

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/303944453>

Telefónica Index on Digital Life: Full Report (<http://indexdigitallife.telefonica.com>)

Technical Report · June 2016

CITATIONS
0

READS
116

3 authors, including:



Erkko Autio

Imperial College London

198 PUBLICATIONS 13,820 CITATIONS

[SEE PROFILE](#)



László Szerb

University of Pécs

133 PUBLICATIONS 1,349 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Management of entrepreneurial ecosystems [View project](#)



Index of Digital Life (digitalisation index) [View project](#)

Telefonica

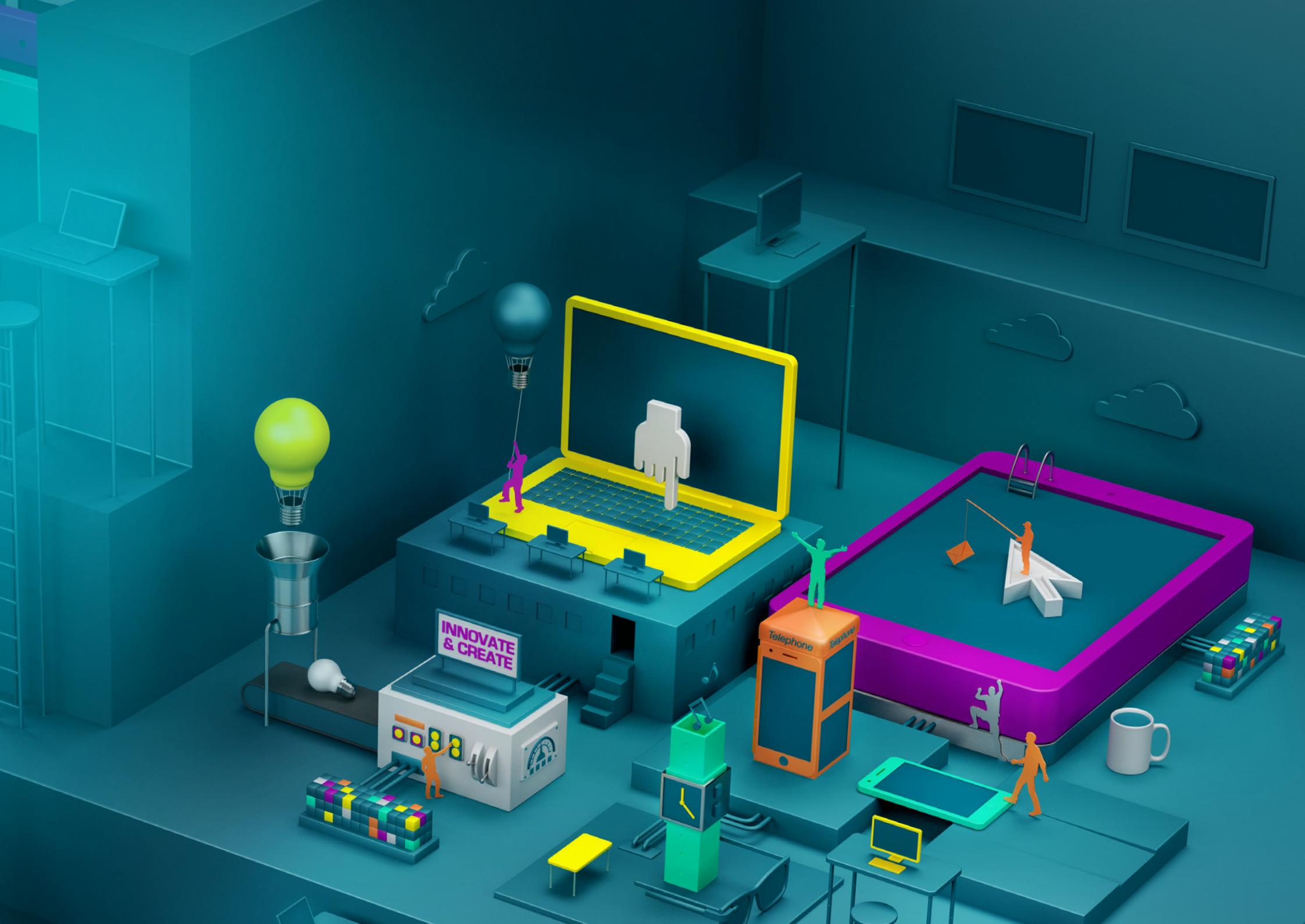
INDEX ON

DIGITAL LIFE

Report

2016





Telefónica Index on Digital Life

The Telefónica Index on Digital Life (TIDL) measures the ability of different countries to progress their Digital Economies and Digital Societies¹. Combined, we call this broad and multifaceted phenomenon Digital Life.

¹The terms: 'Digital Economy' and 'Digital Society' describe economies and societies affected by digitalisation. The term: 'Digital Life' captures both processes.

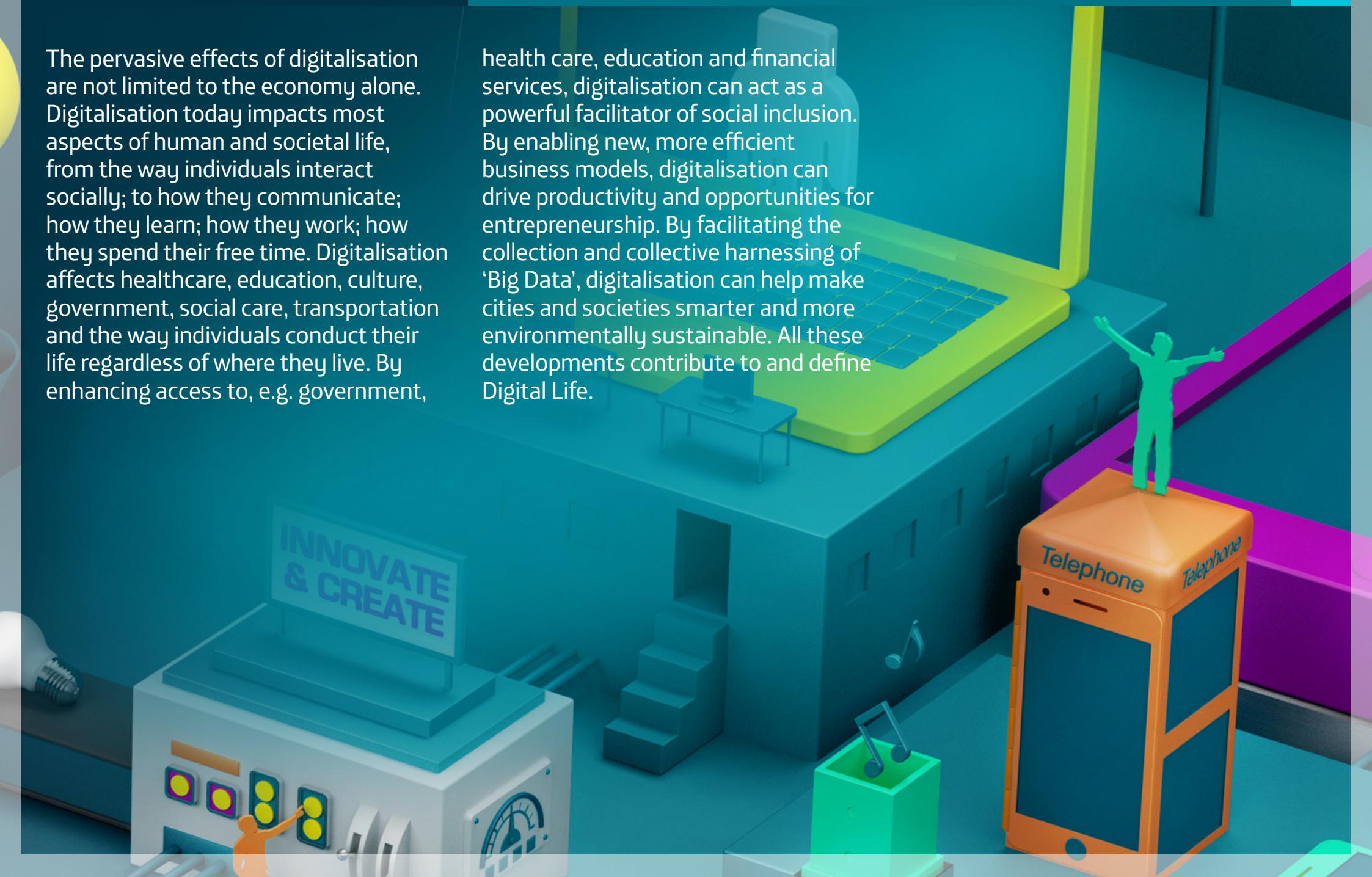
Economies and societies are being digitalised² at an increasing pace. This phenomenon is driven by three technological trends: (1) the trend towards a social networking-driven and interoperable, 'Web 2.0' mode of the Internet, which empowers citizens and organisations to become active, contributing actors in Digital Life;

(2) the trend towards an 'Internet of Things' (IoT), which connects an ever increasing number of devices to the Internet, thus enabling completely new functionalities and services; and (3) the continuing trend towards the wireless medium as the dominant mode of connecting to the Internet.

²Digitisation is the technical process by which analogue information is converted into digital form. Digitalisation is the sociotechnical process by which digitising techniques are applied to broader social and institutional contexts that render digital technologies infrastructural.

The pervasive effects of digitalisation are not limited to the economy alone. Digitalisation today impacts most aspects of human and societal life, from the way individuals interact socially; to how they communicate; how they learn; how they work; how they spend their free time. Digitalisation affects healthcare, education, culture, government, social care, transportation and the way individuals conduct their life regardless of where they live. By enhancing access to, e.g. government,

health care, education and financial services, digitalisation can act as a powerful facilitator of social inclusion. By enabling new, more efficient business models, digitalisation can drive productivity and opportunities for entrepreneurship. By facilitating the collection and collective harnessing of 'Big Data', digitalisation can help make cities and societies smarter and more environmentally sustainable. All these developments contribute to and define Digital Life.



Embracing Digital Life >>>

Digital Life is a complex phenomenon, enabled by digital technologies, that shapes and redefines the economy, society, culture and the individual experience within these. Driven and enabled by digital technologies, Digital Life constitutes a complex socio-economic ecosystem that rests upon and leverages a country's digital infrastructure. This is an evolving system where many different elements come together to co-produce an emergent 'ecosystem service' – i.e. the country's Digital Life.

The Telefónica Index on Digital Life captures the systemic capacity of countries to embrace Digital Life: (1) Digital Openness: how well a country's digital infrastructure facilitates open access to information; (2) Digital Confidence: how readily and confidently individuals and organisations engage with the country's digital infrastructure; and (3) Digital Entrepreneurship: how readily citizens and organisations leverage the digital infrastructure for entrepreneurship and innovation.

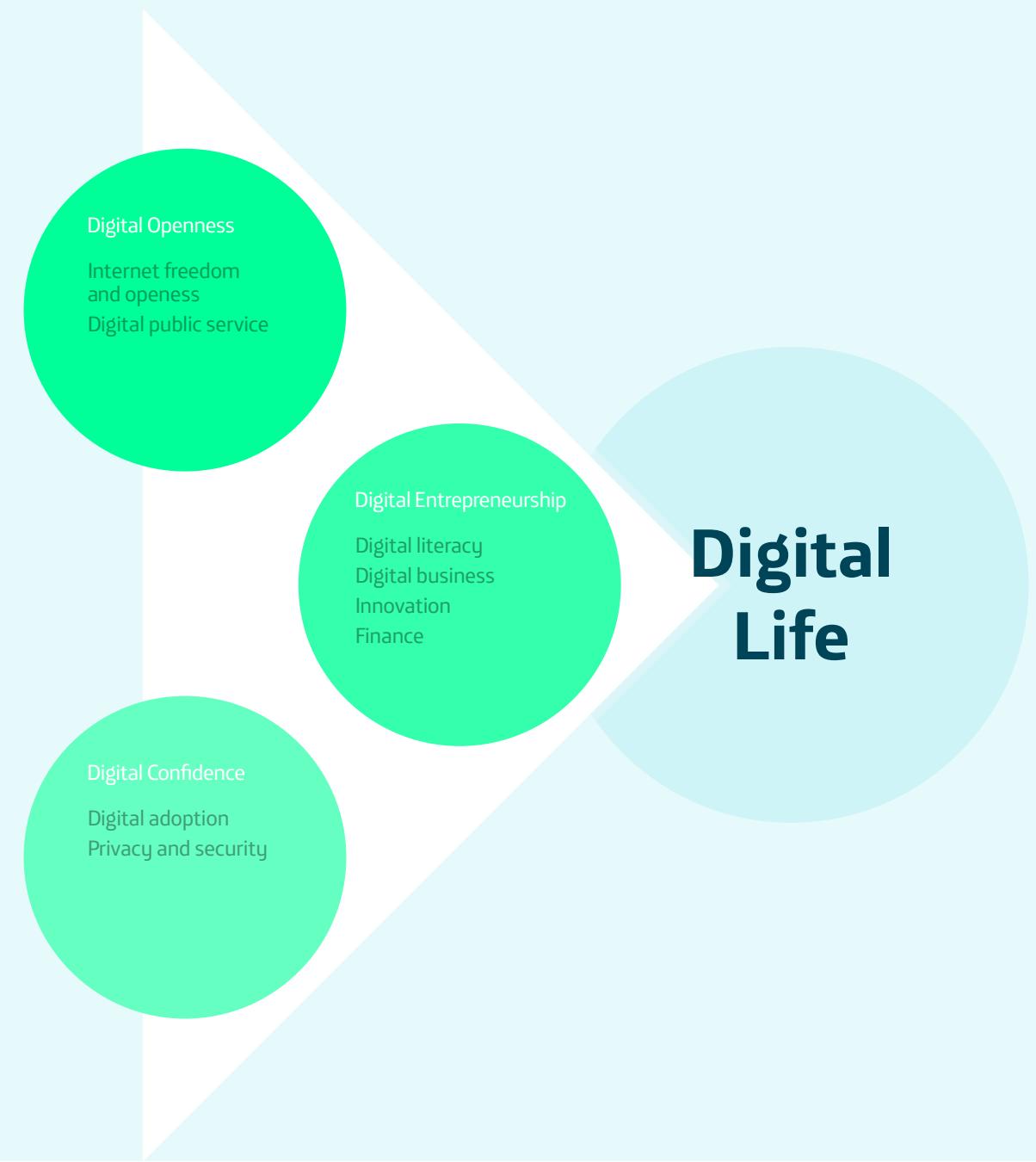
Consistent with this, the Index tracks three systemic capacities in 34 countries: Digital Openness (Internet freedom and openness, digital public service), Digital Confidence (digital adoption, privacy and security), and Digital Entrepreneurship (digital literacy, digital business, innovation and finance). Figure 1 illustrates the Index composition.



Structure of TIDL

The Telefónica Index on Digital Life does not measure a country's digital infrastructure because there are already many indices that measure investment in digital infrastructure. Infrastructure alone will be static and sterile, however, if the country lacks the capacity to leverage it for economic and societal development. It is this dynamic, systemic capacity that the Index focuses on. TIDL is unique in opening up this dynamic 'black box' of Digital Life.

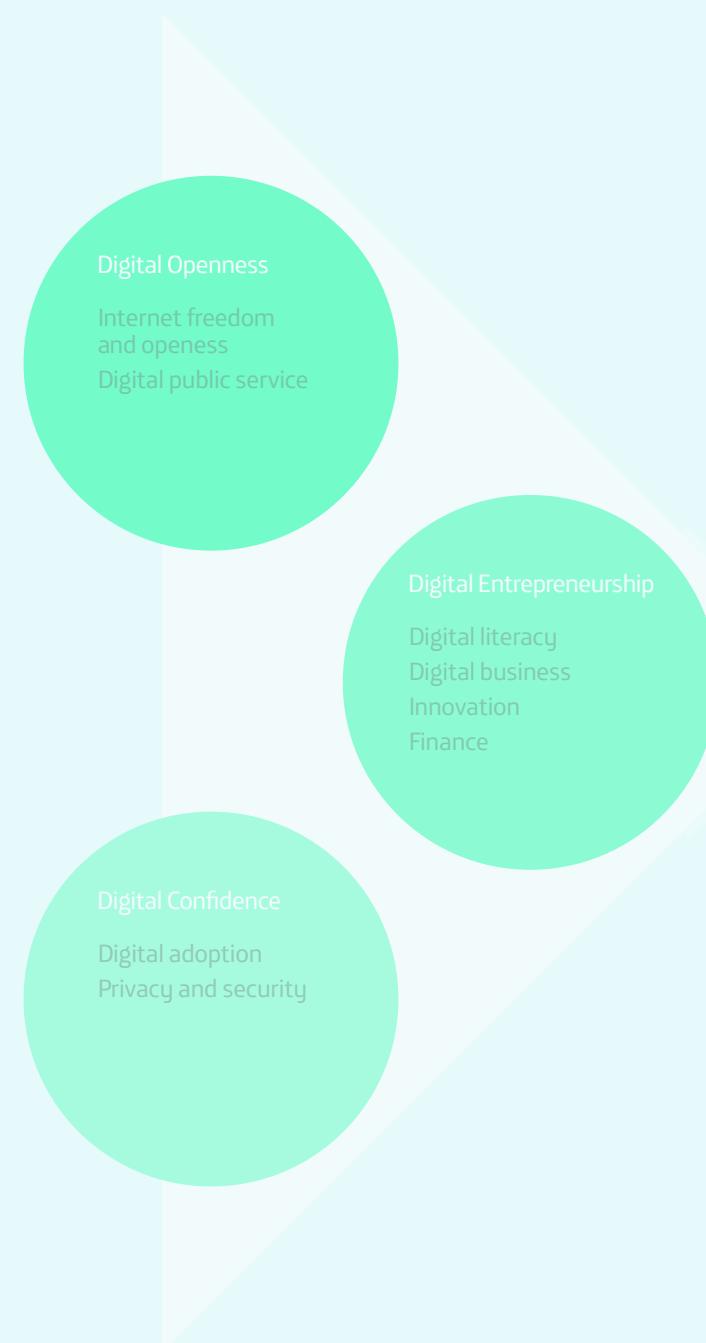
There is substantial information about the coverage and quality of telecommunications networks readily available from different sources. Academy and international organisations are still developing an understanding on the other systematic components needed to improve Digital Life. With regard to digital connectivity, the progress attained after telecommunications markets' liberalisation is widely recognised. In Latin America a study published by CAF in 2013 identified a substantial improvement in telecommunications networks (33.8% between 2010 and 2013), while recognising the relative



Structure of TIDL (continued)

stagnation of other factors conducive to the development of the ICT sector³. On broadband pricing, the Economic Commission for Latin America and the Caribbean (ECLAC) reported sensible improvements in the region from 2010 to 2014 in the region: average household expenditures in broadband access dropped in the period from 17.8% to only 3.84% of household income⁴.

Although it is necessary to maintain investments in telecommunication networks to evolve them towards next generation technologies, it is clear that work needs to be done on the other components of Digital Life. A 2016 report on digital inclusion commissioned by GSMA LA concludes that lack of digital infrastructure is not among the most relevant barriers to Internet adoption in Latin America: while only 10% of the region's population lives in areas where mobile internet services are not offered, 57% of population with coverage do not demand internet services. GSMA points out to very relevant gaps on relevant local content, digital literacy and digital skills⁵.



Digital Life

³ CAF, Towards the digital transformation of Latin America: infrastructures and ICT services in the region, 2013

⁴ ECLAC, Status of Broadband in Latin America and the Caribbean, 2015).

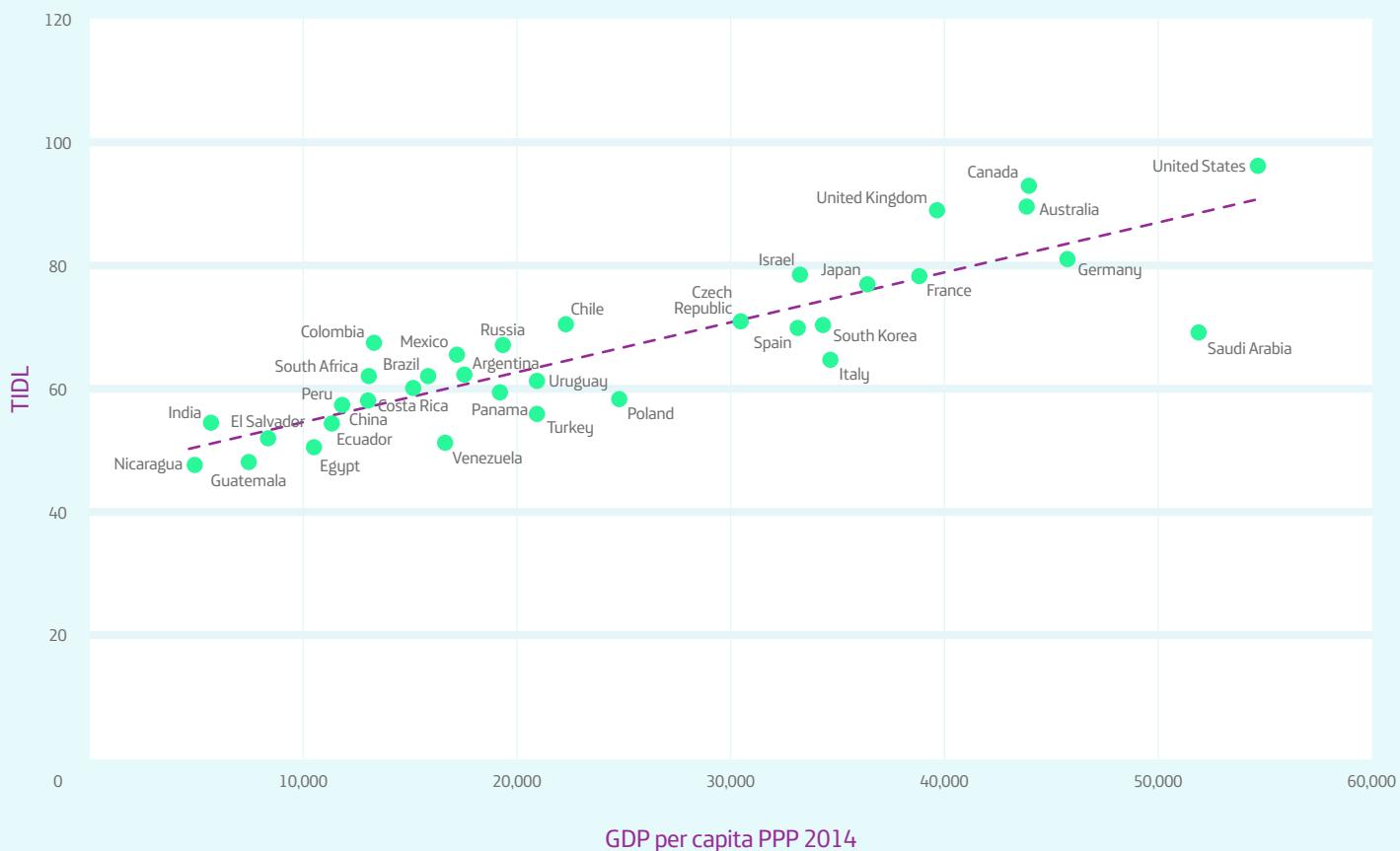
⁵ GSMA, Digital Inclusion in Latin America and the Caribbean, 2016



Figure 2

TIDL Scores Plotted Against GDP Per Capita

TIDL is composed of 3 sub-indices, 8 pillars, and 37 variables from 53 key performance indicators. Statistically comprehensive and globally harmonised data was gathered from 17 different sources, including ITU, World Bank, World Economic Forum, UN and WIPO, among others. Table 1 shows the TIDL scores for the 34 countries on a scale from 0 (low) to 100 (high). Figure 2 plots the TIDL scores (vertical axis) against the countries' GDP (PPP) per capita (2014, in US dollars).





Digital Openness captures how easily citizens and businesses can harness the digital infrastructure that exists in the country. It provides a baseline against which the extent of fragmentation can be assessed. An open Internet is universally accessible, can be globally reached, is interoperable, allows open innovation without the need to obtain permission; enables portability Digital Life between platforms; and it is an environment in which people can publish and access the content, services and applications of their choice, facing no restrictions to switch between them [14]. Digital Openness is important because, if digital infrastructure and services become the fiefdom of a small number of dominant players, user choice is diminished, resulting in negative consequences for Digital Life. This sub-index comprises two pillars: Internet Freedom and Openness and Digital Public Services. Internet Freedom and Openness captures freedom of expression in the Internet, as well as various aspects of market concentration. More concentrated markets are considered as less open, as citizens and businesses have less choice. Digital Public Services captures the degree to which the government and the educational system have embraced the Internet and are therefore easily accessible.

Digital Confidence measures the readiness with which citizens and businesses engage with a country's digital infrastructure, enabled by the level of Internet privacy and security. Even if a country has an open and well-functioning digital infrastructure, poor Digital Confidence may hamper its ability to fully embrace Digital Life. In TIDL, Digital Confidence comprises two pillars: (digital) Privacy and Security, and Digital Adoption. Digital Privacy measures aspects of privacy regulation, software privacy, Internet server security and digital malware infection rates. Digital Adoption reflects Digital Confidence through the adoption lens and measures whether consumers recognise the opportunities of digitalisation, as reflected in adoption rates of Internet, fixed and mobile broadband, various digital devices and digital services.



Digital Entrepreneurship captures the ability of the economy to embrace Digital Life by leveraging its digital infrastructure for innovation, entrepreneurship and economic growth. This element provides the crucial link that actualises the potential created by Digital Openness and Digital Confidence, and, in combination with these, drives Digital Life in a country. In TIDL, Digital Entrepreneurship is made up of four pillars. These are: Digital Literacy, Digital Business, Innovation and Finance. Digital Literacy covers different aspects of education and the use of virtual networks and open standards. These include, e.g. staff training, quality of mathematics and science education, school enrolment, virtual networks, wiki uploads and open office use. Digital Business captures

the use of digital technologies by businesses, including business-to-business and business-to-consumer Internet use, impact of ICT on business and organisational models and opportunity-driven entrepreneurship. Innovation captures the country's innovative capacity, as reflected in innovation capacity, R&D expenditure, computer software spending, ICT patents, deployment of ICT in products and services, technology absorption capacity and innovative entrepreneurship. Finance reflects the availability of venture capital for innovation, the depth of capital markets, and business angel and informal investor activity.

Why Measure Digital Life?

As highlighted above, digitalisation – i.e. the socioeconomic process of applying and harnessing digital technologies in all domains of societal and economic life – is rapidly transforming economies and societies. Major drivers of this phenomenon have been the emergence of the Internet, the convergence between information and telecommunications technologies, the ubiquitous adoption of digital and communication devices such as smartphones, tablets, and laptops, the ubiquitous access to data content and services provided by mobile networks and cloud-based services, the emergence of the application economy – just to name some of the most important developments and trends.

These changes have a transformative impact on how economies and societies work. A particularly salient amalgamation of the different developments is the emergence of the 'Web 2.0' mode of the Internet, often also referred to as the Social Internet. Together with the trends towards an 'Internet of Things' and increased mobility through wireless communications, it is a key driver of progress towards the 'platform economy' and the 'sharing economy'.



Digitalisation and Web 2.0 modes of engaging with the Internet exercise a profound impact on economic value creation [1, 2]. Traditionally, value creation has been neatly organised in vertical, upward-branching value chains. This organisation was the result of two factors: (1) tight coupling between physical products (e.g. cars, shoes) and the function they perform (e.g. driving, walking); and (2) modular product architectures [3, 4]. Tight coupling means that a shoe is a shoe: it cannot be easily converted into a car, for example. Modular product architectures mean that physical products consist of sub-assemblies, each of which may consist of sub-assemblies of their own. When these two are combined, the result is vertical, upward-branching value chains with an integrator firm at its apex. In such value chains, 'value' flows neatly from 'upstream' to 'downstream' – i.e. from suppliers to the customer.

Digitalisation changes this organisation in three ways [2, 4, 5]. First, it breaks the tight coupling between product and function: any digital device can be flexibly reprogrammed to perform different functions. Second, as analogue information is converted to digital form (i.e. digitised), it can be read by any digital device and combined with any other digital information (e.g. combining text with voice and so on). Third, digital properties can also be embedded in physical products, making them programmable, addressable, sensing, communicable, memorising, traceable and associative [6].



These three effects of digitalisation have a profound effect on how value creation is organised, and, by implication, on entrepreneurial opportunity creation and pursuit. In short, digitalisation: (1) re-organises value processes from linear and vertical value chains into horizontal and distributed innovation ecosystems; (2) dramatically speeds up the process of creating new combinations; (3) enables users to become much more engaged in innovation processes than before; and (4) dramatically reduces the cost of creating new bundles of functionalities. The result is a new wave of entrepreneurial activity that takes advantage of the reduced cost of entrepreneurial experimentation while also taking advantage of another property of digital products – i.e. ease of scaleup – to pursue opportunities in novel ways.

These transformations are not limited to IT or Internet sectors, because even physical products (such as 'smart' shoes or smart cars) can increasingly be connected to digital innovation ecosystems; and because the Web 2.0 mode of the Internet has become an indispensable aspect of any business model, virtual or physical. Combined, these developments have had a major impact on the creation of a new, global form of entrepreneurial culture, which constitutes a key element of Digital Life.



TIDL Methodology

The complexity of TIDL reflects the complexity of Digital Life. TIDL is composed of 3 sub-indices: Digital Openness, Digital Confidence and Digital Entrepreneurship. Each sub-index is made up of pillars – i.e. key components that define each sub-index. Combined, TIDL comprises 8 pillars. Each pillar is composed of several variables. In total, the 8 pillars comprise 37 variables. Some variables are composed of several elements, called key performance indicators. In total, therefore, TIDL combines 53 key performance indicators organised into 37 variables, 8 pillars and 3 sub-indices. The choice of the key performance indicators has been guided by relevance, reliability, coverage and salience across a wide range of socio-economic contexts (see Appendix 1 for details of the index calculation method).

We first normalised all data to conform to the same scale. We then capped the data to reduce outlier bias. After calculating pillar values we composed the sub-indices. Two pillars described Digital Openness (Internet Freedom and Openness; and Digital Public Services). Two pillars described Digital Confidence (Digital Adoption; Privacy and Security). Four pillars described Digital Entrepreneurship (Digital Literacy; Digital Business; Innovation and Finance). Finally, the value of the Index was calculated as the arithmetic mean of the three sub-indices.

When reading the index scores, it is important to remember both the strengths and weaknesses of the Index method. Digital Life is a complex phenomenon; the complexity of TIDL reflects this. Like any index of a complex phenomenon, TIDL is necessarily incomplete: it is impossible to capture the full complexity of Digital Life. Although there is considerable value in a carefully crafted multi-item index to reflect a complex phenomenon, the index is not and cannot be the phenomenon itself.

Complex indices like TIDL can be used to support coherent comparisons across countries. However, all countries are unique in their own ways. There is no one 'optimal' or 'correct' model that all countries should aspire towards. Furthermore, comparisons between, say, inherently different high- and low-income economies are not very informative, much like it makes little sense to compare apples and oranges. The best use of multi-item indices is to compare like with like: comparisons between countries with similar economic conditions can provide important clues as to where the strengths of each can be found and what realistically could be done to improve a given country's Digital Life.



The inherent limitations of the index methodology mean that, while indicative, TIDL is not the final word on any given country's Digital Life. When constructing the Index, we have been necessarily limited to using data that is sufficiently available for all 34 countries. Measuring Internet Openness has been a challenge from various points of view. Because of the multi-faceted definition of Internet Openness, there is a lack of relevant comparable data for the purpose of assessing how open the Internet is. Though far from perfect, TIDL's approach has focused on the restrictions to freedom of speech and market competitiveness across various segments of the digital value chain, based on market shares, as the best proxy to Internet Openness. This is just a starting point to better assess how free individuals, companies and organisations are to interact and innovate on the Internet. The definition and measurement of new indicators for this purpose is a challenge that needs to be addressed in a coherent manner across the world. This could be partly solved with indicators reflecting technical restrictions to Internet Openness such as level of IPV6 adoption, the ratio of private to total number of DNS. Other possible indicators relate to government restrictions on cross border data flows and the implementation of local data requirements, as well as indicators of commercial restrictions, which might be measured through the Herfindahl Index across all segments of the digital value chain, churn as an indication of the possibility to change service provider and also the existence of portability mechanisms.

Moreover, even when data is available, we have to consider the quality of the data. Regulatory authorities around the world regularly incorporate in their websites statistical information describing its telecommunications market. In general, it is always possible to find the number of customers of different services and market shares of major telecommunications operators. However, country-by-country differences in the volume and frequency of publication of statistical information are very noticeable. For example, CNMC (Spain) or OFCOM (UK) websites publish a large amount of detailed information, both in terms of time-series and geographical breakdown of market shares, which allows for the analysis of the competitive environment. On the contrary, authorities in other countries, particularly in Central America, publish little information, and that which is available is often out of date, which impedes a proper analysis. It is also very hard to find similar data for service providers who operate 'over the top' of telecommunications networks (OTTs).

Despite the challenges faced in data collection, the best use of the Index is as a starting point for policy debates in different countries, as a way to guide attention to *potential* strengths and challenges in each country and call attention also to phenomena that the Index has not been able to cover. Given the limitations of multi-item indices and the low utility of comparing apples against oranges, we also provide comparisons against each country's 'normal' or 'expected' performance, as predicted on the basis of its GDP per capita. Far too often, only absolute index scores are reported in the press without recognising that countries in different stages of development can have completely different policy goals. We hope that the comparisons against GDP-predicted scores provide a more realistic view on how each country performs.



Headline results

TIDL Global Rankings and Scores 2016

The TIDL global ranking for 34 countries is shown in Table 1, on a scale from 0 to 100.

Rank	Country	TIDL Score	GDP per capita (PPP) 2014, USD	Performance relative to GDP per capita
1	United States	96.3	54,629	++
2	Canada	92.4	44,057	+++
3	Australia	90.1	43,930	++
4	United Kingdom	88.7	39,762	+++
5	Germany	81.0	45,802	-
6	Israel	78.5	33,230	++
7	France	78.3	38,847	+
8	Japan	77.3	36,426	+
9	Czech Republic	71.1	30,407	+/-
10	South Korea	70.8	34,356	-
11	Chile	70.4	22,346	++
12	Spain	70.1	33,211	-
13	Saudi Arabia	69.4	51,924	---
14	Colombia	67.4	13,357	+++
15	Russia	66.9	19,401	++
16	Mexico	65.3	17,108	++
17	Italy	64.8	34,706	--
18	Argentina	62.3	17,554	+
19	South Africa	62.1	13,046	++
20	Uruguay	62.0	20,884	+/-

* GDP per capita (PPP) 2014, current US Dollars

** Indicates over-performance ('+', '++', '+++') or under-performance ('-', '--', '---', '----') based on the difference between actual TIDL score and expected score given the country's GDP per capita

Table 1 (continued)

TIDL Global Rankings and Scores 2016

The TIDL global ranking for 34 countries is shown in Table 1, on a scale from 0 to 100.

Rank	Country	TIDL Score	GDP per capita (PPP) 2014, USD	Performance relative to GDP per capita
21	Brazil	62.0	15,838	+
22	Costa Rica	60.2	14,918	+
23	Turkey	59.5	19,199	-
24	China	58.3	24,744	+
25	Poland	58.3	13,206	--
26	Peru	57.3	11,989	+
27	Panama	56.0	20,895	--
28	India	54.4	5,701	+
29	Ecuador	54.3	11,372	+/-
30	El Salvador	52.0	8,351	+/-
31	Venezuela	51.3	16,666	--
32	Egypt	50.5	10,530	-
33	Guatemala	48.0	7,454	-
34	Nicaragua	47.6	4,918	-



The ranking in Table 1 offers several interesting observations. First, there is important variance across countries: the TIDL score of the highest-ranking country (USA) is twice as high as that of the lowest ranking country (Nicaragua). Second, there is a rough but by no means perfect relationship between the country's TIDL score and its GDP per capita. For example, the second wealthiest country in the ranking, Saudi Arabia, ranks only 13th for its TIDL score. Third, both high- and low-income countries can beat their GDP-predicted scores. For example, countries such as Brazil and Costa Rica over-perform relative to their GDP-predicted score, whereas Italy and Saudi Arabia under-perform.

Of the countries included in this edition of TIDL, the USA ranks first, with 96.3 index points out of 100. It is closely followed by three other Anglo-Saxon economies: Canada (92.4 points), Australia (90.1 points) and the United Kingdom (88.7 points). Behind these there is a small gap to Germany (81.0 points), Israel (78.5), France (78.3 points) and Japan (77.3 points). The top ten is completed by Czech Republic (71.1) and South Korea (70.8 points).

Italy is the lowest-ranking G7 country at 17th place (64.8 points), with all other G7 countries ranking in the top 8 (USA, Canada, UK, France, Germany, and Japan). Russia (15th, 66.9 points) scores higher than Italy.



The highest-ranking Latin American economy is Chile at 11th place (70.4 points), ahead of Colombia (14th, 67.4 points) and Mexico (16th, 65.3 points). Argentina, Uruguay and Brazil are closely matched at 18th place (62.3 points), 20th place (62.0 points) and 21st place (62.0 points), respectively. The United Kingdom is the European leader in Digital Life, followed by Germany and France. Spain ranks 12th globally. Japan is the Asian leader, closely followed by South Korea, and substantially ahead of China. India ranks 28th out of 34 countries.

In the Middle East and Africa region, Israel (78.5 points, 6th) is well ahead of Saudi Arabia (69.4 points, 13th). South Africa is 19th at 62.1 points and Egypt is 32nd at 50.5 points. In the competition among the world's largest countries by population, China (24th, 58.3 points) comes ahead of India (28th, 54.4 points).

There is a cluster of large emerging Latin American economies in the 16th to 26th places: Mexico (16th), Argentina (18th), Uruguay (20th), Brazil (21st), Costa Rica (22nd) and Peru (26th).



Table 2

TIDL Sub-Index Highlights

TIDL and Sub-Index Scores and Performance Relative to GDP Per Capita

Country	GDP per capita (PPP) 2014, USD	TIDL Index 2016		Digital Openness Sub-Index		Digital Confidence Sub-Index		Digital Entrepreneurship Sub-Index	
		Index Score	Relative to GDP*	Index Score	Relative to GDP*	Index Score	Relative to GDP*	Index Score	Relative to GDP*
Argentina	17,554	62.3	2.4	65.9	4.3	66.9	5.8	54.1	-7.2
Australia	43,930	90.1	9.1	89.9	7.2	95.9	11.1	84.4	2.0
Brazil	15,838	62.0	3.4	69.0	8.8	61.5	2.0	55.4	-4.5
Canada	44,057	92.4	11.3	100.0	17.2	88.6	3.7	88.7	6.2
Chile	22,346	70.4	6.7	65.3	-0.1	67.8	2.4	78.2	13.1
China	13,206	58.3	1.8	54.7	-3.4	58.3	1.1	61.8	4.0
Colombia	13,357	67.4	10.9	71.1	12.9	65.1	7.8	66.1	8.2
Costa Rica	14,918	60.2	2.4	56.3	-3.2	62.4	3.7	61.8	2.6
Czech Republic	30,407	71.1	0.9	71.1	-0.8	77.5	4.9	64.6	-7.0
Ecuador	11,372	54.3	-0.7	58.3	1.7	52.3	-3.2	52.3	-4.1
Egypt	10,530	50.5	-3.8	54.1	-1.9	50.9	-3.8	46.6	-9.1
El Salvador	8,351	52.0	-0.5	51.7	-2.5	50.6	-2.2	53.8	-0.1
France	38,847	78.3	1.4	80.0	1.4	73.1	-7.1	81.9	3.5
Germany	45,802	81.0	-1.5	75.3	-8.9	84.4	-2.1	83.2	-0.7
Guatemala	7,454	48.0	-3.8	42.5	-11.0	46.1	-5.9	55.5	2.3
India	5,701	54.4	4.0	59.3	7.2	44.9	-5.5	59.1	7.3

* Column indicates the difference between actual score and GDP-predicted score. Positive values indicate overperformance, and negative values indicate underperformance relative to GDP-predicted score. Colour codes indicate the extent of over – or underperformance.

Table 2 (continued)

**TIDL and Sub-Index Scores and Performance
Relative to GDP Per Capita**

Country	GDP per capita (PPP) 2014, USD	TIDL Index 2016		Digital Openness Sub-Index		Digital Confidence Sub-Index		Digital Entrepreneurship Sub-Index	
		Index Score	Relative to GDP*	Index Score	Relative to GDP*	Index Score	Relative to GDP*	Index Score	Relative to GDP*
Israel	33,230	78.5	6.0	74.4	0.3	78.7	3.5	82.4	8.6 ▼
Italy	34,706	64.8	-8.9	65.4	-9.9	64.8	-11.7	64.1	-10.9 ▲
Japan	36,426	77.3	2.3	85.0	8.3	79.0	0.9	67.8	-8.6 ▼
Mexico	17,108	65.3	5.8	68.4	7.2	64.2	3.5	63.4	2.5 ▲
Nicaragua	4,918	47.6	-2.2	51.4	-0.1	43.3	-6.4	48.2	-3.0 ▲
Panama	20,895	56.0	-6.6	47.2	-17.0	52.2	-11.9	68.7	4.7
Peru	11,989	57.3	1.9	45.5	-11.6	63.8	7.7	62.7	5.9
Poland	24,744	58.3	-7.4	55.5	-11.8	61.1	-6.4	58.3	-8.7
Russia	19,401	66.9	5.5	74.5	11.4	69.6	6.9	56.7	-6.1
Saudi Arabia	51,924	69.4	-18.0	60.3	-28.8	63.5	-28.5	84.3	-4.5
South Africa	13,046	62.1	5.8	71.2	13.2	57.6	0.6	57.4	-0.3
South Korea	34,356	70.8	-2.6	70.9	-4.1	75.2	-1.0	66.3	-8.4
Spain	33,211	70.1	-2.3	66.4	-7.7	72.8	-2.4	71.1	-2.7
Turkey	19,199	59.5	-1.8	55.4	-7.5	56.8	-5.7	66.2	3.6
United Kingdom	39,762	88.7	11.1	93.1	13.8	90.5	9.4	82.6	3.6
United States	54,629	96.3	6.8	97.3	6.1	97.7	3.3	94.0	3.0
Uruguay	20,884	62.0	-0.6	58.1	-6.1	67.3	3.2	60.6	-3.4
Venezuela	16,666	51.3	-7.9	50.5	-10.4	50.6	-9.7	52.7	-7.9

* Column indicates the difference between actual score and GDP-predicted score. Positive values indicate overperformance, and negative values indicate underperformance relative to GDP-predicted score. Colour codes indicate the extent of over – or underperformance.



The TIDL sub-index scores are shown in Table 2. The table highlights important differences both within and across sub-indices. Canada ranks on top for Digital Openness, followed by the United States and United Kingdom. United States ranks on top for Digital Confidence, followed by Australia and United Kingdom. United States also ranks on top for Digital Entrepreneurship, followed by Canada and Australia. United Kingdom ranks 6th in Digital Entrepreneurship.

There are also other interesting patterns in Table 2. Russia ranks relatively well for Digital Openness and Digital Confidence, but clearly its weakest point is Digital Entrepreneurship, where it only ranks 26th. For Saudi Arabia, the opposite pattern is in evidence. Italy's performance is quite mediocre throughout, as it ranks either 17th or 18th for all sub-indices. Japan ranks 5th or 6th for Digital Openness and Digital Confidence but only 12th for Digital Entrepreneurship. Chile is in the top 10 in Digital Entrepreneurship (9th). India ranks second lowest in Digital Confidence.

Performance Relative to GDP Per Capita

As expected, TIDL scores correlate strongly with the country's wealth: wealthy economies have more funds to invest in their digital infrastructure and R&D. The countries' over- or under-performance relative to their GDP is analysed by calculating a GDP-predicted TIDL score for the country and then deducting this from its actual TIDL score. Over-performance (positive difference) suggests that the country is 'punching above its weight'. Under-performance (negative difference) suggests the country may not be allocating its resources as efficiently as it might in order to nurture Digital Life. The over- or under-performance of countries relative to their GDP per capita is shown in Figure 3⁶.

⁶Performance relative to 2014 GDP per capita PPP should be interpreted with caution. Some economies, e.g. Russia, Brazil, and Colombia have experienced important exchange rate fluctuations since 2014. Their TIDL scores are therefore subject to nuanced interpretation since some of the pillar data span from 2009 to 2015. As an example, in Russia, the exchange rate of ruble has fallen from 30 rubles against US dollar in 2010 to 70 rubles in 2014. This exchange rate change may artificially boost Russia's over-performance for some sub-indices

Figure 3

TIDL: Performance Relative to GDP per capita 2014 (PPP, current USD)

When comparing a country's actual TIDL score against its GDP-predicted score, we see that the performance ranking changes considerably. Looked in this way, the United Kingdom, Canada, Colombia, Australia and the United States emerge the strongest over-performers for the Index relative to their GDP per capita, whereas countries such as Saudi Arabia and Italy drop to the bottom. In addition, the scale of over- or under-performance relative to the country's actual TIDL score can be quite large in some cases.

Of Latin American countries, Chile, Mexico, Brazil, Argentina, Costa Rica and Peru over-perform in Digital Life relative to their wealth, exhibiting good ability to harness their Digital Life resources.

Of the largest countries by population, both India and China are over-performing but only moderately.

Saudi Arabia is the worst under-performer with an actual TIDL score 18.0 points lower than its GDP-predicted TIDL score.

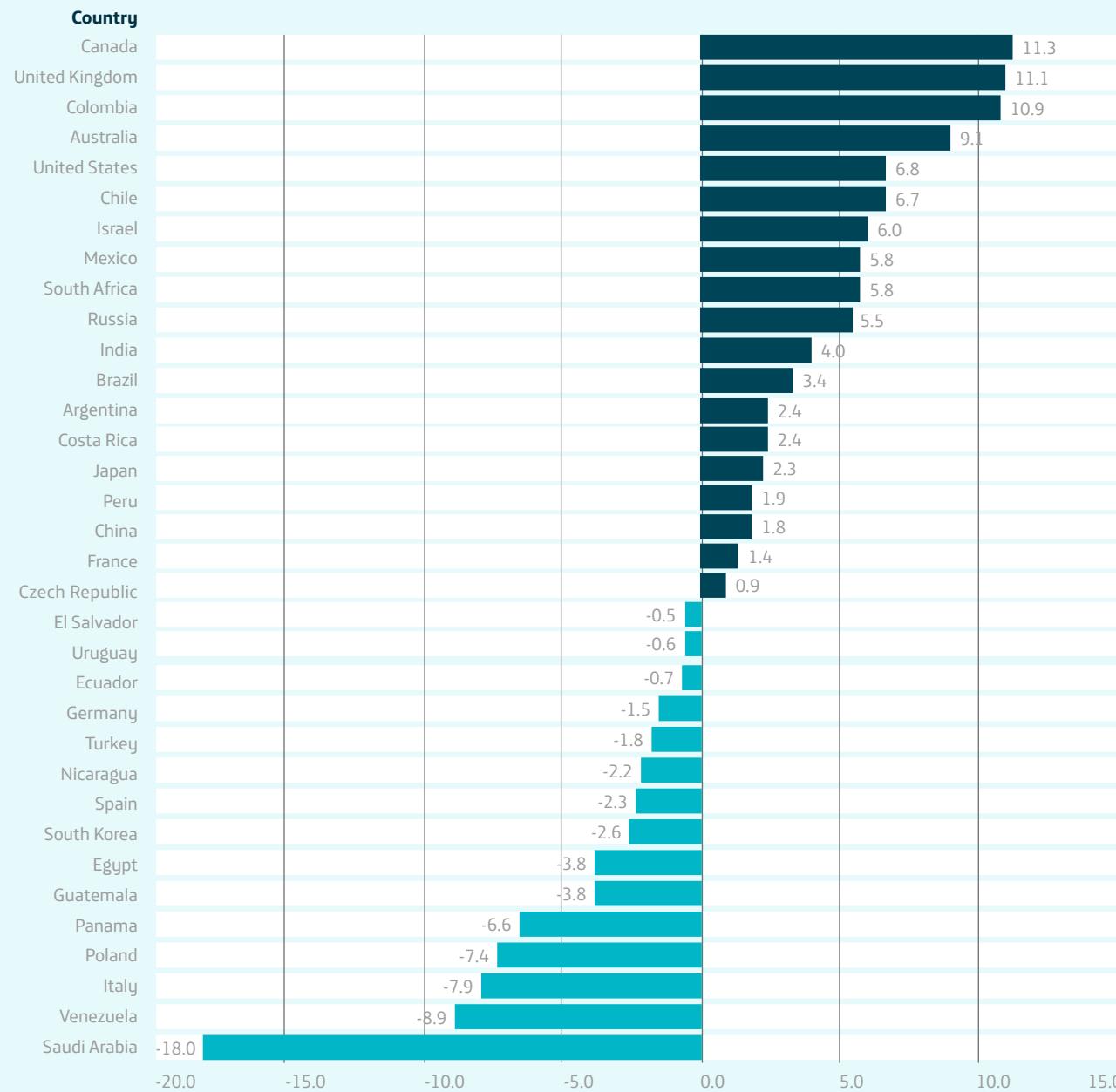


Figure 4

Digital Openness: Performance Relative to GDP per capita

For Digital Openness, Canada, United Kingdom, South Africa, Colombia and Russia are shown as the strongest over-performers relative to their GDP per capita.

In Latin America, Mexico, Argentina and Ecuador over-perform on Digital Openness relative to their wealth.

Among Asian countries, Japan and India over-perform, whereas China and South Korea under-perform.

Saudi Arabia is the worst under-performer for this element, too, as it is for all aspects of Digital Life except for Digital Entrepreneurship.

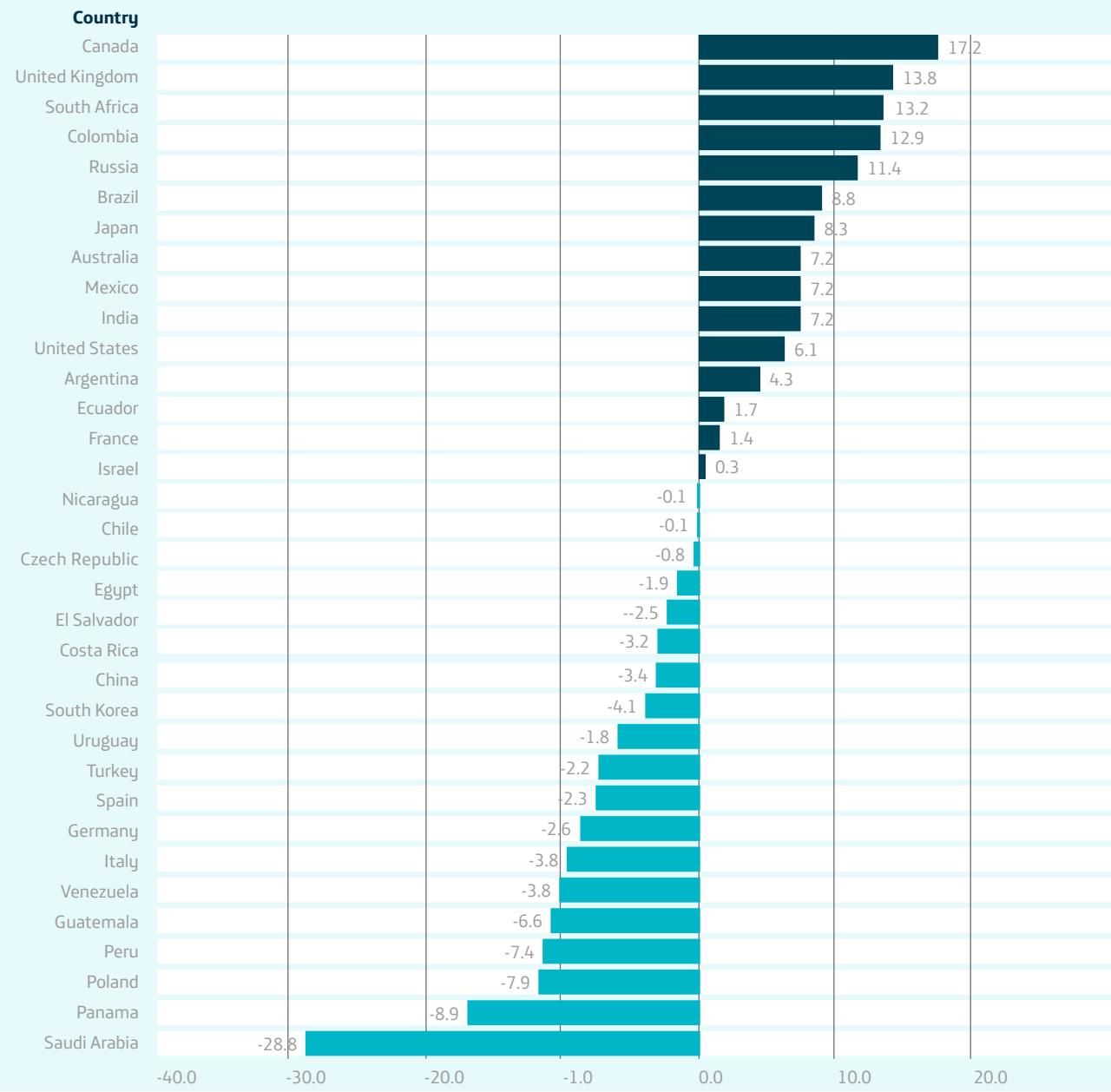


Figure 5

Digital Confidence: Performance Relative to GDP per capita

Looking at Digital Confidence, we observe Australia, United Kingdom, Colombia, Peru and Russia emerging as the strongest over-performers relative to their GDP per capita.

More than half of the Latin American countries over-perform in Digital Confidence relative to their wealth. These countries are Colombia, Peru, Argentina, Costa Rica, Mexico, Uruguay, Chile and Brazil.

Of Asian countries, South Korea and India are under-performers.

Italy and France are among the five worst under-performers with the lowest Digital Confidence relative to their GDP per capita.

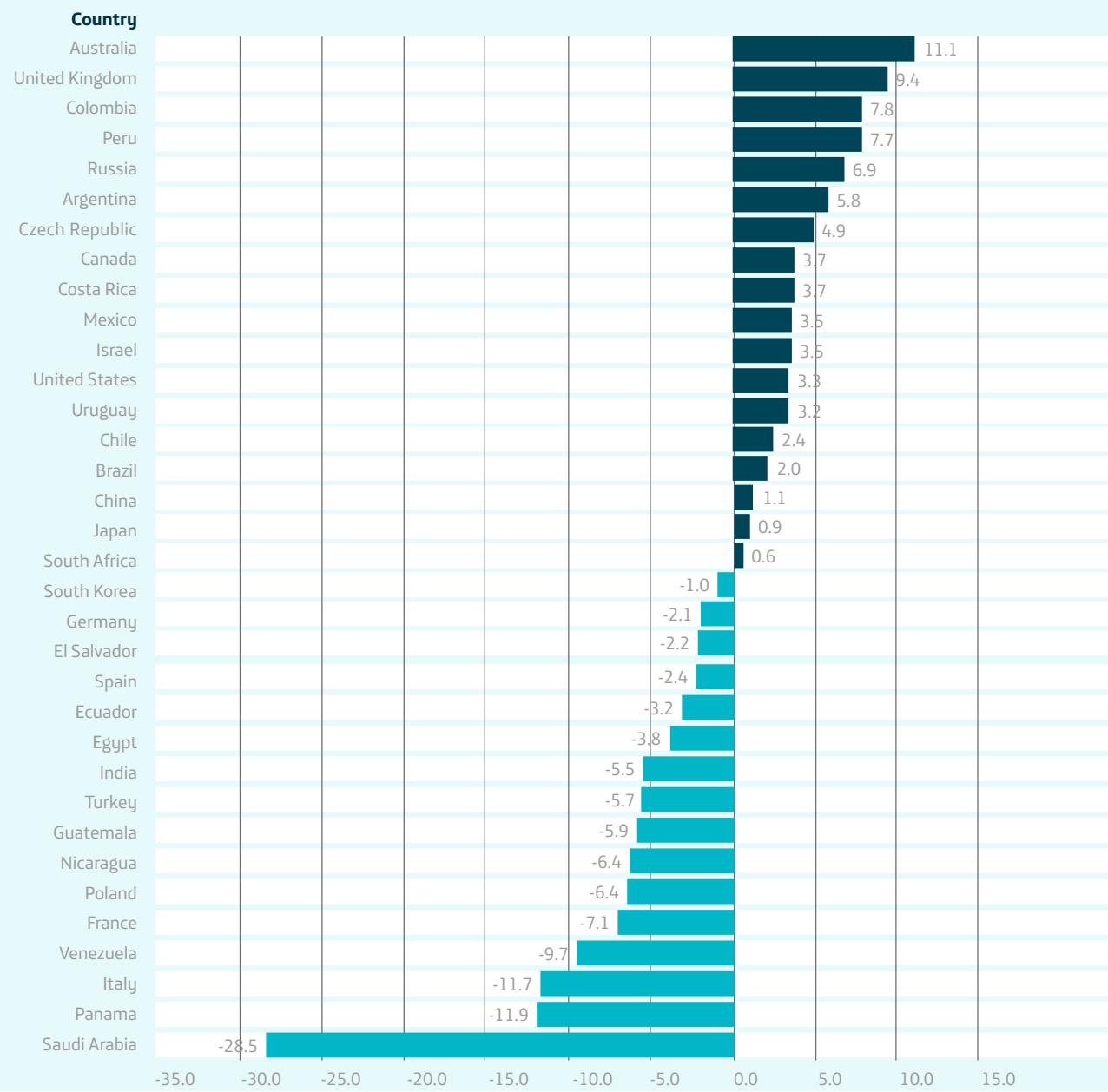


Figure 6

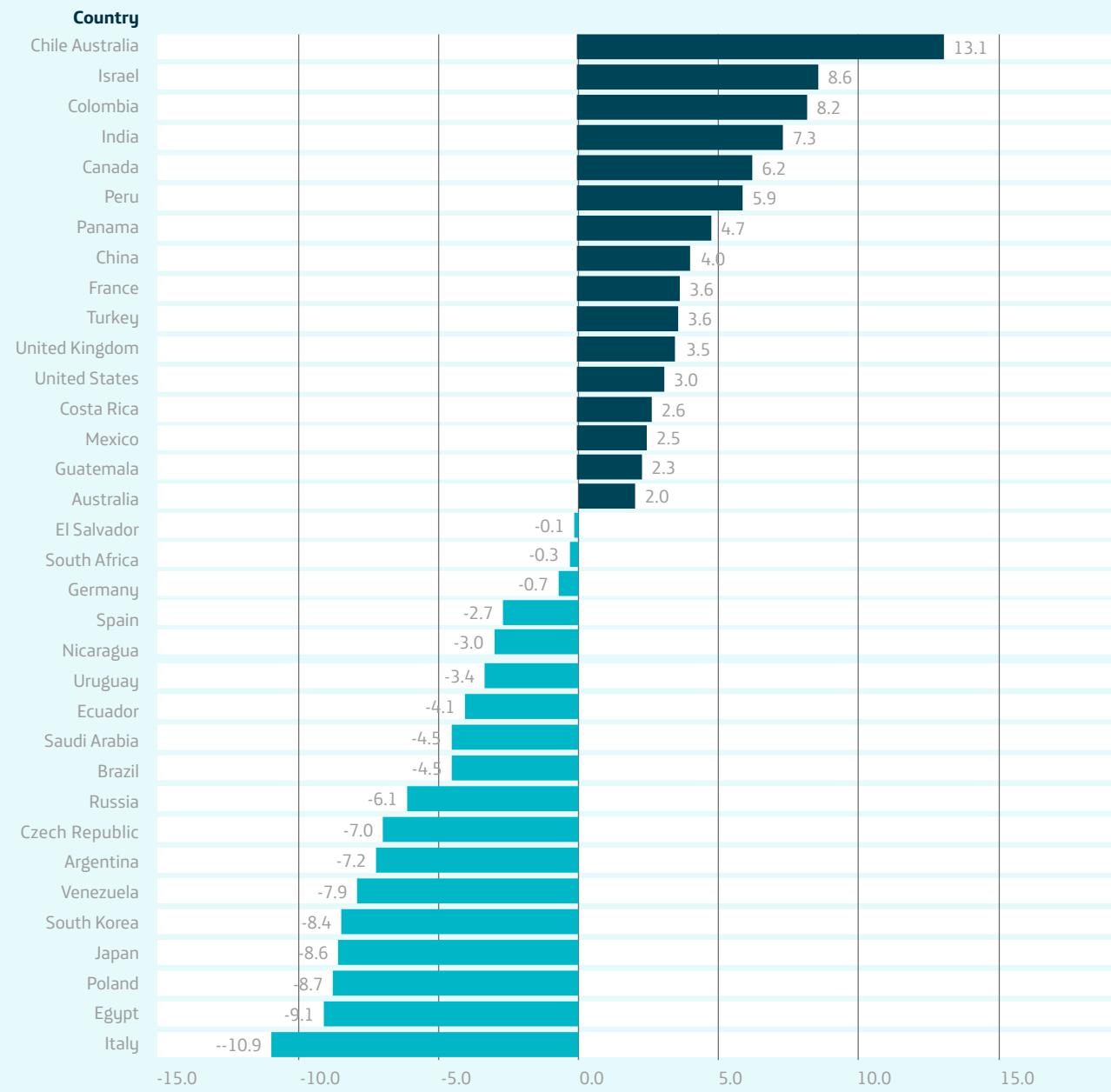
Digital Entrepreneurship: Performance Relative to GDP per capita

Looking at Digital Entrepreneurship, we see Chile, Israel, Colombia, India and Canada emerging as the strongest over-performers relative to their GDP per capita.

Of Latin American countries, Peru, Panama, Costa Rica, Mexico and Guatemala are over-performers of Digital Entrepreneurship relative to their wealth.

India and China over-perform in Digital Entrepreneurship while South Korea and Japan are under-performers.

Italy is the worst under-performer in this sub-Index with an actual sub-Index score 11 index points lower than its GDP-predicted Digital Entrepreneurship score.





Policy implications

TIDL highlights different policy issues in different countries. Eight countries over-performed or matched their GDP-predicted performance for all sub-indices: United Kingdom, Colombia, Canada, United States, Mexico, Chile, Australia and South Africa. For the remaining countries, the TIDL analysis suggests strengths and challenges in varying degrees.

What, then, are these challenges? TIDL is based on the idea that a country's Digital Life is actually an ecosystem that comprises many elements. These elements work together to create an 'ecosystem service' which reflects its Digital Life. A country's Digital Life ecosystem may therefore exhibit bottlenecks – relatively weakly performing elements – that may hold back its overall performance. Where this is the case, a country might benefit from prioritising its efforts in relation to the bottleneck elements, while also ensuring that its strengths continue to be fully leveraged.

The required policy response will depend on the nature of the bottleneck element: is it related primarily to Digital Openness, Digital Confidence, Digital Entrepreneurship, or any combination of them? As shown in Figure 7, the three elements call for different policies. Policies to enhance Digital Openness are primarily concerned with ensuring a level playing field that is not monopolised by any single organisation or technology platform. Open access to digital infrastructure and different technology platforms,



low barriers to switching and ease of migration all ensure that the country's Digital Life ecosystem does not become the fiefdom of a single technology platform, monopoly, or group. Policies to enhance Digital Confidence are primarily concerned with ensuring that citizens and organisations in the country have the skills and confidence to fully engage the country's digital infrastructure. Policies to enhance Digital Entrepreneurship are primarily concerned with ensuring that citizens and organisations in the country have the skills and resources to fully leverage the opportunities opened up by digitalisation. It is important to recognise that these challenges transcend traditional policy 'silos' and cannot be sub-ordinated to any individual government agency. Effective policies to advance Digital Life are likely to require concerted action across multiple policy domains and agencies and involve stakeholders from many different parts of the society.

The policy framework presented in Figure 7 helps interpret the policy implications of country-specific data. The TIDL methodology implies that when the different elements of a country's Digital Life ecosystem are in balance, it is likely to be able to advance Digital Life most efficiently. The descriptions in Figure 7 suggest policy emphases that might be pertinent for each element. As the TIDL analysis also indicates whether a given country is over- or under-performing relative to its GDP per capita, this provides an indication of where the country stands relative to its peers for each element of its Digital Life ecosystem.

Figure 7

TIDL Policy Framework

Arrow of Digital Life

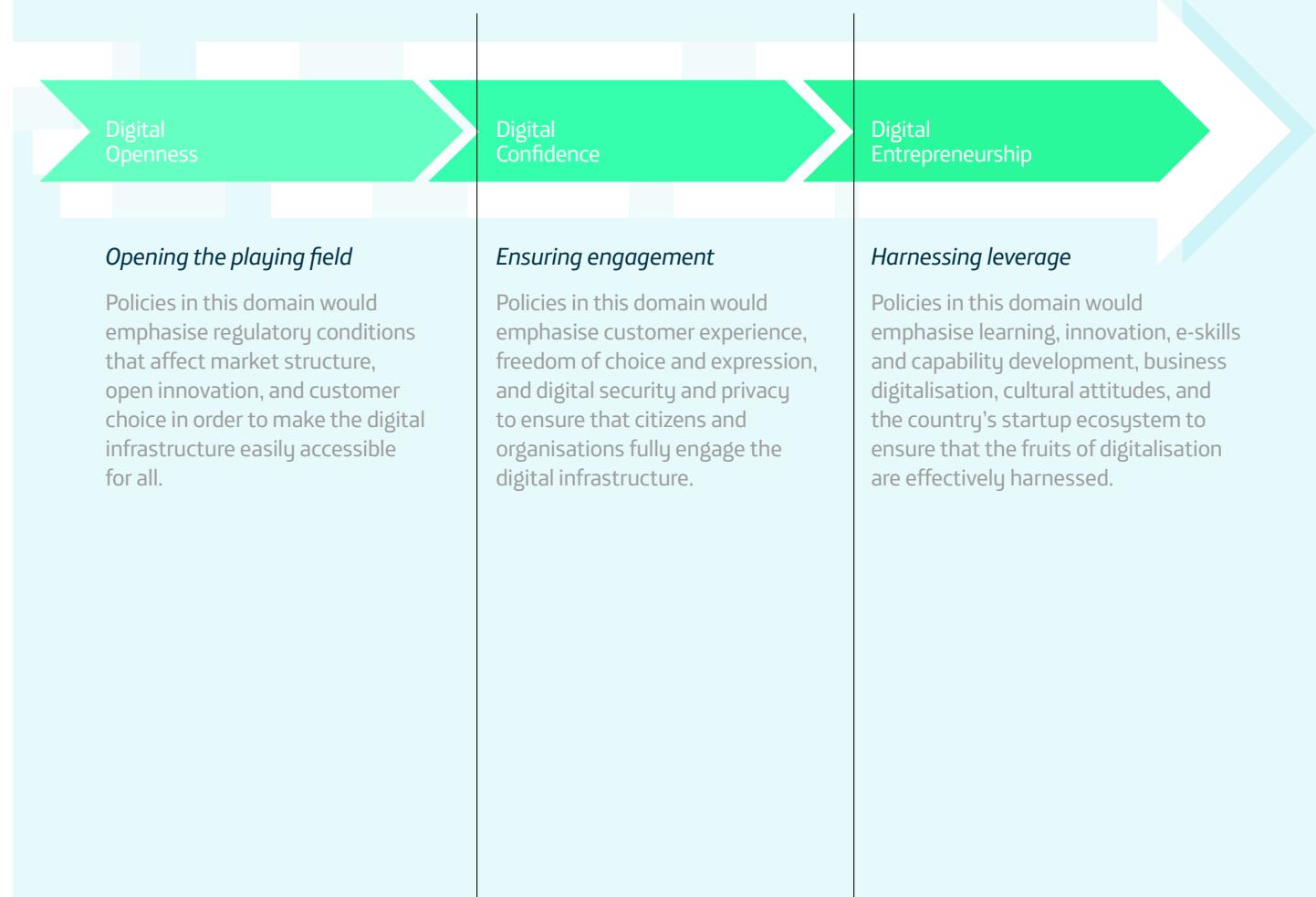




Figure 8 provides an overview of the role of governments and possible actions to facilitate Digital Life. The list of policy measures and areas is necessarily incomplete because of the complexity and overarching character of Digital Life ecosystems. Broadly, governments can nurture Digital Life ecosystems either through direct intervention or through indirect facilitation. The most natural role for governments is in regulation. This is a wide policy bucket, as regulatory action may range from regulating, for example, network building (coverage requirements, infrastructure sharing, location of antenna masts and so on); market structure; net neutrality; digital freedom and security; digital money; and content and IP protection. Of these, regulations regarding digital money (including regulation of the financial system and banking institutions) are likely to be particularly relevant for advancing financial inclusion and reducing informal-sector activity (the 'grey economy') in emerging economies. Spectrum allocation and management policies play an important role in shaping the availability and adoption of 3G, 4G, and eventually, 5G mobile services.

Governments can also facilitate (and potentially inhibit) Digital Life through taxation. Whilst taxes and licenses can be an important source of public revenue, the revenue-generating motivation needs to be balanced against incentivising investment in digital infrastructure, and also, facilitating productivity-driving externalities through digitalisation. It is important for governments to recognise that digitalisation does not only generate value directly through growth in technology sectors: still more benefits are created indirectly, such as through the productivity-enhancing effects of the digitalisation of traditional manufacturing sectors, through social and financial inclusion or through innovation and entrepreneurship.



Governments can also advance Digital Life by digitalising their own processes – government services, the educational system, the health system – and by championing open data and smart infrastructure for power and transport. Access to education and health care can be widely extended through 'mEducation' and 'mHealth', facilitating inclusion. The digitalisation of government services not only eases access but also increases service transparency, thus reducing opportunities for corruption. Smart application of 'Internet of Things' (IoT) systems has an important role to play in advancing liveability and environmental sustainability, particularly in cities. Finally, through investment in digital R&D, governments can nurture the skills and knowledge for the design, implementation, and adoption of new services and applications that improve Digital Life.

Figure 8

Policy Tools to Facilitate Digital Life Ecosystems

Policy Action to Enhance Digital Life

Direct Government Intervention

Indirect Government Facilitation

Digital Regulation	Digital Taxation	Government Digitalization	Education and Skills System	Financial System	Startup Ecosystem
Network building	Investment incentives	Digital government	Digital literacy	Financial regulation	Accelerator creation
Market structure	Externality facilitation	mEducation	Entrepreneurial skills	Banking regulation	Startup support
Platform openness	Revenue generation	mHealth	Teacher training		Scaleup support
Quality of service		Smart traffic	Hackathons		Public-private partnership
Net neutrality		Smart cities	Digital application skills		Crowdfunding
Digital freedom		Smart grids			Application development
Digital security		Open data			Content development
Digital money					
Spectrum Governance	Digital R&D				
Spectrum allocation	University research				
Spectrum auctions	R&D subsidies				
Spectrum licensing	Public research institutes				



It is important to recognise that the role of governments is not limited to direct intervention only. It is equally important to facilitate the broader context in which digital infrastructures are built and digital technologies and applications are adopted. Currently, three domains of indirect facilitation appear particularly salient: the country's education and skills system, its financial system and its startup ecosystem. Through education and skills system, governments can enhance not only digital literacy and digital skills, but also, entrepreneurial skills and attitudes. Teacher training is important to ensure that digital skills are effectively taught and digital technologies harnessed to drive the adoption of new teaching content and digitally based education methods. Hackathons have an important role to play in developing digitally-based local solutions and advancing grassroots-level engagement with Digital Life in local communities. Intervention in the financial system is important to advance financial inclusion especially in emerging economies as well as in advanced economies.

Finally, as noted in the introduction, digitalisation is lowering the cost of entrepreneurial experimentation, startup and scaleup, which is dramatically transforming the way in which opportunities can be recognised and pursued. Most new business models and applications that promise to advance Digital Life will be created by new startups. Therefore, nurturing effective startup and scaleup systems is crucial for advancing Digital Life, and the ecosystems of Digital Life and entrepreneurship are closely intertwined. Facilitating effective startup systems involves: teaching entrepreneurship skills; reducing the burdens of bureaucracy and compliance using the rule of law and fighting corruption to encourage to take place in the formal-sector (as opposed to informal sector, or 'grey economy' activity); direct government investment as well as public-private partnerships to establish a supportive infrastructure; and facilitating support for entrepreneurial experimentation such as through new venture accelerators and crowdfunding.



All countries are unique and their economic, social, and cultural conditions influence the choice of appropriate policy approaches. Therefore, we take a regional view of the policy implications of TIDL with the following separate discussions for Latin America, Europe, North America, Asia-Pacific and the Middle East and Africa.

Policy Implications for Latin America

Latin America constitutes the world's fourth largest mobile market, with over 350 million unique subscribers and over 700 million connections [7]. This region has witnessed major transformations in the past couple of years, with the world's most rapid increases in smart phone adoption rates (although from a lower level than in many other regions), rapid transition from 2G to 3G and increasingly towards 4G (LTE) mobile telephony networks, opening up of markets for mobile telephony with a rapid increase of entries by new Mobile Virtual Network Operators (especially in leading



markets such as Brazil, Mexico and Chile, where Telefónica has the biggest number of MVNOs, and Colombia, with the largest MVNO customer base market share) and generally falling prices. Yet, this region also continues to face important challenges. The digital divide persists – a legacy of some of the world's highest inequality rates. Despite massive investment by telecommunications operators during last two decades, Internet access remains highly socially stratified, with digital devices remaining out of reach for large sections of the lower-income population. Large Latin American countries continue to be especially challenged to provide comprehensive geographical coverage, with the efforts of established operators sometimes hampered by rigid municipal regulations, continued high taxation in some countries, high spectrum prices, extremely low ARPU and intensifying competition that has seen operator profits fall below those in other major world regions.

Latin America stands out for its diversity – across income categories and across countries. There are many positive signs, with increases in mobile telephony adoption rates and expanding service offerings. However, in spite of constituting, for the most part, a uniform language area, this region is also challenged by bottlenecks in local-language content production and customisation. Herein also resides a potential opportunity for Digital Entrepreneurship. Although the Internet is dominated by English-language content, a potential strength of the Latin American region is its shared language, with most countries in the region Spanish speaking, and even the exception (i.e. Brazil) having the world's fifth largest unilingual (Portuguese-speaking) population. This linguistic homogeneity provides the Latin American region with a potentially major advantage that it can harness – through Digital Entrepreneurship – for better Digital Life.



Latin America: Regional Outlook

Chile, Colombia, Mexico, Argentina, and Uruguay are the top-scoring Latin American countries in the Index, ranking in the top 20 countries group. Except Uruguay, all these countries also over-perform in TIDL relative to their GDP per capita. The two largest countries in the region, *Argentina* and *Brazil* rank close to one another, on the 18th and 21st places, respectively. Together with Peru, the performance of these countries relative to their GDP per capita is thus on the positive side. These countries are trailed by a group of Central and South American countries, who mostly under-perform (except for Nicaragua) relative to their GDP per capita: *Panama, Ecuador, Nicaragua, Guatemala, Venezuela* and *El Salvador*.

This general pattern – that countries with higher absolute TIDL scores also tend to over-perform relative to their wealth, whereas countries with lower absolute TIDL scores also tend to under-perform – indicates the catalysing effect of digitalisation. The benefits of digitalisation tend to be self-reinforcing, because digitalisation does not only produce direct benefits through, e.g. easier access to digital services and content, but also, indirectly through its general productivity-enhancing effect in the economy and society. Productivity gains achieved through e-government and mobile services further enhance the ability of the economy to invest in its digital infrastructure. This creates a self-reinforcing pattern where gains from digitalisation drive further gains from digitalisation.



This self-reinforcing effect of digitalisation appears to grow stronger, up to some level, as the country grows wealthier. Yet, this is also potentially good (if challenging) news for the countries lagging behind in TIDL score, because it suggests that if the country manages to kick-start a self-reinforcing digitalisation dynamic, this dynamic will feed itself and drive productivity gains if appropriately nurtured.

Argentina exhibits good strengths in Digital Openness and Confidence and challenges in Entrepreneurship. It posts generally high digital device and service adoption rates, good level of Internet freedom, strong Internet privacy and low digital infection rates. As for Digital Entrepreneurship, Argentina's main challenges are low informal and venture capital investment availability, low levels of software spending and ICT application in business and low levels of open platform use.

Together with Brazil and Ecuador, Argentina faces the challenge of increasing its investment in Digital Entrepreneurship to ensure that this investment is effectively leveraged for economic growth.

Brazil exhibits a profile similar to Argentina, with good strength in Digital Openness and Confidence, but also, challenges in Digital Entrepreneurship. It has high digital device adoption rates, high ISP market openness, and strong Internet freedom. Brazil's challenges are in Digital Entrepreneurship, where it under-performs relative to its GDP per capita. Here, Brazil's main weaknesses are in business angel activity, innovation aspirations by entrepreneurs, low levels of open platform use and software spending and generally low education levels of entrepreneurs.



Together with Argentina and Ecuador, Brazil faces the singular challenge of improving its strengths in Digital Entrepreneurship to ensure that this investment is effectively leveraged for economic growth. This is likely to require a range of actions, including long-term investment in improving the country's education system such that it teaches more technical and STEM skills that can be harnessed for entrepreneurship.

Chile is a strong across-the-board performer in Digital Life relative to its GDP per capita. Chile's strongest points are Digital Entrepreneurship and Digital Confidence: in Digital Entrepreneurship it is the strongest over-performer among all TIDL countries. In Digital Entrepreneurship, Chile particularly excels in Finance and in Digital Business, although scope for improvement remains in, e.g. software spending and application in business and in open platform utilisation. Relative challenges are observed in Digital Openness, where Chile performs 'only' at the GDP-predicted level. Chile's unique geographical shape creates its own challenges for infrastructure and the regulatory emphasis on encouraging infrastructural asset sharing in 4G-LTE roll-out appears well advised.

Colombia is Latin America's most outstanding over-performer in Digital Life relative to its GDP per capita. It beats GDP-predicted expectations in all domains of Digital Life, showing equal over-performance in each. However, this does not mean there is room for complacency, as Colombia only performs to Latin American average for innovation. Also the application of ICT technologies by established businesses remains low, as does expenditure on software. On a positive note, Colombia government's active role in promoting mobile and e-money and financial inclusion should contribute to continued improvement in Digital Life. Our analysis recommends that Colombia should increase its investment in R&D and ICT.



Costa Rica over-performs in Digital Confidence and Digital Entrepreneurship but under-performs in Digital Openness. In Digital Confidence, it leads Latin American countries in privacy and security. However, in Digital Openness, it is behind its regional peers in e-government. In Digital Entrepreneurship, it is strong in Digital Literacy in staff training and in education but the attitude of its young population (18-34 age group) toward education and innovation is weak. Both e-government and open platform use appear to be areas where Costa Rica could likely do better with appropriately targeted policy action.

Ecuador performs quite close to its GDP-predicted performance, coming slightly ahead in Digital Openness and slightly behind in Digital Confidence and Digital Entrepreneurship. Ecuador's greatest strength is in digital business but gaps in innovation and finance hamper its Digital Entrepreneurship performance. In Digital Openness, Ecuador leads Latin America in mobile OS openness and scores reasonably well also in Internet freedom, strengthened by the recently introduced Organic Law on Telecommunications. This law, however, is a double-edged sword with some articles within it having positive effect mentioned above (e.g. the right of users to access any kind of content on the Internet and the prohibition of ISP providers from blocking or discriminating against Internet traffic), but some articles within it may have an adverse impact on the investor environment (e.g. newly introduced taxation on telecommunications) in the country. Both R&D expenditure and innovation in ICT appear to be areas where Ecuador could likely do better with appropriately targeted action.



El Salvador's strongest aspect is Digital Entrepreneurship where it performs quite well in innovation attitudes, VC availability and innovation capacity. When compared to its GDP, it under-performs slightly in Digital Openness and Digital Confidence and it performs to expected level in Digital Entrepreneurship. Young individuals in El Salvador (18-34 age group) exhibit positive attitudes towards innovation.

Guatemala over-performs in Digital Entrepreneurship but under-performs in Digital Openness and Digital Confidence. It lags behind Latin American average in Internet freedom, digital public services, digital adoption, and digital literacy. In Digital Entrepreneurship, it shows strength relative to GDP per capita at innovation and digital business, business use of the Internet, technology availability, technology absorption and opportunity perception among its young population (18-34 years old). The main challenges for Guatemala include improving its digital public services and improving ISP openness to enable Digital Openness to support Digital Life. Its Digital Confidence is weak due to low Internet adoption and weak Internet security. Because Guatemala performs quite well, relatively speaking, in Digital Entrepreneurship, its main policy focus should be on enhancing the two other elements of its Digital Life ecosystem: Digital Openness and Digital Confidence.

Mexico over-performs relative to its GDP per capita in Digital Openness, Digital Confidence, and Digital Entrepreneurship. Its citizens have the best digital public service, e-government in particular, when compared to its Latin American peers. In Digital Entrepreneurship, it exhibits good innovation related to ICT impact and application, technology availability and technology absorption. Its 18-34 year old age group exhibits a positive perception of entrepreneurial opportunities. In Digital Confidence, Mexico exhibits a good level of Internet privacy. In order to fully exploit its relative strengths in Digital Openness, Digital Confidence and Digital Entrepreneurship, Mexico might benefit from appropriately targeted policy action to enhance entrepreneurial Finance and Digital Literacy.



Nicaragua performs as expected in Digital Openness, and under-performs in Digital Confidence and Digital Entrepreneurship. In Digital Openness, it has strong digital public service. The challenges Nicaragua face in promoting Digital Life is Digital Confidence with low Internet adoption and weak Internet security. In Digital Entrepreneurship, although its 18-34 years old age group has positive attitude toward entrepreneurial opportunities, it lacks informal venture capital and has low software spending to support innovation.

In order to advance its Digital Life ecosystem, Nicaragua needs to enhance primarily its engagement and leverage drivers with knowledge-based and innovation policies (see Figure 7). Its greatest challenge appears to be to improve its Digital Confidence, where it trails all other countries featured in TIDL.

Panama over-performs in Digital Entrepreneurship but under-performs in Digital Openness and Digital Confidence. In Digital Entrepreneurship, it posts strong digital business and the highest business use of the Internet among its Latin American peers. It also leads its peers in VC availability, technology absorption, and technology availability. However, Panama's Digital Entrepreneurship still needs to be improved by more informal venture capital, and more positive attitude of its 18-34 year old age group toward education. In Digital Confidence, Panama faces challenges in Internet privacy. In Digital Openness, Panama's main challenge is e-government. It also faces an additional challenge in Digital Openness and should act to ensure greater choice, flexibility and responsiveness for its citizens.



Peru over-performs in Digital Confidence and Digital Entrepreneurship. It posts strength in digital business and the most positive entrepreneurial attitudes among 18-34 year old citizens when compared to its Latin American peers. The same age group also exhibits good positive attitude toward innovation. However, there is more to be done in this area to improve Peru's Digital Life by making more informal venture capital available for entrepreneurs, and facilitate more open platform use. In Digital Confidence, Peru has strong Internet privacy and low digital infection rates. In Digital Openness, Peru's main challenge is digital public service. Improvements in secure Internet servers and improved Internet security appear as areas where Peru could likely do better with appropriately targeted action.

Uruguay over-performs in Digital Confidence but under-performs in Digital Openness and Digital Entrepreneurship. Digital Life in Uruguay is supported by its overall strong Digital Confidence evidenced in being the best in privacy among its Latin American peers. The challenges Uruguay faces in promoting Digital Life is Digital Openness with weak ISP market and low R&D expenditure in supporting innovation.

Venezuela is strong in digital business, with its young population (18-34 age group) showing a strong positive attitude toward entrepreneurship, but under-performs in Digital Openness, Digital Confidence, and Digital Entrepreneurship, relative to its GDP per capita. No doubt the fact Venezuela is suffering an economic contraction in different indicators is impacting its performance in Digital Life. The major opportunities for Venezuela's Digital Life are improvements to its digital privacy, innovation and finance for entrepreneurs.



Policy Implications for Asia-Pacific

The Asia-Pacific region constitutes half of the world's mobile market, with more than 1.8 billion unique mobile subscribers and over 3.6 billion connections. From the 1.8 billion subscriptions, 1.3 billion are smartphones. This region is forecast to experience the second fastest growth in mobile subscriptions after Sub-Saharan Africa. This reflects the low current level of mobile subscriptions within the poorer, yet population rich countries in the region. For example, there are more than 1.6 billion people in India, Pakistan and Bangladesh combined, but their mobile penetration rate is only 36% as of 2014. From a technology diffusion perspective, growth rates in 4G adoption are already faster in China, Japan, and South Korea than they are in North America and Europe. Because of the competitive market

structure in many countries in this region, prices of devices and services are generally affordable, encouraging citizens in the region to embrace Digital Life. Yet, this region also continues to face important challenges. The digital divide persists, as the region as a whole has 1.75 billion people living below an extreme poverty line. This represents a major inclusion challenge (and perhaps also an opportunity), as the poorer countries in the region need to find ways to harness digitalisation to ensure more equal access to mHealth, mEducation, eCommerce and eGovernment. Affordability of quality services via Broadband or mobile Broadband remain exceptionally high for average citizens in poor countries in the region, such as Cambodia and Nepal. Although some regulatory frameworks have been changed to lower operator taxes and fees in Thailand, taxation of mobile services remains high in Bangladesh and Sri Lanka. While the developed countries in this region have advanced digital literacy, some countries (e.g. Papua New Guinea, Bangladesh) are among the least literate countries in the world with lower than 30% literacy rates among their youths.



Summarising, the Asia-Pacific region exhibits huge diversity, comprising more than 50 countries. The challenges for advancing Digital Life are equally varied across countries within the region. In the case of the wealthier and advanced economies such as Australia, Japan, Hong Kong, Singapore, South Korea and Taiwan, the patterns of digitalisation and Digital Life closely resemble those in North America and Europe. On the other hand, growth in market penetration, from a device and service adoption perspective, will come from countries like Indonesia, Bangladesh, India, among others. As for innovation in applications, IoT, M2M, local content, and handsets, most advances are likely to come from Australia, China, India, South Korea and Japan. Australia and Japan lead in the governance on privacy and security, setting examples for other countries in the region. Compared to Japan and South Korea, India and China fare much better in Digital Entrepreneurship, suggesting a potentially important advantage these two populous countries can harness to nurture better Digital Life.

Asia-Pacific: Regional Outlook

Australia exhibits the strongest performance in the region, excelling in all aspects of Digital Life. In TIDL, Australia ranks third, trailing behind the USA and Canada and slightly ahead of the UK. In Digital Confidence, Australia is also the best performer out of the 34 TIDL countries in privacy and security. In Digital Entrepreneurship, Australia is strongest overall performer in digital literacy, ahead of France and the USA. Australia over-performs in TIDL and all the sub-indices relative to its GDP per capita. However, this does not mean there is room for complacency, as Australia's ISP market openness is less competitive than in Japan and its software spending trails behind South Korea and China. In Digital Entrepreneurship, the attitudes toward innovation among 18-34 year old citizens are less positive than in China and India.



Given Australia's all-round strengths, it should probably pursue balanced policies, with attention paid to balanced development of all components of its Digital Life ecosystem. However, Australia would probably be able to extract more output from its traditional strengths in innovation by focusing specifically on further strengthening its startup and scaleup ecosystems. This is the domain where Australia received its lowest sub-index score. This emphasis is also consistent with Australian government's recent policy emphasis on strengthening entrepreneurship.

China exhibits good strength, relatively speaking, in Digital Entrepreneurship. It over-performs relative to its GDP in overall TIDL score and in all sub-indices except for Digital Openness. However, in Digital Openness and Digital Confidence, China faces challenges in Internet freedom and market openness, e-government, privacy and security. In Digital Entrepreneurship, individuals in the 18-34 year age category demonstrate relatively positive attitudes toward entrepreneurship, innovation and finance. The fact that China has produced two of the ten largest unicorns in the world shows its potential strength in Digital Entrepreneurship – one that it should be able to leverage even better provided that it improves its Digital Openness.

India over-performs in Digital Openness and Digital Entrepreneurship relative to its GDP. Being the largest democracy in the world in terms of population, India has good Internet freedom in contrast to China. India also exhibits relative strength in Digital Entrepreneurship, with strong positive innovation attitudes among its young (18 – 34 years old) citizens. In Digital Confidence, India has weak Internet privacy and Internet security. The policy challenge for India, therefore, is to while also employing user- and market-focused policy approaches to enhance its Digital Confidence. At the same time it should continue to work on strengthening its Digital Entrepreneurship system, as its large domestic market provides excellent potential for achieving rapid growth – as illustrated by the success of Flipkart, for example.



Japan exhibits solid absolute strengths in Digital Openness and good strength in Digital Confidence. Japan over-performs in TIDL overall scores, Digital Openness and Digital Confidence, but it under-performs in Digital Entrepreneurship relative to its GDP per capita. Japan excels in Internet freedom, trailing only slightly behind Australia and leads with South Korea in mobile search engine openness. In Digital Entrepreneurship, Japan has the highest institutional technology availability and technology absorption in innovation, but it is relatively weak in open platform use and informal finance.

For Japan, the most acute challenge comes from its Digital Entrepreneurship, with its younger population (18-34 olds) exhibiting weak perception of entrepreneurial opportunities. Relative weaknesses is also evident in innovation and finance. Although Japan has world-beating strengths in its established corporate sector, its relative weakness in Digital Entrepreneurship risks slowing down its Digital Life. This is a particularly important issue, given that new digital business models are typically introduced by new ventures and less often by established incumbents. A sign of this weakness is that Japan has produced significantly fewer unicorns than the US, China or Europe – i.e. new scaleups with a valuation greater than \$1 Billion.

South Korea exhibits reasonable strength in Internet freedom. In Digital Openness, South Korea is relatively weak in privacy, similar to the level of China. In Digital Entrepreneurship, South Korea is relatively weak in open platform use. In Digital Openness, Digital Confidence, and Digital Entrepreneurship, South Korea also under-performs relative to its GDP per capita. Relatively speaking, Digital Entrepreneurship is the weakest aspect of its Digital Life ecosystem. A sign of this is that South Korea has produced fewer unicorns than Japan. Providing VC availability for entrepreneurial activities for its young people appears as an area where South Korea could likely do better with appropriately targeted action.



Policy Implications for Europe

Europe is, in many areas, a global leader in Digital Life. It has the highest unique subscriber penetration rate of mobile phones, with 78% population coverage (world average: 51%; Northern America: 70%) [8]. 4G adoption rates are expected to triple to 60% by 2020 – which is good progress but it will trail behind Northern America (expected to be at 80%) and countries such as South Korea [9]. Some of the highest mobile broadband speeds in the world are currently found in Europe, with only South Korea ahead of it [9]. Europe has been a leader in the adoption of previous generations of mobile phones and it continues to pioneer technological breakthroughs in many areas. According to GSMA, four out of the top five mobile application –based gaming companies are European and, according to Vision Mobile, there are 1.3 million application developers, or 23% of the global base of application developers [9].

However, this positive overall outlook should not divert attention from important challenges, some of which appear quite urgent. Importantly, the EU lags behind the US in fixed line and mobile broadband coverage [10]. During the period from 2007 to 2012, the US broadband industry invested more than twice as much as the European industry per household in network development such as in fibre optical networks. Some of this difference in propensity to invest is attributed to different regulatory regimes in EU and in the US, notably, the difference between the US 'facilities-based competition' model, under which Internet Service Providers (ISPs) own the underlying networks, and Europe's 'leased access' model, under which ISPs lease transmission lines at regulated rates from incumbent telecommunications firms [11]. Evidence suggests that the facilities-based competition model provides more incentives for stakeholders to invest in network development to gain competitive advantage than does the leased access model, which may be burdened by onerous regional coverage and quality of service (QoS) regulations. There are also many unresolved issues related to net neutrality and the need for a 'level playing field' between different parts and actors in the digital ecosystem.



Furthermore, while Europe generally excels in innovation and startup activity and although the production of scaleups with a valuation of €1 Billion or greater is increasing, the EU trails behind the USA, China and India and is not currently home to any of the top ten most valuable scaleups in the world. In spite of much policy effort in developing its startup systems, Europe's scaleup systems trail behind those of global leaders.

In addition to balancing policy choices such as those between facilities-based competition and leased access in network provision, the above gaps are also attributable to the continued fragmentation of the EU markets for digital goods and services. Domestic policy related to Digital Life in EU member states continues to exist in silos, constraining the ability of European businesses and service providers to scale up their operations. For example, today only 15% of European consumers engage in cross-border online shopping as opposed to 44% who do so domestically. The huge potential of EU markets is not yet being realised. Only 7% of European SMEs sell goods and services to customers beyond national borders. On average, small online businesses in the EU incur €9k of extra costs when trading in another EU

country due to the need to adapt to local laws [12]. 42% of online services are conducted domestically within a single member state and 54% of online services are conducted with a US-based service provider [13]. So although the EU has strengths in application development, there is a risk that the fragmentation of its markets for digital goods and services will hand leadership to larger domestic markets such as USA, China and India, where companies can scale up their operations more easily.

These challenges mean that while individual European countries each need to continue to nurture their own Digital Life ecosystems consistent with their individual strengths and challenges, collective, EU-wide action is urgently required to address supra-national challenges, the most important of which is the European Digital Single Market. The successful implementation of this EU-wide policy initiative is crucial for individual European countries and the EU as a whole if they hope to continue to lead progress in Digital Life.



Europe: Regional Outlook

Although Europe shows great overall strength in different areas of Digital Life, there are important regional variations. Four of the top ten performers in this year's Index are European. The United Kingdom is the strongest European country in the Index, in the fourth place (88.7 points) overall. The other three EU countries in the top 10 are Germany (5th), France (7th), and Czech Republic (9th). Outside the top ten are Spain (12th), Russia (15th), Italy (17th), and Poland (25th). The difference between the top and bottom performer is nearly 30 index points, suggesting important variance within the EU. Collectively, the greatest strength of the EU member states is Digital Confidence, whereas the greatest challenge is in Digital Entrepreneurship. Even in entrepreneurship, however, there is important regional variance, with many clusters of innovative startups and most of Europe's unicorns found in Northern Europe.

The United Kingdom is the strongest over-performer in TIDL relative to its GDP per capita ranking fourth in the index overall with 88.7 points out of 100. It beats its GDP-predicted score for all sub-indices, with the strongest over-performance being in Digital Openness, and Digital Confidence. For Digital Entrepreneurship, the over-performance is less pointed, yet comfortable. As a country, the UK has many strengths that make it poised to excel in Digital Life: English-language content and applications dominate in the Internet, the UK has traditionally strong media, content, advertising, and financial industries and a world-class university sector. The UK government has consistently invested in digital economy research, for example in the form of the UK Research Council's Digital Economy Programme. It has EU's largest concentration of 'unicorns' (digital start-ups with a valuation exceeding €1Bn) and new venture accelerators. Although London is a global financial hub, the availability of micro-scale venture capital (i.e. informal investors or business angels and venture capital) could be stronger.



As one of the all-round over-performers in TIDL sub-indices (together with Australia, Canada, Colombia, Mexico, Israel and South Africa), the UK needs to pursue an all-round development strategy to advance its Digital Life, perhaps putting a little bit more emphasis on Digital Entrepreneurship than the other elements. It should be well poised to do this, with strong regional clusters not only in London (notably, the 'Silicon Roundabout') but quite evenly spread across the UK, in clusters such as Cambridge, Oxford, Glasgow and Belfast, among many others.

Germany ranks first in Digital Entrepreneurship in Europe, but ranks lower than the UK in Digital Openness, and lower than both UK and France in Digital Confidence. In innovation, Germany and France jointly lead their European peers. When comparing its actual and GDP-predicted TIDL scores, Germany performs as expected in Digital Entrepreneurship but under-performs in Digital Openness and Digital Confidence. For Digital Openness, Germany trails behind the UK in mobile OS openness, mobile search engine openness, e-government and e-education, although it has a small lead over the UK with a perfect score in Internet freedom.

Both e-government and e-education appear as areas where Germany could likely do better with appropriately targeted action. It also appears that as a traditionally manufacturing-oriented economy, Germany may also need to do more to fully embrace the kind of service culture that characterises many digital economy industries. Germany, however, is in an excellent position to take advantage of growth in the 'Industrial Internet' and the 'Internet of Things' digitalising its traditional manufacturing sectors (as it has already started to do through, for example, its 'Industrie 4.0' initiative).

Spain performs best in Digital Confidence, followed by Digital Entrepreneurship and Digital Openness. Digital Confidence in Spain is boosted by its strong Digital Adoption. Digital Entrepreneurship is quite strong, as Spain ranks within the top ten among 34 countries. In Digital Entrepreneurship, young Spaniards (18-34 years old) exhibit the most positive attitudes toward informal venture capital for entrepreneurial activities compared to their peers in the region. For Digital Openness, Spain's strength is in its e-government. However, when looking at the overall TIDL score, Spain under-performs slightly relative to its GDP per capita.



Spain's profile implies that it should probably prioritise user- and market-based policies, and, in particular, learning and innovation capabilities in its Digital Life policy. A gradually strengthening startup culture already exists, but this is an area where Spain probably could do much more to take advantage of entrepreneurial opportunities created through digitalisation – in both European and Latin-American markets.

Russia over-performs in Digital Openness and Digital Confidence relative to its GDP. Russia's strength in Digital Openness stems from it having one of the most competitive market places for ISP and mobile search services. In both cases the market leader is the least dominant when compared to other countries in this year's index. Russia's strength in Digital Confidence arises from its balance in

government privacy protection policy and the extent to which its citizens perceive the importance of privacy protection. In Digital Entrepreneurship, Russia exhibits a good level of digital literacy, but weaknesses in digital business, innovation and finance when compared with its European peers. Russia's main challenge is its lack of informal venture capital and low level of positive entrepreneurial attitude among its 18 to 34 years old citizens. Russia's TIDL profile suggests policy approaches that emphasise user- and market-centric policies, as well as investment in the capabilities that underpin a Digital Economy. Russia's economy is over-dependent on oil and it is in urgent need of diversification. In order to take advantage of its engineering skills, it is important for Russia to advance rule of law and predictability in contract enforcement and to strengthen the entrepreneurial skills of its population.



Poland faces challenges in Digital Openness, Digital Confidence and Digital Entrepreneurship. It is an overall under-performer relative to its GDP-predicted score. Poland under-performs in Digital Openness, Digital Confidence and Digital Entrepreneurship. In Digital Openness, Poland faces challenges in mobile OS and mobile search engine openness. In Digital Confidence, Poland is weak in privacy. In Digital Entrepreneurship, Poland exhibits good positive attitudes towards innovation among its 18 to 34 years old citizens but it could expect an improvement in Digital Life from additional investment in venture capital potential and innovation capacity.

Poland's profile suggests that it needs to invest in leveraging capabilities in order to achieve balanced progress in Digital Life (see Figure 7). Nurturing entrepreneurial skills and attitudes appears particularly important for Poland, as it only ranks 24th overall for Digital Entrepreneurship.

The Czech Republic exhibits a relatively well balanced performance in all socio-economic factors supporting Digital Life. It exhibits good relative strengths in Digital Confidence and Digital Openness, but it under-performs in Digital Entrepreneurship relative to its GDP per capita. In Digital Confidence, its strength is in privacy. For Digital Entrepreneurship, its young population (18-34 age group) lacks strong positive attitudes toward education and faces some challenges in innovation. In order to fully leverage its relative strengths in digital privacy and security, the Czech Republic needs to do more to nurture a strong startup ecosystem that will help it advance Digital Life.



France over-performs in Digital Openness and in Digital Entrepreneurship relative to its GDP per capita. In Digital Openness, France's strength lies mainly in a very strong e-government and high Internet freedom. Digital Entrepreneurship in France is strong due to its positive attitude towards entrepreneurship among its 18-34 year olds. Within Digital Entrepreneurship, France excels in open platform use and virtual network use. France faces greatest challenges in Digital Confidence, where its privacy and security score is below average for the 34 countries.

Italy faces multiple challenges in nurturing Digital Life. It under-performs in overall TIDL as well as in all sub-indices relative to GDP per capita. In Digital Openness, it exhibits strong Internet freedom, but its market openness in ISP and mobile search engines is relatively weak. In Digital Confidence, Italy is weak on Internet security and privacy. The challenge Italy faces in Digital Entrepreneurship is its lack of availability of informal venture capital funding.

As an overall relative under-performer, Italy appears to need a national Digital Life strategy that simultaneously addresses all elements of its Digital Life ecosystem. Because of the overarching character of the policy effort required, the effort would require high-level cross-departmental coordination to solicit strong private sector involvement.



Policy Implications for MEA

The *Middle East and Africa* region covers over 585 million unique mobile subscribers in 2014 and over 1.1 billion connections. The numbers of subscribers and connections are larger than those of Europe. This region has the largest growth forecast because the consumer markets in the region are yet to be saturated. From a technology diffusion perspective, 4G is becoming widely adopted in the Middle East countries, such as Qatar, Oman, Saudi Arabia, Bahrain and Dubai. These countries are building Smart Cities to advance Digital Life in mHealth, eTransport, mEducation, eCommerce and eGovernment. Kenya has its own Silicon Savannah, turning out tech firms like M-Pesa or Ushahidi. With highly competitive marketing practices, prices of devices and services have become more affordable,

encouraging citizens in the region to navigate their daily lives in the digitalised world. In 2015, Chinese-based vendor Xinwei Telecom launched a cheap (less than USD20) mobile phone and service in Malawi that supports voice and video calls and Internet browsing. Yet, this region continues to face important challenges overall. First, in spite of fast connections available in some Middle Eastern countries and Eastern and Southern African countries, 90% of connections in Central and West African States remain 2G-based. The connectivity divide between cities and rural regions remains acute notably in sub-Saharan Africa. Second, the digital divide persists as a result of uneven distribution of wealth across and within countries. Third, affordability of quality services via fixed broadband or mobile broadband, with costs often further elevated because of rigid taxation structure, remains exceptionally high for average citizens in countries like Gabon, Tanzania and Ghana. Lastly, while the developed countries (e.g. Israel and Saudi Arabia) in this region have advanced digital literacy, 40% of the population in Sub-Saharan Africa remains illiterate.



MEA comprises more than 70 countries, thus exhibiting tremendous variety in societal and economic development and conditions. This region includes innovation leaders such as Israel and oil-rich countries such as Bahrain, Qatar, Saudi Arabia and Kuwait. The consumption and penetration patterns in these countries resemble those observed in Europe and North America, although some oil-rich countries such as Saudi Arabia under-perform significantly in Digital Life relative to their GDP per capita. On the other hand, there are large growth opportunities in Sub-Saharan Africa in particular, where current adoption rates are low, but where increased digitalisation could turn out to become a central driver of economic development, if correctly nurtured. Once digital adoption is diffused, digital skills should become a policy priority for most parts of this region.

MEA: Regional Outlook

Egypt faces many challenges when it comes to Digital Life. It under-performs in all dimensions of Digital Life in relation to its GDP per capita. In Digital Openness, Egypt's market competitiveness remains low in mobile OS market. Digital public services in Internet availability at school are weak. Internet adoption at both individual and household levels is low. Mainly due to low Internet security, Egypt does not perform well in Digital Confidence. Its Digital Entrepreneurship is exceptionally weak. Egypt's general under-performance even relative to fairly modest expectations suggests that it is in real risk of missing out on potential productivity and social benefits offered by Digital Life. If Egypt does not reverse this negative trend, there is a risk that the negative cycle becomes self-reinforcing, causing Egypt to fall even further behind relative to its peers. In order to reverse the situation, Egypt needs a national policy effort to address all elements of its Digital Life, including its market structures and openness, digital adoption and security.



Israel is the most outstanding performer in Digital Life in this region. It over-performs relative to its GDP per capita in Digital Entrepreneurship and Digital Confidence and it performs as expected in Digital Openness. In Digital Entrepreneurship, Israel excels in innovation capacity, technology absorption and VC availability. Its young (18-34 years old) population also exhibits positive attitudes toward education, innovation, and informal venture capital. In Digital Confidence, Israel exhibits strength in privacy and a high Internet penetration rate at both individual and household levels.

Saudi Arabia exhibits good strength in Digital Entrepreneurship, with the most positive attitudes by young (18 to 34 years old) citizens among the TIDL countries towards entrepreneurial opportunities, education, innovation and informal venture capital. Saudi Arabia also exhibits good VC availability, digital literacy and finance. Relative to its GDP, however, Saudi Arabia under-performs in all dimensions of Digital Life. With regard to Digital Openness, Saudi Arabia is not strong in e-education. The biggest challenge for Saudi Arabia, however, is Internet freedom.

South Africa over-performs in Digital Confidence and Digital Openness and performs as expected in Digital Entrepreneurship relative to its GDP per capita. Its over-performance in Digital Confidence is largely based on good attitudes toward privacy, supported by good enforcement of digital privacy protections by its government. As regards Digital Entrepreneurship, an improved level of informal venture capital and a more positive attitude towards education among South Africa's young (18-34 years old) population should lead to improvements in its Digital Life.

Turkey exhibits good relative strength in Digital Entrepreneurship but this over-performance is tempered by relative under-performance in Digital Openness and Digital Confidence. Turkey's strengths include strong positive attitudes toward innovation and finance and relatively high software spending. Turkey faces challenges in Digital Openness with the most limited eGovernment activity in the region to facilitate Digital Life. Digital Confidence in Turkey under-performs mostly because of its low level of Internet security. This profile suggests a broad-based combination of policies designed to open up market structures and enhance the confidence of Turkey's citizenry to engage in Digital Life. This would also involve policies designed to improve transparency in business transactions and encourage a merit- and performance-based business culture over one dominated by personal relationships.



Policy Implications for North America

North America has more than 250 million unique mobile subscriptions. Of these subscriptions, more than half involve smartphones. The majority of mobile connections are under the 4G standard. This region continues to produce digital entrepreneurs who deliver disruptive technologies and business models that extend and advance the potentialities of Digital Life. North America also dominates the consumer market, where it represented the largest geographical market for smartphone sales in 2014. It is also the largest application market worldwide. USA has been the source of most of the innovations and radical business models that advance the sharing economy, as reflected in the success of unicorns such as Air BnB and Uber. It generally offers arguably the best socio-economic environment to advance Digital Life in

mHealth, eCommerce, eEducation and eGovernment. Yet, this region also faces important challenges. While the gender gap in digital usage has been closing, digital divide persists between college-educated adults and non-college educated adults. Pew Research Centre recently reported that the gap between these two groups is almost 30% in terms of digital engagement. Another challenge is digital affordability, where OECD recently ranked the USA 30th among 33 countries. These two challenges are related, as in neighbourhoods with average income above \$75,000 per household, Internet penetration rate is 91%, whereas in neighbourhoods with average income below \$25,000 per household, Internet penetration rate is below 45%. Closing this gap is a challenge for the USA, as is rolling out network coverage to poorer neighbourhoods at an affordable rate such that inhabitants in these neighbourhoods can access eEducation, mHealth, eGovernment and similar services. For Canada, the set of challenges is different and mostly related to its low rural broadband connection quality and a weaker (as compared to the USA) Digital Entrepreneurship ecosystem.



North America: Regional Outlook

United States leads in the Index with 96.3 points out of 100. Its superior strength rests notably in Digital Confidence and Digital Entrepreneurship. Particular in Digital Entrepreneurship, USA leads by nearly 10 points over the second-placed Australia, and it performs exceptionally well in innovation and finance. The attitudes of the young age category (18 to 34 year olds) toward informal finance are the strongest among TIDL countries. USA also exhibits very strong Digital Confidence in both privacy and security and digital adoption.

Canada ranks second in the Index with 92.4 points out of 100. It exhibits excellent strength in Digital Access, Digital Openness, and Digital Confidence. It over-performs in all three areas of Digital Life. In Digital Openness, Canada is the best performer among the TIDL countries in Internet freedom, ISP market openness, e-Education and nearly the best in e-government. In Digital Confidence, Canada also excels in digital adoption. In Digital Entrepreneurship, Canada's young population (18-34 years old) has strong attitude toward innovation, entrepreneurial opportunities, and finance. However, attitudes toward education are not equally strong. Another improvement to Digital Life could also be achieved through improved digital privacy.



References

1. Wareham, J., Fox, P.B., and Cano Giner, J.L. 2014. Technology Ecosystem Governance. *Organization Science*, 25(4): 1195-1215.
2. Autio, E., Thomas, L., and Gann, D. 2016. *Ecosystem Value Co-Creation*, in I&E Working Papers, Imperial College Business School, Editor, London.
3. Yoo, Y., Boland Jr, R.J., Lyttinen, K., and Majchrzak, A. 2012. Organizing for Innovation in the Digitized World. *Organization Science*, 23(5): 1398-1408.
4. Tilson, D., Lyttinen, K., and Sørensen, C. 2010. Research Commentary-Digital Infrastructures: The Missing Is Research Agenda. *Information Systems Research*, 21(4): 748-759.
5. Yoo, Y., Henfridsson, O., and Lyttinen, K. 2010. Research Commentary-the New Organizing Logic of Digital Innovation: An Agenda for Information Systems Research. *Information Systems Research*, 21(4): 724-735.
6. Yoo, Y. 2010. Computing in Everyday Life: A Call for Research on Experiential Computing. *MIS Quarterly*, 34(2): 213-231.
7. GSMA. 2014. *The Mobile Economy Latin America 2014*, GSMA, Editor. GSMA, London.
8. GSMA Intelligence. 2015. *Unique Subscriber Penetration Rates Q3 2015*. GSMA, London.
9. GSMA Intelligence. 2015. *The Mobile Economy Europe 2015*. GSMA, London.

- 
10. Negreiro, M. EU Lagging Behind in Fast Broadband. 2014 [cited 2014 November 14]; Available from: <http://epthinktank.eu/2014/11/17/eu-lagging-behind-in-fast-broadband/>.
 11. Layton, R. When It Comes to High-Speed Internet, the Grass Isn't Greener in Europe. 2014 [cited 2014 February 7]; Available from: <http://www.forbes.com/sites/realspin/2014/02/07/when-it-comes-to-high-speed-internet-the-grass-isnt-greener-in-europe/#5358df2f6231>.
 12. EU Commission. Why We Need a Digital Single Market. 2015 [cited 2015 May 6]; Available from: https://ec.europa.eu/priorities/publications/why-we-need-digital-single-market_en.
 13. Sapiro, M. Forging an EU Digital Single Market: Difficulties and Opportunities. 2015 [cited 2015 September 22]; Available from: <http://www.forbes.com/sites/realspin/2014/02/07/when-it-comes-to-high-speed-internet-the-grass-isnt-greener-in-europe/#5358df2f6231>.
 14. Vinton, W. J. D. G., and Kleinwächter, C. W. 2016. Future of the Internet Initiative White Paper, Internet Fragmentation: An Overview, WEF; Available from: http://www3.weforum.org/docs/WEF_FII_Internet_Fragmentation_An_Overview_2016.pdf



Technical Appendix

TIDL is composed of 3 sub-indices, 8 pillars, and 37 variables from 53 key performance indicators. Statistically comprehensive and globally harmonised data was gathered from 17 different sources, including ITU, World Bank, World Economic Forum, UN and WIPO, among others. Below we provide a brief description of the steps that were used to calculate the Index. A full technical report, which explains the calculations in full, is available for download from the TIDL website at: indexdigitallife.telefonica.com

Step 1 Pre-processing the KPIs

The first step was to pre-process the KPI values so they could be combined into an index. This process involved capping and normalisation. With capping, extreme values were first capped into a reasonable maximum value, so the index would not be unduly biased by extremes. With normalisation, the original KPI values were re-scaled to a range from 0 to 1. The capping and normalisation formulas are presented in the technical report. We used a distance method which guaranteed that the best performing country(ies) for a given KPI always received the maximum score of 1. The worst performing country's score depends on its relative position to the best country's score but is not necessarily zero.

Step 2 Creating KPIs within Digital Entrepreneurship Sub-Index

The Digital Entrepreneurship sub-index sought to capture attitudes of young, 18-34 years old individuals in the 34 countries. This age group is sometimes referred to as the 'millennials' generation. We harvested data from the Global Entrepreneurship Monitor (GEM) dataset. We combined data describing entrepreneurial abilities (opportunity motivations, education) and aspirations (innovation, informal venture capital) with data describing general entrepreneurial attitudes within the millennials population. This process produced four new KPIs. The four new entrepreneurial KPIs represent millennials' attitudes toward education, entrepreneurial opportunities, innovation and informal finance.



Step 3 Calculating and Normalising the Index Variables

After all KPIs had been created and pre-processed, they were combined into a total of 37 variables distributed across the three sub-indices of Digital Openness, Digital Confidence and Digital Entrepreneurship. Details are found in the technical report. After calculation, the resulting 37 variables were re-normalised.

Step 4 Calculating and Normalising Index Pillars

The 37 variables were then combined into a total of 8 sub-index pillars. In the Digital Openness sub-index, the pillars were Internet Freedom and Openness; and Digital Public Service. In the Digital Confidence sub-index, the pillars were Digital Adoption; and Privacy and Security. In the Digital Entrepreneurship sub-index, the pillars were Digital Literacy; Digital Business; Innovation; and Finance. After calculating the pillars, they were again re-normalised.

Step 5 Pillar Equalisation

In order to avoid potential distortion resulting from different pillar means, we conducted a transformation to equalise pillar means. This step fixed each pillar mean to the same value. Equations 6, 7, and 8 in the technical report provide details on this step.

Step 6 Calculating the Sub-Indices

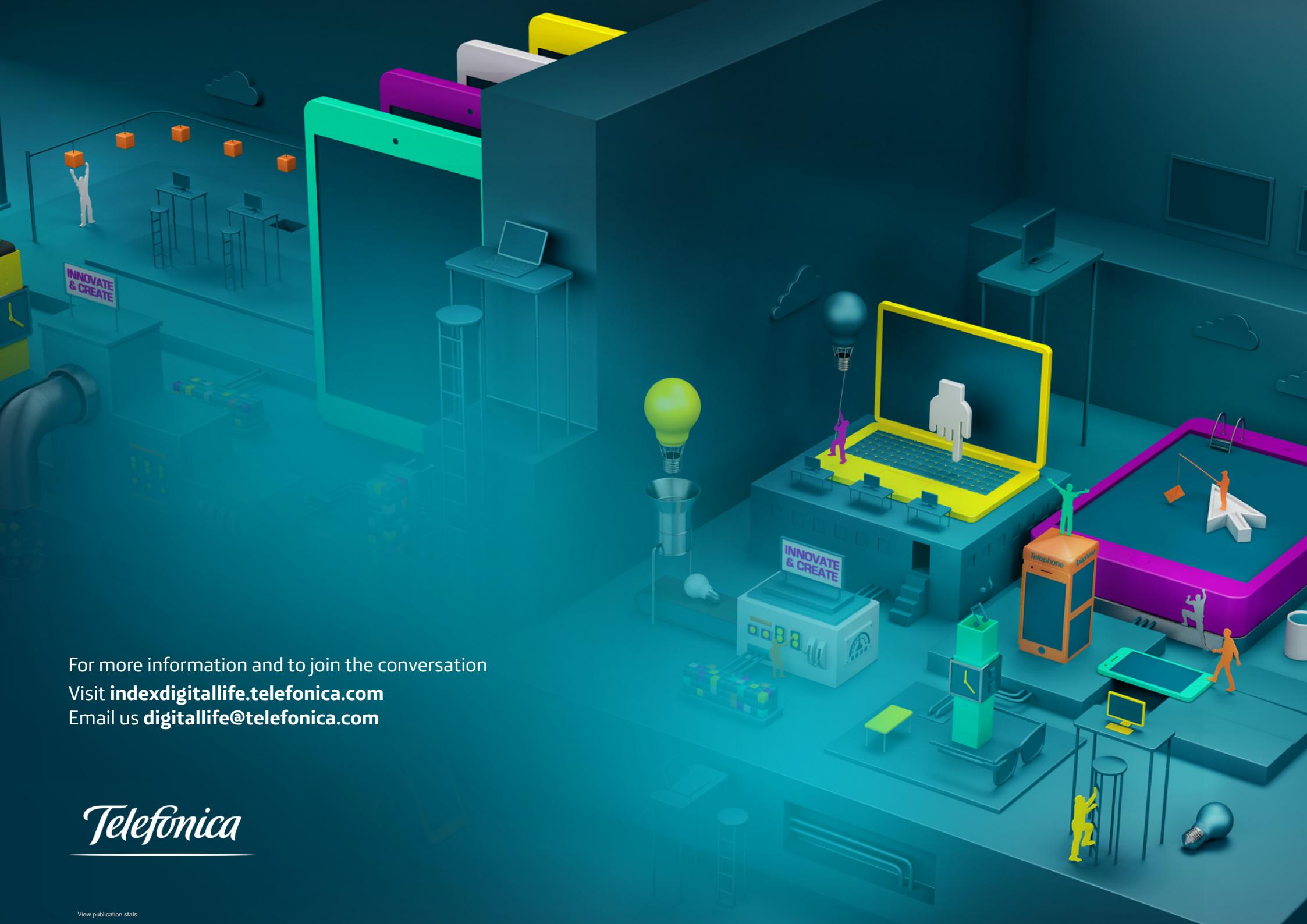
The three sub-indices were calculated as the arithmetic average of their constituent pillars and then multiplied by 100 in order to scale the resulting sub-index scores to a range from 0 to 100.

Step 7 Calculating TIDL

As the final step, the Index was calculated as the arithmetic average of the three sub-indices.

Step 8 Checking Missing Data Bias

Our dataset consists of 34 countries and 53 KPIs. As is the case with most multi-item indices that cover a wide range of countries, not all the data were available for all countries. To address potential bias, we developed a measure that estimates the potential distortion of missing data using a simplified form of the Mudgett methodology, which has been developed to estimate index bias resulting from missing data. All 34 countries except Nicaragua exhibited good or excellent Mudgett estimates, meaning that missing data bias was not a problem in the Index. The calculation of the Mudgett index for each of the 34 countries is available in the technical report available from the TIDL website.



For more information and to join the conversation
Visit indexdigitallife.telefonica.com
Email us digitallife@telefonica.com

Telefonica