Digital Transformation:
The Role of Mobile Technology in Papua New Guinea

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This publication is the output of a project funded by Australia's Department of Foreign Affairs and Trade (DFAT), for the benefit of developing countries. The views expressed are not necessarily those of DFAT.

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Published March 2019

To cite this report: Highet, C., Nique, M., Watson, A. H. A., & Wilson, A. (2019). Digital Transformation: The Role of Mobile Technology in Papua New Guinea. London, United Kingdom: GSMA.

Acknowledgements

The GSMA would like to thank the following individuals and organisations for their input to this project:

Chakriya Bowman, **Australian Department of Foreign Affairs and Trade**, Jeremy Miller, **Autonomous Bougainville Government Directorate of Media and Communications**, Prakash Ranjan, **BIMA**, Athula Biyanwila, **bmobile vodafone**, Flierl Shongol, Maisen Windu, **Department of Communication and Information**, Tom Tiki, Appala Saripalli, **Department of Finance**, Langa Kopio, Jessie Tibola, Niandruan Kilepak, Wilson Gusmao, Livia Kiele, Debbie Kamaso, Nicole Masta, Joelson Anere, Vesna Tomala, Alex Ginet, **Department of National Planning and Monitoring**, Darren Hanniffy, **Digicel**, Glen Hayoge, **Fresh Produce Development Agency**, Theresa Lyon, **The Knowledge Group**, Tony Westaway, Genevieve Daniels, Trudi Egi, **MiBank**, Jackson Kariko, Vlado Doncevski, Veari Iru, **National Information and Communications Technology Authority**, Ronald Sofe, Francis Odhuno, **National Research Institute**, Jessy Pendene, **Origin Energy**, Stanley Mark, **PNG Power**, Xavier Victor, **Telikom PNG**, Stephanie Laryea, **United Nations Papua New Guinea**

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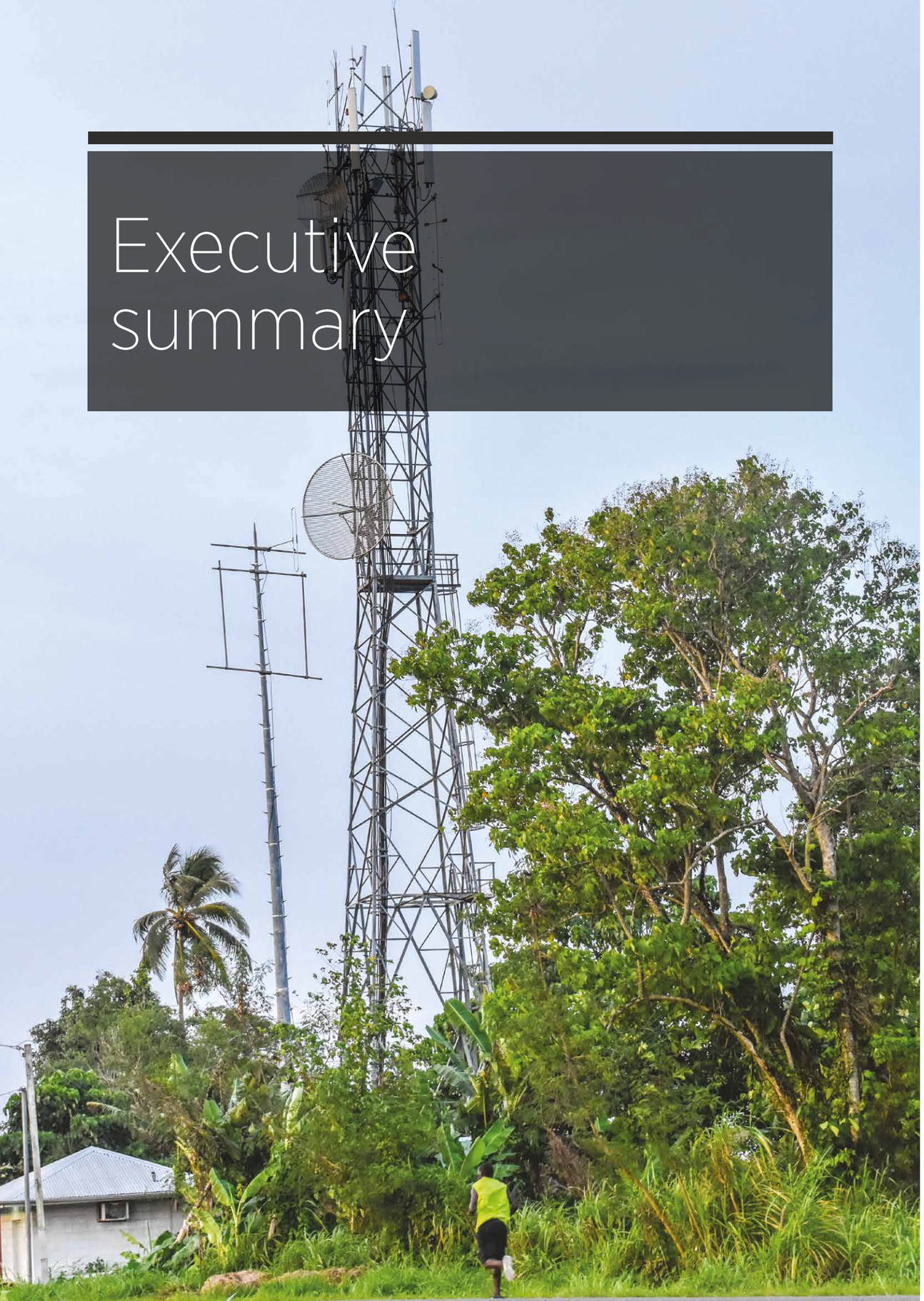


> *Connecting people, in all areas, to new digital frontiers is key to realising technology's potential to deliver better job prospects and living standards, and will be our laser focus in APEC as we move forward during Papua New Guinea's chairmanship.*
>
> **Ambassador Ivan Pomaleu, 2018 Chair of APEC Senior Officials.**

Under the theme of *"Harnessing Inclusive Opportunities, Embracing the Digital Future"*, the Asia Pacific Economic Cooperation (APEC) 2018 sessions prioritised how Information and Communication Technologies (ICT) could promote inclusive and sustainable growth for all. In line with the 2018 APEC activities in Papua New Guinea (PNG), and commissioned by DFAT InnovationXchange, this reports provides insights and recommendations on the potential of mobile technologies for digital transformation in PNG. The term 'digital transformation' implies transformational change at the local level, defined as *change to policies, programming or projects within national or organisational strategies, which lead to positive, sustainable results towards the 2030 development agenda.*

Papua New Guinea (PNG) is a nation of opportunities and challenges. As efforts are being made to achieve upper middle-income country status by 2050[1] — a key part of PNG Vision 2050 — affordable and accessible mobile technology is a promising and unique platform for advancing and strengthening social and economic development.

With its ability to reach across geographies, income levels and cultures, mobile technology is ideal for enabling a digital transformation in PNG and leapfrogging traditional brick-and-mortar approaches. However, these changes are still in early stages. The recent deployment of new mobile infrastructure, improvements in network quality[2] and the launch of 4G LTE have supported the expansion of PNG's mobile broadband sector. There are up to 1 million unique mobile internet subscribers in PNG, primarily in cities where mobile internet penetration grew by 20 per cent in 2018. Yet, mobile penetration is still low compared to other countries in the Pacific, with less than a third of the population being unique mobile subscribers.[3] With a rural population of 87 per cent, there are widespread disparities in mobile phone access and use between PNG's urban centres and rural areas, but also men and women. Many of those who have a mobile phone still rely on basic GSM prepaid services.

The impact of mobile technology across sectors is nascent and it is too early to understand how the current mobile ecosystem will transform the country. To make progress on its digital journey, and strive to achieve the Sustainable Development Goals, PNG must overcome some major challenges, including: poverty and inequality, violence and corruption, natural disasters and climate change. However, the potential is vast to build new foundations and achieve PNG's strategic vision, underpinned by the collaboration between the government, the mobile industry, the wider private sector, civil society organisations and development agencies.

The creation of a digital society that brings benefits to all sectors and regions will not happen without a collaborative approach and innovative financing mechanisms from government and institutional donors. Stakeholders need to act now to ensure that PNG's digital future is inclusive and leaves no one behind.

1. GoPNG, n.d., page 58.
2. The launch of 4G LTE in major urban areas and the upgrading of some 2G towers to 3G capability.
3. GSMA Intelligence data, 2018.

Supporting digital inclusion for all: With 67 per cent of the population within reach of mobile coverage, a large part of the population remains unconnected, mainly due to the complexity of extending mobile networks in remote and mountainous terrains with low population density. Although mobile internet penetration continues to grow, mobile broadband availability and network quality, affordability of devices and services, and limited digital literacy skills are key barriers to adoption and use. Prioritising efforts to target these barriers will be key to ensure the digital divide doesn't grow and further exclude communities, including women and rural populations.

Mobile technology as a vehicle for financial inclusion: Although the percentage of the population with access to formal financial services has largely improved over the past years (37 per cent of the population in 2018), financial exclusion remains the norm, especially for rural communities, women and among micro, small and medium enterprises (MSMEs). With efforts from the local banks and mobile operators, mobile money services could improve financial inclusion, based on widespread digital financial education and training, an extensive mobile money agent network to facilitate transactions and the digitisation of payment streams, including for wages, farming activities, and health payments.

Improving women's access to mobile technology: Across low- and middle-income countries there is a gender gap in mobile phone ownership and usage, preventing women from realising the full range of benefits of mobile technology, including access to health information, financial services and employment opportunities. Key barriers to mobile phone ownership and usage faced by women in PNG include affordability, accessibility (including limited access to identification documents, electricity and limited mobility to access network coverage), safety concerns, and usability and skills. Accelerating digital and financial inclusion for women in PNG requires a concerted effort by stakeholders to address these barriers in a holistic way, guided by an understanding of the social norms and significant gender inequalities that exist in PNG.

Building a digital identity: Up to 80 per cent of PNG's population do not have access to any clear form of identification. As countries move into the digital age, the ability to prove one's identity is increasingly essential to gaining access to a range of life-enhancing services. Although promising, the current implementation of the national ID programme, aiming to provide every person with a digital identity by 2021, is facing challenges. The likely use of biometrics may add complexity to the expansion of the national ID, but if implemented properly and in a privacy-respecting way, could increase the robustness of the ID ecosystem.

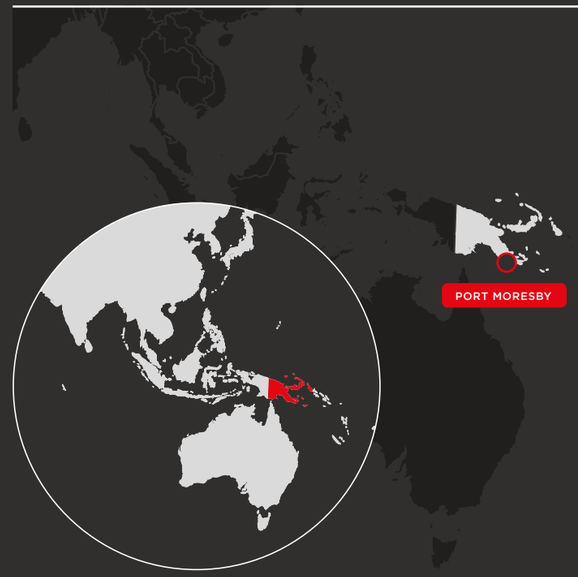
Enhancing data availability and quality in the health sector: There are multiple challenges to improving access to health services and their efficiency: fragmented data, data quality, data sharing, poor availability of basic drugs and equipment, and cash flow issues for service delivery. The transition from the existing national health information system (NHIS) to an electronic platform (eNHIS) would help to decentralise data entry and improve reporting rates. Efforts should be put on further digitising drug inventory, supply-chain management and patient records, and integrating platforms for doctor booking and payments (from patients to doctors as well as health professional payrolls).

Improving access to finance and information for farmers: The agricultural sector represents a large part of the PNG economy and digital tools would help modernise the sector and make it better equipped to face current and upcoming challenges. With a large proportion of stunting children in some regions and increasing extreme weather events, addressing food security issues will increasingly be one of the biggest challenges for development. By enabling farmers to have access to better information on agricultural inputs and nutrition, crop prices, and weather data, and by facilitating access to finance through mobile money channels, some of these challenges could be addressed and productivity boosted.

Supporting Innovation: As the capital, Port Moresby, eagerly awaits the new internet Coral Sea Cable System and as the country becomes a cradle for digital experiments with frontier technologies such as blockchain, there is an opportunity to harness the entrepreneurial energy PNG has to offer. A new generation of talented entrepreneurs is emerging and further support needs to be provided to educate and train leaders, and create start-up success stories. For many industries and businesses in the region, paper is still king, and efforts are needed to support "analog complements" to enable the full transition to digital, and prevent a digital divide as well. These complements include policies and regulatory frameworks, accessible and affordable technology, and digital education and training.

Infrographic 1

Papua New Guinea: key facts



7.6Million
Total population

Port Moresby
Capital

465,000 km²
Approximately land area

800+
Languages

PNG is the most linguistically diverse country on earth, and has four official languages: Tok Pisin, English, Hiri Motu, PNG Sign Language

Physical geography

Mountainous/highland terrain, scattered islands

Decentralised government system with

22 provincial governments

89 districts

325 local governments

Unicameral parliament with democratic elections every

5 years

Became an independent Commonwealth nation on 16 September

1975

The Autonomous Region of Bougainville was formed following the Bougainville Peace Agreement in 2001. Three other provinces — New Ireland, East New Britain and Enga — are working towards autonomy.

Sources: ADB 2019, Baker 2015, Commonwealth Governance, Curry, Dumu & Koczberski 2016, DNPM 2015, Loop 2018, Matane & Ahuja 2005, UNDP 2018, WFP 2016, World Bank 2016; 2018

87%
of the population live in rural villages and remote areas

80%
of the population is semi-dependent on rainfed subsistence farming

MORE THAN **3/4**
of the food consumed in the country is grown locally. There are few cash-earning opportunities outside agriculture

THE AGRICULTURAL SECTOR HAS REPRESENTED **25-40%**
of GDP for the last 40 years

GNI PER CAPITA
$2,410

GDP GROWTH RATE (2018 FORECAST)
-1.7%

POVERTY
2m
people live below the poverty line

LIFE EXPECTANCY
62.9
years

LITERACY RATE
37%
of people are illiterate

HUMAN DEVELOPMENT INDEX
153rd
out of 187 countries

GENDER INEQUALITY INDEX
159th
out of 187 countries

ACCESS TO ELECTRICITY
Less than **15%**
of the population has reliable access to electricity

To understand how mobile technology can address some of PNG's main socio-economic issues, it is important to first understand the current context and key challenges.

Key Challenges

PNG's low ranking on the Human Development Index (HDI) — 153rd out of 187 countries — is symptomatic of many challenges affecting progress in the island nation. There are several major areas to address:

- **Limited formal economy and economic downturn.** PNG has a "two-tiered economy".[4] One tier is occupied by about 70 per cent of the population who live at a subsistence level.[5] Fewer than 250,000 people in this tier, or about one in 25, are formally employed.[6] For this segment, the informal economy continues to be their dominant source of livelihood, with the bulk of economic activity taking place in traditional subsistence farming.[7] The other tier is the cash economy and includes agricultural products, mining, manufacturing and other industries and services. PNG has been described as having a "poverty of opportunity"[8] or "lack of access to basic services, jobs, and education."[9] In 2018, PNG experienced an economic downturn.[10] The response to a polio outbreak and the expense of hosting APEC meetings introduced additional costs and budgetary pressures.

- **Natural disasters.** Regular natural disasters pose major challenges to the provision of basic infrastructure and services. In February 2018, a major earthquake in PNG's highland areas caused loss of life, injuries, displacement and disruption of services.[11] Many people are still living in care centres and require ongoing support. The Manam Island volcano in Madang Province also erupted again in 2018, creating challenges in terms of care for internally displaced people.[12]

- **Rule of law.** Levels of petty crime, sexual violence and land disputes are high. While on paper the country has robust laws and a sound judicial system, law enforcement is insufficient. In the absence of police and other officials, disputes are often settled informally by local communities, such as through village courts. Police and justice services are hampered by a small workforce, poor infrastructure, language and cultural differences, and challenges reaching rural populations.[13]

- **Corruption.** Perceptions of public sector corruption in PNG are very high, with Transparency International scoring PNG 29 out of 100 on its 2017 Corruption Perceptions Index.[14] While few officials have been convicted for corruption, there have been investigations and accusations at the highest levels of government. These enquiries extend to PNG's rich mineral resources; the Parliamentary Public Accounts Committee has estimated that 25 per cent of PNG's GDP is siphoned off through corruption.[15]

- **Physical geography and infrastructure.** The provision of basic infrastructure (roads, electricity, communication, etc.) presents major challenges in such a varied topography.[16] The level of investment required to serve the country's predominantly rural population is extremely high and a challenging business case for potential investors. For rural residents, this everyday reality limits their movement and access to services, and any hopes of accessing the modern job market.

- **Gender inequality.** The rate of violence in PNG, including sexual violence against women and children, is extremely high.[17] Although data is limited and outdated, it has been estimated that "family violence" occurs in two-thirds of households.[18] Bride price is still paid in some communities in PNG, and can negatively impact on the status of women, if they are viewed as property. Women remain underrepresented across the spectrum of life in PNG, from primary school attendance to the workforce to political representation. There are currently no female members of parliament.[19]

- **Lack of a robust identity system.** It is estimated that up to 80 per cent of PNG's population do not have access to any clear form of identification,[20] which affects the efficiency and effectiveness of service delivery and the general progress of the country.

The Government's vision for PNG

The PNG constitution ('mama lo' in Tok Pisin) contains a set of five national goals: integral human development; equality and participation; national sovereignty and self-reliance; conservation of natural resources and environment; and locally appropriate approaches.[21] The Government of Papua New Guinea (GoPNG) has a vision to be ranked within the top 50 countries in the United Nations Development Programme (UNDP) Human Development Index by 2050, becoming an upper middle-income country.[22] Figure 1 illustrates how the seven key pillars of the GoPNG's Vision 2050 will help to address local efforts to achieve the United Nations Sustainable Development Goals (SDGs).

When the Government of PNG signed the Millennium Declaration in 2000, it committed the country to meeting the Millennium Development Goals (MDGs).[23] Although significant improvements have been made in most of the target areas (compared to the 1990 baseline), PNG fell short of meeting most of the MDGs.[24] Based on these mixed outcomes, the Government is laying a "firmer groundwork for implementing the SDGs"[25] and the Department of National Planning and Monitoring is now working to localise the SDGs and address key challenges.

4. Matane & Ahuja, 2005, p. 41.
5. Matane & Ahuja, 2005, p. 41.
6. PFIP, 2017
7. Matane & Ahuja, 2005, p. 41.
8. ADB, 2012, p. 13.
9. ADB, 2012, p. 7.
10. Lyons, 2018; Jennett, 2018; Howes, 2017; Howes & Nema, 2018; Nema & Howes, 2017.
11. Australian Government, 2018; Lyons, 2018.
12. Reliefweb, 2018; Mark, 2018.
13. Lowy Institute, December 6, 2017.
14. Transparency International, 2017.
15. Lowy Institute, December 6, 2017.
16. Curry, Dumu & Koczberski 2016.
17. Betteridge & Lokuge, 2014.
18. HRW 2015
19. UNDP, 2018, pg. 4
20. Business Advantage PNG, October 31, 2018, para. 4
21. DNPM, 2014, p. 15; GoPNG, 2010, p. 2; Matane & Ahuja, 2005, p. 30; Turner, 1990, p. 187.
22. GoPNG, 2009, p. 58.
23. GoPNG, 2015, p. 5.
24. GoPNG 2015.
25. Localizing the SDGs, Success Recorded in Papua New Guinea, p.4

Figure 1 Source: GSMA and GoPNG

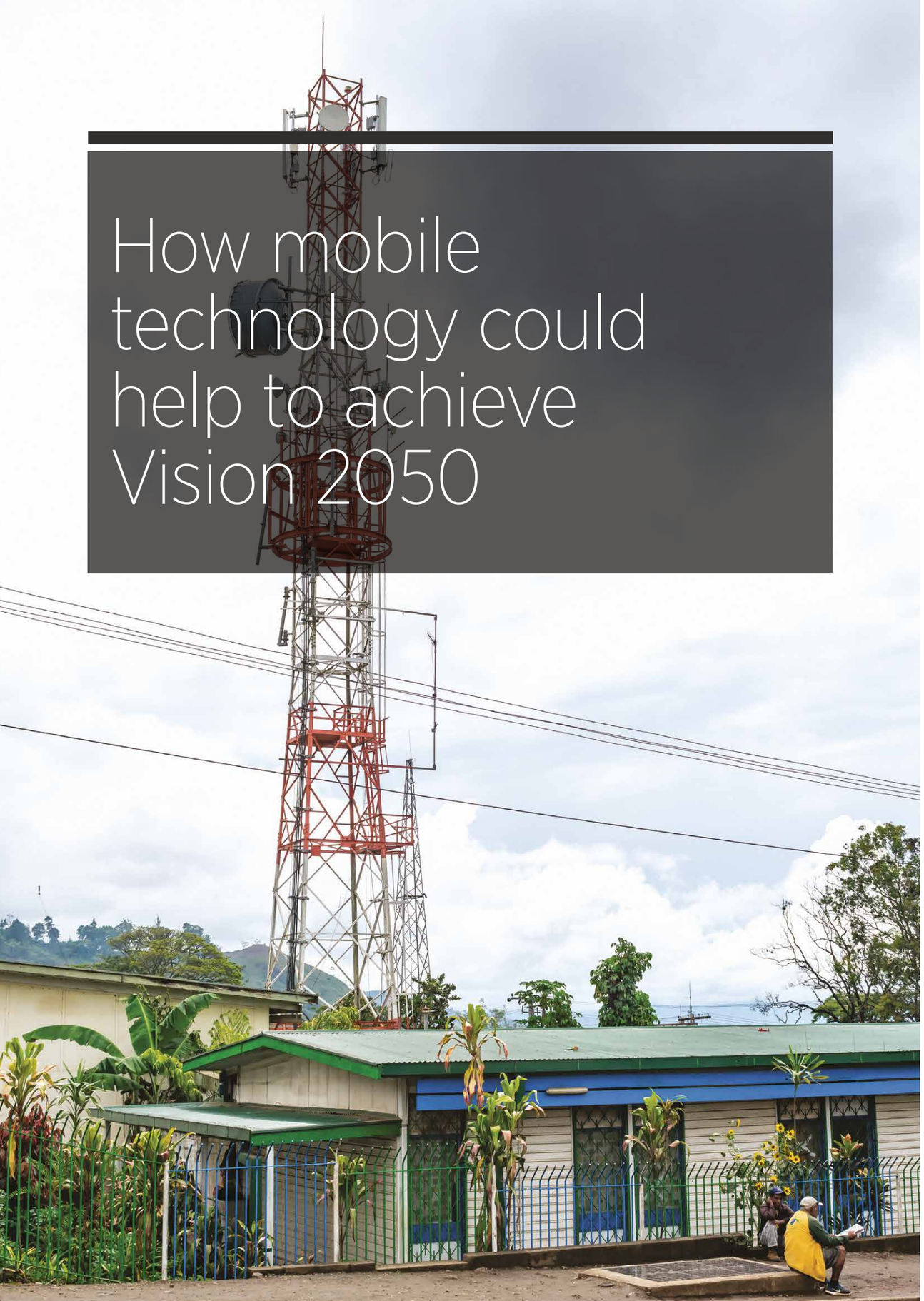
Aligning Vision 2050 and the SDGs in PNG

Tied to Vision 2050 are cascading plans, including the Papua New Guinea Development Strategic Plan 2010–2030, which sets out targets[26] to achieve Vision 2050. The objectives of the Plan are directly linked to the constitution's five goals and Vision 2050's seven focus areas, and all sector plans, government agency plans, and the regional government plans should also be aligned with these key documents.

The National Strategy for Responsible Sustainable Development for Papua New Guinea, commonly known as StaRS,[27] is based on Vision 2050 and is considered the framework for all development efforts in the country.[28] It focuses on long-term thinking and emphasises three equal pillars of sustainable development: economic growth, social equity, and environmental sustainability.[29]

The recently launched Strategy for the Development of Statistics 2018–2027 aims to improve the availability of accurate statistics. It strives to support the implementation of the country's development plans by addressing the lack of core statistics for informed decision-making and evidence-based planning.[30] PNG has performed poorly in this area compared to its neighbours in the region, and this has made it difficult to monitor progress on national goals.

26. GoPNG, 2010, p. xi.
27. DNPM, 2014.
28. DNPM, 2014, pp. 19-20.
29. DNPM, 2014, p. 32.
30. GoPNG, 2018, p. xii.



How mobile technology could help to achieve Vision 2050

Mobile technology can play a critical role in achieving the SDGs and Vision 2050 in PNG. As in many emerging markets where fixed line infrastructure is limited, connectivity in PNG is primarily through mobile phone handsets. Despite operating in one of the world's most remote and geographically challenging regions, the mobile industry in the Pacific Islands has grown rapidly in recent years.[31] As providers of connectivity, services, devices and applications, mobile operators and the broader mobile ecosystem are vital to the transition to a digital society.[32]

In a country where most subscribers rely on prepaid GSM services (close to two-thirds of mobile connections are 2G),[33] basic voice connectivity still offers many social, economic and environmental benefits. Uptake of mobile broadband, smartphones and eventually to machine-to-machine (M2M) and Internet of Things (IoT), would drive rapid digital transformation and could support the government in meeting its SDG targets.[34]

In the next section, we examine priority areas and challenges for PNG and how mobile technology can help to address them.

The contribution of mobile technology to PNG's economy

Across the Pacific region, the value generated by the mobile ecosystem and enabled by the use of mobile services is high.[35] Between 2014 and 2020, it is forecast to increase by about $1 billion to reach $2.8 billion. This growth is predicted across all key economic measures: value addition, employment and the contribution of the public sector to the telecommunications sector.

As a percentage of GDP (for the region), the contribution of the mobile industry is set to increase from 4.7 per cent in 2014 to 6.2 per cent in 2020. This strong growth exceeds the global growth forecast, putting the Pacific Islands among other regions in the world where mobile technologies would have transformative socio-economic impacts. Growth is expected to be especially strong in countries like PNG with lower income levels and relatively low levels of mobile internet penetration.[36] Higher numbers of mobile internet subscribers will drive revenues across the ecosystem, including productivity gains to the economy and business creation enabled by the use of mobile services.

However, the mobile market is feeling pressure from the current economic downturn, which has led consumers to spend less on their mobile phones and top up prepaid credit less frequently. This in turn has had a negative impact on the profit margins of telecommunications companies. Challenges with access to foreign exchange have made it difficult for many businesses, including mobile operators, to make payments to third-party suppliers.[37] Vandalism of infrastructure, such as mobile phone towers, is also a costly ongoing challenge for telecommunications providers (see "The complexity of covering rural PNG", p.22).

31. GSMA Intelligence, 2015
32. GSMA Intelligence, 2017
33. GSMA Intelligence data, 2018
34. GSMA Intelligence, 2017
35. GSMA Intelligence, 2015
36. GSMA Intelligence, 2015
37. Howes, 2018; Massa, 2018.

Digital access in PNG

Infrographic 2

GSMA Intelligence data, Q4 2018

PNG key mobile facts

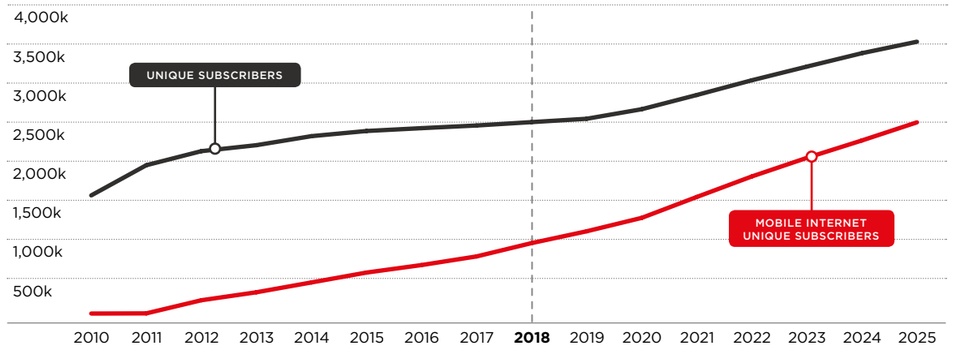
2,525,643

Total number of unique subscribers

999,396

Total number of mobile internet unique subscribers

Total number of unique subscribers and mobile internet unique subscribers – 2010-2025



29.70%

Market penetration, unique subscribers

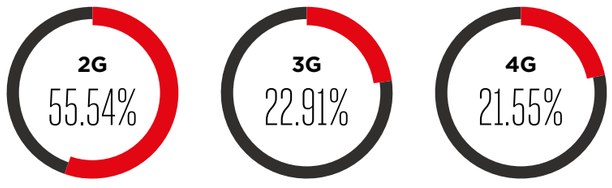
11.75%

Market penetration, mobile internet unique subscribers

1.73%

Growth rate, unique subscribers, annual

Percentage of connections by mobile technology (2G/3G/4G)



67.5%

Percentage of population within mobile coverage (including 2G/3G/4G) (NICTA 2017)

40.9%

Percentage of population within 3G network coverage area (NICTA 2017)

599,285

Number of smartphones

21.92%

Percentage of connections by smartphone

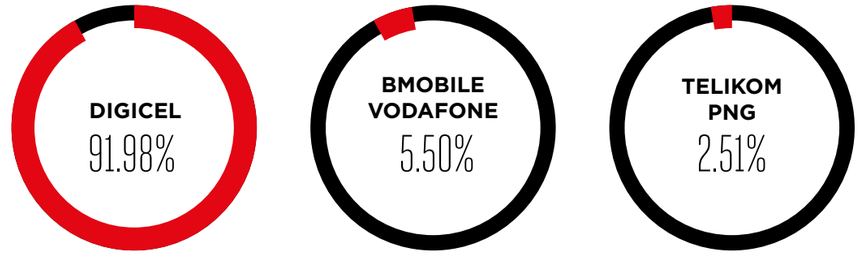
76.20%

Percentage of prepaid connections

5.79USD

Average Revenue Per User (ARPU)

Market share (as of Q2 2018) (before the bmobile vodafone-Telikom PNG merger)



An evolving mobile technology landscape

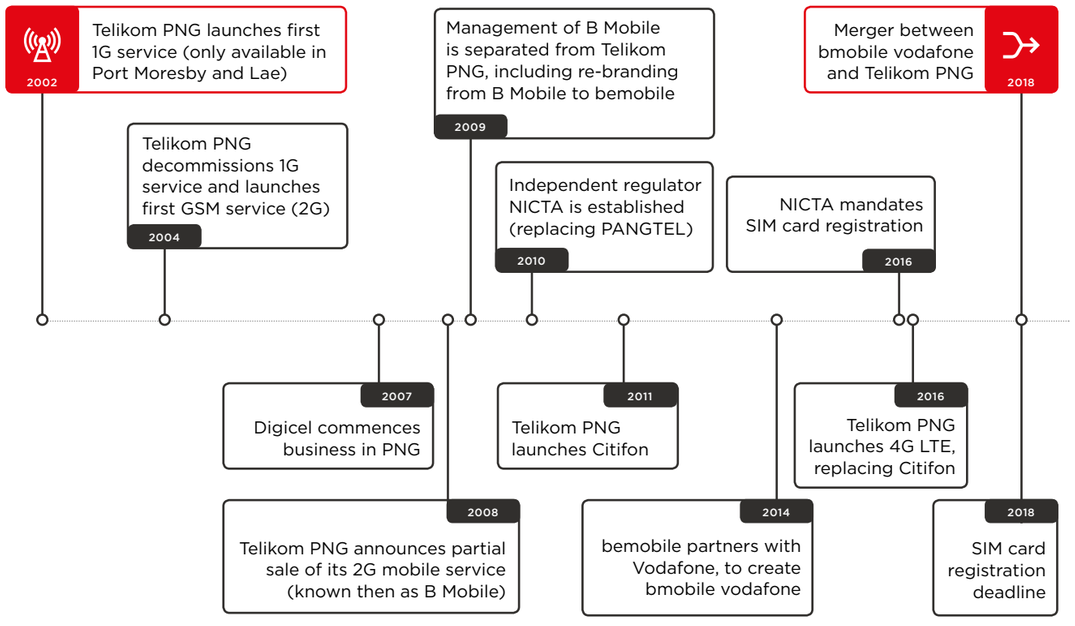
PNG's mobile landscape has seen a burst of activity in the last decade with the emergence of new players and new partnerships, the formation of a telecoms regulatory body (National Information and Communications Technology Authority, or NICTA) and a tremendous increase in mobile phone access and use. There is much enthusiasm and much to be optimistic about as PNG makes strides towards a more digital economy. However, the challenges in serving a predominantly rural, off-grid population are significant.

Access and use of mobile technology in PNG have been shaped by several events and daily realities (see Figure 2): the arrival and investment of a large mobile group, a predominantly rural and off-grid population and low average revenue per user (ARPU). The initial growth trend was upwards and mobile penetration increased from less than one per cent in 2007 to 23 per cent by the end of 2010. This trend has levelled out in recent years, however, and today mobile technology reaches close to a third (30 per cent) of the population. This was driven by upgrades to mobile broadband networks and the uptake of mobile broadband services, mainly in urban areas.

The mobile market is currently going through a merger of state-owned operations[38] — fixed line incumbent Telikom PNG, mobile operator bmobile vodafone and wholesale operator PNG DataCo — under the consortium Kumul Telikom Holdings (KTH). There are now two mobile operators Digicel and bmobile vodafone, Digicel dominating the mobile landscape with 91.98 per cent market share.[39] Once the merger under KTH is complete in 2019, the country's third mobile operator licence will become available.

Figure 2 Source: GSMA and GoPNG

PNG's mobile market journey



38. "Minister claims merger", 2018.
39. GSMA Intelligence data, 2018.

The transition from prepaid to mobile broadband

The vast majority of mobile customers in PNG have prepaid accounts[40] and the market penetration of smartphones is growing (22 per cent in 2018).[41] Despite the declining cost of smartphones and the increase in coverage in recent years, basic feature phones are still the most common due to ease of use and long battery life[42] — an important factor in a largely off-grid country.

However, recent deployment of additional mobile infrastructure and the launch of 4G LTE in urban centres have supported the growth of the mobile broadband sector (mobile internet penetration grew by 20 per cent in 2018).[43] Yet, market penetration for unique subscribers remains low compared to other countries in the region, with a mobile internet penetration (unique subscribers) at 11 per cent.[44] Efforts are underway to improve access to mobile broadband, such as the installation of the Coral Sea Cable System (see Box 1), but demand-side barriers to broadband uptake remain. Theft of mobile phone handsets has been a problem in PNG since mobile phone access began to spread.[45]

Box 1

Coral Sea Cable System

In June 2018, the Australian Government confirmed the deployment of the Coral Sea Cable System (CS2) to improve internet capacity in Papua New Guinea and the Solomon Islands. With a cost of AU$136.6 million, the deployment of over 4,000 kilometres of fibre optic cable by partner company Vocus will provide multi-terabit technology to Port Moresby and improve internet access, speed and affordability (PNG currently ranks 150th out of 200 countries in the Global Broadband Speed Survey).[46]

Scheduled to be completed by the end of 2019, the broader digital access the system will bring is expected to improve economic growth, encourage innovation and entrepreneurship, digital skills and enable better development outcomes. World Bank research estimates that improved internet access and connectivity could increase GDP by more than US$5 billion and create close to 300,000 new jobs in the Pacific region by 2040.[47] Beyond increased internet capacity in Port Moresby, focus should also be put on expanding access to the rest of the country to ensure everyone benefits from the improvements and price reductions.

The construction of the Kumul Domestic Submarine cable by Huawei, to be completed by the end of the 2019, will aim to improve capacity for 15 coastal provincial capitals. It remains to be seen how consumer internet pricing will be impacted to recover the cost of such international and domestic infrastructure.

40. GSMA Intelligence data, 2018 Q3.
41. GSMA Intelligence data, 2018 Q3.
42. Vlies & Watson, 2014.
43. GSMA Intelligence data, 2018 Q3.
44. GSMA Intelligence data, 2018 Q3.
45. University of Rochester, 2016
46. Cable, 2018.
47. Minister of Foreign Affairs, n.d.

The complexity of covering rural PNG

Providing adequate mobile network coverage of rural PNG, where 87 per cent of the population live, remains a challenge for several reasons:

- **Road infrastructure** – There is very limited accessibility through road networks, meaning mobile operators must construct a new road, or use a helicopter to deliver fuel and equipment for maintenance to some towers.
- **Land rights issues** – Land disputes are common in PNG and tribal issues can arise over which community owns the ground on which a tower is erected. This can lead to vandalism of towers or limited access to towers, preventing towers from operating.
- **Demand side issues** – ARPU[48] in rural and remote PNG is very low (~$0.60–$0.90) with limited numbers of customers per site. This makes the business case for tower deployments and operations complex without external subsidies.

In rural areas of PNG, towers must be powered by diesel or renewable energy (mainly solar), which increases deployment, maintenance and operating costs.[49] Combined with low population density, low incomes and inadequate access to electricity (see Box 2), the ability to access and use mobile phones is limited.

NICTA[50] has reported that almost 41 per cent of PNG's population currently has access to 3G mobile broadband services, and 26 per cent have access to 2G only, making total mobile coverage about 67 per cent. Around a third of PNG's population currently has no access to a mobile service; the majority (about 23 per cent of the national market) live in districts that should eventually receive 3G+ service without the need for subsidy. While some areas with 2G coverage or less are similarly commercially viable, other areas (about 29 per cent) will require subsidies to upgrade to 3G network services (both construction and ongoing operational costs).

NICTA has been using the Universal Access and Service (UAS) regime to "encourage the development of ICT infrastructure and improve availability of ICT services within PNG, including in rural communities".[51] The UAS levy uses two per cent of operator gross revenue to fund the extension of broadband mobile coverage throughout unserved areas, as laid out in the UAS Strategic Planning Report 2018–2022. The objective is to cover 100 per cent of PNG's population with wireless networks (at least 3G+) and establish advanced mobile network coverage in all unserved Local Population Centers (LLCs) with at least 20,000 inhabitants. This vision is in line with the country's Strategic Plan to have a "modern and affordable information and communications technology that reaches all parts of the country."[52]

48. Average Revenue Per User (ARPU) is a measure used primarily by mobile network operators, defined as the total revenue divided by the number of subscribers (calculated monthly)
49. Lowy Institute, PNG Country Snapshot, December 6, 2017
50. NICTA Proposed Universal Access and Service Levy for 2018, UAS Strategic Plan (2018-2022), & Projects and Operating Plan 2018
51. Part V of National Information and Communications Technology Act 2009
52. Draft UAS Strategic Plan 2018-2022, p.4

Box 2

Powering the digital ecosystem

One of the chief enablers of a digital ecosystem is reliable and affordable electricity. This includes powering mobile towers that tend to rely on expensive fuel or solar and require high capital expenditure.

Powering the digital ecosystem also includes enabling mobile phone subscribers to recharge their phone locally and conveniently without having to travel to a village shop and pay for a phone charge (the average phone user pays between $7 and $14 a month to charge their phone, with each charge costing between $1 and $3.50).[53]

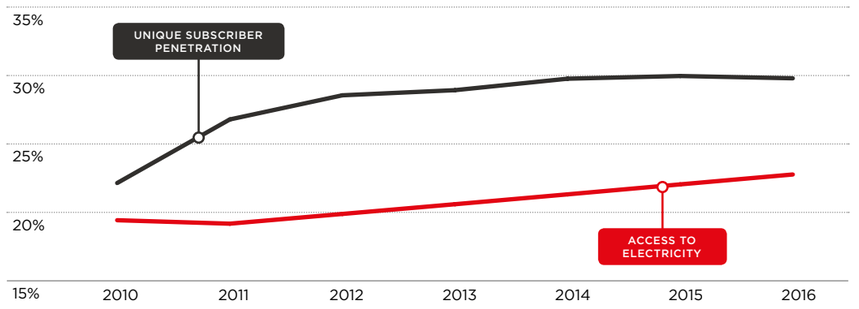
According to World Bank data (see Figure 3), up to 22% of the population of PNG had access to electricity in 2016. However as communicated by the recently announced Papua New Guinea Electrification partnership, only 13% of the population has reliable access to electricity. Meanwhile, those who have electricity pay high prices while contending with frequent blackouts, even in urban centres. The transmission and distribution grid is in poor condition and outages are common, and the national utility, PNG Power Ltd (PPL), has high technical and non-technical losses. Beyond centralised electricity, PPL operates 19 provincial mini-grids and there are about 100 small rural mini-grids operating at the district level run by local governments. Nearly all these mini-grids run on diesel, although some have hydro and solar power. Many are not operating at optimum levels and no greenfield mini-grids are planned, mainly because most people without electricity do not live in large enough population clusters.

Through the Department of Petroleum and Energy, the government is working on a new national energy policy that will reportedly use more renewable energy. Under the national plan, the government's goal is 70 per cent connectivity by 2030 and 100 per cent by 2050, in line with Vision 2050.

With mobile infrastructure reaching beyond access to utility networks and services, there is a growing divide between access to mobile networks and access to electricity. As shown in the graph below, the reach of mobile networks surpassed access to electricity by 2010 and this gap has continued to widen. The GSMA M4D Utilities programme estimated that, in 2016, more than 5.6 million people were covered by mobile networks but did not have access to electricity, the vast majority of whom live in rural areas (about 96 per cent).

Figure 3 Source: GSMA Intelligence 2018, World Bank

Percentage of population with access to electricity and unique subscriber penetration



53. IFC, 2014, pg.10

Mandatory SIM card registration

In 2016, PNG began a process of compulsory SIM card registration.[54] Legislation required every SIM card holder to register in person with their mobile network operator (MNO) and every MNO to establish a database of users. SIM registration is largely driven by a security agenda, often anti-terrorism, and this intensified in the lead up to APEC and the need for increased security protocols.

By the original January 2018 deadline for SIM card registration, only 45 per cent of PNG's 2.8 million SIM cards were registered.[55] This prompted a series of extensions to avoid deactivations over the next six months. In August of 2018, deactivation commenced in urban areas, with further extensions for people in district towns (December 2018) and rural areas (April 2019).

PNG's infrastructure and literacy challenges have made it very challenging to register SIM cards in rural communities where most central government services do not reach, and where movement and access challenges are significant. Teams have travelled to rural areas to assist with the process,[56] which involves capturing a user's photo and identifying the individual. This is an additional hurdle, as few people have formal identification, such as a driver's licence or passport, and the National Identification (NID) project has only registered a fraction of citizens to date.

The Ombudsman Commission of Papua New Guinea commenced court proceedings late in January 2019 questioning the constitutionality of SIM card registration. The submission suggests that various rights enshrined in the constitution, including the right to privacy, freedom from arbitrary search, and freedoms of assembly, association, and conscience, might be violated by the SIM card registration legislation. At the time of writing, the court proceedings are yet to take place.

Diverse and evolving demand for mobile services

PNG's unique diversity has created very different usage patterns across the country. Usage is influenced by several factors: phone ownership (whether the user has a smartphone or a feature or basic phone), literacy levels (traditional, digital, financial), how much the user wants to spend on their phone, available coverage (mobile coverage and electricity) and preferences for consuming content. For example, a mobile phone subscriber in Port Moresby might prefer accessing information through apps, whereas SMS might be more appropriate for a coffee grower in the Highlands, and voice calls or IVR (interactive voice response) might be the most appropriate mobile communication channel for someone in a remote coastal village with a low level of literacy. Box 3 presents an example of how a simple phone service using a text messaging system can help fight corruption in public departments.

Internet usage is skewed towards urban centres, with almost 70 per cent of internet users residing in the cities of Port Moresby and Lae. By contrast, connectivity and power issues are barriers to internet access in rural areas. Internet users tend to be young — almost half are aged between 18 and 24 (48 per cent) and 82 per cent are under the age of 34. According to Facebook data, which can be a strong proxy for mobile internet access, of the approximately 750,000 people active on Facebook (in November 2018), just 39 per cent were women.[57] These statistics underscore the need for ongoing and increased digital literacy efforts with rural, older and female potential users.

Box 3

Strengthening governance with a mobile phone service

Phones against Corruption is a service of PNG's Department of Finance, established with support from UNDP and the Australian Government. Phones against Corruption is a free and user-friendly text messaging system that allows users to anonymously report alleged cases of corruption. Anonymous reports are categorised by the Internal Audit and Compliance Division in the Department of Finance, and those deemed suitable for investigation are either passed on to the internal audit sections of the relevant government authorities or investigated internally. Two public officials have already been arrested for fund mismanagement of over $2 million[58] and other investigations are underway.

Initially, the service was promoted only to Department of Finance staff members in the capital city and at provincial and district treasuries. However, an evaluation determined that the service is quick and easy to use, and that it has formed "a safe space for those deeply engaged in public expenditure management to report cases of corruption".[59] The service has since been expanded to raise awareness among staff members in selected government agencies with active internal audit divisions, including other national government departments, statutory bodies and provincial administrations.

54. A SIM card is a Subscriber Identity Module and is linked to a user's phone number.
55. According to EMTV (2018), Telikom PNG had registered 74% of 200,000 customers, bmobile vodafone had registered 62% of 100,000, and Digicel PNG 42% of 2.5 million, totaling 2.8 million active SIM cards across the three carriers, of which 1,260,000 (45%) were registered, and 1,540,000 (55%) were unregistered.
56. Watson, August 1, 2018
57. Facebook, November 2018.
58. UNDP, 2016.
59. Watson & Wiltshire, 2016, p. 13

Mobile financial services

> *The provision of financial services via a mobile platform, particularly mobile money, is one of the most dynamic innovations in the mobile industry and has provided significant social and economic benefits for users. Mobile money is expanding access to financial services. By providing the poor with the financial services they need to manage cash flows and to save, the mobile money industry is helping eliminate poverty and supporting economic growth. Additionally, mobile money can facilitate payment of utility bills and school fees*
>
> **Governor Loi Martin Bakani, Bank of Papua New Guinea[60]**

A population largely excluded from financial services

Academics have described rural life in PNG in terms of "subsistence affluence",[61] where high levels of social capital (community) and natural capital (e.g. fertile soil) exist alongside lingering vulnerability to disasters and disease, and an absence of physical capital (e.g. road networks) and financial capital.

In 1999, the Asian Development Bank (ADB) found that only about one in 20 people in PNG had access to any financial service.[62] While this has improved in recent years, driven by the First National Financial Inclusion and Financial Strategy Plan,[63] PNG remains largely unbanked. As of March 2018, the Pacific Financial Inclusion Programme (PFIP) estimated that 37 per cent of the adult population had access to some form of formal financial services[64] and 15 per cent had some form of insurance. Financial exclusion affects certain groups more than others; it is more prevalent in rural communities and among MSMEs and women. Overall, there is a significant gender gap in financial access in the Pacific region as women are "still lagging behind men in terms of being financially included; women have lower awareness, information and access to financial tools and products than men, despite being more competent in household financial management."[65]

Although there are systems of financial transfer in rural PNG, the traditional brick-and-mortar banking model is inadequate in such a geographically diverse country with a dispersed population. Villagers receive remittances from relatives living in urban centres like Port Moresby through Post PNG or national banks (including Bank of the South Pacific), but recipients often face high transportation costs to the nearest bank or post office, which consumes much if not most of the payment they receive.

There is also a strong culture of cash in PNG and it is expensive for banks and other institutions to manage small volume cash flows. Savings groups and microfinance institutions are active throughout the country, but the average person has few options to keep their money safe. This also means that money is sent through friends or informal and insecure networks.

With support from the PFIP, the Bank of Papua New Guinea and the Center for Excellence in Financial Inclusion have developed the Second National Financial Inclusion Strategic Plan 2016–2020. The Plan aims to reach two million more unbanked low-income citizens, 50 per cent of whom will be women, with a wide range of financial services that includes savings, loans, remittance services and insurance, by 2020.[66] The first priority area is digital financial services "to continue to actively support innovative use of technology for scaling up financial access and promotion of expansion of digital finance services to reach remote parts of the country".[67] In December 2017, as part of the development of the National Payment System, the Bank of Papua New Guinea signed a contract with BPC Banking Technologies for the supply and installation of a national card and mobile payments switch to support the growth of a robust payment infrastructure.[68] The planned switch will enable payments to be made between the country's various mobile-enabled financial services and across the products offered by financial institutions and MNOs.

There is growing interest in the potential of blockchain and cryptocurrency for financial inclusion in PNG, as these technologies could theoretically eliminate transaction fees and currency exchange costs. The Bank of Papua New Guinea has conducted blockchain trials to improve financial inclusion and reduce remittance-based transaction fees (see "Innovation and entrepreneurship", p.34), but this is still in the pilot stage.

The potential of mobile money

UNCDF's 2009 report, "*Building a mobile money distribution network in PNG*",[69] noted: *"Papua New Guinea presents interesting challenges and opportunities for a mobile money system. There is a great demand for a system that enhances cash safety... which would include not only mobile phone transfers but also a means to transact, store, and accumulate value for later use. Mobile money accommodates the very small and unpredictable cash flows of the poor, allowing them to transact affordably in tiny amounts whenever and wherever convenient."*[70]

Launching a successful mobile money service is challenging, especially in a unique environment like PNG. Although subscribers may already use mobile phones to facilitate cashless person-to-person (P2P) transactions by exchanging mobile phone credit,[71] the adoption and use of mobile money services remains low. Added to the challenges of low financial literacy, low population density and diverse language groups, building and maintaining a widespread and efficient agent network may be the toughest, but most important, challenge of all. The complexity of the mobile money distribution network and limited access to liquidity were among the reasons why Digicel, which launched its mobile money service Cellmoni in 2011, hasn't managed to scale its deployment.

After several years of stagnation, a shift appears to be taking place. Data on the 2018 implementation of PNG's second National Financial Inclusion Strategy shows a 55 per cent increase in users with mobile financial services (MFS) accounts and a 62 per cent increase in women with MFS accounts.

Mobile operators are the cornerstone of the mobile payment ecosystem, and national and local financial institutions such as BSP, Westpac, ANZ and microbank MiBank (see Box 6 below), are leveraging the networks of Digicel and bmobile vodafone to expand banking services to rural areas. Using local networks, such as small traders and businesses armed with tablets, they can open basic accounts and issue debit cards to customers in remote communities. Once the accounts have been successfully opened, customers can use their mobile phone or new debit card to access funds they have deposited, transfer money, or check their balance with a basic mobile phone without having to travel to a bank. While smartphones (and the use of apps) are increasingly common, mobile wallets are still using SMS and USSD (Unstructured Supplementary Service Data) protocols as most people in PNG rely on basic phones and SMS-based services. ID challenges can be addressed by working closely with regulators and bank compliance teams to allow customers to open accounts with biometric and photo identification alongside physical identification by local village leaders.

Beyond bank-led models, mobile operators must drive their own mobile money services. As of August 2018, Digicel was processing more than a million transactions per month, primarily through its bank partners. However, the operator is in a dominant position to

60. Bank of Papua New Guinea, 2018.
61. Centre for Global Development, November 6, 2018
62. Asian Development Bank, June 2, 2015
63. PNG National Financial Inclusion Strategy 2016-2020
64. PFIP, 2017
65. PFIP, n.d.
66. PFIP, n.d.
67. PNG National Financial Inclusion Strategy 2016-2020
68. BPNG, n.d.
69. UNCDF, January 1, 2009
70. UNCDF, January 1, 2009
71. Bank of PNG, n.d.

leverage its extensive distribution network to reach the last mile and expand rural financial inclusion. Digicel has plans to relaunch its mobile money service, leveraging its agents selling flex and electronic top-ups as mobile money agents. As part of the SIM registration process, Digicel customers are given the option to sign up for a mobile wallet.

Digicel is also investigating new use cases to support the growth of the mobile money ecosystem – for example, the potential of mobile money is high to digitise payments in the health and agriculture value chains to improve efficiencies; or to further support access to clean energy in PNG by enabling the solar Pay As You Go model,[72] providing affordable and reliable access to clean energy for off grid populations.

In 2018 bmobile vodafone, which also operates in the Solomon Islands, commissioned a market assessment for deploying Mobile Financial Services there.[73] The research showed that there was a solid business case to deploy mobile money services in the Solomon Islands and bmobile vodafone will move forward with the planning and deployment of their service in 2019. The Solomon Islands context, where a majority of the population is already familiar with electronic top-ups, is different from PNG, but if such deployment is successful, it may also lead bmobile vodafone to consider a strategic mobile money approach in PNG.

Box 5

The benefits of mobile money[74]

The shift from cash to digital delivers widespread benefits up and down the value chain. For customers, mobile money provides a safer, more efficient and more convenient payment option than cash, saving travel time and costs and reducing the risk of theft. A recent study in Uganda by Digital Impact Awards Africa revealed that over a three-month period, each of the five million regular users of mobile financial services saved at least 12 productive hours that would otherwise have been spent travelling to a financial institution and dealing with traditional transaction and payment methods.

Mobile money also makes good business sense. Shifting to digital salary payments saves time and costs for both employers and employees. For similar reasons, governments are switching from cash to digital. In Kenya, more than 250 government services are now available digitally through the country's e-government platform, e-Citizen. Over 90 per cent of all digital payments on e-Citizen are made through mobile money. This has significantly streamlined the collection process: it now takes just one financial day to complete collections, settlement and reporting, down from six months before 2014.

The shift from cash to digital payments has also led to an upsurge in revenue collection and improved operations for government ministries, departments and agencies. After digitising all its services through the e-Citizen platform, Kenya's National Transportation Safety Authority doubled revenue collection between July 2015 and October 2016, from an average of $1.1 million to $2 million per month.

Finally, **the spread of merchant payment solutions represents an opportunity for providers, small and medium-sized enterprises (SMEs), banks and customers alike,** because it is a daily use case. Given the significant role SMEs play in the overall economic growth of emerging markets, increasing adoption of mobile financial services and digital payments among this segment could deliver broad societal benefits. According to McKinsey, SMEs are an important market segment because of their high payment volumes and ability to stimulate mobile money adoption by both customer and supplier networks.

72. IFC, August 2018
73. PFIP, June 2018
74. GSMA, 2017b, pg. 22

Box 6

MiBank

Ms Genevieve Daniels, Manager Digital Financial Services, MiBank

MiBank launched into 2012 with the objective of banking the unbanked, through MiCash. This service offers a straightforward mobile wallet, with easy registration and no additional bank account required. It can be opened in less than five minutes, with an SMS confirmation immediately sent to the new customer.

MiBank has invested heavily in consumer awareness and financial and digital literacy efforts, using traditional community forums, such as the marketplace, as a vehicle to deliver education around numeracy, savings and the MiCash service itself. To date MiBank has a total number of 67,263 MiCash accounts, of which 55% are active. The MiCash service is available through the Digicel network.

Women have been a specific focus for MiCash in expanding the service to rural areas. The team has delivered financial training to over 800 women, with the vast majority of these women then taking the opportunity to open a MiCash mobile money account. 'Active' female MiCash users are utilized during financial literacy trainings to teach other female non-users about MiCash. Currently, 37% of MiCash identified accounts are held by women and 63% by men.

MiBank also recently launched the **Hibiscus Pink Card,**[75] a dedicated debit card for women offering a range of services, including access to MiBank branches and agents throughout PNG, MiCash and the Bank of South Pacific's network of ATM and EFTPOS merchants. There are no account opening fees or monthly service charges, higher than average interest rates on balance of funds, dedicated support services and SMS tips on savings.

MiCash offers several different financial services to its customers, including Paygo solar, micro insurance (through BIMA) as well as pension savings, through Nambawan Superannuation. There are an average of 716 MiCash transactions daily and 22,764 transactions monthly across the urban (56%) and rural (44%) customer base.

Currently, MiCash has 85 active agents nationwide – all of whom received training to ensure customers are supported, and given the same great service they would get in a physical bank branch. MiBank's efforts continue to drive customer uptake and retention, strengthening both outreach and partnerships to reach the financial inclusion goals of PNG.

75. Skerah, October 24, 2018

Digital identity

It is estimated that up to 80 per cent of PNG's population do not have access to any clear form of identification,[76] including 85 to 95 percent of children.[77] As countries move into the digital age, the ability to prove one's identity is increasingly essential to gaining access to a range of life-enhancing services, such as healthcare, education, financial services, employment and social protections.[78] Papua New Guinea is among 147 countries where customers are required to present proof of identity to register for a mobile subscription (including prepaid SIM cards). This means identification barriers will need to be addressed to ensure all citizens have access to a wide range of mobile services.

The Civil and Identity Registry (CIR) has the mandate to register life events, such as births, marriages and deaths, and has offices in 18 provincial capitals and headquarters in the National Capital District.[79] The lack of government investment in birth registration and the highly centralised civil registration system remain critical barriers for parents wanting to access registration services.

UNICEF is currently supporting national efforts to improve birth registration rates by enhancing the legal framework for civil registration and supporting the review of the Civil Registration Act; establishing national coordination mechanisms, such as the National Civil Registration and Vital Statistics (CRVS) Coordination Committee; and testing decentralised approaches to registration in health facilities, schools and churches. In 2017, UNICEF modelled a decentralised approach to registration in the Kairuku District by training teachers and health workers to conduct birth registration activities, reaching 9,300 children.[80] However, to date, the birth registration system has only been decentralised in 50 per cent of provinces and progress has been slow due to funding shortages.

The CIR is putting increased emphasis on the implementation of the national ID programme. In 2015, the PNG Government announced it would electronically capture and register all citizens' ID credentials in a central database and issue photo cards for voting and identification purposes, such as SIM registration or attaining a driver's licence or passport.[81] For the vast majority of the population, the registration process for the national ID will involve registering their birth and obtaining a birth certificate for the first time.[82] The CIR has a target to issue 1.5 million national IDs by the end of 2018, but only about 500,000 have been registered to date and the process has been difficult. In some locations, card printing machines have broken down and funds have been mismanaged, with costs totalling nearly AUD 100 million. The latest aim is to provide a digital identity to every person in PNG by 2021 ahead of the 2022 national election.

Beyond the national ID programme, there have been other efforts to address identity challenges in PNG. In 2017, the Bank of Papua New Guinea supported a pilot of a blockchain-based digital identification system in Lalaura village in the Abau District. "IDBox" connected an individual's fingerprint to their phone number and stored this information on the blockchain.

Biometrics are a crucial component of any national digital ID system as they allow MNOs, banks and other businesses to validate their customers' details against a government database where the same details are stored.[83] This ultimately strengthens health, education and financial inclusion efforts and helps to make progress towards Vision 2050 and the SDGs. The likely use of biometrics may add complexity to the expansion of the national ID, but if implemented properly and in a privacy-respecting way, could increase the robustness of the ID ecosystem.

Box 7

Creating a digital identity for farmers

The rural poor are some of the least likely groups to have access to official proof of identity.[84] In Papua New Guinea, farmers can face the double burden of not having access to a "fixed identity" (i.e. the demographic and biometric details recorded on their identity document) and limited or no information on their more fluid "economic identity" due to their changing social and economic circumstances. Farmers who are unable to prove their creditworthiness or validate other vital credentials (e.g. income and transaction histories, land ownership, crop types, geolocation or farm size) are more likely to face barriers in accessing formal services or connecting to the global economy.

The GSMA has identified digital profiles as one of the key bottlenecks, and opportunities, for digitising the agricultural value chain. A recent MiBank pilot to digitise farmers' payments in Bougainville is one encouraging[85] effort to support farmers' access to affordable and relevant financial services. For mobile operators, digital identities could act as a key enabler for digitising the agricultural value chain and extending a range of services to rural users and enterprise customers.

To learn more, see the recent GSMA report, Digital Identity for Smallholder Farmers: Insights from Sri Lanka.[86]

76. Business Advantage PNG, October 31, 2018, para. 4
77. Although data on birth registration in Papua New Guinea is scarce, local stakeholders suggest that registration rates are between 5 and 15 percent; registration rates in urban areas such as Port Moresby are significantly higher than in rural areas.
78. GSMA, 2018a.
79. Bloomberg Data for Health Initiative, 2018.
80. Unicef, 2017, pg. 33
81. OnePNG, June 26, 2018, para. 2
82. Bloomberg Data for Health Initiative, 2018.
83. GSMA, 2018a, pg. 30
84. ID4D, 2016
85. MDF, 2017
86. GSMA, 2018e

Gender equality

The lives of women in PNG are influenced by complex and deeply ingrained social norms that place lesser value on women and girls in the socio-economic, cultural and political fabric of the country. PNG ranks poorly in all global indicators on advancing gender equality and eliminating violence against women,[87] including access to educational and employment opportunities, levels of gender-based violence and decision-making power. Systems of family and community relationships in PNG often exclude women from leadership and decision-making roles,[88] demonstrated by the lack of female members in parliament.[89]

In 2017, PNG was ranked 153rd out of 187 countries on the Human Development Index, and lower still at 159 on the Gender Inequality Index.[90] The rate of violence, including sexual violence, against women and children in PNG has been described as "widespread, pervasive and highly damaging"[91] and it is estimated that over two-thirds of households experience "family violence".[92] Women in PNG experience some of the highest rates of maternal death in the world (second only to Afghanistan in the Asia Pacific region), with only about 50 per cent of women and girls giving birth in a health facility or with the help of a skilled birth attendant.[93]

The role of mobile technology in empowering women

Mobile technology can play a role in empowering women and helping to address gender inequalities in PNG. It is well documented that mobile phones can make women feel safer, more connected and provide access to information, services and life-enhancing opportunities, including health information, financial services and employment opportunities. For women in PNG, access to mobile technology can bring particular benefits, helping to overcome the lack of traditional infrastructure and availability of key services for men and women alike. This includes the ability to access agricultural market pricing information[94] or receive key maternal and sexual health information through initiatives like Susu Mamas (a free maternal and child health information line)[95] and Haus Lain (see Box 12 in the Health section).

However, it is important to consider the paradoxical relationship between mobile phones and women's safety. While mobile phones can make women feel safer, there are also safety concerns related to mobile phone ownership and use, including risk of theft, harassing calls or messages, online security risks and concerns that mobile use can trigger domestic violence. Mobile-related safety concerns such as these can create a barrier to women's mobile phone ownership and use; these themes are the focus of GSMA's 2018 Framework to Understand Women's Mobile-related Safety Concerns.[96] A 2014 GSMA study on women living at the bottom of the pyramid (BoP) in PNG highlighted that women reported that men were suspicious of women using mobile phones, and that women were fearful of negative associations with mobile phone use, such as gang activity and extramarital affairs.[97] Many women resort to not having a mobile phone or only using one in front of their husband to mitigate the risk of creating tension in the household.[98] Mobile-related safety concerns such as these can create a barrier to women's mobile phone ownership and use.

It is crucial to acknowledge this paradox and the reality that for women to translate "economic advancement into economic empowerment, the norms which constrain and limit their agency and power" (such as domestic violence) must be addressed at a community and familial level.[99] Efforts to accelerate the digital and financial inclusion of women in PNG must take the social context within which women operate, into account. The benefits that mobile technology can bring to the lives of women must be maximised, while risks to their safety associated with mobile phone ownership and use must be mitigated. However, fears and negative perceptions of mobile technology should not be used as an excuse to deny women access.[100] The potential of mobile technology to empower women in PNG and enhance their safety should be emphasised instead.

The gender gap in mobile phone ownership and use

While access to mobile technology can provide important opportunities to women, across low- and middle-income countries there is a gender gap in mobile phone ownership and usage which prevents women from realising the full range of benefits; women are 10% less likely than men to own a mobile phone and 23% less likely to use mobile internet.[101]

While mobile network penetration in PNG is low for men and women overall, further research (including data disaggregated by gender, location, age and other socio-economic factors such as patrilineal versus matrilineal communities)[102] is required to further understand differing levels of access to and usage of mobile technology for men and women in different contexts. According to Facebook data, which GSMA has found to be a strong proxy for mobile internet access,[103] of the approximately 750,000 people active on Facebook in PNG (in November 2018), just 39 per cent were women.[104] Research by the GSMA has identified several key barriers to mobile phone ownership typically faced by women in low- and middle-income countries, including affordability, accessibility (including limited access to ID, electricity and limited mobility to access a mobile network signal), safety concerns, relevance, and usability and skills.[105] There is evidence that these barriers are present for women in PNG so initiatives aimed at enhancing women's digital and financial inclusion should strive to address them.

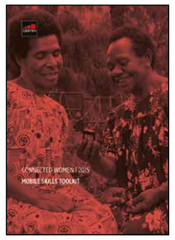
GSMA's 2014 study in PNG revealed that of the women surveyed, only 16 per cent owned a SIM card or handset, and 96 per cent of women without a mobile phone cited affordability as a reason they did not own one.[106] The study therefore identified affordability as an important focus, including a recognition of women's price sensitivity and the importance of finding innovative pricing models or ways to lower the total costs of mobile ownership and use. In terms of usage, the study found that less than two-thirds of women were comfortable making a phone call and less than half were comfortable sending an SMS.[107]

Another GSMA study (2013) looking at mobile financial services (MFS) in PNG found that of those surveyed, 47 per cent of women and 35 per cent of men who wanted an MFS account but had not opened one said the main reason was because they did not understand how to use it.[108] Low levels of digital and financial literacy limit women's perceptions of the usefulness of mobile technology, and a corresponding willingness to invest in it. Box 8 provides an example of a resource that seeks to address this barrier.

87. UN Women, n.d., para 1
88. UNDP, n.d. para. 1
89. UNDP, 2018, pg. 4
90. UNDP, 2018, pg. 4; which takes into account reproductive health, economic activity and empowerment to assess the status of women in a country
91. Betteridge & Lokuge, 2014
92. UNICEF, August 14, 2008, para. 3; HRW 2015
93. Human Rights Watch, 2017, para. 7
94. Suwamaru, 2014
95. Susu Mamas (n.d.)
96. GSMA, 2018c
97. GSMA, 2014a, p. 39
98. GSMA, 2014a, p. 39
99. Eves, 2018, p. xi
100. Broadband Commission, 2017.
101. GSMA, 2019
102. Research conducted in 2014 with informal sellers of fresh produce in East New Britain Province (in a matrilineal location) and Western Highlands Province (in a patrilineal location) highlighted interesting differences in patterns of mobile phone ownership and use across the two locations (Curry, Dumu & Koczberski 2016).
103. GSMA, 2018b, p. 10
104. Facebook Audience Insights, November 2018.
105. GSMA, 2015b
106. GSMA, 2014a, p. 30
107. GSMA, 2014a.
108. GSMA, 2013, p. 2

Box 8

Mobile Technical Literacy Toolkit[109]



This resource seeks to help stakeholders address the digital literacy barrier in PNG. The GSMA's 2014 report on women at the bottom of the pyramid in PNG revealed that 35 per cent of women surveyed were not comfortable making a call and 51 per cent could not send an SMS.[110] Of the women who owned a mobile phone, most were using them to 'press the red button or the green button' (i.e. to make, end or receive calls).[111] This lack of skills and awareness of mobile handset functions is both an obstacle to the adoption of services and contributes to low perceived value of investing in a mobile phone.[112]

Therefore, mobile technical literacy, defined as the ability to use a mobile phone and its non-voice and core functions, was identified as a key barrier to women's awareness and use of mobile services. With few prior efforts to address this issue globally, the Mobile Technical Literacy Toolkit was designed based on in-depth research with women in rural and urban communities in PNG, in partnership with MiBank and UN Women. Through half-day workshops (consisting of lessons, stories and interactive games), radio dramas broadcast by NBC and visual resources, such as posters, step-by-step guides and stickers, the toolkit used learning resources that drew on local experiences and would resonate with women. By taking low literacy levels into account, the toolkit seeks to improve women's fluency with mobile technology and in turn boost their uptake of life-enhancing mobile services. The toolkit is available in both English and Tok Pisin, and can be adapted by others for use in training workshops and various settings.

The GSMA 2014 study also highlighted the importance of considering social context in marketing efforts, including building the case for women's mobile phone ownership to "gatekeepers".[113] It was also found that as women in PNG tend to take advice from other women, such as women's groups or female friends, using these groups and below-the-line (BTL) marketing techniques can be helpful in reaching more women customers.[114] Using design features that appeal to women is important and must also take into account the environmental and technical realities of most rural residents, such as the need for durability and long battery life.[115]

Reducing the barriers women face to accessing and owning mobile technology has the potential to not only accelerate digital and financial inclusion for women, but also address wider gender inequalities, but this will require concerted efforts from stakeholders. See Box 6 in the Mobile Financial Services section, which provides an example of how one organisation, MiBank, has sought to address their gender gap in MiCash users and reach women customers with mobile financial services in PNG.

109. GSMA, 2015a
110. GSMA, 2014a, p. 23
111. GSMA, 2014b
112. GSMA, 2014b
113. GSMA, 2014a, p. 39
114. GSMA, 2014a.
115. GSMA, 2014a

Education and mobile learning

Education is a key component of PNG's Vision 2050 within the pillar "Human capital development, gender, youth and people empowerment". The nation has also recognised several international commitments to education, including the Education For All (EFA) agreements and the SDGs.

However, for many children in PNG it is hard to go to school, and there are low attendance rates for all levels of education. Around half of primary school-aged children are not in school and are more likely to be girls.[116] On average, boy children receive two more years of education than girl children.[117] Lack of schools and teachers, travel distance, school sanitation facilities and family environments all contribute to low attendance. The United Nations Population Fund (UNFPA) estimates that youth (those under 25) comprise approximately 60 per cent of PNG's population.[118] Still, gross enrolment in secondary education was only around 40 per cent in 2012,[119] and many leave school without developing adequate literacy and numeracy skills, leaving a generation of youth unprepared for the thriving economy PNG seeks to achieve by 2050.

To date, there have been relatively few promising mobile technology initiatives to improve educational outcomes in PNG. The exception is SMS Story (see Box 9). Mobile phone handset functions used by students with basic mobile phones include the alarm and calculator, and those with advanced handsets can use the internet for research.[120] Even at this nascent stage, a study across several provinces showed that mobile phones are the preferred communication method between teachers, parents and students.[121]

The future holds enormous potential, particularly as mobile penetration and mobile internet coverage in PNG continue to increase. Teacher absenteeism could be addressed by using mobile money to pay teachers' salaries (one reason for teacher absenteeism)[122] and mobile internet could be used to support both student and teacher learning in rural areas.[123] For cultural, environmental and literacy reasons, radio is still a heavily used medium for education across the Pacific.[124] Using mobile phones in combination with radio provides a simple feedback mechanism, offering remote listeners a simple way to engage with broader content and audiences. This approach has been successful in other locations, and there is scope to do this in PNG.

Despite widespread optimism about the potential of mobile phones to enhance educational outcomes, there are significant technical, educational, social and economic challenges.[125] While some hurdles are common in other parts of the world, others, such as the high cost of data and devices, limited electricity and mobile network coverage, are felt much more keenly in PNG.

116. McPhee, L. & McLachlan, 2017, p.17
117. Global Issues, April 29, 2012
118. UNFPA, n.d., para 1
119. McPhee, L; McLachlan, S, 2017, pg. 17
120. Suwamaru, 2015, p. 3.
121. Suwamaru, 2015, p. 3.
122. Trucano, 2014c; Vlies & Watson, 2014.
123. Suwamaru, 2014; Suwamaru, 2015.
124. Chan Mow, Vaai, Thomson & Taloka, 2017, p. 349.
125. Sharma et al., 2017, p. 601.

Box 9

Case study: SMS Story[126]

The SMS Story project is a controlled research trial that has proven that mobile phones can deliver effective and strategic learning interventions, in this case, by improving children's reading ability.

In 2013, elementary teachers in rural and remote schools in Madang and Simbu provinces received two daily text messages. The first message was a short story based on a structured and progressive phonics and high-frequency word scheme. The second message was a simple lesson plan based on the day's story. This lesson plan included various activities, such as reading comprehension questions, key sound practice, word practice and writing activities. (Example text messages are below.)

Analysis showed that the text messages to teachers had a positive and statistically significant influence on students' reading ability. The number of participating children who could not read anything was almost halved compared with the control schools. The research also showed, through lesson observations and interviews with teachers, an improvement in classroom teaching practices. Overall, the SMS Story project demonstrated the effectiveness of an important mobile learning intervention.

SMS Story was designed and managed by Voluntary Service Overseas (VSO) and funded by the Australian Government. The project advisory group included officers from relevant sections of the PNG Department of Education.

The story (Message 1: 152 characters)	**The lesson plan** (Message 2: 160 characters)
Ben is a big man. He has a big dog. The dog is dirty Don. Don likes bananas. Ben picks bananas for Don the dirty dog. But bananas make Don sick. Oh Don!	Teach new sound: 'b' (Ben, big). New words: big, man, bananas, sick, but. Practise blending words on board with class using fingers to count sounds in the words.

126. Kaleebu, Gee, Jones, Jauk & Watson, 2013.

Health

Major challenges to universal health coverage

PNG's geography, dispersed population and current infrastructure all make delivering health services a significant challenge. There is a critical shortage of health workers, with just 0.5 physicians and 5.3 nurses per 10,000 people,[127] and there is limited access to both medicine and medical centres. Rural health centres are closing,[128] medicine and equipment are in short supply and some health workers have not been paid for months.

Some of the main health issues in the country include extremely high rates of maternal and infant mortality.[129] Only a third of women have access to modern contraceptive methods, only 54 per cent of pregnant women attend at least one antenatal care visit and only 40 per cent of women deliver their babies with the assistance of a skilled birth attendant.[130]

PNG has the fourth-highest child stunting rate in the world[131] (a significant risk factor for noncommunicable diseases in adulthood), with nearly one in two children experiencing stunted growth due to chronic malnutrition.[132] Low consumption of nutritious food and geography-related diet restrictions have contributed to a nutrition crisis in PNG. Starchy carbohydrates, such as taro, yam, sweet potato and banana, are the staple crops of communities in the highlands,[133] while those near the coast and rivers can access fish and sago, but have a limited vegetable supply. In 2016, the economic costs of child undernutrition accounted for about 2.8 per cent of GDP.[134]

Immunisation rates in PNG are low (43 per cent for measles and 52 per cent for the third dose of the pentavalent vaccine, which protects against five life-threatening diseases).[135] Infectious diseases, such as acute respiratory tract infections, tuberculosis, malaria and HIV/AIDS, are the leading causes of morbidity and mortality in PNG:

- Infectious disease outbreaks are not uncommon, notably cholera in 2009[136] and polio in 2018.[137]
- Malaria infections in PNG have jumped in recent years, with 432,000 people infected in 2017.[138]
- Tuberculosis kills more people in PNG than any other infectious disease[139] and the number of TB cases has increased, including new drug-resistant strains.[140]
- PNG has the highest rate of HIV/AIDS in the Pacific region. Approximately 47,000 people are living with HIV, and there are challenges maintaining a consistent supply of antiretroviral medicines.[141]

Exposure to modernisation and rapid lifestyle changes are causing a rise in the incidence of noncommunicable diseases (NCDs), including diabetes, heart disease, chronic kidney conditions and tobacco and alcohol-related illnesses.

PNG's National Health Plan 2011–2020 aims to achieve universal coverage of basic health services and has prioritised eight Key Result Areas (KRAs), including improving child survival, improving maternal health, reducing the burden of communicable diseases and promoting healthy lifestyles. Overall, PNG has made moderate progress in achieving these national targets (including reducing maternal mortality and under-five mortality rates), but did not meet the MDG targets in these areas.[142] Based on progress to date, achieving the

127. WHO, 2008
128. Tahana, 2018b.
129. Sauk, 2018; Morris and Somanathan, 2011, p. xv; Watson, Sabumei, Mola and Iedema, 2015, p. 121.
130. World Bank, 2017, p. 47
131. International Food Policy Research Institute, 2016.
132. Save The Children, 2017, p. 7
133. New Agriculturalist, 2013
134. World Bank, February 7, 2018, para. 4
135. WHO, 2018; Tahana, 2018.
136. Horwood and Greenhill, 2012; Horwood et al., 2014.
137. Tahana, 2018.
138. Howes, 2018b.
139. Sauk, 2018, n.p.
140. Sauk, 2018, n.p.
141. Tahana, 2018b; Sauk, 2018; Morris & Somanathan, 2011, p. xv.
142. World Bank, 2017, xii

SDG targets will require accelerating improvements from now until 2030.

Public spending on health as a share of GDP is high in PNG relative to comparator countries, but health outcomes are generally lower.[143] PNG's geography is a major reason for higher service delivery costs. Despite the pressing need to improve health outcomes, current budget projections indicate that health spending is likely to decline substantially in coming years and will force the sector to rely on efficiency rather than additional resources to improve service delivery.

There are some key areas for improvement in PNG:

- Health data issues are often so serious that providing evidence for even basic health questions can be difficult.[144] Fragmented data, data quality, data sharing and inconsistency between national and international data are all major challenges.
- Improvements in the availability of basic drugs, equipment and materials are essential to improve service quality and access. In a survey of health facilities in eight provinces in 2012, it was found that the average availability of basic drugs was only 74 per cent.[145]
- Severe cash flow issues are also a key constraint to effective service delivery. The pace of decentralisation in PNG has arguably exceeded the speed at which regional and local systems have been able to adapt to their increasing responsibilities. The result has been disbursement delays at all levels of government.

PNG's health minister recently mentioned that a new e-health system will help to address ongoing issues like shortages of health specialists at the district level.[146]

The potential of digital health

Digital health, as outlined in Figure 4 below, has the potential to improve the efficiency of service delivery in PNG. Globally, the number of digital health initiatives continues to grow, led by governments, health tech companies and mobile operators. The main use cases can be divided into four categories.

Figure 4 Source: GSMA

Key categories and use cases for digital health

HEALTHCARE SYSTEMS (B2G OR B2B)

- Digitisation of supply-chain management
- Digitisation of patient information (vital event tracking)
- Integrated digital platform for booking and payment
- Personal data hosting & storage
- Data analytics (e.g. disease outbreak risk)

HEALTHCARE CENTRES (B2G OR B2B)

- Digitisation of health centres
- Remote patient monitoring
- Remote diagnostics
- Mobile health records
- Imaging

HEALTHCARE PROFESSIONALS (B2G OR B2B)

- Digitisation of professionals and their interaction
- Workforce management
- Education and training
- Telemedicine
- Data collection and reporting

HEALTHCARE PATIENTS (B2C)

- Application to Person (A2P) health and wellness information
- Peer-to-peer (P2P) anonymous consultation
- P2P medical advice
- Digital payment for health purposes
- Insurance

143. World Bank, 2017
144. World Bank, 2017, pg.43
145. Howes et al., 2014, p. ix.
146. "PNG minister touts 'e-health' as answer", 2018

In many countries and across most use cases, the transition from paper to digital in health systems is a major undertaking that includes the digitisation of drug inventory, supply-chain management and patient records, and integrating platforms for doctor booking and payments (from patients to doctors as well as health professional payrolls). The following case studies demonstrate how entrepreneurs and government are using mobile technologies and devices to facilitate health information flows via voice, SMS and apps.

Box 10

Milne Bay Province Childbirth Emergency Phone

Mr. Billy Naidi, Chief Executive Officer, Milne Bay Provincial Health Authority

Since its inception in 2012, the Childbirth Emergency Phone has markedly improved obstetric care and response in remote and peripheral areas of Milne Bay Province. By providing a toll-free number that rings in the labour ward of the provincial hospital, the service has helped to increase the number of obstetrics and gynaecology emergency referrals, which are supported by a helicopter (medivac) service.

Together with other initiatives, the Childbirth Emergency Phone has made a significant contribution to reducing maternal deaths — almost 60 per cent in the last five years. In 2017, about 150 calls were received, which accounted for 90 per cent of all calls received for emergency referrals (126). In 2012, the Australian Government provided support for the health authority to inform health workers throughout the province about the phone number and how the service works. A project evaluation at that time found that it was effective[147] and it has continued to operate since that time.

There are challenges with the service, particularly network coverage and reliability. However, the Childbirth Emergency Phone provides a link for outstation nurses to communicate directly with specialists on obstetrics and gynecology cases and ongoing clinical consultations. This has provided a convenient and successful way to collectively manage patients where they are and boosted the morale of staff in rural areas.

147. Watson & Sabumei, 2013a; Watson & Sabumei, 2013b; Watson, Sabumei, Mola, & Iedema, 2015.

Box 11

Reducing tuberculosis treatment default through mobile technologies

Mr. David Valentine, Co-Founder, Refer Tech

Refer Tech is a data collection, analytics and health innovation company formed in Papua New Guinea in 2016 by two local entrepreneurs. The company focuses on the collection and processing of information for data-driven development in emerging economies, with a strong focus on health.

In 2018, Refer Tech was awarded a grant to fund the development of a web-based patient management system and data analytics engine specifically for use in an urban tuberculosis clinic in Port Moresby. The system was designed to improve the efficiency of patient-health worker interactions by automating and digitising several steps in the process, from drug dispensation to data collection. The analytics engine provides previously unavailable insights into the data for all stakeholders, including health workers, international development partners and national policymakers, which enhances decision-making at multiple levels.

Tuberculosis is a complex and key regional health issue in PNG where disease metrics are heavily influenced by a range of socio-economic indicators, including education and employment status. The Refer Tech team hopes to have over 1,000 registered patients within 12 months of system installation, to provide much-needed data and analytic tools to improve health service delivery and policy formulation.

Box 12

Haus Lain

In 2012, with the support of DFAT, Population Services International (PSI) set up an SMS service called Haus Lain to encourage positive behaviours around a range of health issues, including maternal health and sexually transmitted infections (STIs). Using any Digicel account, users could opt-in to the service by sending a key word, and then receive free weekly health tips in English or Tok Pisin to their mobile phone. The service was promoted on radio stations, and within one month over 10,000 people had signed up to the service, and after six months this had grown to 30,000 people.[148] Although it was an innovative approach to communicating with beneficiaries in rural areas, this service eventually ceased due to funding and questions about impact.[149]

148. Cullen, 2017, p. 327,
149. Cullen, 2017, p. 327

Most business-to-customer (B2C) digital health solutions (e.g. health information and consultation) are accessible via 2G mobile channels (SMS, IVR and voice) and basic phones. This enables greater population coverage and simplicity of use, as the cost and coverage of internet is a significant limiting factor for the majority of the population. Use of mobile phones for business-to-business (B2B) communication can be valuable in the health sector in PNG. For example, the Western Highlands Provincial Health Authority in PNG has a closed user group (CUG) that allows officers to make unlimited calls and exchange unlimited SMS messages with one another.[150]

National efforts are underway to investigate how a transition from the existing national health information system (NHIS) to an electronic platform (eNHIS) would help to decentralise data entry and improve reporting rates. A recent review of the first pilots of the PNG NHIS Rural Primary Health Services Delivery[151] found that the eNHIS has been capable of timely and reliable health data collection, analysis and presentation in 184 health facilities in five of PNG's 22 provinces. The review found that the timeliness, quality and usage of data had all improved, and on that basis recommended rolling out the eNHIS in the remaining 17 provinces. The report also pointed out that this information system must be developed further to realise the full benefits, including the effective use of data by decision makers in the national health system and strengthening the capability and capacity of the National Department of Health to effectively manage future eNHIS activities.

150. Yamo, 2013; Yamo & Watson, 2014.
151. Matheson, Douglas & Bhattacharya, 2016

Agriculture

Major challenges to develop the agricultural sector

Agriculture is a key part of PNG's cultural fabric and is often referred to as the backbone of the economy. For the last four decades, the agricultural sector has accounted for 25 per cent to 40 per cent of GDP and approximately three-quarters of PNG's population depend on subsistence livelihoods.[152]

Agriculture-related products contribute to 11 per cent of exports, including palm oil, coffee, cocoa and copra.[153] Coffee and cocoa are the main cash crops, employing half the country's entire labour force. However, rising local production costs and increased competition in the global market make over-reliance on these products risky. PNG's agricultural sector, including cash and subsistence crops, is dominated by smallholder farmers in rural settings, although there are also larger enterprises operating in oil palm, copra, tea, coffee, cocoa and fisheries industries for export.[154]

The cost and limited availability of modern agricultural inputs and technologies, lack of irrigation and poor access to support services, all contribute to low yields.[155] The World Bank[156] has estimated that coffee yields have dropped by 30 to 50 per cent due to a lack of support services and efficient farming techniques. Logistical costs are high due to the poor transport network and a lack of market organisation and market information, discouraging small farmers. Despite the importance of the sector in PNG, farming has long been hampered by insufficient foreign investment, limited public spending (about two per cent of GDP per year), ambiguous land policies, major infrastructure gaps and lack of access to credit for smallholder producers.[157]

Agricultural development is also hampered by weather extremes and hazards related to climate change. In 2015 frost brought by El Niño affected a third of the population, leaving more than a million people facing serious food insecurity in vulnerable parts of the highlands and lowlands. From the National Weather Office, recent reports of drought in the Western Province confirmed that the likelihood of an El Nino phenomenon is very high this year, with severe risk of water shortage in coastal areas.

This upcoming drought will increase pressure on food security in PNG already facing nutrition challenges. The country is roughly split between highlands and coastal areas, and this diverse and challenging geography leaves little room for agriculture — only about a quarter of the country's land is arable.

Domestically, there is upward demand for fresh produce, which is primarily imported because current agricultural practices do not produce the volume needed to meet domestic demands. Innovative Agro Industries (IAI) built its 9 Mile Agro Farm outside Port Moresby in 2014 and focuses on replacing imports of tomatoes, cucumber, capsicum and lettuce with quality, locally produced crops.

152. UNDP, n.d., para 1
153. Market Development Facility, n.d., para 7
154. ADB, March 2015, para. 2
155. IFAD, n.d., para. 5
156. World Bank, 2014
157. Oxford Business Group, 2018.

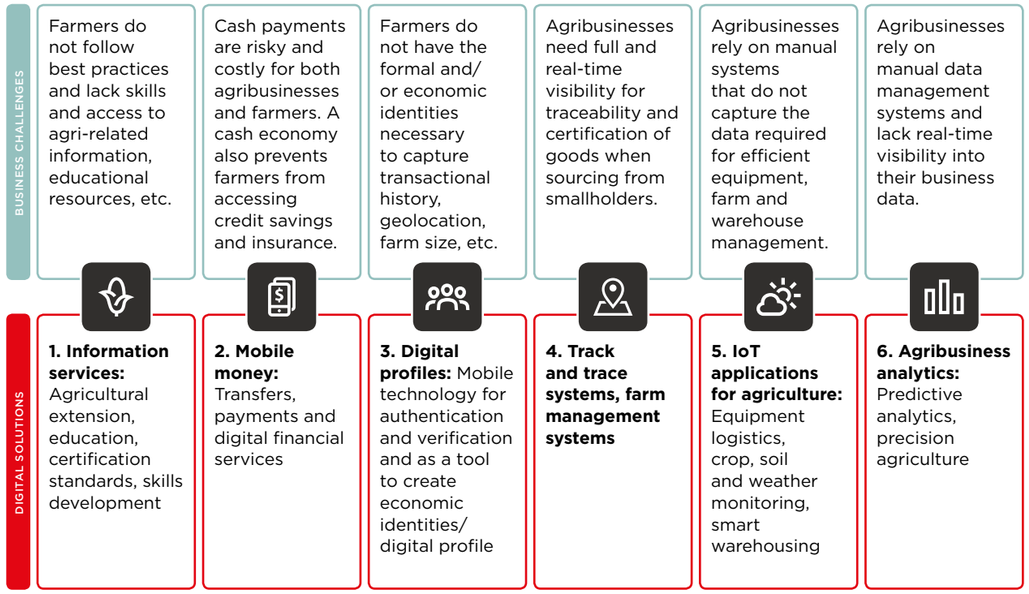
New digital interventions in agricultural practices

The digitisation of agricultural value chains is an emerging opportunity for developing countries like PNG. Holistic enterprise solutions for the agriculture sector might include a combination of digital payments for crop procurement from smallholder farmers, digital farmer records, agricultural information and track and trace services. These digital tools enable agribusinesses to better control and monitor operations, make transactions more transparent and establish effective communication channels, both internally and with smallholder suppliers.

Agricultural value chains contend with a variety of inefficiencies: theft and fraud, the time and travel required to receive cash payments for crops and overall lack of visibility for buyers and sellers. However, a range of digital tools can help to improve business performance for farmers and agribusinesses and ultimately create a path to financial inclusion for farmers.[158]

Figure 5 Source: GSMA

The six digital agriculture channels



158. GSMA, 2018f, p.6-14

The potential for mobile technology to benefit farm communities in PNG is significant. Mobile-enabled agricultural services could offer transparent market pricing and payments to smallholder farmers, enable better production monitoring and volume forecasting, alert farmers to weather changes and allow them to have access to more accurate price information, potentially reducing the price volatility of food commodity markets. Although there are relatively few mobile-enabled agricultural services in PNG, there are some agricultural information services. For example, Olam's digital strategy is to develop a full-service mobile-enabled supply chain, and a pilot and feasibility study took place in Bougainville to introduce mobile financial services and digitise the cocoa value chain.

Low levels of financial inclusion make digitising agricultural value chains a challenge as most payment channels tend to be informal (cash-based). Such informal transactions can make supply chains harder to manage and scale, hence digitized payments could solve inherent efficiencies. After a review of PNG's first national financial inclusion strategy (see Mobile Money section), two priority areas were added to the subsequent strategy, that is, the informal economy including agriculture and the resources sector, recognising the need to leverage opportunities and advance financial inclusion within the resources sector; and enhance access to and usage of finance for enterprises in the informal economy including agriculture.[159]

The challenges that affect all other parts of the mobile ecosystem – connectivity, electricity, women's access – are all keenly felt in mobile-enabled agriculture, but tend to be exacerbated in rural environments. Women are less likely to own mobile phones, and lower literacy rates limit their ability to access agricultural extension services. Similarly, farmers might not fully benefit from mobile-enabled agriculture services if they have to frequently travel large distances to charge their phones or if mobile coverage is consistently unreliable or non-existent.

A Food and Agriculture Organisation (FAO) regional project on e-agriculture strategy development, together with the Department of Agriculture and Livestock and other key stakeholders, has initiated the development of an e-Agriculture Strategy in Papua New Guinea (2017–2023).[160]The strategy is aimed at "harnessing the ICT potential of the country in achieving the agriculture goals and further strengthening the role of ICTs in accelerating the growth of the agriculture sector in a sustainable and equitable manner."[161]

The active participation of mobile operators would help unlock the opportunity to digitise agricultural value chains in PNG, primarily to enable coverage and connectivity in rural areas, but also to support functioning and liquid mobile money networks. Besides mobile operators, the industry at large — mobile money providers, Agriculture technology companies and regulators — must work together to create enabling environments for the uptake of mobile money services in rural areas.

Box 13

NKW Fresh Produce[162]

NKW Fresh Produce was established in 2014 in Morobe Province and works with local communities to provide fresh produce to the Hidden Valley Mining Project (it also supplies fresh produce to other markets, including supermarkets and catering companies). To address the challenges faced by smallholder farmers, including getting produce to market, improving quality and minimising waste, NKW Fresh Produce, with support from Market Development Facility (MDF), has developed a supplier farmer database to help identify and track farmers' activities. The project will also recruit and build the capacity of field officers to assist farmers with crop planning through the use of smartphones and crop management software. By collecting and analysing data, farmers will be better able to forecast demand and distribution of inputs, which will in turn provide consistent supply to NKW Fresh Produce and the potential to increase their incomes.

Box 14

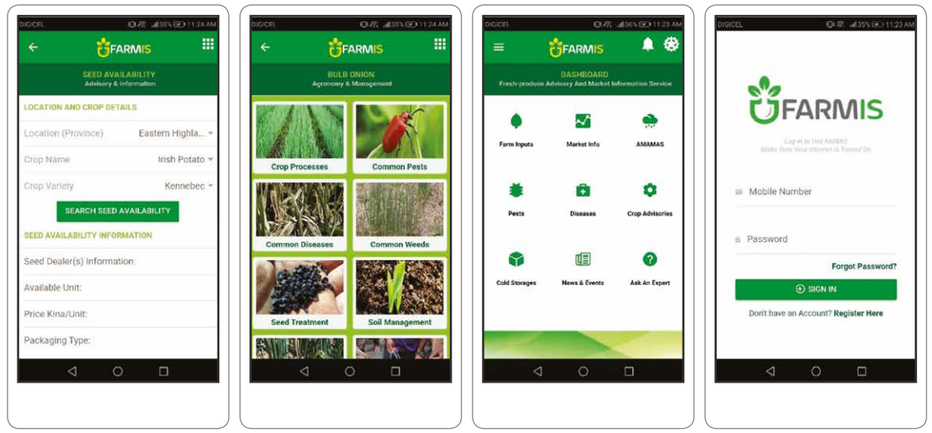
Information services for farmers

Mr. Glen Hayoge, ICT Officer, FPDA

In 2018, the Fresh Produce Development Agency (FPDA) launched the FARMIS platform — a one-stop information portal with end-to-end solutions for farmers growing fresh produce in PNG. FARMIS stands for Fresh-Produce Advisory Resources Market Information Services and builds on an earlier version of a mobile-enabled agricultural information platform, Mobile Market Information Service (MOMIS) launched in 2009, which provided up-to-date market information on fresh produce to farmers in the value chain. Funded by the Australian Government and in partnership with Digicel, MOMIS allowed smallholder farmers to send text messages to a shortcode to request and receive information on the quality, quantity or prices of 12 common fruits and vegetables at eight markets around the country for 35 toea (about 10 cents) per SMS.

In addition to accurate and timely market information in English and Tok Pisin, FARMIS will also offer weather and crop advisory services that can be tailored to a farmer's needs, considerably reducing the cost of extension services. FARMIS will work across several digital channels — web, mobile app, USSD menu, chatbot and voice services — an approach designed to include those with low literacy levels.

Screenshots of FARMIS mobile app (Android, iOS and Windows)



159. Keynote address by Mr Loi M Bakani, Governor of the Bank of Papua New Guinea, at the Asia-Pacific Financial Inclusion Forum on "The Inclusion Imperatives: Advancing Policies, Targets and Plans", Tokyo, 27-28 June 2018.
160. FAO, n.d.
161. Department of Agriculture and Livestock, 2016
162. NKW Fresh, n.d.

Box 15

World Food Programme mobile Vulnerability and Analysis Mapping (mVAM)[163]

Since April 2015, the El Niño Southern Oscillation (ENSO) has had a severe impact on PNG. In 2016, the World Food Programme (WFP) and the National Disaster Center (NDC) used the WFP's mobile Vulnerability and Analysis Mapping tool, mVAM, to conduct a mobile-based survey of 3,708 respondents to assess the impact of the 2015/16 El Niño on food security and livelihoods. Food security was strongly or severely affected by drought and frost in 54 local-level government (LLG) areas, affecting 1.47 million people. In 2017, the fourth nationwide mobile survey conducted phone interviews with 4,450 respondents. Approximately 25 per cent of households surveyed throughout the country were estimated to be severely food insecure, according to the Food Insecurity Experience Scale (FIES), an official indicator used to track progress towards the SDG target of zero hunger. mVAM surveys were also conducted in March and April 2018 to assess the impact of the February highlands earthquake. The results indicated that 14 per cent of 1,534 households contacted in affected areas were displaced after the earthquake.[164] The survey also found that households in nine of 31 LLGs surveyed experienced high or extreme food shortages, with the destruction of food gardens in these areas removing the main source of livelihood and food supply for the majority of people.

Innovation and entrepreneurship

A nascent start-ups and SMEs ecosystem

In a 2017 report on digital entrepreneurship in APEC member countries, researchers from RMIT University in Australia reported there is "considerable opportunity for PNG in digital entrepreneurship and foundational capacity building work would contribute to realising digital opportunities".[165]

Yet, the technology and start-up ecosystem in Port Moresby and beyond is still in its infancy and there are few statistics on the number of local start-ups. There are major physical and financial barriers to supporting a generation of aspiring entrepreneurs, and a survey by Australian Lowy Institute found that innovators,[166] mostly under 35, identified reaching customers online and securing contracts as major obstacles.

For example, in urban areas of PNG where local merchants operate mainly offline, the capacity for online payments is limited. There is a need for awareness-raising among SMEs of the commercial opportunity of the internet and websites, and to introduce foundational ICT and digital education in schools and the business community to foster low-cost e-commerce and website development. Both will strengthen PNG's capacity to realise its digital aspirations.

163. WFP 2016
164. Reliefweb, 2018
165. RMIT (2017)
166. AUS-PNG Network, June 24, 2016

Box 16

A digital marketplace for local crafts

Social entreprise Real Impact, with the support of DFAT InnovationXchange, has established a B2B e-commerce digital marketplace, Considered by Real, for MSMEs in PNG to sell their artisanal products to local and international buyers. Real Impact also provides investment-readiness technical assistance to local artisans and has partnered with global crowdsourcing platform Kiva to provide working capital loans of up to $50,000 for four SMEs.[167]

Attrition levels among small businesses in PNG remain high, with just 20 per cent of SMEs surviving for five years or more.[168] SMEs face obstacles to financing, including a lack of collateral and guarantees, and are often perceived as high-risk by commercial lenders. SME financing is one of the key priority areas for the **Second National Financial Inclusion Strategy**, which aims to expand access to financing for small businesses and enhance knowledge and data on financial inclusion for SMEs.[169]

Unveiled in 2016, the **SME Policy and Master Plan 2016–2030** set objectives for PNG to become a middle-income country by 2030 and a high-income country by 2050 in part by boosting the number of SMEs from 49,500 to 500,000 by 2030.[170] SMEs, which are mainly concentrated in wholesale, retail, agriculture, tourism and fisheries, currently account for six per cent of GDP and 0.7 per cent of SME outputs are currently exported. Provided with the right business skills, entrepreneurship could offer a solution to reducing high rates of youth unemployment in PNG (e.g. in Port Moresby where 40,000 youth are unemployed, many without secondary education and limited skills for entry-level positions). Local innovators are keenly aware of the dynamics and complexity of the local market — an advantage over innovators from outside the country. There is a strong social and financial business case for supporting the local innovation ecosystem in PNG.

e-Commerce, data flows and trade

The increased bandwidth and lower internet costs promised by the upcoming connection of the Coral Sea Cable will clearly benefit e-commerce. However, as PNG's Minister for Foreign Affairs and Trade has pointed out, "the issue of digital trade, e-commerce or e-trade are creating more opportunities for our MSMEs but also present a new set of challenges. We need to find the balance between facilitating free flow of data while protecting consumer data and security."[171]

Parliament passed the Cybercrime Code Act in 2016, covering hacking, forgery, infringement of intellectual property rights and identity theft. More needs to be done to increase confidence in the business community through regulation and legislation on privacy and data protection. In 2018, the GSMA commissioned a report to identify specific steps that can be taken to support the evolution and convergence of data privacy frameworks in Asia and meet the growing challenges facing ASEAN and APEC regulators.

167. Real Social Impact (n.d.)
168. Oxford Business Group, 2015
169. CEFI, 2018
170. "Papua New Guinea introduces measures", n.d.
171. Honourable Rimbink Pato, APEC, May 29, 2018

Box 17

Regional privacy frameworks and cross border data flows[172]

How ASEAN and APEC can protect data and drive innovation

Regulatory frameworks for data privacy are critical to facilitate cross-border data flows in Asia and around the world. Over the last decade, international data flows have increased global GDP by 10.1 per cent. Data flows accounted for $2.8 trillion of global GDP in 2014, a larger share than the global trade in goods. More than $339 billion could be saved by export-focused MSMEs through the use of digital tools, and the shift from cash to digital payments could increase GDP across developing economies by six per cent before 2025, adding $3.7 trillion and around 95 million jobs.

Governments in Asia have worked hard to develop and implement data privacy frameworks that can effectively protect the data of their citizens, while also allowing data to flow across borders in ways that support trade and innovation. Now is an important time to accelerate progress so that the region can continue to expand business and trade.

The Constitution of the Independent State of Papua New Guinea expresses the right to privacy for its people. Although PNG does not have a dedicated privacy law, several other laws provide some limited data protection provisions, such as the Cybercrime Code Act 2016 and the National Information and Communication Technology Act 2009. The government of PNG may begin engaging with the public and private sectors to get a sense of their understanding of data protection and develop practical ideas to enhance it. As a country with close ties to others in the region, such as Australia, it could start discussions with the Australian Information Commissioner on potential capacity building workshops and knowledge sharing.

Support for capacity building

Although entrepreneurs in Port Moresby have limited access to facilities, business training and incubation, recent initiatives are paving the way for positive change. Kumul Game Changers (KGC), set up in 2015 with the support of the PNG Governance Facility to identify, train and resource high-potential PNG entrepreneurs, has become one of the Pacific's leading entrepreneurship programmes. KGC has already supported many regional entrepreneurs in their cohort and facilitated exchange with companies and universities from the Silicon Valley.

The PNG Digital ICT (PNGD-ICT) Cluster was launched in 2018[173] and aims to become a platform for innovative partnerships between businesses, universities and public authorities, and build a strong foundation for a domestic start-up culture. A new SME Accelerator programme has been created in partnership with the University of California Berkeley to support the development of innovative SMEs in Port Moresby. The DPNG-ICT Cluster has also opened a digital lab in Port Moresby to encourage the participation of women and can host up to 20 entrepreneurs from all sectors of the economy, including agriculture, health, education and financial services.

Connectivity is key

As PNG's Minister for Commerce and Industry has stated, "technology and connectivity are extremely important in the MSME sectors."[174] Mobile technology plays a central role in enabling local tech innovation, and start-ups and SMEs will benefit from access to better infrastructure, faster and more affordable internet, and reliable and cheaper power.[175] Beyond mobile platforms, tech hubs and innovators could also benefit from greater collaboration with mobile operators to accelerate the development of new content and services and mitigate route-to-market challenges for start-ups. The scale (e.g. customer base and distribution networks), financial resources and technical assets of mobile operators, such as Application Programming Interfaces (APIs) and billing systems, can enhance the functionality and reach of new digital solutions from tech start-ups.[176]

Box 18

GSMA supports Pacific Ads Group

Kaung Sitt, Market Engagement Manager, GSMA Ecosystem Accelerator

For its third round of funding, the GSMA Ecosystem Accelerator (EA) programme has selected Pacific Ads Group (Emerging Classified Ventures – EVC), which aims to create two platforms: **pnghometask** and **MyWanTok** to connect micro or small businesses to homeowners and other consumers who require their services. By enabling security-verified services to bid for small tasks, the platform reduces transaction costs on both sides by providing a wider market reach for services and more options for customers to choose from. Completed transactions are recorded in business' accounts for easier tax compliance, and customer reviews and ratings are available for future reference.

The two platforms are expected to be launched in five cities across Papua New Guinea during the grant period (2019–20), with company representatives appointed for each city for better customer service. The Ecosystem Accelerator Innovation Fund will help the team develop the two platforms into a working product and launch them across PNG, where they will explore partnership opportunities with mobile operators.

Emerging technologies

Frontier technologies, such as blockchain and big data, offer potentially powerful ways to address development challenges and leapfrog traditional approaches to reach underserved populations without access to formal services. To maximise the socio-economic impact of these technologies and achieve development goals, stakeholders in PNG need to create the necessary enablers to pursue these experiments.

Blockchain

Blockchain is a secure platform based on distributed ledger architecture that allows individuals and organisations to share information with each other with a high degree of trust and transparency. By automatically distributing blocks of information across an entire network, the blockchain ensures that every user sees the most up-to-date information, the database has no single point of failure and no single institution can control how the information is recorded, audited or managed.

172. GSMA 2018d
173. Amini, 2018.
174. Hon. Wera Mori, APEC, September 11, 2018
175. RMIT, 2017b, p.29
176. GSMA, 2017a

Blockchain could be used by the government and its partners in the following areas:

- Health – to address security, incompatibility and portability issues of health records, resulting in greater standardisation;
- Identity – to enhance Know Your Customer (KYC) processes to speed up business registration and drive Government to Person (G2P), Government to Business (G2B) and Business to Consumers (B2C) transaction growth;
- Agriculture – to secure land transactions and verify ownership;
- Oil and gas – to strengthen the availability and transparency of production and distribution information.

Several pilots are underway in PNG in different sectors (e.g. IDBox, AgUnity and Coin-sure), many in very early stages, and the government is moving forward with the creation of a special economic zone in Morobe Province to test blockchain innovations. The Australian Government has been actively supporting blockchain innovations, such as Coin-sure, which is pairing with Melbourne-based business Generative Solutions to develop a prototype and business model. The Blockchain Pasifik conference, held in Port Moresby in October 2018, provided an opportunity to discuss recent developments and highlight the activities of the Blockchain Pasifik Junior Challenge, an initiative in schools in the capital to explore the use of blockchain in land title registration, carbon emissions trading and identity registration.

It remains to be seen how PNG can leverage blockchain to leapfrog development stages. Many industries in the Pacific still rely on pen and paper, and transitioning to more digital advanced technologies like blockchain may take time. As the 2016 World Development Report points out, "digital dividends depend on key 'analog complements' needed for digital networks to succeed, including appropriate policies and regulatory frameworks, competition, accommodating bureaucratic processes for start-ups, and strong and inclusive education."[177] The question is whether this focus on emerging technologies like blockchain is distracting attention from what should be the real priority: enabling a digital transformation today.[178]

Big data

Mobile networks generate huge amounts of data on customer location, demographics and spending habits. Analysing anonymised and aggregated data can generate valuable insights and accelerate efforts by governments, development agencies and NGOs to address socio-economic, environmental, and governance challenges, as well as achieve the SDGs. For example, insights on population location, mobility and demographic makeup can support efforts to:

- Prevent or control the spread of diseases;
- Prepare and respond to natural disasters;
- Plan urban settlements and infrastructure investments, such as schools, hospitals and transport; and
- Improve tourist destinations and services.

In PNG, UN Pulse Lab is collaborating with Digicel to analyse anonymised call detail records across Digicel's Pacific operations to ultimately inform public policy and humanitarian action.[179]

Powered by frontier technologies like Internet of Things (IoT) and Artificial Intelligence (AI), the digital economy has created a shift in the data landscape. The personal data of individuals is increasingly being used to gain new business and behavioural insights to deliver better products and services to customers. As organisations harness the value of data, it is crucial that they understand the importance of using personal data responsibly and putting adequate safeguards in place to prevent abuse or unauthorised disclosure or access to information.[180]

177. World Bank, 2016, World Development Report 2016: Digital Dividends
178. Kenneth Katafono, November 7, 2018
179. Pulse Lab Jakara, 2018
180. GSMA 2018d. p52

Accelerating mobile-enabled progress on the Sustainable Development Goals

The digital transformation of a society is a continuous process of improving connectivity, developing and integrating digital services across different sectors of the economy, and educating citizens on how to use digital content. In Papua New Guinea, a multi-stakeholder approach is needed to maximise the impact of mobile technology on national development.

The role of stakeholders

A variety of stakeholders contribute to digital transformation in PNG. Five key stakeholder groups play particularly important roles in the digital ecosystem:

- **Government departments and agencies** set national development goals to address the needs of underserved populations and integrate digital technologies in national strategy plans; create an enabling environment for digital transformation by implementing coherent policy frameworks across government departments; support digital skill-building for professional development; provide e-government services; and create incentives for collaboration between stakeholders.

- **Mobile industry and technology ecosystem** provide the infrastructure, devices and services to support affordable digital inclusion for all; expand financial inclusion by deploying mobile money services and applications; support digital skill-building efforts; create and distribute locally relevant content; and work with other stakeholders to develop innovative solutions for specific challenges.

- **Other private sector companies** use digital solutions to improve efficiency and productivity, and provide funding, technical and market access to start-ups and other players in the technology ecosystem.

- **Civil society organisations** are increasingly leveraging digital tools to reach out to the population and for advocacy work; conducting awareness-raising campaigns on the availability and benefits of digital solutions across sectors; and advocating for universal and affordable access to digital services.

- **Development agencies** work with the government and government agencies to address socioeconomic challenges; use digital solutions to provide support and services to underserved populations; and provide funding and other support to technology hubs and innovators.

In addition to these roles and activities, stakeholders need to collaborate on action plans that will accelerate progress on both national and international development goals. The following sections explore specific actions stakeholders can take to create positive impact using mobile-enabled digital technologies.

While this report makes specific recommendations by sector, there are other broad areas that need to be addressed to realise PNG's potential as a digital economy. First, PNG needs robust regulation to encourage competition and enable innovation. This could allow new players to enter the ecosystem, potentially ensuring appropriate services reach the last mile. Second, access to electricity is a fundamental requirement of any digital ecosystem and must also be a priority in PNG. Finally, high levels of corruption are curbing investment in PNG and creating additional costs and risks for existing investors. Given that significant international investment will be needed to improve the country's infrastructure, the government needs to address corruption seriously.

There is no silver bullet, but this report offers recommendations to create a more enabling environment for mobile technology, in order to achieve both national and international development goals.

Calls to action

Supporting the Digital Enablers

DIGITAL ENABLERS	KEY ACTIONS AND RECOMMENDATIONS
Digital Access	◦ To extend access to mobile technology infrastructure • The PNG Government could consider providing incentives to stimulate roll out in rural areas, such as tax breaks on imported equipment for rural network deployment. • The PNG Government and mobile operators could facilitate active and passive infrastructure sharing on a voluntary basis, to further extend coverage to the rural population. • Development agencies should consider exploring innovative funding solutions to support the roll out of new infrastructure. • Mobile operators, electricity utility and energy suppliers could consider developing new models of energy delivery such as community power (e.g. microgrids providing power to the community and mobile phone tower). ◦ To make mobile services and devices more affordable and accessible to all • As mobile broadband costs in PNG are very high by world standards, initiatives to reduce costing, such as caching popular services in country, could improve uptake and usage of mobile internet. • Online content could be produced so that it uses minimal bandwidth, thus reducing consumer data costs. • Mobile operators and other providers should explore financing options for customers who cannot afford the upfront cost of a handset, including direct financing like instalment plans, partnership with a microcredit institution, or bundling service. • Development agencies and private sector players could subsidise the cost of handsets and mobile services for low-income beneficiaries and/customers. • Stakeholders should collaborate and streamline efforts to improve digital literacy in PNG to ensure no one is left behind, including the country's most vulnerable populations. ◦ To make content relevant and impactful • All stakeholders should work to understand the needs of different customer segments (e.g. women) so they can design and deliver relevant products and services and help to close gaps in digital access. • Government and development agencies should pursue digitising information and services over mobile channels and in local languages (if relevant). • Private sector players should shift their understanding of tech innovation from a 'corporate social responsibility' (CSR) perspective to a 'corporate social investment' (CSI) perspective.
Digital Finance	◦ Provide support to deploy and sustain robust mobile money agent networks throughout the country and training for agents in digital financial literacy and cash flow management. ◦ Continue and strengthen efforts to ensure that people in the country's most rural areas can access and use appropriate digital financial tools. ◦ Sustain investment and collaboration in financial education and digital financial literacy to increase awareness of the benefits of mobile financial services. ◦ Improve women's access to and usage of mobile financial services.

	◦ Promote interoperability of mobile money services, which is not yet regulated through the central bank, but would support the growth of the ecosystem. ◦ Introduce relaxed KYC and compliance to facilitate registration of low risk customers.
Digital Identity	◦ Greater oversight, accountability and allocated funds are needed to support and advance the national ID system. ◦ With the 2021 deadline for national IDs just two years away, additional card printing machines will need to be purchased and deployed across rural provinces. ◦ Government and NGO stakeholders should consider how mobile technology could be leveraged to improve identity enrolment and provide greater access to civil registration services. ◦ Consider allowing mobile operators and other private sector organisations to participate in the review of the Civil Registry Act (which is currently being drafted and reviewed by consultants/stakeholders) to ensure that new, modern civil registration systems can be embedded in law.

Supporting the impact of mobile technology across customer segments

SEGMENTS	KEY ACTIONS AND RECOMMENDATIONS
Gender	◦ Understand the paradoxical relationship between mobile phones and women's safety and aim to maximise the benefits of mobile while reducing safety risks. Approaches to address safety concerns should consider the family as a holistic unit or team, including possible gatekeepers, in order to limit further detractors to women's mobile phone access and use. ◦ Conduct further research, and collect data disaggregated by gender, location, age, socio-economic group and other key factors, to better understand the differences in access and usage for men and women, and address the barriers that women face in a holistic way ◦ Recognise women's additional price sensitivity and find innovative pricing models or other ways to lower the total cost of ownership to help drive adoption and make it more affordable to charge phones.[181] ◦ Address technical literacy challenges. ◦ Consider social norms when designing products and services or consumer awareness and education campaigns. Social and cultural barriers also need to be addressed in marketing efforts, including an awareness of how 'gatekeepers' influence women's access to mobile phones (e.g. engaging with husbands and fathers, demonstrating benefits to the family and community, or efficiency/economic gains). ◦ Utilise women's groups and BTL (below-the-line) marketing techniques.[182] ◦ Engage with local stakeholders in the research and design stages for products/ services to understand the diverse realities of women's lives in PNG and how they vary across regions.[183] ◦ Include design features that are appealing to women[184] and consider the environmental and technical realities of most rural residents (e.g. longer battery life, ease of use, waterproofing and durability).
Health	◦ Encourage health service providers at provincial levels to strategically utilize mobile phone services for communication between health workers.[185] ◦ Thoroughly assess existing health programmes and gaps in delivery and how these align with the priorities of the National Department of Health. Interventions must carefully consider the local context, such as which groups have access to mobile phones, whether at-risk groups of women have unimpeded access, and levels of mobile literacy and engagement. ◦ Public-private partnerships (PPPs) can be the most viable business model to share resources, capabilities and opportunities/risks. Recent PPPs in South Asia involving mobile operators include a partnership in Indonesia between the government, Telkom Indonesia (the country's largest mobile operator) and Philips to provide a mobile-based digital health solution to address high rates of maternal mortality. ◦ As use of digital technologies continues to grow and more data is generated, mobile operators could use big data to understand health crises and epidemics, population flows, and assist health organisations to respond to the spread of disease and organise relief and intervention efforts more effectively.
Agriculture	◦ Conduct more pilots of the digitisation of the agriculture value chain and assess the benefits to farmers before scaling. ◦ Roll out appropriate interoperable payment channels (a crucial element in digitising value chains). ◦ Increase digital literacy efforts in rural communities to drive and expand the use of mobile phone-based agricultural information services. ◦ Support mobile operators and banks that are expanding mobile money services in rural PNG to improve access to finance across the agricultural value chain and expand both export and domestic markets.
Innovation & entrepreneurship	◦ Support the creation of local technology hubs to provide access to working spaces and affordable broadband connections for entrepreneurs. ◦ Raise awareness among SMEs of the commercial opportunity of using mobile technology, the internet and websites. ◦ Introduce foundational ICT and digital education in schools and the business community. ◦ Expand access to financing for small businesses and collect data to better understand financial inclusion for SMEs. ◦ Facilitate the free flow of data while protecting consumer data and security. ◦ Mobile operators should continue to engage with start-ups by providing access to their core resources, including their customer base and distribution networks, financial resources, and technical assets, such as APIs and billing systems.

181. GSMA, 2014a.
182. GSMA, 2014a, p. 39
183. Curry, Dumu & Koczberski, 2016
184. GSMA, 2014a.
185. Yamo & Watson, 2014; Watson, Sabumei, Mola, & Iedema, 2015.

Support for Emerging Technologies

TECHNOLOGY	KEY ACTIONS AND RECOMMENDATIONS
Blockchain	◦ Engage lawmakers and decision makers early to support adoption. ◦ Involve the younger generation, exposing them to the technology early and helping them develop problem-solving skills to address the challenges affecting them. ◦ Share lessons on blockchain projects, whether successful or not, that have been implemented in the Pacific Islands. ◦ Collaborate with other stakeholders in the region to share knowledge and provide access to resources. ◦ Continue to support the basic building blocks of digital transformation (connectivity, digital skills, affordability) while experimenting with blockchain technology.
Big Data	◦ Policymakers should encourage efficient use of data in the economy and promote good practice through transparent, clear, fair and consistent data protection policies. ◦ Government should empower relevant agencies, such as the Department of National Planning and Monitoring and the Department of Communication and Information, to implement the changes necessary to respond to the data revolution and promote sustainable guidelines for efficient data sharing between mobile operators and other stakeholders in the ecosystem, including across government agencies. ◦ Mobile operators and governments/development agencies should collaborate to invest in skills and infrastructure to support big data solutions. ◦ Stakeholders should seek to implement sustainable business models to support the long-term use of mobile big data solutions rather than one-off pilots.

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