All About That App

March 2015

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About Plum

Plum offers strategy, policy and regulatory advice on telecoms, spectrum, online and audio-visual media issues. We draw on economics and engineering, our knowledge of the sector and our clients' understanding and perspective to shape and respond to convergence.

About this study

This study follows up on a previous study published in September 2013 which focused on the European app economy. The focus of this study is on the use of apps to transform how we work and live. The study was funded by a Fortune 500 consumer electronics, software and online services company.

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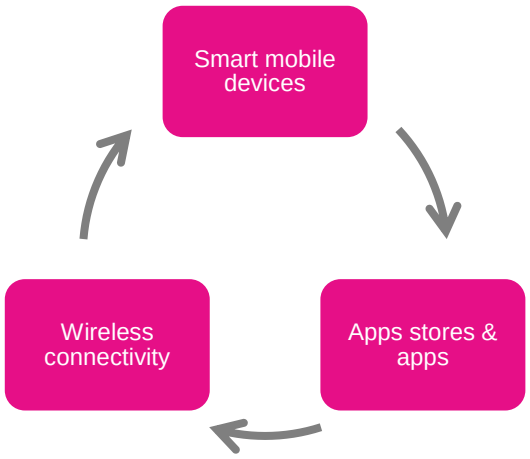
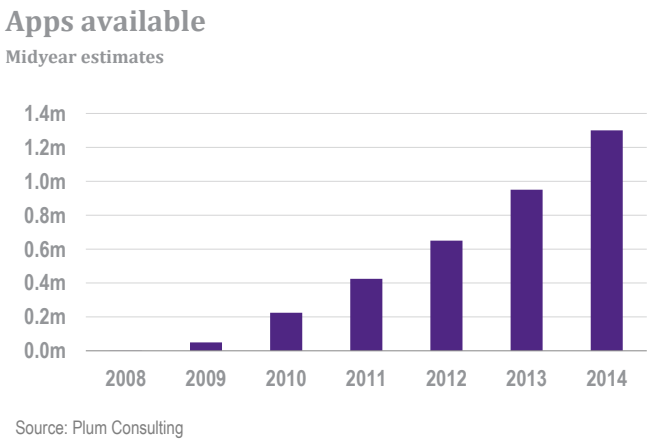
Summary

Mobile-apps have developed at an unprecedented pace since apps stores first appeared in 2008 following the launch of multi-touch smartphones. Apps have also stimulated investment in mobile data networks.





Source: Plum Consulting

Today over 50% of people in a number of countries in Europe have a smartphone and there are over one million apps available from apps stores. Yet the mobile-app industry is still at an early stage of development.

Whilst app development is an important and growing activity in Europe, the greater opportunity will come from apps use by European citizens to transform how they work and live. The pivot from fixed internet and PC to mobile apps opens up enormous scope for innovation and social and economic benefit.

How apps are transforming the economy

The internet is no longer confined to the delivery of digital content and applications, but can transform previously offline activity – from ride sharing to health care delivery. Mobile apps are helping information and communications technology reach beyond the 5% share of GDP it constitutes to transform the other 95% of the economy.

In health care, apps and wearables promise to transform both provision and individual monitoring of health and fitness. A trial in the UK of the use of an app, instead of paper charts, to record patients' vital signs saved over 750 lives at two hospitals over a year (equivalent to 600,000 potential lives saved per year if similar benefits were achievable throughout Europe).

Smartphones and apps also facilitate innovation in relation to other devices, for example smart thermostats which improve comfort and save energy. Once devices are software enabled innovation can apply to the installed base, not just new devices. A software update to smart thermostat-app tado° allowed real time weather forecast information to be used to improve home heating efficiency.

Apps are also facilitating the sharing economy which allows better use of underused assets and resources including cars and homes. For example, use of the French carpool app BlaBlaCar has

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grown rapidly with 10 million members in 13 countries in Europe with access to a fleet of more than one million cars.

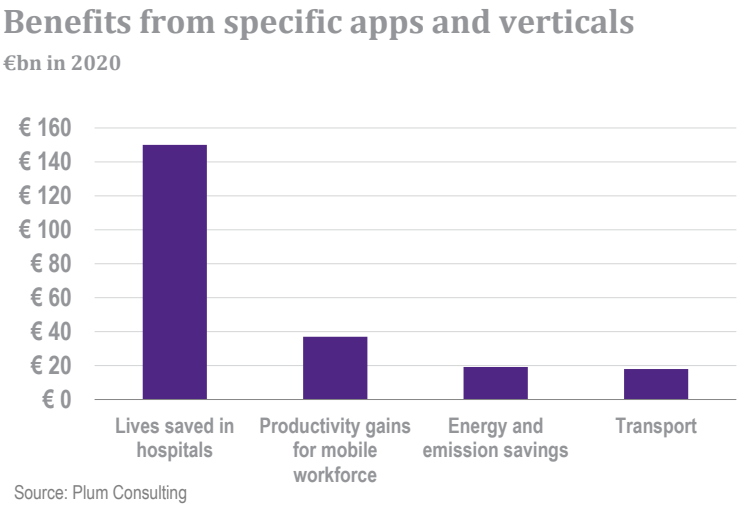
Apps also provide real time information services including information on public transport availability, routes and services updates. This enables people to save time and better plan their journeys. Apps may also crowd source data to improve journey planning. The economic and environmental benefits are substantial.

Widespread development and adoption of enterprise apps is arguably in its infancy, yet the potential has now been demonstrated via applications in particular verticals of the economy. Enterprise app developer Mubaloo developed an app for UNITE, a UK operator of student accommodation, allowing mobile workers to process maintenance jobs via the app. Productivity gains of 30% were achieved.

Scale of benefits

One measure of the importance of apps is the time spent using them. This now exceeds time spent on the desktop internet, with mobile apps growing the total time "online". This alone indicates that the benefits are very large.

Another approach to estimating the benefits of apps is to consider specific use cases and examples. Considering apps for information handover in hospitals, apps for mobile workers, smart thermostat apps and transport information apps we estimate potential benefits across Europe of over €200 billion per annum by 2020 – as illustrated below.



These estimates are based on specific applications in verticals amounting to 29% of GDP – so the overall benefit is expected to be greater. However, achieving these gains will require policy change.

A new game requires new rules, not a level playing field application of old rules

As innovation around apps changes what is possible and the way markets are structured, old rules and regulations may no longer be fit for purpose. A new game requires new rules, not a 'level playing field' application of the old rules.

Different rules may also be appropriate for what, from a consumer point of view, is essentially the same service. For example, rather than apply existing taxi regulation to ride sharing apps, a tailored and proportionate approach is required for these new "transportation network companies".

The focus of digital policy should be on facilitating the benefits European citizens can derive through the use of apps and information and communications technology throughout the economy. Policy priorities may therefore increasingly lie outside the 'traditional' digital economy areas, requiring a cross-cutting portfolio approach to ensure the economy is open to mobile apps-driven innovation.

Recognising that data is the raw material of the 21st century governments can also support apps driven innovation by opening up government held data, subject to confidentially constraints, for app developers. The benefits of doing so have, for example, been demonstrated via apps which provide real time information for users of public transport.

Re-orientating priorities in terms of network service availability and digital inclusion towards mobile and apps would not only help get people online but also ensure that they can benefit from app economy.

The following sets out the proposed priorities.

Embrace app driven innovation throughout the economy	• Remove barriers to innovation in every vertical e.g. sharing economy • Reprioritise expenditures e.g. smart thermostats vs. smart meters • Limit sector regulation & rely on general competition & consumer law
Facilitate open access to government data	• Promote open data & standard formats at all levels of government • Benchmark & monitor open data progress • Foster advocacy groups & user communities
Enhance connectivity & inclusion	• Prioritise spectrum availability for wireless • Create clear & predictable spectrum rights • Focus digital inclusion initiatives on mobile

Finally, at an overall strategic level the Digital Agenda for Europe was conceived well before the extent of the pivot towards mobile apps was apparent. It was framed around an initial phase of convergence - the movement of digital content and applications online. However, convergence has now progressed to a phase where online is transforming physical, previously offline, activity. Policy priorities should also change.

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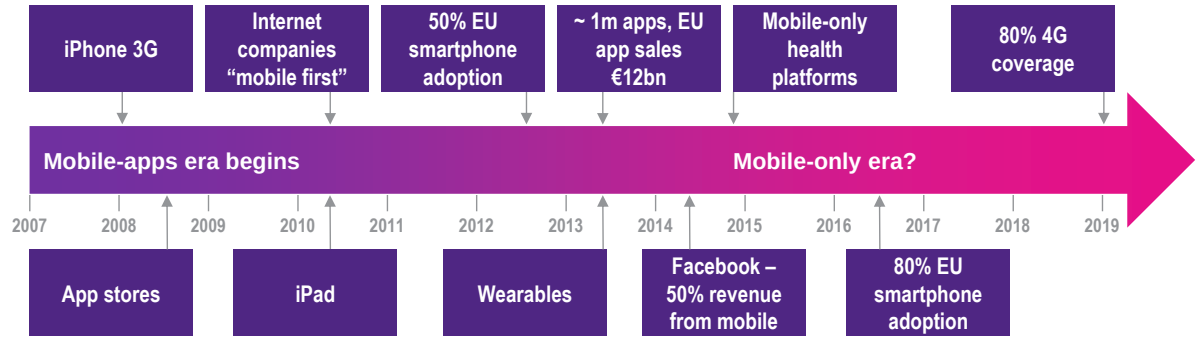
1 The origin and development of apps

1.1 Smart mobile and apps stores

Before the mobile-app era, fixed broadband, the desktop PC and software began to transform economic activity and society. Services such as search, e-commerce and social networking developed, while business software and gaming took off on the PC. However the online and offline "bricks and mortar" worlds remained fairly distinct realms.

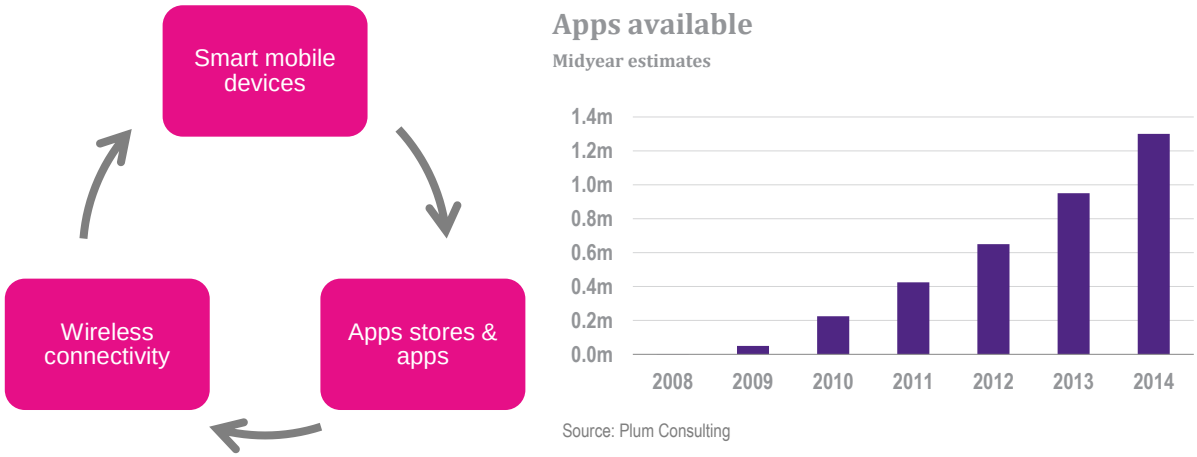
The mobile-app era which began in late 2008 - following the launch of multi-touch smartphones and apps stores - is blurring the online-offline boundary. This is because mobile is extending the power of the internet and software to more people and to previously "offline" areas of life and the economy. Figure 6-1 illustrates the dawn of the mobile-apps era and its evolution to mobile-first and mobile-only.

Figure 1-1: The mobile apps era



The combination of smart mobile devices with a user friendly interface, an application development environment with low entry barriers and improved wireless connectivity created the virtuous circle illustrated in Figure 1-2.

Figure 1-2: Synergy & critical mass – devices, apps and connectivity



The rapid adoption of smartphones and development of over one million apps are extraordinary, particularly having occurred post the 2007 financial crisis. As Bresnahan *et al* (2014) put it:[1]

> *"Describing the industry calls for superlatives: after just a few years, it has the largest installed base of programmable devices in the history of computing and the largest group of app developers, most entrepreneurs, ever to enter a technology industry. Despite this size the industry is still at an early stage."*

The benefits of apps, mobile devices and wireless connectivity are deeply intertwined. The role apps stores have played in fostering an ecosystem of hardware and applications is illustrated in Figure 1-3.

Figure 1-3: The role of apps store in the mobile software ecosystem

Mobile apps stores are a recent phenomenon. Prior to apps stores there were software applications for mobile, but the market was limited. As one commentator put it:[2] *"Before the iPhone and the App Store there were many different web-based software fiefdoms for PalmOS, BlackBerry, Symbian, and Windows Mobile that collected a hodgepodge of different freeware, shareware, and commercial apps, attached to a variety of check-out systems, employed inconsistent and often annoying licensing schemes, and required a lot of work to install and make work. And they were relatively expensive by today's standards."*

Further, whilst web apps were an option (and HTML apps continue to play a role as an alternative to native apps) they were constrained by their lack of access to a smart phone's core functionality, their relatively poor performance compared to native apps, and the difficulties involved in charging for them.

All that has changed, but why? Apps stores provide (note that enterprise apps distributed independently of apps stores are curated by the enterprise rather than the operating system provider):

- A degree of assurance that an app would work as intended and not harm the user experience or privacy. Developers in turn benefit from the brand of the apps store. Apps stores promote trust.
- For users they provide various advantages – a way to discover apps and how other users rate them, a convenient way to install and pay for apps, and a degree of consistency in terms of user interface.
- For developers they provide access to a global market, a means of monetisation and access to steadily improving application programming interfaces (APIs) and software development platforms driven by competition between platform providers.
- At a deeper level apps store owners have an incentive to invest in fostering their developer community through events and training, and hands on help in improving and marketing individual apps.

The proliferation of apps is also the underlying driver of investment in ubiquitous broadband wireless networks including public Wi-Fi and 4G. These investments would not have happened in the absence of apps, as apps are driving consumer demand and willingness to pay for enhanced wireless access.[3]

[1] Bresnahan, David and Yin. 2014. "Economic value creation in mobile applications." http://www.nber.org/chapters/c13044.pdf

[2] http://www.imore.com/history-app-store-year-zero

[3] WSJ. November 2014. "European Telecoms Bet on Data, Investment in 4G Infrastructure." http://online.wsj.com/articles/european-telecoms-bet-on-data-investment-in-4g-infrastructure-1416571267

Ericsson. September 2013. "App coverage - rethinking network performance for smartphones." http://www.ericsson.com/res/docs/whitepapers/wp-app-coverage.pdf

1.2 The potential of mobile apps

With over a million apps already available in app stores one might think the market is already mature. However, mobile-apps diffusion and innovation are at an early stage. The realisation of the full benefits of new technologies can take decades, since it takes time for technology to diffuse and for people to work out new ways of doing things based on new technology, as illustrated by the PC internet era described in Figure 1-4.

Figure 1-4: Parallels with the PC internet era and earlier general purpose technologies

Commercial computing developed from the 1960s on with the launch of pre-assembled PCs in 1977, and adoption of the mouse interface by Microsoft and Apple in 1983/84. Yet in 1987 Nobel winner Robert Solow quipped that: *"You can see the computer age everywhere but in the productivity statistics"*

However, General Purpose Technologies (GPTs) such as steam, electricity and ICT take time to diffuse and to reach their full potential. By 1900 one might have remarked that "electric dynamos were to be seen everywhere but in the productivity statistics."[4] It took approximately two decades for the extent of electrification to reach 50%, but that alone was not sufficient. Initially central steam or water power sources were replaced with central electric motors, and the system of drive shafts, belts and supporting structures left intact. Only when factories were redesigned with small distributed electric motors and light weight structures did large productivity gains arise.

From the second half of the 1990s clear evidence of a significant overall impact on productivity growth attributable to ICT emerged. Innovation, including new business models, only really took off when a critical mass of users had built up and with the networking of computers; particularly with the launch of the World Wide Web in 1993 which lowered entry barriers for start-ups. This was followed by the launch of internet companies including Amazon and eBay in1995, Google in 1997 and Facebook in 2005; and services including iTunes in 2003 and Google maps in 2005.[5]

A critical mass of users coupled with networked computers utilising the internet has driven innovation and social and economic benefits. However, this phase was tied to places rather than people, and the PC is arguably not deserving of the label "personal". Mobile devices, apps stores and mobile connectivity have changed this, and as a critical mass is reached a parallel wave of productivity growth and consumer benefit can be anticipated. For mobile and apps it is still early days.

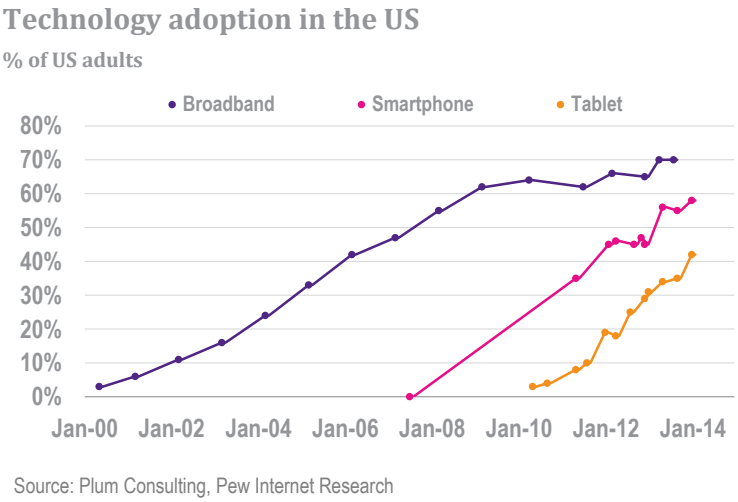
The same combination of factors that drove innovation around the PC and the internet has taken hold with mobile devices. Diffusion and ongoing innovation will drive a long wave of benefits associated with mobile apps.

Diffusion alone will increase the social and economic benefits of apps. When nearly everyone has a smart mobile device, and when wireless is near ubiquitous, the potential of apps will be greatly expanded. Further, the rate of adoption of mobile devices is faster than previous technologies including broadband, as illustrated in Figure 1-5.

[4] Paul A. David. May 1990. "The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox: *The American Economic Review*, Vol. 80, No 2. http://www.dklevine.com/archive/refs4115.pdf

[5] Pew Internet timeline. http://www.pewinternet.org/2014/03/11/world-wide-web-timeline/

Figure 1-5



Source: Plum Consulting, Pew Internet Research

In Europe smart mobile device adoption is growing rapidly, with adoption expected to exceed 50% on a population basis in all EU-5 countries by 2015.[6] Within five years the vast majority of people in Europe are likely to have a smartphone.

Whilst Europe has lagged in advanced wireless network deployment,[7] 4G network coverage is nevertheless expected to grow from 25% in 2013 to 80% by 2019 (with 3G coverage reaching 95%).[8] Apps, and the accompanying demand from consumers and businesses for connectivity, are the key driver of more advanced mobile data network coverage expansion.

Improved connectivity and near-universal adoption will further stimulate the development of new and improved apps. As diffusion progresses, incentives (driven by accessible market size and access to richer data) to experiment with new ways of doing things increase.

Further, underlying technology innovation will continue, expanding the scope for new apps and business models. More sophisticated devices, sensors and indoor and outdoor location-utilising beacons will open up new possibilities. These developments, coupled with wearable technology and new app development platforms (such as Apple HealthKit and Google Fit) will drive the development of new applications and services.

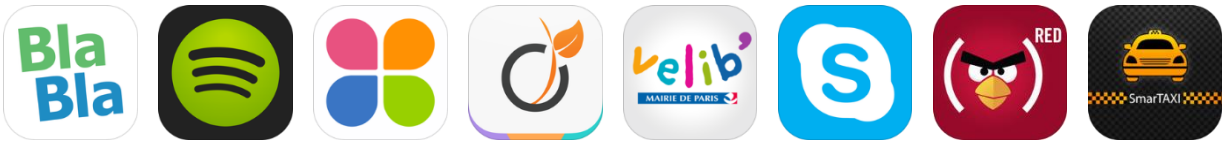
[6] WSJ. May 2013. "Europe Tops Global Smartphone Penetration." http://blogs.wsj.com/tech-europe/2013/05/29/europe-tops-global-smartphone-penetration/

[7] WSJ. February 2014. "Europe Trailing in Mobile Network Spending". http://graphics.wsj.com/4g-european-investment/

[8] Ericsson. June 2014. "Europe: Ericsson Mobility Report Appendix." http://www.ericsson.com/res/docs/2014/emr-june2014-regional-appendices-europe.pdf

2 Apps production

Europe has a vibrant app producing sector which generates significant revenues and jobs. The sector has grown rapidly from its begging in 2008, at a time when the overall economy has been flat. European app developers have succeeded in a wide range of categories including music, gaming, health and fitness, education, finance and enterprise productivity apps.

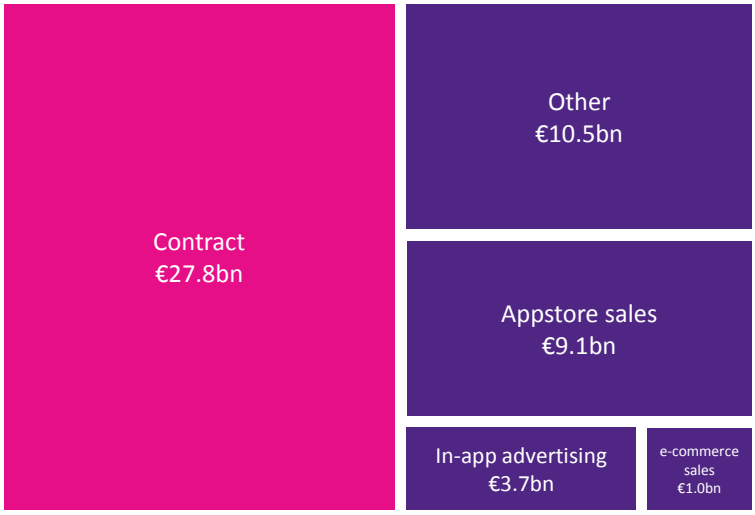


The sector continues to grow, driven by global smart device adoption and European excellence in specific verticals including, for example, music and financial services.[9]

2.1 Global app revenues

Figure 2-1 shows estimated global app revenues.[10] This shows that apps produced under contract to enterprise bring in as much revenue for developers as apps distributed via apps stores.

Figure 2-1: Global app developer revenue breakdown for 2013



Contract apps are also relatively important for European developers with 38% of developers in Europe identifying contract work citing contract work as a revenue source versus 27% globally.[11]

[9] FT. April 2013. "London's 'fintech' start-ups aim high". http://www.ft.com/cms/s/0/112c6932-bf37-11e3-a4af-00144feabdc0.html#axzz3KMD9TcJH

[10] Vision Mobile and Plum Consulting. Sep 2013. "The European App Economy" http://www.plumconsulting.co.uk/pdfs/Plum_Sep2013_The_European_App_Economy.pdf

[11] Vision Mobile. February 2015. "European App Economy 2015." https://www.developereconomics.com/reports/european-app-economy-2015/

2.2 European app developer revenues & jobs

European developer revenues account for an estimated 35%[12] of global app revenues, a substantial share in comparison with the overall share of global technology company revenues attributed to Europe. Figure 2-2 shows total annual app revenues generated by European app developers (70% of which are paid out to developers).[13]

Figure 2-2

Source: Plum Consulting, Apple, AppAnnie

A significant number of jobs are also attributed to app development and associated activity, but available estimates differ. A study for the European Commission[14] estimated that there were 1.8 million direct apps jobs of which 1 million technical jobs in February 2014 whilst Vision Mobile[15] estimated that there were 846,000 direct technical jobs and 456,000 direct non-technical jobs in 2015 (approximately double a previous estimate by Vision Mobile).[16] Further, official estimates from statistical agencies including Eurostat are not at present available.

However, the greater impact of apps on the economy and society relates to their use. Apps use offers consumer and productivity benefits which in turn result in improvements in quality of life, income and jobs. We consider the impact of apps use in the next section.

[12] Calculated using cumulative app revenues reported by Apple for Europe and globally. https://www.apple.com/uk/pr/library/2015/02/23Apple-to-Invest-1-7-Billion-in-New-European-Data-Centres.html

[13] Estimated from reported global revenue figures from Apple and Google, scaled down to Europe by the ratio of 35%.

[14] Gigaom. February 2014. "Sizing the EU App Economy." http://eurapp.eu/sites/default/files/Sizing%20the%20EU%20App%20Economy.pdf

[15] Vision Mobile. February 2015. "European App Economy 2015." https://www.developereconomics.com/reports/european-app-economy-2015/

[16] Vision Mobile. July 2013. "Developer Economics: App Economy Forecasts 2013-2016." http://www.visionmobile.com/product/app-economy-forecasts-2013-2016/

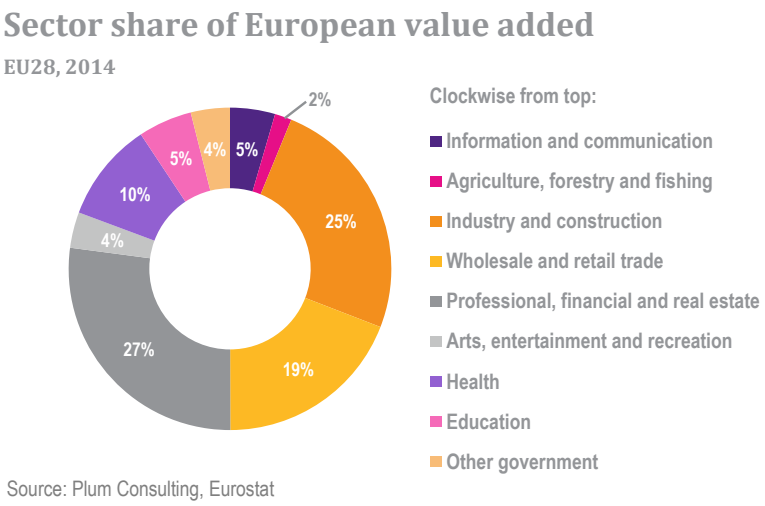
3 Apps use

Whilst app production is an important and growing part of the economy, an even greater opportunity arises from the more extensive use of apps, which in turn will stimulate further apps development.

3.1 Apps use will have wider impact than apps production

The information and communications technology sector is, and will likely remain comparatively small, even as its impact grows. What really matters is not the 5% of the economy made up by ICT, but the other 95%. Technology, software, and mobile apps are transforming the traditional bricks and mortar economy at an unprecedented rate. Figure 3-2 shows the relative shares of GDP in Europe.

Figure 3-1



Source: Plum Consulting, Eurostat

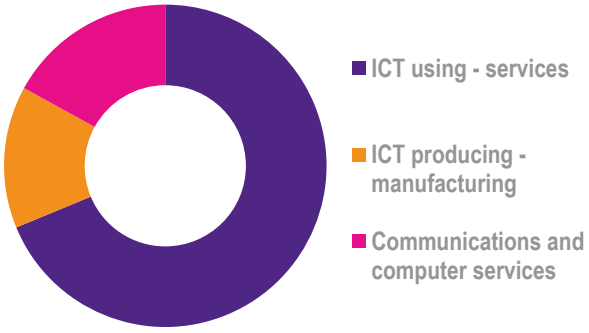
This illustrates the huge potential for gains as apps raise productivity levels in different vertical segments of the economy. As with the wave of productivity growth associated with ICT from the mid-1990s on, we would expect the benefits of apps to come predominantly from the use of apps rather than their production *per se*.

Figure 3-2 shows that the productivity growth benefits from the use of ICT were around two-thirds of the overall growth benefits attributed to ICT by 2007 (using smoothed trend data). We expect a similar pattern to emerge for apps, potentially with an even stronger bias towards benefits from use given the utility and low cost of apps, and the fact that they can leverage an existing base of mobile devices.

Figure 3-2

Use dominates productivity growth contribution

EU27, 2007



Source: Plum, KLEMS

3.2 Mobile apps are bringing online to offline, software to hardware

As hardware – e.g. thermostats, cars and bathroom scales – acquires an element of software and a means of communicating, the online and offline boundary is blurring. Smart mobile devices and apps provide a ready-made means of connecting with a wider network of things and a ready-made human interface. Coupled with the cloud and artificial intelligence (AI), the stage is set for a deeper and faster transformation of the economy and society, facilitated by mobile apps. Hardware can be adapted rapidly to incorporate software, building on an existing base of smartphone ownership.

For example, the conventional home heating thermostat had remained more or less unchanged for many decades. Within a short space of time, new thermostats from, for example, NEST, tado° and Hive have incorporated intelligence and a real time link to the cloud and to users' smart devices. This sort of transformation can happen almost anywhere in the economy and as it is consumer driven, it has the potential to happen fast.

Adding intelligence to things such as a thermostat immediately allows better management of comfort and energy use, without the need for behavioural change by the user. Perhaps more importantly, it allows a device that previously remained unchanged for decades to adapt at the pace of software updates.

3.3 Embedded software innovation reaches the installed base

New releases of smart thermostat software and apps have periodically improved functionality, for example by including the use of real time weather forecast information. This enables the app to manage heating load given a desired comfort level. Using the location data of individuals it can also manage when the heating should be turned up or down. As software learns about the user and the characteristics of the building, energy use can be better managed. New functions can be added on the fly, and an update applies to the entire installed base, not just new installations.

3.4 Sharing economy apps support new forms of "trade"

Various terms are used to describe the sharing economy including the collaborative, access and peer-to-peer economy. The concept is old and existed before the internet and before mobile. However, mobile, apps and location awareness have facilitated the development of the sharing economy by allowing resources to be located and tracked, and by facilitating interaction and trust between providers and renters/borrowers.

The sharing economy includes the re-use or shared use of resources (e.g. cars, accommodation) and services such as peer-to-peer lending and crowdfunding of start-ups.[17] It offers benefits for users, improved utilisation of assets such as cars and a reduced environmental footprint.

Examples of app platforms facilitating sharing or renting (rather than owning) include Airbnb for accommodation, BlaBlaCar for ride sharing and Uber for taxi services. There are also a growing number of municipal schemes such as the city bike scheme Vélib' in Paris. Further detail in relation to transport and the sharing economy is considered under the transport vertical. The sharing economy concept is also being extended to health care provision.[18]

3.5 Real time data & AI deepen the capability of apps

Data is the raw material of the 21st century and requires investments in extraction and refinement before value can be realised. Building on big data, artificial intelligence (AI) is also becoming more prominent as a means of extracting value from large amounts of data, and as an interface between mobile users and data.

Advances in computing, sensors, connectivity and software – particularly in relation to mobile and apps – are pushing down the costs associated with the production, collection, storage, analysis and distribution of data. Apps and mobile not only facilitate the use of services built around data, but also provide real-time data (via sensors) and contextual awareness of a user's location and preferences.

For example, someone seeking information on the best way to travel from where they are to a specified destination can be presented with real time information relevant to their current location and time of day. Apps can also use "crowd sourced" data from multiple users to enhance the value to everyone, for instance, using anonymised location data to estimate travel times based on real time congestion information.[19]

Open government data has a particular role to play in facilitating apps development, since the government, local and city authorities have unique data sets including mapping data, post code databases, real time public transport data etc.

[17] The Economist. March 2014. "All eyes on the sharing economy." http://www.economist.com/news/technology-quarterly/21572914-collaborative-consumption-technology-makes-it-easier-people-rent-items

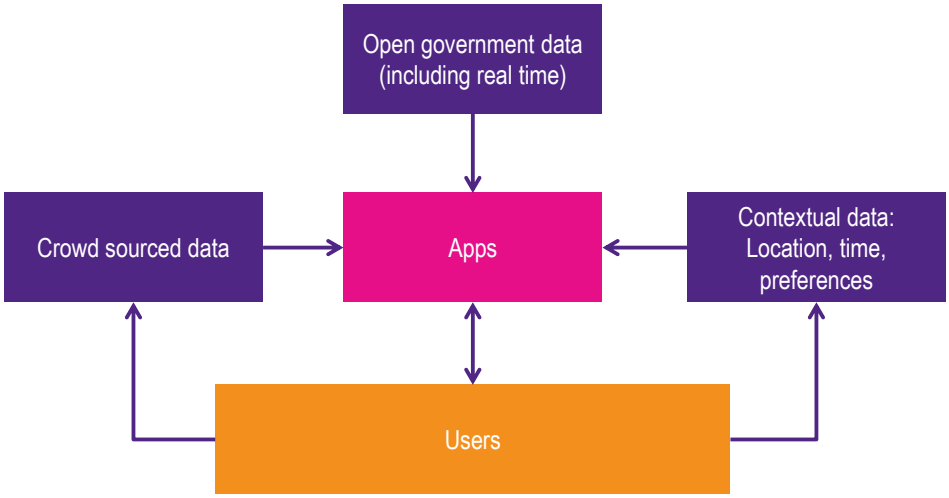
Nesta. September 2014. "Making sense of the UK collaborative economy." http://www.nesta.org.uk/event/making-sense-uk-collaborative-economy

[18] Recode. November 2014. "The Sharing Economy's Next Horizon: Health Care." http://recode.net/2014/11/26/the-sharing-economys-next-horizon-health-care/

[19] Wired. May 2014. "By the People, for the People: Crowdsourcing to Improve Government." http://www.wired.com/2014/04/people-people-crowdsourcing-improve-government/

The relationship between open government data, individual, business and government users, and crowd sourced and contextual data – mediated by apps – is illustrated in Figure 3-3.

Figure 3-3: Role of apps in data-driven innovation



There are significant benefits of combining data from multiple sources – deeper insights can be gained; better and more responsive services can be developed; and the impact of services can be measured.

Apps act as an intermediary between suppliers of data and the end consumers of services. By enabling data to be used in innovative ways, apps create incentives for the release of open data and also facilitate the generation and collection of more useful data. This symbiotic relationship between open data and the app ecosystem represents a transformative virtuous circle.

3.6 Enterprise apps are gaining momentum

Enterprise apps, utilised by private, voluntary and government organisations, can be categorised into four classes:

- Native apps on devices, including email, calendar and contacts.
- Productivity apps from apps stores, including note taking apps, PDF readers etc.
- Enterprise software packages with app interfaces, including Oracle and SAP, and newer market entrants such as Xero.
- Bespoke apps, B2B or consumer facing, developed in-house or by third parties.

The first category above, native apps, pre-date apps stores and are widely used. Illustrative examples of the second category above are provided in Table 3-1.

Table 3-1: Apps for enterprise available from apps stores

Category	Illustrative apps
Communication, scheduling & collaboration	Various email & calendar apps, Dropbox, Google Hangouts
Productivity tools	Keyboards including Swipe and Voice assistants Siri, Cortana, Google Now
Networking & job search	LinkedIn, Viadeo & XING
Accounting & management	Xero, Intuit, Salesforce
Content creation	Microsoft Office, Videolicious

These apps are utilised by governments and enterprises, but are also particularly attractive for individuals and SMEs given their ease of set-up, use and scalability. The internet and apps are enabling small companies to become "micro-multinationals" and compete globally. Other consumer-oriented apps such as Facebook and Twitter are also utilised by enterprises for communication, marketing and customer feedback.

However, the enterprise apps market has lagged behind the consumer apps market, and is only just beginning to take off. There may be a number of reasons for this: the need for mass deployment of devices and apps across a workforce, centralised decision making processes and the importance of getting it 'right first time' (as opposed to the consumer market where individual adoption is a low cost low risk decision).

The enterprise segment is less visible than the consumer apps markets as many apps are distributed via private platforms, rather than apps stores. Nevertheless, developer revenues are substantial in this segment, perhaps as much again as apps stores revenues.

An illustrative example of the comparatively recent development of the enterprise apps market is the release of Microsoft Office for iOS and Android phones in mid-2013, for the iPad in March 2014 and for Android tablets (as a preview) in January 2015. An example of the use of bespoke apps is the use of apps by the veterinary pharmaceutical company Hipra, headquartered in Spain.[20]

A partnership between Apple and IBM has produced its first set of tools for verticals including:[21]

- Plan Flight (Travel and Transportation) addresses the major expense of all airlines – fuel - permitting pilots to view flight schedules, flight plans, and crew manifests ahead of time, report issues in-flight to ground crews, and make more informed decisions about discretionary fuel.
- Advise & Grow (Banking and Financial Markets) puts bankers on premise with their small business clients, with secure authorisation to access client profiles and competitive analyses, gather analytics-driven insights to make personalised recommendations, and complete secure transactions.
- Incident Aware (Government) converts an iPhone into a crime prevention asset, presenting law enforcement officers with real-time access to maps and video-feeds of incident locations;

[20] IBM. 2013. "HIPRA reduces time for issue resolution from months to days". http://public.dhe.ibm.com/common/ssi/ecm/en/wsc14497usen/WSC14497USEN.PDF

[21] Apple. December 2014. "Apple and IBM Deliver First Wave of IBM MobileFirst for iOS Apps." https://www.apple.com/uk/pr/library/2014/12/10Apple-and-IBM-Deliver-First-Wave-of-IBM-MobileFirst-for-iOS-Apps.html

information about victim status, escalation risk, and crime history; and improved ability to call for back-up and supporting services.

- Pick & Pack (Retail) combines proximity-based technology with back-end inventory systems for transformed order fulfilment.

To gain a perspective on the development of apps for enterprise, we spoke to Mubaloo, an enterprise app developer with offices in the UK and Germany (see Figure 3-4).

Figure 3-4: Bespoke enterprise apps development by Mubaloo

Mubaloo identify three categories of enterprise apps: apps used by employees; apps used by customers and apps for business partners. They note that one of the challenges of developing enterprise apps is the integration with existing data and systems. Further, the process of developing enterprise apps may involve going back to fundamentals in terms of business reengineering.

The rate of take-up also differs across sectors with the pharmaceutical industry and financial services sector relatively early adopters. The integration of apps is now moving into other sectors including utilities,[22] facilities management, logistics and retail supply chain management.

The facilities management company UNITE were able to move from a paper based process to an apps based process, saving time previously set aside for data entry and increasing the number of jobs completed by 30%.[23] Scheduling of work was also improved with real time information and matching of maintenance staff to tasks.

A growing area for enterprise apps is the use of micro location (based on iBeacons technology introduced in late 2013).[24] An example is information triggered by location within a warehouse. Mobile apps, sensors including temperature and humidity sensors, and beacons can also been combined, for example, for logistics management.[25]

Location information may also be used to protect workers, for example, manual movement of pallets was identified from a pattern of repeated back and forth movements. This situation was then remedied as it constituted a breach of the company's service agreement that workers have access to a pallet loader.

Enterprise apps are seeing strong growth, having lagged mass market apps adoption initially. One reason for this is that the full benefits of enterprise are only realised when business processes and organisation are rethought around apps – a process that takes time but for which the potential has now been demonstrated. Data analytics and AI are also now developing rapidly and will strengthen the capability of enterprise apps.

[22] Mubaloo. 2014. "Apps for utilities". https://www.apps-world.net/media/docs/resources/apps-for-utilities.pdf

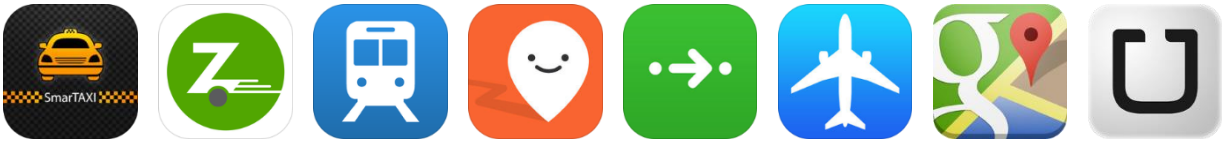
[23] http://mubaloo.com/clients/unite

[24] Mubaloo. 2014. "Beacons: The Technical Overview". http://mubaloo.com/perch/resources/beacons-technical-overviewmibeacons-white-paper.pdf

[25] Mubaloo. 2015. "Mobile and Logistics: the strive for competitive advantage". http://mubaloo.com/news-info/white-papers/mobile-and-logistics-the-strive-for-competitive-advantage

4 Transformation of verticals

4.1 Transport



In the transport sector apps provide a plethora of new services, including:

- Real time transportation information – apps which provide navigation and route-planning tools for users by leveraging open transport data such as bus and train schedules, mapping data and geolocation functionality of smartphones (e.g. street map-navigation apps, and apps including Citymapper, Moovit, Inrix etc).
- Taxi hailing and transport network services – these apps enable users to hail a taxi or hire a ride (e.g. taxi.eu, Hailo, Uber, Lyft, Kabbee) and providers to respond more rapidly to demand (e.g. Smartaxi which allows drivers to share information on demand hot spots[26]). The transportation network company concept has also been extended to trucks, resulting in improved capacity utilisation.[27]
- Sharing services – these involve both fleet-based services (e.g. car2go, ZipCar, Bicyclette) and peer-to-peer sharing of unused or under-utilised resources, such cars, bicycles, rides and parking spaces (e.g. BlaBlaCar, JustPark). BlaBlaCar is considered in Figure 4-1.

Figure 4-1: Transport and the sharing economy - BlaBlaCar

BlaBlaCar is a popular peer-to-peer ride sharing service in Europe. The founders of BlaBlaCar, motivated by what they saw as an inefficient allocation of resources, came up with an idea is to match passengers and drivers with empty seats on similar long-distance trips through an online platform.[28] For passengers the service provides a cheap and easy travel alternative to trains and flights while for drivers the service helps saves costs of long distance car journeys. The average occupancy for BlaBlaCar is 2.8 people per car compared to the EU average of 1.5 occupants per car.[29] The service also helps build trust among users through background checks and reputation rating system. As of September 2014, the service has more than 10 million members in 13 countries in Europe with access to one million cars and used by 2 million every month.

[26] EC. September 2014. "An app helps taxi drivers to find you." http://europa.eu/rapid/press-release_IP-14-993_en.htm

[27] Recode. January 2015. "Transfix Brings the Uber Model to the $800 Billion Trucking Industry". http://recode.net/2015/01/20/transfix-brings-the-uber-model-to-the-800-billion-trucking-industry/

[28] The Guardian. April 2014. "BlaBlaCar is to car hire what AirBnB is to the hotel industry". http://www.theguardian.com/business/2014/apr/13/blablacar-hire-airbnb-hotel-car-share-service

[29] European Environment Agency. July 2010. "Occupancy rates of passenger vehicles". http://www.eea.europa.eu/data-and-maps/indicators/occupancy-rates-of-passenger-vehicles/occupancy-rates-of-passenger-vehicles-1

These new services are changing the economics behind the travel choices of individuals and the business models for transportation providers. They may also offer environmental benefits by facilitating use of public transport, car sharing and ride aggregation for taxi services. Algorithmic supply and demand matching may also have benefits beyond efficiency, as discussed in Figure 4-2.

Figure 4-2: Algorithms – could greater transparency be a benefit?

The use of algorithms for matching supply and demand may also involve unanticipated benefits, as one of the authors of this study discovered from discussion with his Uber car driver.

The identity of the driver and the user are provided to each party by default along with a map showing the route and time of the trip. Further as cash does not change hands, the risk of crime is reduced – an important benefit highlighted by the driver. These factors also suggest that the way in which a service is delivered may impact on the appropriate form of regulation. It is therefore not the case in general that the "same service" should be subject to the same regulation. The driver also liked the fact than an algorithm decided the price based on an optimised route and matched cars with customers based on location, instead of relying on dispatch operators who may display "favouritism". For drivers and passengers, this improves transparency and efficiency.

In his view this not only better served customers, but was also resulted in a better and fairer deal for drivers, increasing utilisation and reducing "favouritism" (he put it less subtly) which he claimed was endemic within the minicab industry in London. It is an important insight that an algorithm could help "clean up" an industry.

Support for this hypothesis was also gained from a separate discussion with a minicab driver who was seeking to become an Uber driver as he wanted to escape from the subjectivity and scope for favouritism that he said plagued the minicab industry.

Many apps combine geo-location and mapping services with social media and cloud computing functions to aggregate information from transport providers drivers, and commuters. Other relevant data, such as weather and traffic information, are also used. This reduces transaction costs and improves decision making and route planning for both commuters and transport providers. By providing multi-modal options (e.g. walking, cycling, buses, and trains) and integrating reservation and payment systems, apps provide a variety of choices to cater to individuals' budgets and preferences.

The potential benefits are significant. For example, it is estimated that in London the value of time saved from avoided travel disruptions (but excluding gains from route planning) through the existing use of is between £15 million and £58 million annually.[30]

There are also apps such as BlindSquare – a navigation aid which enables blind and visually impaired people to travel safely and independently by describing the environment and announcing points of interest and street intersections.

Crowdsourcing is another common feature of transport apps which can complement data from public transport agencies and help improve the quality and consistency of transport data. For example Moovit, another public transport app, combines crowdsourced data from users with other open data feeds to provide real time feedback across all transport modes. Users can also provide reports on overcrowding, cleanliness, Wi-Fi availability and driver rankings.

[30] Deloitte. May 2013. "Market assessment of public sector information". https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/198905/bis-13-743-market-assessment-of-public-sector-information.pdf

4.2 Energy

Consumer decisions have a material impact on energy consumption, and apps offer new opportunities for the intelligent management of demand.

Conventional approaches to energy management have, to an extent, relied on providing feedback on energy use to consumers to motivate behaviour change. However, this approach, whilst it can be successful, may be too demanding for many both in terms of the attention it requires and the amount of information consumers can realistically process.

Smart metering, under active consideration since at least 2007, aims to provide a near real time feedback loop from energy consumption to consumers.[31] This is illustrated in Figure 4-3. A different approach is to use smart thermostats, which leave "executive level" decisions such as temperature preference to the user, whilst the smart thermostat, the app and cloud-based intelligence micro manage the system. This is illustrated in Figure 4-4.

Figure 4-3: Smart meter: User micro-management with feedback

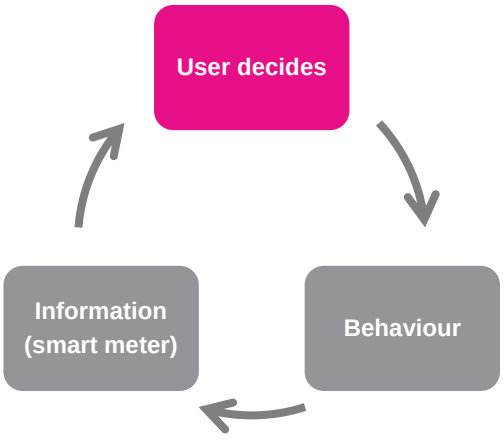
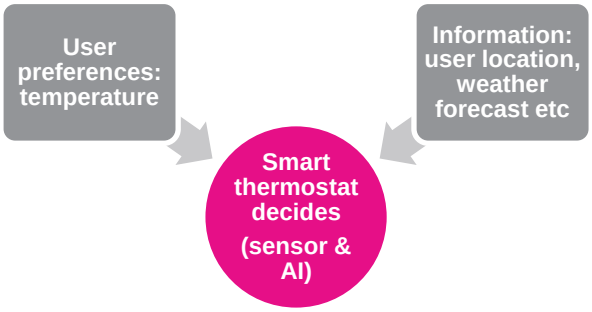


Figure 4-4: Smart thermostat: "Executive level" user input with AI micromanaging



Smart thermostats are easier to fit than smart meters and more likely to be located within reach of existing home Wi-Fi network which mean adoption by consumers can occur on a "grassroots" basis. The app and its intelligence can also adopt new features via software updates, for example, the ability to utilise local weather forecasts to fine tune the optimal time and rate at which to heat a house. One

[31] European Commission – Smart Grids Task Force. http://ec.europa.eu/energy/en/topics/markets-and-consumers/smart-grids-and-meters/smart-grids-task-force

study estimated savings from smart thermostats of around 14-26% of heating energy consumption.[32] Another study, including a review of experience of households with smart thermostats, estimated savings of 10-12%.[33] A key difference in savings estimates is how much consumers are assumed to manage their thermostat in the absence of a smart thermostat.

These systems are comparatively recent, at least compared to smart metering. For example, tado° launched in in the German-speaking area of Europe in November 2012 and was made available throughout Europe from October 2013. Given these developments, and the potential for significant savings, it may be appropriate to revisit energy policy priorities.

We also note that some of the developments underway in relation to transport and the sharing economy may also result in energy savings. For example, taxi ride pooling[34] - which is only feasible via a mobile app utilising real time location data - would reduce energy use per journey. Airbnb may also generate save energy relative to hotel stays. Airbnb has also partnered with the smart thermostat company NEST to improve the user experience and save energy.[35]

4.3 Health

Health care represents around 10% of GDP in Europe, and the health care sector is expected to face increasing demands as the population ages.[36] Smart mobile devices and apps may impact on health outcomes and health expenditure by improving the efficiency and effectiveness of health service delivery and by promoting healthy living and facilitating improved health monitoring.

4.3.1 Health care delivery

Changing health care delivery generally requires centrally coordinated change, though individual initiatives by health care professionals are also possible.

An illustration of the potential of apps and mobile devices to improve productivity and save lives is provided by the use of iPods and apps to record patient data and send alerts based on agreed triggers in hospital trials in the UK (see Figure 4-5).

[32] Fraunhofer Institute for Building Physics IBP. 2013. "Simulation study on the energy saving potential of a heating control system featuring presence detection and weather forecasting." http://www.ibp.fraunhofer.de/content/dam/ibp/en/documents/ResearchNews/IM-527_englisch_web.pdf

[33] NEST. February 2015. "Energy Savings from the Nest Learning Thermostat: Energy Bill Analysis Results". https://nest.com/downloads/press/documents/energy-savings-white-paper.pdf

[34] WSJ. November 2014. "Uber Launches Car Pooling Service in Paris". http://online.wsj.com/articles/uber-launches-carpooling-service-in-paris-1415896525

[35] https://www.airbnb.co.uk/press/news/airbnb-partners-with-nest-to-help-community-continue-to-save-energy

[36] Economist Intelligence Unit. 2011. "The future of health care in Europe." http://www.janssen-emea.com/sites/default/files/The-Future-Of-Healthcare-In-Europe.pdf

Figure 4-5: iPods-apps instead of paper charts save 750 lives[37]

The use of iPods and the VitalPAC[38] software app, instead of paper charts, to record patients' vital signs reduced the number of deaths at Queen Alexandra Hospital in Portsmouth by 397 and at University Hospital Coventry by 372 over the period of a year.[39] The British Medical Journal editorial, commenting on the study, noted that :

"Hospital mortality has been stubbornly resistant to improvement, so the lowering of mortality at the two study hospitals reported by Schmidt et al represents a truly dramatic improvement."

Nurses use the system to record patients' blood pressure, heart rate, oxygen levels and temperature, as well as how well a patient feels. The data goes to a central computer system which nurses, doctors and administrators can access, and patients are given overall scores which are used to prioritise attention. Trigger points agreed by clinical teams are incorporated which will send an alert to the clinical team if the trigger is reached.

The system improved productivity and reduced errors, reduced costs by reducing the need for intensive care, and saved patients' lives. The reduction in mortality is estimated at 15%, equivalent to 400 fewer deaths per year in a 1,000 bed hospital.

The above example represents one possibility for improving the efficiency and effectiveness of health care delivery. Mobile devices and apps will have numerous other applications including clinical reference, drug dose calculation, patient education, accessing medical records, and clinical decision support. The capacity for monitoring and analysing physiological data will also be extended. The integration of real time data (including real time monitoring) and new kinds of sensors is discussed by Bates and Zimlichman (2014) who note:[40]

> *"We believe that the coming together of four major trends or innovations promises substantial improvements to patient outcomes by preventing this perennial problem of delayed recognition and management of deteriorating patients on general hospital wards. These trends include the uniform use of electronic health records in hospitals, major advances in physiological sensor development, the rapid adoption of mobile technologies, and the ability to perform analytics in the background to provide decision support at the point of care."*

A by-product of automatic central collation of medical data will be new opportunities for the identification of patterns, which will lead to improvements in the understanding of underlying causes of poor health, diagnosis and treatment. Collecting data from the wider population - rather than just from patients within a hospital setting - would expand these possibilities. It would also open up the potential for self-monitoring and, potentially, motivate healthier lifestyles.

[37] Yahoo News. September 2014. "iPods instead of paper charts save 750 lives in hospital trials." http://yahoonewsdigest-gb.tumblr.com/post/98289983858/ipods-instead-of-paper-charts-save-750-lives-in

[38] http://www.thelearningclinic.co.uk/vitalpac.html

[39] Schmidt et al. September 2014. "Impact of introducing an electronic physiological surveillance system on hospital mortality." *BMJ Quality and Safety*. http://qualitysafety.bmj.com/content/early/2014/09/23/bmjqs-2014-003073.short?q=w_qualitysafety_ahead_sidetab

[40] Bates and Zimlichman. September 2014. "Finding patients before they crash: the next major opportunity to improve patient safety." http://qualitysafety.bmj.com/content/early/2014/09/23/bmjqs-2014-003499

4.3.2 Personal health, fitness and independent living

Health and fitness apps are one of the fastest growing apps categories in terms of use, with time spent in health and fitness apps growing 51% over the year to August 2014.[41] This category of apps is complemented by improvements in activity tracking sensors built into smartphones and a growing range of wearables including Jawbone Up3, Microsoft Band, Apple watch and Withings Activité which variously track movement, altitude and location and may include heart rate, UV, skin temperature and galvanic skin sensors. Figure 4-6 shows the variety of sensors provided by French company Withings.

Figure 4-6: Withings sensors for weight, pulse, blood oxygen, blood pressure and activity

Sensors and apps lower the costs of self-monitoring and expand the range of things that can be monitored.[42] They also allow data to be collated and visualised in ways that are more informative, and may help with individual self-motivation in pursuing a healthier lifestyle.

Analytic capabilities are also improving, drawing on an increased flow of data, experience across multiple users and correlations with other factors. Apps can automatically categorise activity types and offer advice, assist via early health warnings and record adverse events for analysis. An illustration of the use of an app and wearables to manage epilepsy is provided in Figure 4-7.

Figure 4-7: Use of bracelet and smartphone app to monitor epilepsy[43]

"…four out of five people living with epilepsy can lead seizure-free lives, according to Dr Rupert Page, a neurologist who set up the Dorset Epilepsy Service in 2009. The key is prompt specialist intervention to ensure that medication is adjusted to the patient's individual needs."

"In the Epilepsy Networks Project…patients believed to be at risk will be equipped with "seizure detection bracelets" linked to their smartphones. If the bracelet's accelerometers and other sensors detect that the wearer is having a seizure, a whole set of communications can be triggered. The phone's screen could be locked with a message telling first responders what to do and the wearer's location texted to a next of kin."

"Most significant from a long-term treatment point of view, the seizure can be recorded immediately in the patient's electronic medical record, to be flagged up the next time someone from the epilepsy care team logs in. Dr Page stresses that all this is with the patient's consent. Recording exactly when a patient has had a seizure is vital, he says, because it shows the medication is not working and that complex doses need to be adjusted."

[41] Localytics. September 2014. "Time in app increases by 21% across all apps". http://info.localytics.com/blog/time-in-app-increases-by-21-across-all-apps

[42] The Economist. "Health and appiness." http://www.economist.com/news/business/21595461-those-pouring-money-health-related-mobile-gadgets-and-apps-believe-they-can-work?frsc=dg%7Cc

The potential for individual "grassroots" adoption means that change could happen more readily and rapidly than the potential transformation of health care delivery, which requires central coordination. Apple and Google have also introduced health software platforms - HealthKit and Google Fit - which support third party software and device development, and provide users with a unified interface for health and fitness information.

The combination of new software development platforms, wearables, innovative use of sensors and development of new sensors will stimulate innovations in health care and healthy living. These developments will also open up possibilities in terms of support for independent living for the disabled and elderly.

Sensor technology is also developing rapidly, and people are finding novel ways of utilising existing sensors, including smartphone cameras and microphones (see Figure 4-8).

Figure 4-8: Innovative uses of sensors in relation to health

- Measuring pulse with a smartphone camera. A number of apps allow this when a finger is placed on the camera. It is also possible to process video of a person's face to reveal the underlying pulse, possible irregularities and movement, for example, breathing.[44]
- Measuring lung function (for example, to monitor asthma or cystic fibrosis) utilising the microphone.[45] [46] A smartphone attached mobile stethoscope might also be used to record heart sound for detecting heart disease.[47]
- Use of multiple sensors to diagnose illness, for example, use of phone sensors to perform voice, postural sway, gait, finger tapping and reaction time tests to detect Parkinson's. [48]
- Attachments for smartphones can perform medical screening which previously involved specialist standalone equipment, for example, ultrasound screens[49] and blood analysis.[50]

4.3.3 Integrating personal health monitoring with health care delivery

Heath care delivery and personal health monitoring using smartphones, wearables specialist sensors and apps will increasingly be integrated.

[43] Raconteur. December 2014. "NHS on new information pathway". http://raconteur.net/technology/nhs-on-new-information-pathway

[44] Wu *et al*. 2012. "Eulerian Video Magnification for Revealing Subtle Changes in the World." ACM Transactions on Graphics. http://people.csail.mit.edu/mrub/papers/vidmag.pdf

[45] UbiComp Lab. 2012. "SpiroSmart - Tracking Lung Function on Any Phone." http://ubicomplab.cs.washington.edu/projects/SpiroSmart

[46] Economist. June 2013. "Teaching old microphones new tricks." http://www.economist.com/news/technology-quarterly/21578518-sensor-technology-microphones-are-designed-capture-sound-they-turn-out

[47] Ashrafuzzaman et al. 2012. "Heart attack detection using smartphone." *International Journal of Technology Enhancements and Emerging Engineering Research*, Vol 1, Issue 3. http://www.ijteee.org/final-print/oct2013/Heart-Attack-Detection-Using-Smart-Phone.pdf

[48] FT. September 2014. "Smartphones used as 'pocket doctors' to detect Parkinson's." http://www.ft.com/cms/s/0/cb6ec31a-376b-11e4-971c-00144feabdc0.html#axzz3EQDsmXP7

[49] MobiSante - Smartphone Ultrasound. http://www.mobisante.com/products/product-overview/

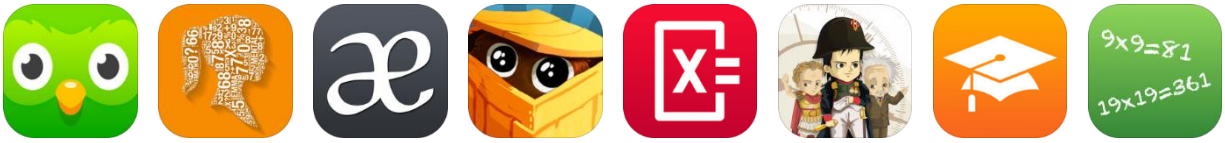
[50] BBC. August 2014. "Blood diagnosis app 'can detect diseases'". http://www.bbc.co.uk/news/technology-28658155

An indication of the potential for integration of health care delivery and personal monitoring is the adoption of HealthKit by hospitals. Fourteen of 23 top hospitals in the US contacted by Reuters had rolled out a pilot programme using HealthKit as a repository for patient-generated health information.[51]

The potential for personal health monitoring, and integration into health care delivery, has also been recognised by Prof Sir Bruce Keogh of the NHS:[52]

> *"Technology is emerging which enables those [sensors] to be brought together and transmitted through mobile phones or other methods where health professionals can analyse them and act upon any warning signs."*

4.4 Education



Just as in the enterprise and health sectors, the potential of apps in transforming education is only beginning to be realised. Where ICT use in education was previously confined to PCs and expensive IT systems and software in schools, mobile apps are widening access to education, improving learning and teaching effectiveness and enabling the development of new pedagogical techniques.

Ease of use, accessibility and interactivity are the more obvious benefits of education apps. Online learning and the use of education apps have become mainstream in recent years, as evidenced by the rise of massively open online courses (MOOCs). There are also a multitude of apps that provide learning materials on all subjects from languages, science, mathematics, history and art. The example of Digischool is discussed in Figure 4-9.

Figure 4-9: Digischool's educational content

Digischool is a French digital education company which works with teachers to produce, aggregate and curate educational content based on different subjects, categories and proficiency levels. The company was founded in 2011 in France and its content is now available in 10 countries over multiple devices and applications. In 2014 their apps were downloaded more than 2 million times up from about 100,000 in 2013. The apps are increasingly used by students, and the structure of an app lowers the cost of translating content for other markets, compared to websites.

Beyond widening access to education materials, apps also provide tools to improve learning efficacy. Apps, such as inClass, enable students to take notes, create images of slides or handouts and share materials with classmates through Facebook and iTunes. With mobile devices and apps, collaborative and personalised learning become more feasible and intuitive. Apps (e.g. Explain Everything, ScreenChomp) facilitate peer assessment among students and also allow teachers to provide personalised feedback to student work. Studies on the use of iPads in schools have shown increased

[51] Reuters. February 2015. "Apple's health tech takes early lead among top hospitals". http://www.reuters.com/article/2015/02/05/us-apple-hospitals-exclusive-idUSKBN0L90G920150205

[52] The Guardian. January 2015. "Prof Bruce Keogh: wearable technology plays a crucial part in NHS future". http://www.theguardian.com/society/2015/jan/19/prof-bruce-keogh-wearable-technology-plays-crucial-part-nhs-future

levels of autonomy, motivation and engagement among students, while encouraging students to take more responsibility for their own learning through the use of a variety of apps. [53]

Apps not only enhance learning, they also improve the productivity of teachers and the quality of teaching. Apps can help deliver more personalised and engaging lessons. For instance Socrative is an interactive polling app which allows teachers to set up questions for students, who then use the app to receive the questions and submit answers.

Classroom management and administrative tasks can also be made simpler and quicker through apps such as Class Dojo and iDoceo, which perform a variety of functions including incentivising good behaviour, grading assignments, marking attendance, generating student reports, communicating with parents and scheduling classes.

Apps and mobile devices are facilitating greater experimentation and development of new strategies for delivering education (some examples are discussed in Figure 4-10). The potential benefits are enormous not only for students and teachers, but also for governments and society at large.

Figure 4-10: Digital strategies for future education

New digital strategies are being explored and implemented by educators and institutions across the world, and apps have a key enabling role in many of them including:

- The "flipped classroom"[54] – a blended learning concept in which learning occurs outside the classroom through apps and online platforms (e.g. TED, Khan Academy) with assignments and homework being done in class where discussion and guidance can be more interactive and personalised.
- "Bring your own device" (BYOD) – a common workplace strategy, which is increasingly being adopted by education institutions to facilitate one-to-one learning. BYOD helps schools and educational providers overcome a lack of funds and staffing while delivering high quality education to students through the use of apps.
- Education "gamification" – the delivery of education through effectively designed games and incentive-reward schemes which provide better motivation and stimulate productivity gains among learners. An example is Duolingo – an app in which users learn a language while translating websites and documents. By rewarding correct answers with skill points and time bonuses, students gain more confidence and motivation to complete lessons. The Duolingo system is also designed to be adaptive and by tracking completed lessons, tests and practice sessions.
- A/B testing of alternative approaches to learning – the way something is taught can be varied and the speed of learning assessed, allowing a virtuous feedback loop that would take years in the conventional education system. With 15 million active users Duolingo can run experiments every day, discover what works best, and adapt the approach.[55] Algorithmic optimisation of the learning approach may turn out to be one of the most important advantages of app based learning.

[53] University of Hull. October 2012. "iPad Scotland Evaluation". http://www2.hull.ac.uk/ifl/ipadresearchinschools.aspx

[54] http://www.knewton.com/flipped-classroom/

[55] Recode. November 2014. "Why a computer is often the best teacher." http://recode.net/2014/11/03/why-a-computer-is-often-the-best-teacher-according-to-duolingos-luis-von-ahn-full-video/

5 The benefits of apps use

The app economy is a recent phenomenon, and whilst there are metrics sizing the app production economy, information on benefits from the use of mobile apps is partial and must be assessed using different methodologies. The benefits of apps use will be spread throughout the economy, and whilst we expect the benefits to be substantial they may not be readily attributable to apps *per se*. We therefore use two approaches to estimate the benefits of apps use:

- We assess the overall benefit consumers place on apps by considering the value of time they spend using them versus alternatives. We note that this approach reflects the value of apps whether they are free or paid.
- We assess the potential benefits from particular apps - time saved using transport apps, money and greenhouse gas emissions saved using smart thermostats/apps, lives saved in health care and productivity gains for the mobile workforce.

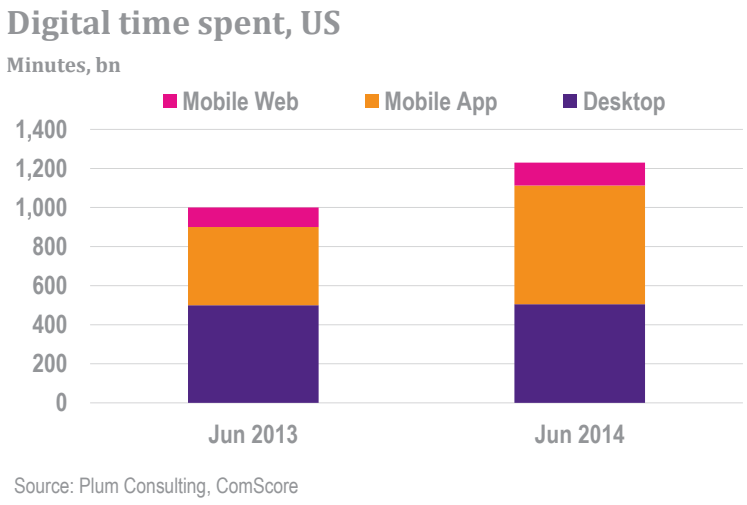
5.1 Overall value based on time spent using apps

How people allocate their time provides a proxy for the benefits. For some time-intensive goods, such as internet connectivity and apps, time spent provides a truer reflection of value than the price paid.

Brynjolfsson and Oh (2012) estimated the value of the internet based on time spent using the internet in the US at $838 billion per annum averaged over the period 2007-2011 (around $2,600 per person or $3,100 per internet user).[56]

Since the Brynjolfsson and Oh study, which utilised data up to 2011, the use of mobile apps has increased overall time "online". Figure 5-1 shows recent growth and the split between mobile web, mobile apps and desktop time.[57]

Figure 5-1



Source: Plum Consulting, ComScore

[56] Brynjolfsson and Oh. 2012. "The Attention Economy: Measuring the Value of Free Digital Services on the Internet."

[57] ComScore. August 2014. "The U.S. Mobile App Report." http://www.comscore.com/Insights/Presentations-and-Whitepapers/2014/The-US-Mobile-App-Report

Utilising time spent on apps to scale the Brynjolfsson and Oh estimate, scaling for the population difference and converting to Euros we obtain an estimate of €1.5 trillion for the consumer benefit of mobile internet and apps use in Europe. Whilst this is based on time use for the US, data for the UK and Italy shows that time spent on smartphones and apps is higher than in the US.[58]

5.2 Time saved in transport

The value of time savings via the ability to avoid delays by altering travel plans in London (including the metro, buses, private road users and rail travel) were estimated to be £15-58 million per annum in 2012[59]. This estimate is based on the value of non-working time, did not factor in the ability to better plan routes and was made at a time when adoption of smartphones and transport apps was still comparatively low.

We derive an estimate around €5.7 billion in 2015 for the EU by scaling for the total number of trips for the EU urban region.[60] By 2020 this could rise to more than €18 billion per annum with the growth in smartphone penetration, higher app usage and the increase in public transport journeys. Open real time data is a necessary catalyst for these time savings benefits.

Beyond time savings from avoided disruption, other benefits of transport apps which are not quantified here could also be significant. These include the value of time savings through better planning and personalised travel options to cater to individual activities and preferences, and benefits from better information on travel fares.

5.3 Lives saved in health care

We estimate the results for one application trialled in the UK (see Figure 4-5) which utilised iPods, apps and the cloud to record patient data and to improve patient handover and the targeting of intervention in hospitals. This resulted in a reduction in mortality estimated at 15%, equivalent to 400 fewer deaths per year in a 1,000 bed hospital.

Scaled to the UK based on total beds and to Europe based on population, we estimate around 600,000 potential lives saved per annum. There appear to be few barriers to the adoption of this type of app, and we assume widespread adoption is plausible by 2020. Assuming that the average life saved in hospital is extended by the difference between life expectancy and the average age of people in Europe, and utilising a median value for a life-year of €52,000,[61] the monetary equivalent of 600,000 lives extended is around €150 billion per year.

[58] Nielson. February 2014. "How smartphones are changing consumers' daily routines around the globe". http://www.nielsen.com/us/en/insights/news/2014/how-smartphones-are-changing-consumers-daily-routines-around-the-globe.html

[59] Deloitte. May 2013. "Market Assessment of Public Sector Information. Report for Department for Business, Innovation and Skills". https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/198905/bis-13-743-market-assessment-of-public-sector-information.pdf

[60] The International Association of Public Transport (June 2014) estimates 56.8 billion passenger journeys on local public transport (bus, tram, metro, railway) in urban and suburban areas. We added estimated journeys by car/motorcycle/taxi using London data. http://www.uitp.org/sites/default/files/cck-focus-papers-files/Local_PT_in_the_EU_web%20%282%29.pdf

[61] European Commission. February 2005. "Methodology for the Cost-Benefit analysis for CAFE: Volume 2: Health Impact Assessment". http://ec.europa.eu/environment/archives/cafe/pdf/cba_methodology_vol2.pdf

5.4 Energy saved at home

Smart thermostats have significant potential to save energy, whilst maintaining comfort and demanding very little of the user. We utilise an energy savings estimate of 15% for heating based on simulation results and experience (see Section 4.2), and allowing for improvements in information and algorithms, for example, to reflect near term weather forecast information and real time user location.

Smart thermostats can also be adopted on a "grassroots" basis and the market is increasingly competitive, with innovation, marketing and partnerships with energy suppliers. Comparatively rapid adoption therefore appears plausible.

We estimate energy savings assuming that adoption rises from negligible today to 25% of households by 2020, and based on average energy consumption for heating by households in Europe.[62] Based on average domestic electricity prices[63] we estimate savings of €13.8bn in 2020. We also estimate the value of the reduction in carbon dioxide emissions (based on an externality price of €90 per tonne)[64] amounting to an additional €5.3bn in 2020.

5.5 Productivity gains for the mobile workforce

UNITE, a UK operator of student accommodation, utilised mobile technology to enable their facilities team to manage jobs more efficiently and achieved an increase in jobs completed of 30%.[65] It is plausible that similar savings can be achieved by other mobile workers through more efficient task management and information recording.

In order to estimate the potential from these sorts of applications we used the UK workforce estimate for 'no fixed abode' of 8.4% of the total.[66] Another estimate, based on analysis of the categories in the UK Labour Force Survey, estimated that 6.5 million workers in the UK are "non-desk mobile" workers, 22% of the total.[67]

Assuming 30% productivity gains are achievable across 10% of the workforce the overall gains would be around 3% of GDP, or €45 billion per annum based on European GDP of around €15 trillion per annum.

Whilst savings of 30% might be considered high there are many more workers who are in part mobile. We chose an estimate of the mobile workforce of 10%, slightly higher than those with 'no fixed abode' but significantly lower than the estimate of "non-desk mobile" workers of 22%.

[62] Based on one tonne of oil equivalent (= 11.6 MWh) per household per annum. http://www.odyssee-mure.eu/publications/efficiency-by-sector/household/

[63] Based on €0.1385 per KWh, excluding taxes (Eurostat)

[64] Ricardo-AEA. January 2014. "Update of the Handbook on External Costs of Transport." http://ec.europa.eu/transport/themes/sustainable/studies/doc/2014-handbook-external-costs-transport.pdf

[65] http://mubaloo.com/clients/unite

[66] ONS. March 2014. "2011 Census Analysis - Distance Travelled to Work." http://www.ons.gov.uk/ons/rel/census/2011-census-analysis/distance-travelled-to-work/index.html

[67] Robert Kenny. September 2014. "Out-of-home use of the internet." http://www.broadbanduk.org/wp-content/uploads/2014/11/BSG-Out-Of-Home-Internet-Usage-Report.pdf

5.6 Overview of annual benefits by 2020

	Benefit today pa	Benefit by 2020 pa	Comment
Overall time use for apps	€1,500bn	€2,400bn	Time spent on apps has overtaken desktop time, and total time online and on apps has grown significantly. Estimate for 2020 assumes time on apps scales with smartphone adoption (to date average time per user on apps has also been growing).
Estimates for single app categories in individual verticals			
Time saved in transport	€4.6bn	2bn hours Value €18bn	Based on avoided disruption costs. Does not include benefits of transport mode choice, route planning and navigation.
Lives saved in hospitals	<1,000 lives <€0.25bn	600,000 lives €150bn	Based on proof of concept for a single application to improve coordination and patient management in hospitals. Greater potential may arise outside of hospitals from health monitoring and promotion of healthy and independent living supported by apps and wearables.
Energy saved via smart thermostats	Small	100,000 GWh €19bn	€19bn saving is based on energy saving of €13.8bn and 60 million tonne CO_2 saving valued at €90 per tonne
Productivity gains for the mobile workforce	Small	€45bn	Assuming 30% gains for 10% of workforce.

Figure 5-2 illustrates the benefits of the specific apps (or app categories). The verticals considered account for 29% of Europe's GDP (Figure 5-3) and there are, and will be, many other applications both within and beyond these verticals. The majority of the benefit of apps will come from their use.

Figure 5-2

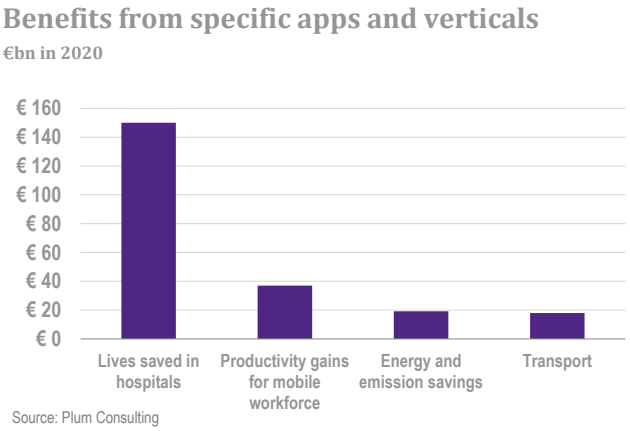
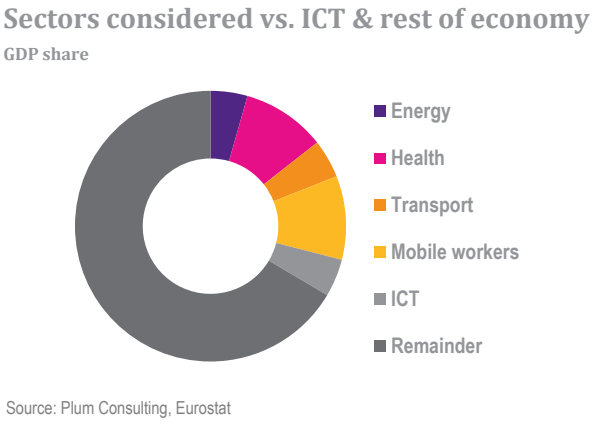


Figure 5-3



6 Unlocking the potential

This section discusses policy priorities to facilitate diffusion and innovation in relation to apps use.

6.1 Enhancing connectivity & inclusion

The policy focus in Europe has been on broadband availability to the premise i.e. on connectivity to places. However, connectivity to people rather than places is important for two reasons. First, around 25% of people remain offline in Europe (those aged 16 or over had not used the internet in the past 3 months) – a total of 120 million people. Second, ubiquitous wireless coverage is key to realising the full potential of apps.

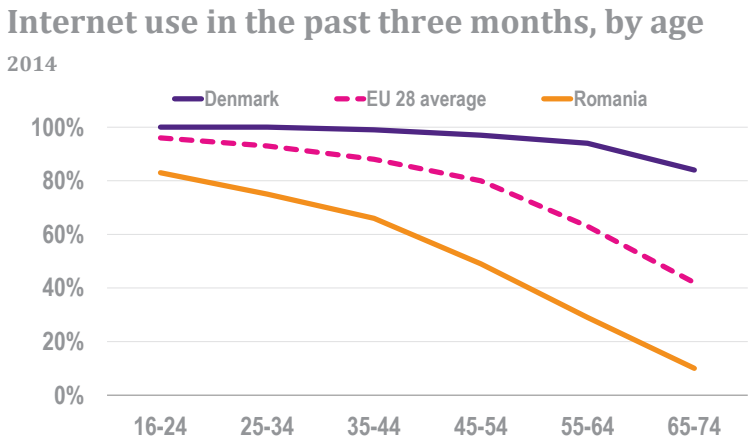
6.1.1 Enhanced wireless connectivity

The key to enhanced wireless connectivity is access to radio spectrum coupled with network investment to increase the coverage, speed and capacity of cellular and Wi-Fi network access. Spectrum needs to be harmonised, at least on a European basis, to be valuable. In relation to licensed spectrum, investors should have sufficient confidence regarding property rights (long or indefinite spectrum rights, the opportunity to trade and freedom from *ex post* spectrum taxes) to promote innovation and investment in network infrastructure. Sector-specific e*x ante* regulation should be focussed on any network bottlenecks, with horizontal competition law and general consumer law only applying to services and applications.

6.1.2 Digital and apps inclusion

In Europe many people remain offline (i.e. have not used the internet in the past 3 months) with non-use increasing in relation to age but with substantial variation between countries (see Figure 6-1).

Figure 6-1

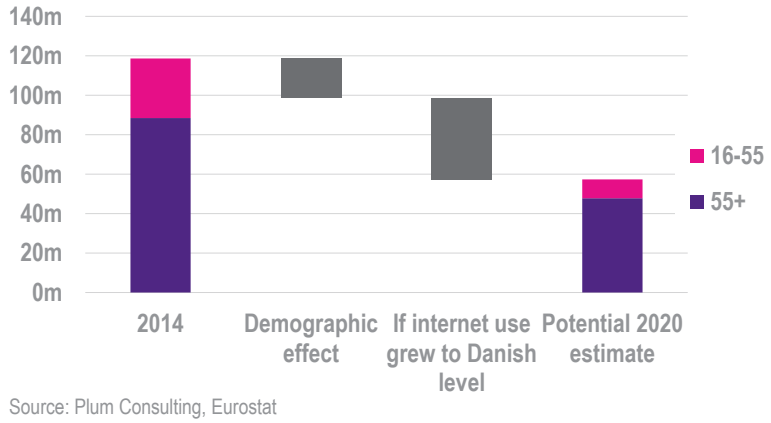


Source: Plum Consulting, Eurostat

Demographics alone are reducing the offline population as those who are online age. However, a forecast based on demographic effects alone leaves the offline population at 100 million by 2020 compared with 120 million in 2014. If, in addition to demographics, internet use throughout Europe converged on the level in Denmark, then those offline would be reduced by 2020 to 57 million.

Figure 6-2

Internet non-users in Europe



Source: Plum Consulting, Eurostat

Growing the population of internet users, and in particular mobile app users, would grow the overall app ecosystem. "Mobile app inclusion", as opposed to internet use *per se*, would also help ensure a wide cross section of society can utilise the emerging class of mobile only applications and platforms such as Apple HealthKit and Google Fit.

Mobile and apps may also help get people online by overcoming barriers including relevance, cost and skills. For users, particular apps, as opposed to "going online" may be seen as more relevant; whilst mobile devices, connectivity and apps may be more affordable than fixed broadband and a PC. In skills a study by Ericsson on the use of the internet by seniors noted that:[68]

> *"Smartphones and tablets are much easier to use, and have more intuitive interfaces than existed previously. This is something that is possibly more important for this generation."*

Further, in relation to tablet adoption Ofcom noted that:[69]

> *"The number of people aged 65 and over accessing the internet has risen by more than a quarter in the past year, driven by a three-fold increase in the use of tablet computers to go online."*

However, achieving a substantial increase those online will require a shift in approach:

- Digital inclusion programmes should be reoriented to include mobile devices and interfaces.
- Trials should be conducted to establish what approaches to digital inclusion work best.

[68] Ericsson. August 2014. "Connecting the Senior Generation." http://www.ericsson.com/res/docs/2014/consumerlab/connecting-the-senior-generation.pdf

[69] Ofcom. April 2014. "Tablets help drive increase in older people going online." http://consumers.ofcom.org.uk/news/tablets-help-drive-increase-in-older-people-going-online/

- Government services should be adapted to ensure they are compatible with mobile interfaces.

Achieving higher levels of digital inclusion would benefit citizens (including both those new to online and others via network effects), spur the development of applications targeted at the needs of those currently under-represented online, and facilitate a shift towards provision of government services online.

6.2 Facilitating access to government data

Facilitating access to government data is one of the more immediate ways of stimulating apps development and increasing the utility of apps. In effect it shifts the boundary of government and city authorities allowing more diverse and rapid innovation around the ways in which data is accessed and utilised to add value for consumers and citizens.

A range of national, regional and global initiatives aim to promote access to government data. At a global level the G8 Open Data Charter includes the principle of open government data by default, released in open formats wherever possible.[70]

The opening up of public data is also a key action under the European Digital Agenda of 2010.[71] In June 2013 the European Parliament adopted a revision of the EC Directive on the re-use of public sector information.[72] European Commission activities around open data include open data guidelines[73] and the EU open data portal.[74]

EU Member States have two years to transpose the provisions into national law. The revised legislation introduces a right to re-use of all content that can be accessed under national access to documents laws.

Figure 6-3 shows the wide gulf among EU countries according to the Global Open Data Index. [75] Another recent survey by the Open Data Barometer[76] also shows considerable discrepancy among European countries. While the UK, Denmark and France are among the leading lights, progress on open data has been slower in a number of other European countries.

[70] G8 Open Data Charter, June 2013 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/207772/Open_Data_Charter.pdf

[71] http://ec.europa.eu/digital-agenda/en/pillar-i-digital-single-market/action-3-open-public-data-resources-re-use

[72] Directive 2003/98/EC of the European Parliament and of the Council of 17 November 2013 on the re-use of public sector information http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:345:0090:0096:EN:PDF

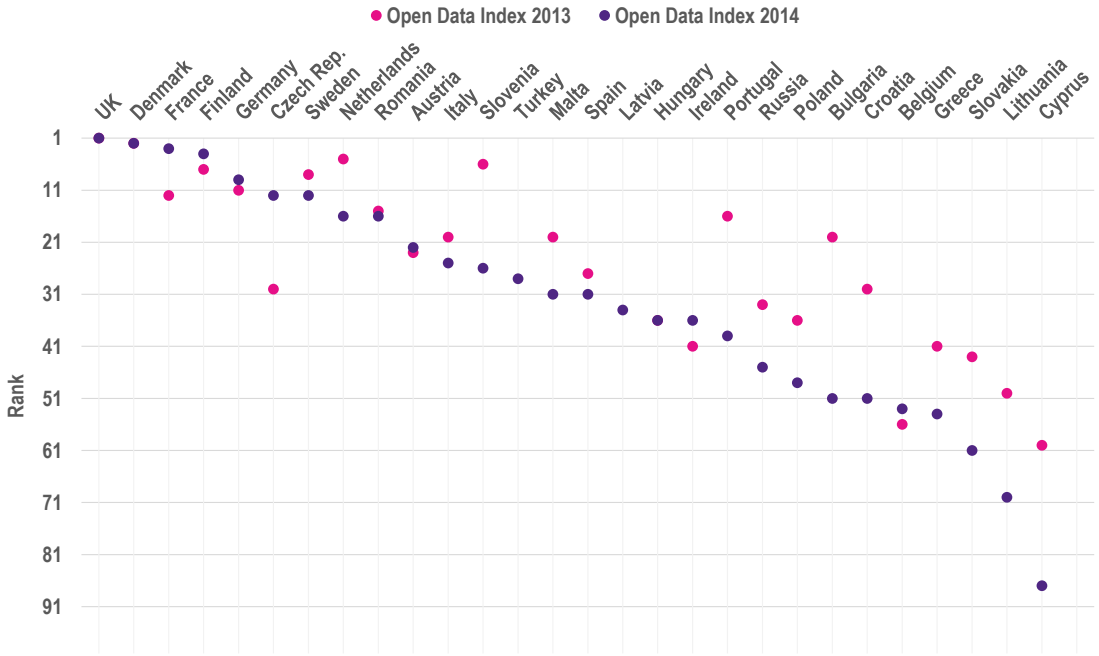
[73] Commission Notice. Guidelines on recommended standard licences, datasets and charging for the re-use of documents. 17 July 2014 https://ec.europa.eu/digital-agenda/en/news/commission-notice-guidelines-recommended-standard-licences-datasets-and-charging-re-use

[74] http://open-data.europa.eu/en/data/

[75] The Global Open Data Index evaluates 10 categories of data from over 100 countries and ranks countries according to technical openness and the legal status of openness of their datasets. http://index.okfn.org/place/

[76] The Open Data Barometer scores countries according to three criteria: readiness to secure benefits of open data; implementation of open data practice; and impacts of open data. http://www.opendatabarometer.org/

Figure 6-3: Ranking of European countries – Global Open Data Index



Note: Estonia and Luxembourg are not covered in the Open Data Index
Source: Plum Consulting, Open Knowledge Foundation

Figure 6-4 lists initiatives amongst European leaders on open data - the UK, Denmark and France.

Figure 6-4: European leaders in open government data

In the UK, the government established data.gov.uk, one of the largest open data resources in the world. London datastore is an open data initiative by the Greater London Authority which has led to the creation of more than 200 apps. Every government department has specific open data commitments in their business plans. An Open Data White Paper was published[77], followed by a comprehensive review of public sector information which set out the strategic approach and recommendations which were accepted by the government.[78] A non-profit organisation co-funded by government and business, the Open Data Institute[79], helps build the demand side for open data by working with start-ups and training businesses to best utilise and innovate with open government data. A National Information Infrastructure listing the datasets considered the most important has been developed.[80] Funding is available to help government organisations overcome financial barriers to the release of data.[81]

In Denmark, the importance of open data was recognised in the eGovernment Strategy 2011-2015[82] and the Danish government and local government have committed to making core public sector data including real estate, businesses, maps and geography available free of charge to all users.[83] In contrast to the UK[84], Denmark decided that access to a central address database should be free and without conditions.

In France, the government has made open data a priority since 2011 when it created the Etalab mission under the direct responsibility of the Prime minister. The mission administrates the French open data online platform[85], with a new version of the platform launched a year ago, and more generally coordinates the government's action to facilitate the widest possible reuse of public data. As a result of these efforts, France has moved from 12th to 3rd in the 2014 Global Open Data Index compared to 2013.

[77] HM Government. June 2013. "Open Data White Paper".
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/78946/CM8353_acc.pdf

Open data principles should apply for all levels of government – national, regional, local, city – including other administrative and regulatory bodies. Governments should develop a coherent strategy with specific responsibilities, targets and action timetables for implementation. To address barriers to open data governments should:

- Review existing legislation to ensure that all government data is 'open by default', subject to data protection requirements. Open standard licensing should be adopted; in particular rights should be perpetual, royalty-free, irrevocable, non-exclusive and applicable globally (to the extent allowed under national law). Open data requirements might also be, where appropriate, a requirement where public funding is received.
- Identify and prioritise the release of key datasets in specific high value areas. The European Commission has identified five categories which should be prioritised for release – geospatial data, earth observation and environment, transport, statistics and companies. City- and local-level open data initiatives should be supported as a complement to national-level programmes.[86]
- Improve accessibility and encourage use both within government and by others by ensuring that:
  - Published data is accessible through a common portal which is not just be a repository for datasets but also provide relevant information (e.g. usage guidelines), search functionality, developer tools and serves as a forum for interaction with the open data community.
  - Ensure that datasets are published in a timely manner, updated regularly and are of a high standard. There should also be certainty regarding the duration of data availability so users can invest in building apps. Data should be published in open, standardised formats with open APIs where feasible to facilitate usage by developers.[87] Certification schemes which inform users on data quality, such as the 5-star rating system[88], should be adopted.
  - Encourage agencies more familiar with the publication of open data (e.g. national statistics bodies, land registries) to provide insights to other government departments. The sharing of best practice between countries should also be encouraged.
  - Support partnerships and intermediary bodies which play an important role in connecting suppliers with users of open data, and contextualising open data tools to local needs. These can include open data advocacy groups, academic institutions, start-up incubators and user communities such as API and app developers. The functions played by these bodies include working with both suppliers and users of open data, providing advice, training and support to data users, promoting collaboration and sharing knowledge and skills.

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[78] HM Government. June 2013. "The Government response to Shakespeare Review of Public Sector Information." https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/252172/Government_Response_to_Shakespeare_Review_of_Public_Sector_Information.pdf

[79] http://theodi.org/

[80] https://www.gov.uk/government/publications/national-information-infrastructure

[81] https://www.gov.uk/government/publications/breakthrough-fund-and-release-of-data-fund

[82] http://www.digst.dk/Servicemenu/English/Digitisation/~/media/Files/English/Grunddata_UK_web_05102012_Publication.pdf

[83] http://www.epsiplatform.eu/content/denmark-goes-open-data-big-time

[84] Economist. 20 September 2014. "Getting on the map." http://www.economist.com/news/international/21618822-physical-location-becoming-even-more-important-digital-world-has

[85] www.data.gouv.fr

[86] World Wide Web Foundation. Open Data Barometer Global Report, Second Edition. http://www.opendatabarometer.org/

[87] https://www.data.gov/developers/apis

[88] http://5stardata.info/

6.3 Embracing innovation throughout the economy

For technology innovation to deliver its full social and economic benefits two things are required: diffusion of the technology throughout society and the economy; and adoption of new ways of doing things which make best use of the new technology (moving beyond a bolt-on approach).

These transformations require sufficient flexibility to happen.[89] A wide-ranging re-examination of old rules and institutions, built up over many years in every vertical, is required (involving variously the European Commission, national governments, local and city administrations and regulators).

We consider specific issues arising in relation to health, enterprise and the sharing economy.

6.3.1 Health

Existing rules may conflict with innovation and adoption of new app based approaches in health care, for example, by requiring costly and slow prior approval even where specific issues in relation to consumer protection may not arise.

For example, Biosense Technologies ran into regulatory difficulties in the US when it unveiled a kit that lets people use their phone cameras and an app "UChek" to read subtle colour differences on test strips (made by Siemens and Bayer) designed to show unhealthy levels of proteins and other substances in their urine. The automation of the process via smartphone and app, rather than the underlying test, triggered a letter from the US Food and Drug Administration (FDA) to Biosence:

> *"Though the types of urinalysis dipsticks you reference for use with your application are cleared, they are only cleared when interpreted by direct visual reading. Since your app allows a mobile phone to analyze the dipsticks, the phone and device as a whole functions as an automated strip reader. When these dipsticks are read by an automated strip reader, the dipsticks require new clearance as part of the test system."*[90]

Subsequently the FDA issued guidance in September 2013 an effort to provide clarity and predictability for manufacturers of mobile medical apps.[91] In Europe there are also initiatives to clarify the rules. However, the approval process can be slow and costly, and ambiguity (or too wide a definition) of what constitutes a medical device may slow innovation and adoption. [92]

The existing approach is unlikely to be the last word on how best to draw the boundary of regulation and to regulate the rapidly emerging field of health related apps. The approach should be reviewed in the light of experience in both the US and Europe.

[89] Bartelsman. April 2013. "ICT, reallocation and productivity." http://ec.europa.eu/economy_finance/publications/economic_paper/2013/pdf/ecp486_en.pdf

[90] Wired. June 2013. "FDA Can't Hold Back Stream of Mobile Health Apps". http://www.wired.com/2013/06/fda-gets-pissy-with-urinalysis-app/

[91] FDA. "Mobile Medical Applications." http://www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/ConnectedHealth/MobileMedicalApplications/ucm255978.htm

[92] BBC. October 2014. "Health tech: When does an app need regulating?" http://www.bbc.co.uk/news/business-29605951

6.3.2 Enterprise

Policies that promote internet adoption, open government data and allow transformation of verticals will offer benefits in terms of enterprise apps development and use. The use of micro location data to trigger context specific information is also an area where reform may be required in some countries. Rules and practices need to be adapted to allowing the use of location within enterprise apps, whilst maintaining appropriate individual protection.

Another area is technology-specific implementation of regulatory requirements, for example in relation to financial services, which may limit the potential to utilise mobile apps. Rules should be adapted to achieve desired consumer protection whilst allowing innovations including apps to be utilised.

6.3.3 The sharing economy

The sharing economy offers considerable potential benefits, but has proved contentious as illustrated in Figure 6-5 for ride sharing in the US and Figure 6-6 for accommodation sharing in Europe.

Figure 6-5: Evolving approach to regulation of ride sharing in the US

Ride sharing apps have proved controversial. Some regulators have sought to impose existing taxi regulation which may be incompatible with the proliferation of new business models based around apps (there may be a case for some form of regulation, but it is unlikely to align with existing regulation).

New York City, which initially declared Uber illegal, then allowed a one-year pilot program.[93] Other innovations, such as ride pooling which would reduce energy use per ride, have also encountered regulatory impediments.[94] The Federal Trade Commission (FTC) has commented on the principles to govern regulation in evolving industries:[95]

> *"The initial question for regulators, therefore, is whether there is a public policy justification for regulating them at all, either through entirely new regulatory mechanisms or expansion of current systems for regulating commercial passenger motor vehicle transportation services. Unregulated markets can be adept at accommodating new and innovative forms of competition, whereas traditional regulatory frameworks may lack the flexibility to do so precisely because they tend to mirror, and even entrench, the business models that have developed in the past." Page 4.*

In August 2014 the National League of Cities, a group of municipalities from across the United States, announced that it was forming a new network of startups, cities, and academics to identify the regulatory challenges posed by the disruptive technologies that power the sharing economy. The press release noted that:[96]

> *"Cities are looking for ways to update and improve their current regulatory framework to ensure that regulations like safety and health protect residents, while at the same time supporting the growth of new businesses. It is imperative for cities to learn how this industry operates and discover ways to engage in order to support these new modes of doing business and to create jobs."*

More recent evidence points to growing accommodation in relation to the regulation of ride sharing apps with the development of new rules tailored to what has been termed "transportation network companies".[97]

This also points to a general policy conclusion, namely that different means of delivering what from a consumer point of view is the same or a very similar service may require different forms of regulation.

[93] Wired. December 2012. "Uber Is Back for NYC Cabs as Taxi App Wars Escalate." http://www.wired.com/2012/12/uber-flywheel-taxi-app-wars/

Figure 6-6: Evolving approach to regulation of short term rentals in Europe

Short–term rental is one of the most hotly contested policy areas within the collaborative economy. This is spurred in part by the rapid growth of new platforms such as Airbnb, LoveHomeSwap and Knok, alongside older variants like VRBO and HomeAway. The key short term rental policy questions typically involve taxation, neighbourhood planning, effects on tourism, and overall housing access.[98]

In the UK, the Minister for Housing at the Department of Communities and Local Government has indicated that some portions of the law are "outdated and unworkable" and it is imperative to work towards a "fairer, more flexible private rented sector", prompting a review of the private rented sector to be launched in February 2014. In February 2015 the government published details of how the law will be changed to allow short term rentals in London.[99]

Local governments have taken a range of approaches to address these issues. In many cities, local authorities require a permit or certificate to be obtained by individuals who wish to offer short term rental accommodation, and may limit the number of days per year such activity is allowed.

In Amsterdam, individuals who wish to let a property on a short–term basis must be the principal occupier of the home, or obtain permission from the owner or landlord, and pay required taxes. They are able to let a property for up to 60 days per year and a maximum of four guests at any time.[100]

In France, the new ALUR (l'Accès au Logement et à un Urbanisme Rénové) law enables residents to rent out their primary residence without additional registration requirements, although it does allow cities to define additional criteria under certain circumstances.

The above experience is illustrative of the challenges that will need to be addressed throughout Europe. As Nesta noted in relation to the collaborative economy:

> *"Many of the rules governing our economic activity reflect the trends of past decades – such as large corporate structures and the pre–eminence of individual ownership. As the collaborative economy grows worldwide, policy and regulatory regimes need to catch up."*

The UK government launched a review of the social and economic potential of the sharing economy which concluded with 30 recommendations.[101] The following were highlighted by Debbie Wosskow, founder of LoveHomeSwap, who led the review:

- Create a sharing economy industry association where businesses can come together, introduce standards and guidelines and better represent the industry in front of the government.

[94] Recode. September 2014. "California Regulator Says Commercial Carpooling — Like What Uber and Lyft Are Doing — Isn't Legal." http://recode.net/2014/09/11/california-regulator-says-sharing-ride-sharing-like-what-uber-and-lyft-are-doing-isnt-legal/

[95] http://www.ftc.gov/system/files/documents/advocacy_documents/ftc-staff-comment-honorable-brendan-reilly-concerning-chicago-proposed-ordinance-o2014-1367/140421chicagoridesharing.pdf

[96] http://www.nlc.org/media-center/news-search/sharing-economy-advisory-network-created-as-resource-for-cities

[97] WSJ. January 2015. "Uber Laws: A Primer on Ridesharing Regulations." http://blogs.wsj.com/digits/2015/01/29/uber-laws-a-primer-on-ridesharing-regulations/

[98] Nesta. September 2014. "Making Sense of the UK Collaborative Economy." http://www.nesta.org.uk/publications/making-sense-uk-collaborative-economy

[99] Department for Business, Innovation & Skills. February 2015. "Measures to boost sharing economy in London." https://www.gov.uk/government/news/measures-to-boost-sharing-economy-in-london

[100] Department for Business, Innovation & Skills. November 2014. "Unlocking the sharing economy: independent review." http://www.collaborativeconsumption.com/2014/02/14/amsterdam-embraces-sharing-economy/

[101] November 2014. "Unlocking the sharing economy: independent review." https://www.gov.uk/government/publications/unlocking-the-sharing-economy-independent-review

- Resolve insurance issues for participants in the sharing economy by working with the insurance industry (and the British Insurance Brokers' Association who have released a guide to insurance for sharing economy businesses).
- Resolve the debate and confusion around tax by creating a guide to taxation in the sharing economy (via HRMC and the Treasury).

Other recommendations included promoting digital inclusion to broaden the market, opening up government procurement to sharing economy businesses and allowing short term rentals without planning permission.

6.4 Principles and priorities to guide reform

Change to existing laws, regulation and norms built up around existing ways of doing things may be resisted even where it is in the public interest. Clear principles to guide reform are therefore required to ensure that consumer and citizen interests - rather than vested producer interests – remain central.[102] Strong leadership and a dialogue with innovators will be required.

As innovation around mobile-apps changes what is possible, old rules and approaches may no longer be fit for purpose. A new game – a new market environment with new players – may require new rules, rather than an extension of old rules to "level the playing field".

It is also not in general the case that the same regulation should apply to what is ostensibly the same service but delivered in different ways. For example, different regulation might apply to taxi and payment apps with different levels of user authentication and protection compared to conventional services.

Given the dynamic nature of the internet and apps market, horizontal regulation – *ex post* competition law and general consumer protection law – may be preferred to *ex ante* sector specific approaches more applicable to relatively 'static' utilities.

Where new app-based services compete with legacy services this may suggest reducing existing specific regulation (as the European Commission when it removed telecommunications voice services from the list of relevant markets susceptible to *ex ante* regulation due to increased competition, including that from over the top applications).[103]

The means by which existing public policy goals are delivered may also need to change. For example, adoption of smart thermostats may be a more cost effective option in terms of energy efficiency gains than the implementation of smart metering, whilst a different model for health care delivery may be appropriate when consumers are routinely using health apps and wearables.

More generally, the boundary between state provision, individual initiative and entrepreneurial activity may need to change given low cost means for individual citizen and developer involvement in achieving desired outcomes. For example, it may be efficient for Government to shift from offering the

[102] FTC. April 2014. "Who decides how consumers should shop?" http://www.ftc.gov/news-events/blogs/competition-matters/2014/04/who-decides-how-consumers-should-shop

[103] European Commission. 9 October 2014. "Telecoms: Commission to cut number of regulated markets in Europe". http://europa.eu/rapid/press-release_IP-14-1112_en.htm

whole service to offering a platform in some areas, as Transport for London have done in moving from provision of travel information apps to provision of open data to app developers.[104]

Given that the majority of benefits from apps, and digital services more generally, are anticipated to come from their use rather than production, policy priorities may increasingly lie outside the 'traditional' digital economy areas. Careful examination of the rules applying to every vertical in the economy will therefore be required to ensure it is open for innovation. One approach, proposed in the context of the European Digital Single market, is to apply a digital stress test:[105]

> *"All new legislative proposals should be innovation-friendly and subject to a digital stress test as part of their impact assessment. And the existing body of law needs to be reviewed to ensure it's still fit for the digital age."*

Figure 6-7 sets out priorities for reform.

Figure 6-7: Priorities for policy reform to support mobile app driven innovation & use

Finally, at an overall strategic level the Digital Agenda for Europe was conceived well before the extent of the pivot towards mobile apps was apparent. It was framed around an initial phase of convergence - the movement of digital content and applications online. However, convergence has now progressed to a phase where online is transforming physical, previously offline, activity. Policy priorities should also change.

6.5 Refreshing the Digital Agenda for Europe

The Digital Agenda for Europe was launched in May 2010 and built on inputs from the Digital Competitiveness Report 2009. The Digital Agenda was conceived before the extent of the pivot towards mobile was apparent.

[104] Stott (2014) cited in Walravens, Breuer and Ballon. 2014. "Open data as a catalyst for the smart city as a local innovation platform." *Digiworld Economic Journal*, No 96.

[105] Department for Business, Innovation & Skills and Prime Minister's Office. January 2015. "The UK's vision for the European Union's digital economy." https://www.gov.uk/government/publications/the-uks-vision-for-the-european-unions-digital-economy

The Digital Agenda focused on the development of high-speed networks – specifically fixed access to the home. The Digital Agenda was also framed around the first phase of convergence, namely the movement of digital content and applications online. However, apps require ubiquitous mobile data access and convergence has progressed to a phase where online transforms offline, rather than offline transferring online.[106]

The fundamental premises of the Digital Agenda – that ICT is a powerful source of growth and that networks, applications and content are mutually reinforcing – remains valid. However, the way in which this is translated into policy and targets is showing its age. Five years is a long time for the internet economy.

Apps stores have stimulated an enormous amount of innovation in terms of applications and content. There is no longer a shortage of demand for broadband access, in particular mobile broadband access. Digital content and applications are still moving online, but the bigger picture is that mobile, apps and intelligence embedded in things are transforming the offline economy.

Policy priorities should also shift. For example, Pillar IV of the Digital Agenda relates only to broadband speeds to the premises. The 111 actions listed under the Digital Agenda Pillars are, not surprisingly, silent on many of the issues identified in this study as critical enablers of mobile apps and app-enabled benefits for EU society. The Digital Agenda is also, for example, silent on the range of issues arising in relation to the sharing economy.

Some actions have stood the test of time and remain relevant, for example, Action 3: "opening up government data sources for reuse". However, to encourage learning from open data leaders and catch-up by lower ranked nations the European Commission could develop an open data index, similar to the Global Open Data Index Survey discussed earlier.

Other actions, for example Action 73: "Member States to agree common additional functionalities for smart meters" - might have been framed differently had today's technology – smart thermostats and their relationship with mobile apps - been evident at the time.

This illustrates a more general point, namely that apps and artificial intelligence are facilitating grassroots opportunities for consumers to adopt technologies which contribute to Digital Agenda goals, but which were not envisaged when specific actions were formulated.

The Digital Agenda should be refreshed in light of apps and the benefits they can contribute for European citizens.

[106] Brian Williamson. Winter 2014/2015. "Convergence enters a new phase." *Intermedia*, Volume 42 (4/5). http://www.iicom.org/resources/open-access-resources/doc_download/591-ready-for-a-new-ride-brian-williamson