policies aimed at developing a critical mass of firms and commercial relationships in relevant fields – for example, offering help to relevant firms in innovation 'clusters'.
- *Open data* initiatives, whereby public datasets (ranging, for example, from roadworks updates to companies' tax records to government spending) are made accessible using standard formats and Application Programming Interfaces (APIs) so that firms can develop innovative services that create value from existing data.
- *Skills development* to ensure that firms have a sufficiently large talent pool of experts in relevant fields (including data mining and predictive analytics).
- *Technical standards* for data exchange to facilitate collaboration and trading between firms.

Removing regulatory barriers

The main ways in which governments can remove regulatory barriers to data-driven innovation include the following:

► *Providing a clear and effective regulatory climate*

As with any other type of business, regulatory uncertainty acts as a barrier to investment in data-driven innovation, as investors need to reflect the risk of adverse future regulations when assessing business plans (in addition to the technical or commercial risks inherent in any innovative business). As a result, and in particular, a lack of clarity concerning future regulations on data protection (which we discuss extensively below) may lead to smaller and fewer investments. Thus, ensuring that the scope and key aspects of regulations are clear is a key priority.

Similarly, if consumers are unsure that their data will be treated in accordance with their expectations, they will be less willing to provide it. Accordingly, having clear, enforceable and enforced data protection regimes can help create an environment of trust which is important for a successful DDI sector.

Given this, and in a context in which the Internet has made data processing an increasingly important consideration both for businesses and for consumers, governments around the world have embarked on efforts to update and clarify their data protection policies. Key examples include the European Union's proposed *General Data Protection Regulation*,[139] the White House's *Consumer Privacy Bill of Rights*,[140] and the US National Telecommunications and Information Administration's (NTIA) request-for-comments on *Big Data and Consumer Privacy in the Internet Economy*.[141]

► *Enabling international regulatory interoperability*

In certain circumstances, businesses that rely on processing personal data can be prevented from working with overseas partners or end users. This happens as a result of concerns that foreign firms operating in a different regulatory environment may not uphold the principles that are enshrined in law in the country of origin of the data. However, as we will see later in this section, the ability to exchange data internationally is key for domestic DDI service providers who want to offer services globally; for domestic DDI services who wish to rely on best-in-class overseas partners for some of their activities; and for domestic firms in traditional verticals that wish to benefit from the services of an overseas DDI service provider.

National and regional governments have created a variety of arrangements aimed at mitigating these issues. These include:

139 See http://ec.europa.eu/justice/newsroom/data-protection/news/120125_en.htm.

140 See http://www.whitehouse.gov/sites/default/files/privacy-final.pdf.

141 See http://www.ntia.doc.gov/federal-register-notice/2014/request-comments-big-data-and-consumer-privacy-internet-economy.

- 'Safe harbour' and 'Privacy shield' arrangements, which allow domestic firms to be bound by the data protection rules that apply in their customers' jurisdictions (e.g. data coming from the EU into the USA could be treated in accordance with EU rather than US principles), although these are currently under review.[142]

- Multilateral certification arrangements, such as APEC's Cross Border Privacy Rules system[143] (CBPR). Companies that apply to and are certified into the scheme undertake to adhere to certain principles irrespective of the country where data is processed.[144] The scheme allows for transfers not only between different countries but also between different firms.

- The European Union's Binding Corporate Rules (BCRs) scheme which, subject to approval by the Data Protection Authorities (DPAs) involved, allows multinational corporations to transfer data in and out of the EU (but within the same corporate group) in compliance with EU law.[145]

- The 'common referential',[146] which seeks to facilitate dual compliance with the BCR and CBPR schemes.

- Certain 'derogations' or exceptions to rules limiting international transfers, based on, for example, user consent or contractual considerations.[147]

While these schemes all share the key objective of facilitating data transfers by providing cross-border legal arrangements (including accountability and enforceability), they also reflect a variety of degrees of 'interoperability', or lack of 'friction', between jurisdictions. At the end with the least friction, 'safe harbour' arrangements result in the lowest transaction costs for firms, as they incorporate blanket agreements into which firms are allowed to self-certify themselves as compliant. CBPRs require a firm-level self-assessment, which must be certified by an independent third party; once accepted into the scheme different firms in different APEC countries can exchange data. At the more demanding end, schemes such as BCRs not only require firm-by-firm application to Data Protection Authorities (which can for example take a year to process[148]), but limit data transfers to members of the same corporate group (thereby requiring inter-firm transfers to be covered by alternative and potentially more burdensome contractual arrangements).[149]

142 In the case of EU law, overseas rules need not be exactly the same but should offer an adequate level of protection. This is specified in Article 25 of the EU's General Data Protection Directive (95/46/EC), and Article 45 of the GDPR

143 See http://www.cbprs.org/.

144 http://www.futureofprivacy.org/2014/05/01/japan-approved-to-participate-in-apecs-cross-border-privacy-rules-system/.

145 See http://ico.org.uk/for_organisations/data_protection/overseas/binding_corporate_rules.

146 See http://ec.europa.eu/justice/data-protection/article-29/documentation/opinion-recommendation/files/2014/wp212_en.pdf.

147 For example, Article 26 in the EU's General Data Protection Directive (95/46/EC).

148 According to the UK's Information Commissioner, "a straightforward application could take 12 months to conclude." See http://ico.org.uk/for_organisations/data_protection/overseas/binding_corporate_rules

149 A useful comparison between BCRs and CBPTs is provided at http://www.iispartners.com/downloads/IIS%20CBPR-BCR%20report%20FINAL.pdf

In the absence of formal arrangements for data exchanges, high-level international guidelines such as those issued by the OECD[150] mean that, when these are reflected in local law, at least a minimum of interoperability exists.

► *Reassessing existing data protection rules*

Finally, governments are reassessing their existing data protection regimes in the light of technological changes and the need to reconcile the demands of privacy with those of innovation. However, as we will see in the rest of this section, this is an extremely difficult endeavour.

C.1.2 Constraining policies

The ambition to encourage data-driven innovation development must co-exist with a range of policies, laws and regulations (for simplicity, 'rules') which may restrict certain uses of data for innovative purposes, presenting barriers to data-driven innovation. These rules exist in order to protect important public interests, such as privacy, crime prevention, or national security. None of these can be neglected, nor can data-driven innovation simply be expected to take precedence over them.

Although there are important exceptions, in general these rules revolve around the protection of personal data[151] – that is, they are *personal data protection* rules. But, notably, as data becomes increasingly interlinked, it becomes increasingly difficult to separate personal from non-personal data. Accordingly, personal data protection rules may have a broad scope across many types of data.[152]

Figure C.2 lists the main types of rules, which we have grouped either around the different data processing activities introduced earlier, or thematically:

Figure C.2: Key types of data protection rules [Source: Analysys Mason, 2013-2016]

Group	Rules	Rationales
Rules linked mainly to specific data processing activities		

150 See http://www.oecd.org/internet/ieconomy/oecdguidelinesontheprotectionofprivacyandtransborderflowsofpersonaldata.htm.

151 Specifically, personally identifiable information, or data that can be linked to an individual.

152 In the words of a recent OECD report on DDI, "these developments challenge a regulatory approach that [is based on] the 'personal' nature of the data involved. As the scope of non-personal data is reduced, the difficulty of applying existing frameworks effectively becomes more acute". See OECD (2013), "Exploring Data-Driven Innovation as a New Source of Growth: Mapping the Policy Issues Raised by "Big Data"", *OECD Digital Economy Papers*, No. 222, OECD Publishing.

Group	*Rules*	*Rationales*
Collection	• Firms may be restricted from **collecting data in the background**,[153] i.e. without users actively contributing the data (e.g. through cameras, online tracking, etc.) • Firms may be restricted from **collecting data indiscriminately**, in a way that is not justified by the purpose for which consent is given	• Minimising the amount of data that is collected limits the risk of subsequent harm through misuse or security breaches • Users may prefer to keep information confidential on personal grounds
Storage	• Firms may be required to **delete** data beyond a set period, or after it is no longer needed for its original purpose • Firms may be required to **retain** certain data for at least a minimal period in connection with 'lawful intercept' requirements	• Increased likelihood of security breaches or loss of traceability • Data minimisation / purpose limitation • Law enforcement
Combination and repurposing	• Firms may be prevented from using datasets for **purposes** other than those for which collection was authorised[154] • Firms may be prevented from **combining different datasets** collected for different purposes and /or by different service providers unless explicitly allowed by data subjects	• Possibility of unwanted commercial targeting • Possibility of re-identification (see below)
Analysis	• Special regulations may apply to **pseudonymous** data which, through analytics and combination with other data, may allow individuals to be **re-identified**[155]	• Re-identification may effectively amount to collection of personally identifiable information, with attendant risks and obligations[156]
End use	• Regulations may apply to **automatic decisions** based on algorithmic **profiling** (e.g. on service price, characteristics, availability, etc.) • Rules may limit **unsolicited messaging** (phone calls, email spam, etc.)	• Using sensitive information (e.g. race, sexuality, gender or other factors) to influence decisions may be illegal • Errors may have high personal cost
Rules applying to multiple data processing activities		

153 Also referred to as 'passive' data collection.

154 For example, in the USA, the FTC has prevented Facebook from combining datasets created before its acquisition of mobile messaging service WhatsApp with those created by the latter before it was acquired unless it could get "affirmative consent" from end users; see http://www.ftc.gov/news-events/press-releases/2014/04/ftc-notifies-facebook-whatsapp-privacy-obligations-light-proposed.

155 Re-identification can be defined as the process by which formerly anonymous data can be linked to named individuals, thus rendering it personal data. For extensive background, see http://ec.europa.eu/justice/data-protection/article-29/documentation/opinion-recommendation/files/2014/wp216_en.pdf.

156 A study of 58,000 volunteers by the University of Cambridge and Microsoft Research was able to show that "easily accessible digital records of behaviour, Facebook Likes, can be used to automatically and accurately predict a range of highly sensitive personal attributes including: sexual orientation, ethnicity, religious and political views, personality traits, intelligence, happiness, use of addictive substances, parental separation, age, and gender." See "Private traits and attributes are predictable from digital records of human behaviour", PNAS 2013 110 (15) 5802–5805.

Group	*Rules*	*Rationales*
Transfer between firms	• **Transfer between firms** (whether for purposes of outsourcing or trade of data) may be disallowed without consent • Firms may be required to **conduct due diligence** of prospective partners • Firms may be required to use 'back-to-back' data protection provisions in **contracts**	• Increased difficulty of subsequent access to their data by consumers, enforcement and redress (especially with long chains of intermediaries) after data has gone through multiple hands • Difficulties in enforcement or in identifying the required restrictions may increase the probability of violation of consent conditions or of substantive conditions
International transfers	• **International transfers** may be disallowed for certain kinds of data • International transfers may be **limited to selected countries** (e.g. under 'safe harbour' arrangements)	• Overseas data protection may be seen as inadequate or incompatible • Extraterritorial enforcement may be seen as administratively challenging • National security concerns • Industrial policy aimed at incentivising domestic data processing
Security	• Users must be notified **(breach notification)** if their data becomes compromised • Service providers that hold sensitive data may need to be **certified** and/or undergo periodic **auditing**	• Illegal or unauthorised use of data • Disclosure of private information

The restrictions outlined can often be overridden through consumer consent. For example, if a service provider needs to store data for a longer period than would normally be allowed, then once it obtains user consent the relevant restrictions may no longer apply.[157] Thus, data protection regulations often represent only the 'default setting' under which service providers must operate *unless* they obtain consent from users to operate in a different way.

It is worth mentioning at this stage that, as we will see in Section C.2.3 below, consent is not a 'silver bullet'; by requiring an unrealistic degree of engagement from end users, stringent consent regulations may lead to consent being given in a less than meaningful way, or being denied unnecessarily, thereby unduly limiting DDI services' activities.

The rules listed above are not comprehensive, and the associated rationales are only posited for discussion and may or may not correspond to the intent behind specific rules in specific jurisdictions. We will return to the question of rationales for data protection rules in Section C.3.1.

C.2 Strategic impact of data protection on the development of DDI services

In addition to the direct link between data protection and DDI services that we explored above, certain types of restriction can also have a more indirect, but potentially more profound, negative impact on data-driven innovation by constraining the *processes* of innovation and entrepreneurship

157 However, in some jurisdictions certain requirements e.g. concerning sensitive personal information cannot be waived through consent.

through which new services can develop and flourish. Specifically, as developed in this section, limits on repurposing can hamstring innovation; restrictions on international transfers can hinder the global competitiveness of local DDI start-ups; and restrictive consent requirements can slow or even prevent DDI services' growth.

C.2.1 Innovation and purpose limitation

Finding hidden patterns in data, and extracting value from these, is a key aspect of innovation with data. Such patterns are often only visible after combining datasets containing different types of data – for example, when IP addresses are combined with geographical locations. It is through this process that unexpected patterns may emerge, or that the existence of such patterns, suspected by innovators, can be confirmed. These patterns can then be exploited by services that create value for their users.

This process often involves the combination of datasets collected for different purposes. Furthermore, and almost unavoidably, the ultimate purpose of the new service being developed (a purpose which may not even be clear during development) could not have been foreseen at the time of data collection and consent. And even if these uses were foreseen before research began, the nature of innovation is such that new patterns with new uses may arise serendipitously during product development.

Purpose limitation rules can thus hinder the combination and repurposing of datasets that is key not only to the functioning of certain DDI services but also to the experimentation involved in their development – and hence to innovation.

C.2.2 Competitiveness and links on international transfers

DDI services are often built by combining datasets from multiple firms and/or combining technical functionality contributed by different firms, often in real time over the Internet. The firms involved may be in different countries – e.g. an IP geo-location service[158] may be provided by a US firm, while an analytics service might be provided by a Japanese-based one. Even when domestic options are available, competitiveness requires the selection of partners with the best price–performance combination, regardless of their location. For example, the lowest-cost provider of long-term data storage might be in Europe. Partnering with overseas DDI providers can also allow domestic players to leverage large-scale infrastructure quickly, thereby shortening time-to-market.

Importantly, even in cases that do not involve outsourcing the storage of data, relying on such partners may not simply be a matter of 'importing' data from overseas; collaboration often requires deep technical integration (e.g. the use of 'remote procedure calls'), which often implies a two-way sharing of at least some data.

As a result, rules limiting the international transfer of data risk hindering DDI service providers to compete for customers globally and/or to offer a world-class service to their local customers.

158 Business-to-business services that allow other services to determine a user's geographical location on the basis of an IP address.

C.2.3 Growth and restrictive consent requirements

Consent requirements can vary in terms of the degree of *explicitness* to which users must actively give consent for their data to be collected and/or processed in certain ways (i.e. 'opt in' vs. 'opt out') as well as in the degree of *specificity* of their consent. Thus, for example, if a user has agreed to have his data collected by a supermarket for the purposes of a marketing programme, this may be understood to imply permission to, for example, pass on some of this data to an external analytics partner without having to ask the user explicitly about this (*deemed consent*).

If a given service relies on an activity for which consumer consent is legally required, then the need to obtain consent represents a 'hurdle' that service providers must overcome. If consent needs to be explicit, the hurdle is higher, and if a similar situation applies to multiple activities involved in delivering the service, then users must be required to understand and consent in detail to each relevant activity – an even higher hurdle. All of this means that fewer potential users adopt DDI services, because:

- they disagree with their data being used in certain ways (e.g. international transfers), or
- they lack the time or inclination to engage with a privacy policy or statement.

Both cases may limit take-up, which may render some innovations financially unviable. In the first case (consumers disagreeing with their data being used in certain ways), this may reflect consumers' own decisions as to the appropriate balance between their privacy and the benefits of data-driven innovation, and as such may be deemed to be unproblematic from a policy standpoint (effectively it is a voluntary transaction).

In the second case (consumers lacking the time or inclination to engage with the notice given to them), however, consumers might have been happy to give consent if only this had not required so much of their time. In those cases, consent requirements result in foregone value for both the consumer and the service provider, which is a form of deadweight loss.

C.3 Reconciling DDI development and data protection by focusing on outcomes

In seeking to promote data-driven innovation while also protecting privacy and other public interests, policymakers face a difficult situation. Existing policies can both make DDI services difficult to operate and may hinder their development and growth. At the same time, however, the public interests that these policies aim to protect cannot be neglected.

However, although data protection rules may clash with data-driven innovation in specific cases, the broad policy *aims* of fostering data-driven innovation and protecting other public interests (e.g. privacy) are *not* fundamentally at odds with each other; they are simply about different things. This suggests that, at least in some cases, it may be possible to achieve the desired aims of data protection without unduly hindering data-driven innovation by reconsidering the specific rules and regulations involved.

In this section we explore how such reconciliation may be possible in certain cases. As a starting point, we discuss a conceptual framework that considers the risks and harms of data processing activities.

C.3.1 Risks and harms

Data protection policies seek to prevent certain *harms* to individuals or society, or at least to minimise the *risk* that such harms may materialise. For example, the handling of information such as credit card numbers is protected so as to prevent fraud. More generally, the rationales for rules such as those outlined above can be linked to consumer harms such as fraud, illicit discrimination or the invasion of privacy.

Such linkages implicitly assume a certain 'causal' model describing how things could 'go wrong' if rules are not followed, ultimately causing *harm* to individuals.[159]

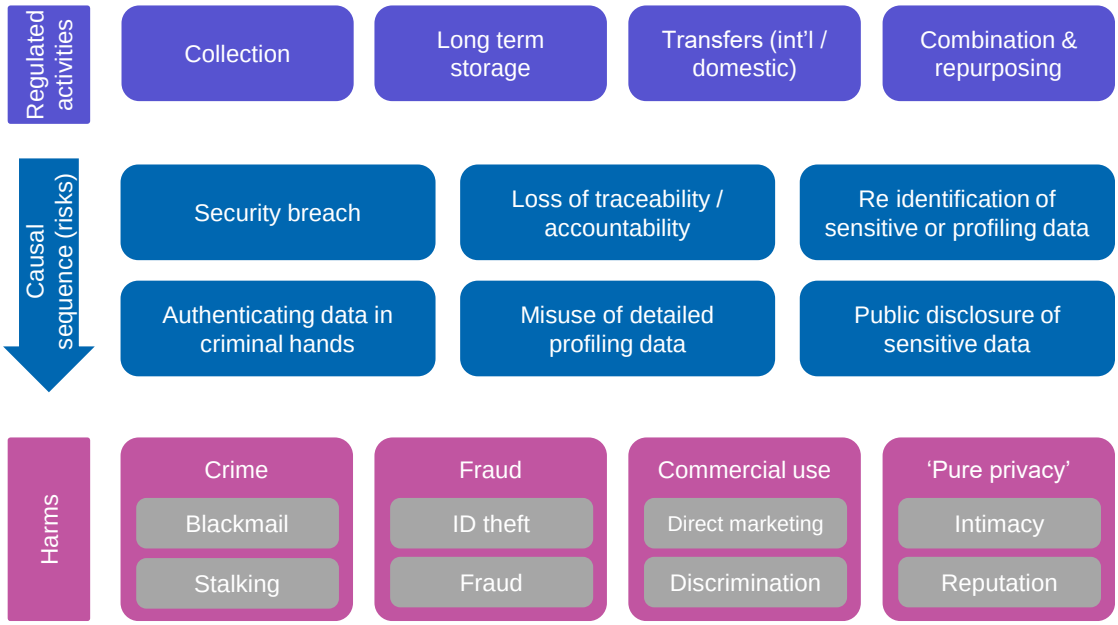
This might proceed as follows:

- There might be excessive collection of data, data might be stored for too long, it might be transferred to a third party, or it might be used for purposes not authorised by the user.
- This may then lead to a security breach; a loss of traceability (if data changes hands too many times); or the 're identification' of formerly anonymous but highly sensitive or detailed personal data through analysis of multiple datasets
- In turn, this could in some cases lead to 'authenticating data' like credit card numbers ending in criminal hands; to excessively detailed, non-anonymous data being used by marketers without authorisation; or to sensitive personal data being publicly disclosed.
- Finally, this could eventually lead to fraud (e.g. ID theft); other crime (e.g. blackmail), commercial misuse (e.g. unauthorised direct marketing); or simply the invasion of privacy (e.g. images of private grief).

This is illustrated in Figure C.3:

159 Our causal account above is by no means authoritative, and policymakers may not assume this type of causal flow. This is not because our account may not fit the rationale behind policies in any given jurisdiction but rather because, in general, the question of harms in data protection is a matter for disagreement and debate. In the words of leading privacy scholar Daniel Solove, "privacy is a concept in disarray". See Solove, Daniel J., "A Taxonomy of Privacy." *University of Pennsylvania Law Review*, Vol. 154, No. 3, p. 477, January 2006; GWU Law School Public Law Research Paper No. 129. Available at SSRN: http://ssrn.com/abstract=667622

Figure C.3: Illustrative link between data processing and harms [Source: Analysys Mason, 2014-2016]



Thus, in general,[160] data protection rules can be seen as an attempt to minimize the probability of certain things happening which may carry an increased *risk* of leading to *misuse* of data that would be *harmful* to individuals. Put differently: the regulated activities are not in themselves harmful, but can be the first step in a sequence that has a *risk* of leading to harm.

Based on a similar reasoning, in recent years the so-called 'risk-based approach to privacy' has gained prominence among privacy experts as an alternative to an exclusive reliance on rules that restrict data processing practices that may be valuable to data-driven innovation and not in themselves be harmful.[161] As a particular application of this approach, certain authors have proposed that policy should focus less on regulating data *collection* (and the consent requirements involved in it) and more on its *misuse* ("databuse"), relying on legal accountability and/or technology to minimise the risk of harm.[162]

We believe the risks-and-harms framework, as described above, is a useful tool when seeking to balance data protection with intent to allow the development of data-driven innovation.

160 Except for cases where rules explicitly disallow certain uses of data (e.g. rules concerning the use of profiling data for discrimination).

161 See for example: "A Risk-based Approach to Privacy: Improving Effectiveness in Practice". A paper by the Center for Information Policy Leadership (Hunton & Williams LLP), June 2014. Available at http://www.hunton.com/files/upload/Post-Paris_Risk_Paper_June_2014.pdf .

162 For the general approach, see B Wittes: "Databuse: digital privacy and the mosaic", Brookings Institution, 2011, available at http://www.brookings.edu/research/papers/2011/04/01-databuse-wittes. For the technological approach, see C Mundie: "Privacy Pragmatism" *Foreign Affairs*. 12 Feb. 2014 available at: http://www.foreignaffairs.com/articles/140741/craig-mundie/privacy-pragmatism.

C.3.2 Reconciling DDI and data protection by focusing on outcomes

As alluded to previously, the tension between consumer protection and data-driven innovation does not appear to be intrinsic, and must instead be contingent on the specific rules adopted to achieve a balance between them. On this basis, a key question when considering a give type of data protection rule is whether alternatives can be found that address the same risks to a similar or higher extent, but without conflicting with data-driven innovation.

We believe this is often possible. If we consider the harms that policies aim to prevent (i.e. the *outcomes* sought), and then consider whether the associated risks can be addressed through different sets of policies that are compatible with data-driven innovation, it is often the case that the risks at stake can be addressed in ways that do not conflict with data-driven innovation.

We discuss three key examples below, which we have selected on the basis of their role in the analysis presented earlier in this document: combination, repurposing and the de-anonymisation of datasets; international transfers; and consent requirements. For illustration, in each of these cases we focus on *one* set of risks that existing policies may seek to address; however, we recognise that in each case policies may seek to limit other risks. In principle, a similar analysis may also apply to those other risks; however, we also acknowledge that in some cases this may not be possible, so that 'the best of both worlds' is not achievable and a compromise must be reached. We discuss this last possibility later, in Section C.4.

Using robust authentication as an alternative to limits on repurposing pseudonymous data

Traditionally, a common solution to the need to observe rules on purpose limitation, while allowing data to be reused in new services, has been to anonymise or pseudonymise[163] data so that it cannot be traced back to the identity of the original data subject.

However, in recent years, some influential research has shown that by analysing and combining large datasets, it is sometimes possible to link formerly anonymous or pseudonymous information to specific individuals, thereby possibly inferring 'sensitive' information that users may not have intended to disclose (concerning e.g. health, lifestyle choices, religion, etc.).[164] While the degree to which this conclusion can be generalised is a matter of debate,[165] this has led some actors to claim that "anonymisation no longer works when identities are actively sought",[166] and others to call for

163 Pseudonymous data is data that relates, but is not by itself linkable, to a single, real individual; a key example "user ID" numbers used by websites to detect repeat visitors even if the user's identity is unknown. Anonymised data is not only not linkable to an individual but may relate to one or to multiple individuals.

164 See e.g. Narayanan and Shmatikov: "Robust De-anonymization of Large Sparse Datasets (How to Break Anonymity of the Netflix Prize Dataset)", available at http://arxiv.org/pdf/cs/0610105v2.pdf.

165 See, e.g., A Narayan and EW Felten: "No silver bullet: De-identification still doesn't work", available at https://freedom-to-tinker.com/blog/randomwalker/no-silver-bullet-de-identification-still-doesnt-work/. For a reply, see A Cavoukian and D Castro: "Big Data and Innovation, Setting the Record Straight: De-identification Does Work", available at http://www2.itif.org/2014-big-data-deidentification.pdf.

166 EDRi (2012): *An introduction to data protection*. Available at http://www.edri.org/files/paper06_datap.pdf.

pseudonymous data to be accorded similar status to personally identifiable data,[167] in particular subjecting it to purpose limitation constraints.

This would risk hindering much of the combination and repurposing of datasets that is essential to DDI experimentation (see Section C.2.1), and it could also limit the potential of DDI services that use anonymised information from consumers (who may not be users of the service) to benefit their users or the public in general, such as traffic monitoring apps or public health planning. Notably, this is particularly the case for services of the 'intelligent planning' type, which often rely on the use of extensive datasets of anonymous and pseudonymous data.[168]

Concerns about pseudonymous data revolve around the risks involved in any disclosure of private information and may involve concerns about fraud, crime (e.g. blackmail), commercial misuse (e.g. unsolicited marketing) or 'pure' privacy loss (e.g. the disclosure of embarrassing facts). However, among these, concerns about the possibility of fraud loom large.

To the extent that the objective is to prevent fraud and other similar misuses of data (e.g. identity theft), an alternative to imposing consent requirements on pseudonymous data might be to develop policies aimed at ensuring stronger authentication methods (e.g. through reliable, universally available certificate authorities), which might render the possession of most types of personal data insufficient to commit fraud. This would not only avoid conflicts with data-driven innovation, but might also be more effective at preventing fraud – especially if we consider that determined fraudsters may be able to obtain the relevant information by easier means (e.g. by hacking end users' devices or online accounts).

Using bilateral or multilateral agreements instead of ban on international transfers

As we have seen in Section C.2.2, limits on international transfers (e.g. rules on data localisation) can severely constrain some DDI business models and/or their underlying technologies. Again, it is worth clarifying the desired outcomes of such policies. Depending on the country in question, these may include avoiding consumer harm from inadequate or unenforceable legal protection overseas; national security; and (in some cases) industrial policy.

Of these three rationales for restrictions on international transfers, the first (concern about adequacy of data protection overseas) is arguably the main and most common. But in respect to this concern, solutions that are targeted specifically at ensuring that data is adequately protected overseas (i.e. schemes such as those listed earlier, including Privacy Shield, BCR, CBPR etc.) may be more appropriate and less costly in terms of impact on data-driven innovation than limitations or bans on international data transfers. Such schemes may explicitly aim at minimising harms (for

167 See for example http://history.edri.org/eudatap-issuesheets#defi.

168 Several commentators have stressed the importance of not limiting data analysis to statistical samples where possible. For example, Savage and Burrows argue that "the sample survey came to enjoy a certain pre-eminence in a situation where the principles of statistical inference had been developed and the technologies for the conduct of surveys invented, and data deriving from routine transactions could not be easily collected, stored and manipulated. This state of affairs existed between about 1950 and 1990, but decreasingly applies." See M Savage and R Burrows "The coming crisis of empirical sociology", *Sociology* 2007 41:885; also See e.g. Mayer-Schönberger and Cukier *ibid*, ch 2.

example, this is the first principle in the APEC's Privacy Framework), and/or or they may involve provisions ensuring that data processing in general is carried out in a way that is compatible with different countries' provisions (e.g. the APEC's CBPR scheme or the EU's safe-harbour provisions).

Alternatives to strict consent requirements

As we have seen in Section C.2.3 above, onerous consent requirements can be detrimental to the growth of new DDI services. It is thus relevant to ask about the underlying aims of such requirements from the perspective of a risks-and-harms framework.

On the surface, consent requirements give consumers a means to avoid harms such as those outlined above by ensuring that potentially risky activities do not take place without their consent. But as we have seen, this is achieved at a potentially high cost to consumers who may be expected to engage in detail with technical matters for which they lack the time or understanding.[169] This can lead to uninformed consent ('choice fatigue',[170] which defeats the purpose of the policy) or to an uninformed refusal to give consent (which may be a loss to everyone).[171]

Thus, explicit and detailed consent requirements may not be a particularly effective tool to prevent privacy-related harms, and it may also be self-defeating. If this is accepted, then the next question is whether other means should be considered. We suggest two approaches:

- First, greater emphasis may be placed on substantive restrictions on data use and/or processing, which would be set at a level that reflects what users might normally agree to. Provided that services operate within these boundaries, no consent would be needed. For example, if it is agreed that pseudonymous data can be combined, repurposed and shared freely between firms that meet certain criteria, then DDI service providers would not need users' permission for this. (However, as this example illustrates, deciding the precise 'levels' or limits of automatically permitted activity may be a matter of debate.)

- Second, the explicitness requirements for consent may be lowered, or kept low, where explicitness acts as a hindrance to users. In particular, this may mean allowing 'deemed' or 'opt out' consent to apply in more contexts. For example, continued use of a service that offers personalised music recommendations might be deemed to imply that the user has consented for relevant data to be collected and processed for the purposes of providing the service.

169 Although there are efforts to mandate simplicity in privacy statements, there is an inherent limit to the extent to which this can be done meaningfully.

170 See, for example, Augenblick, Ned and Nicholson, Scott, *Choice Fatigue: The Effect of Making Previous Choices on Decision Making*, available at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.175.2560&rep=rep1&type=pdf

171 Additionally, there is a growing body of research suggesting that too much choice may be neither beneficial to society nor appreciated by consumers. See, for example, Schwartz, B, *The paradox of choice* (2005), and Botti, S. and Iyengar, S. S., "The Dark Side of Choice: When Choice Impairs Social Welfare", *Journal of public policy and marketing* Vol 25(1), 2006.

As compared to a reliance on strict consent requirements, either of these approaches would achieve a reduction in 'transaction costs' and may also lead to an improvement in privacy. In practice, a solution might involve a mix of both options depending on local considerations.

C.4 Facing trade-offs between innovation, privacy and other policy goals

In the previous section we have shown how, in some cases, it may be possible to address certain key objectives of data protection through alternative routes that may have a relatively small impact on data-driven innovation. However, it is important to acknowledge the limitations of this approach.

In each of the examples we gave, it is also possible that other considerations not discussed by us might argue for the permanence of the restrictions in question. For example, where we considered calls for rules requiring that pseudonymous data be afforded protections comparable to those applying to personal data, we suggested that relevant fraud-related harms might best be addressed through other mechanisms such as enhanced authentication requirements.

But what if the concerns about pseudonymous data have more to do with, e.g., the potential for embarrassing facts to become known (i.e. a 'pure privacy harm') if the de-anonymised data is subsequently compromised? How much importance should be accorded to this concern would depend partly on public opinion (e.g. how concerned would the public be about this?), and partly on the plausibility of the relevant causal link from data processing to harm – i.e. the degree of risk. In particular, if and when it is believed that re-identification is highly unlikely, then the concern might be said to be unjustified.

Similarly, although we have argued that explicit and detailed consent requirements may not always be in users' best interests, this is not to say that consent mechanisms are undesirable. Consumers may care deeply about controlling their data. To the extent that this is addressable through user-friendly consent policies that are simple and/or rely on 'opt out' mechanisms, this need not have an unduly negative impact on data-driven innovation. However, we cannot rule out the possibility that public opinion may veer towards explicit and detailed consent even if (in the light of our analysis) this isn't necessarily to anyone's advantage – and in a democracy we cannot dismiss this as illegitimate or unimportant. In this case, an informed public debate about the role of consent may be appropriate.

In cases like these, it may be that an impact on data-driven innovation cannot be avoided, and that an adequate balance between the interests of DDI development and other public interests (e.g. privacy or national security) must be struck. Here, we believe that an approach grounded on the specifics of each situation should prevail; the potential downsides or harms (such as impeding DDI development or limiting privacy) should be assessed realistically in terms of the risk of them materialising, and this in turn may depend on the specific types of data, data processing or firms involved. This calls for a flexible approach that avoids all-or-nothing solutions where possible. This can mean high level laws, so that details can be assessed by regulators or sector-specific rules. Alternatively, it can mean laws or regulations calling for firms to carry out case-by-case

assessments, which in turn may consist of 'balancing tests' between the conflicting interests and/or a case-specific analysis of potential harms.

A key example of a flexible approach is the 'legitimate interests' doctrine employed in EU data protection (see Figure C.4; this has been updated in the recently-passed General Data Protection Regulation, or GDPR, but the doctrine remains), which allows firms to conduct a structured 'balancing test' between their own and consumers' interests, thereby allowing a flexible, nuanced approach. We note, however, that recent discussions about updating the 'legitimate interest' provisions have given rise to passionate controversies. To us, this reinforces our view that the trade-offs involved in DDI policy cut across important public interests, and that discussion of these issues calls for an evidence-based and democratic debate.

Figure C.4: The 'legitimate interests' doctrine in EU data protection law [Source: Analysys Mason, 2016]

Article 7 of the EU's Data Protection Directive (Directive 95/46/EC[172]) deals with conditions under which data may be legitimately processed. These include user consent, contractual reasons and compliance with legal obligations. Condition (f) of the article states that personal data may lawfully be processed if it "is necessary for the purposes of the legitimate interests pursued by the controller or by the third party or parties to whom the data are disclosed, except where such interests are overridden by the interests for fundamental rights and freedoms of the data subject which require protection […]". Notably, unlike conditions (a) to (e), condition (f) does not specify grounds under which processing can be considered *a priori* legitimate (e.g. if the user has given explicit consent), but rather calls for a *balancing test* of the interests at stake, including those of the data subject and the data controller (from our perspective, the DDI service provider). Thus the legitimate interest provision allows for a flexible, case-by-case assessment of the interests at stake.

The legitimate interests (LI) doctrine is not without controversy. Its general nature has led to divergent interpretations as to its scope, which has prompted the Article 29 Working Party[173] to issue an Opinion[174] setting out its views on the appropriate scope, providing hypothetical examples of cases where LI would apply (e.g. some cases of simple direct marketing) and others where it would not (e.g. some cases of direct marketing involving extensive background data collection, repurposing and combination).

172 See http://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:31995L0046.

173 "The Article 29 Data Protection Working Party was set up under the Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data. It has advisory status and acts independently." Source: Article 29 Working Party website. See http://ec.europa.eu/justice/data-protection/article-29/index_en.htm.

174 See http://www.cnpd.public.lu/fr/publications/groupe-art29/wp217_en.pdf.