Creating the climate for growth

A manifesto for the digital technologies industry in Scotland

ScotlandIS

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Creating the climate for growth

We live in a digital age, where our citizens have instant access to unprecedented information and services. New businesses and organisations are created on a daily basis that turn established business models on their heads. Content whether in the form of learned papers, online encyclopedias, magazines, blogs, videos, photographs, news, books and social media is available to more and more of the world's population and is growing exponentially. All of this is driven by digital technologies.

This document offers practical proposals for Scotland to embrace digital technologies wholeheartedly, to educate our workforce, business and public sector leaders, wider society and, most importantly, our young people in the benefits digital technologies can deliver. It outlines where industry, working with government, can make a step change to deliver economic and societal value.

Alastair O'Brien, Chair

We must become a digital nation. In doing so we have the opportunity to deliver a healthier and wealthier nation, to reshape our society, to deliver highly skilled and fulfilling jobs and to drive efficiencies and productivity gains in our public services and established businesses.

In the next five years let's double the numbers of people working in digital technologies – to over 150,000. The multiplier effect of that skill base will be enormous. **Let's plan** for the next generation of advanced connectivity. **Let's work** with our universities to pick a few winners and deliver on them rapidly and with passion. **Let's really deliver** on digital public services; citizen friendly and with a ruthless focus on waste and inefficiency. **Let's use** data analytics to live healthier and more productive lives. **Let's work** with the smart cities alliance and the city deals to deliver connected, efficient and carbon neutral cities across Scotland. And most importantly, **let's equip the next generation for the world we will be living in tomorrow**.

Graeme Gordon, Deputy Chair

We have made a number of key recommendations, including:

- Accelerating the availability of next generation connectivity
- Realising the full potential of the digital technologies industry
- Addressing the gender balance
- Ensuring the digitally excluded are included
- Creating the workforce of the future, through new entrants and reskilling and retraining current employees
- Harnessing the latent capabilities in the innovation centres
- Building on the research strengths in Scotland's academic institutions

The digital technologies industry is an enabler of growth and prosperity capable of delivering economic wealth to Scotland and creating high value, high tax base jobs that benefit everyone. So we should aim high!

Alastair O'Brien, Chair   **Graeme Gordon, Deputy Chair**

ScotlandIS

Executive Summary

The Prize

We have the opportunity to convert the undeniable potential Scotland harbours into reality by creating an effective digital economy. The prize if realised is calculated as being worth £13 billion[2]. This document highlights how Government working with the digital technologies industry can deliver this growth.

To achieve this requires the following:

Political Leadership

The aspiration is to make Scotland a digital nation, held up as an exemplar by other countries and the location of choice for digital businesses to base their European headquarters. Public Services need to be transformed and made more efficient and accountable. Electronic voting and citizen engagement needs to become the norm. Our own parliament needs to lead by example and become a model of efficient administration based on digital technologies. For that to happen requires a tangible commitment from politicians of all parties.

Connectivity

Delivering the aspiration contained within the BroadBand 2020 programme by driving through universally available internationally competitive connectivity against an aggressive timetable.

Fuelling the growth of the digital technologies industry

Doubling the value of the digital technologies industry over the next five years would unlock an additional £5 billion in GVA for the economy. This requires a partnership with industry to establish and deliver a programme of focussed interventions to underpin the industry's ambition, set stretch targets for growth and excite and celebrate the new generation of entrepreneurs.

Opportunities

Scotland is a small country but we do have outstanding capabilities in certain areas. By harnessing these, and developing internationally competitive products and services in specialities such as data science and cybersecurity we can generate additional export earnings, research funding and inward investment.

Productivity

It is essential we eradicate the productivity deficit which we face compared to our European and US competitors. Espousing the successful adoption and exploitation of digital technologies in all parts of the economy and society is a key enabler in addressing this challenge.

Digital Inclusion

One in seven Scots is digitally excluded. We have to change this as not only are their lives disadvantaged but we lose the opportunity for them to contribute positively to the digital economy.

Delivering Culture Change

Engaging all citizens in the vision of a world class digital economy that exploits the benefits of digital, and utilises these to create a fairer more equal society requires strong leadership.

Imagine if...

In 2025, Scotland is an international leader in digital technologies and computer science. Edinburgh is a major startup hub and Scotland's cities are top European locations for international technology businesses. All our citizens understand the benefits of this valuable industry and actively promote it.

Education and awareness of STEM in schools is world class, particularly in the field of Computer Science, with interest encouraged from a young age and increased diversity and higher participation throughout the system. Scottish students regularly compete and excel in Informatics and Mathematics Olympiads.

Close collaboration between academia, industry and government is the norm, with the Innovation Centres focusing on world leading research and innovation in industry-relevant fields.

Scotland has nurtured its tech incubators: a 10-year focus on delivering business results and thinking big has resulted in the creation of new digital business ventures, with annual revenues exceeding £3 billion.

Over the same period, increased national focus on digital industries has resulted in the creation of over 30,000 new high-end jobs. The wider business base has wholeheartedly adopted digital, trading increasingly online, fostering an internationally competitive IT services, ecommerce and software supply base.

The Scottish Government has embraced digital technology; their lead in Open Data and investments in world-class online services for businesses and citizens has helped Scotland emerge as an advanced and flourishing digital society. Exploitation of data analytics has improved the health of citizens, through personalised health planning, and individuals with long term conditions such as diabetes have access to their own treatment regimes which they can share eg with family members.

Smart cities data has greatly reduced carbon emissions with joined up transport systems based on a "One Scotland" smart city planning approach, low emission intelligent street lighting, and much improved power management systems for offices, shops and work premises.

A pipe dream or something we can all deliver?

Scotland's digital technologies industry

Scotland is home to a vibrant digital technologies industry with over one thousand companies engaged in a variety of activities from software development and IT services to digital agencies, games development and telecommunications.

Digital technologies are disrupting traditional industries, creating new, innovative 'born-digital' businesses with new ways of working and are now an essential element of the Scottish economy. The pervasive nature of digital means that wider Scottish business is increasingly adopting digital technologies to deliver new products and services, drive productivity and open up fresh markets.

In a low oil price economy the digital technologies industry is of even greater strategic importance to the future growth of the Scottish economy and the Government's vision to create a world class digital nation by 2020.

There is a significant opportunity to double the value of the industry over the next five years, delivering an additional £5 billion to the economy.

The industry has grown substantially over the last five years despite a challenging economic climate, with increasing start-up activity creating a wide range of new entrants. Over 84,000 people currently work in digital technologies roles across Scotland, generating more than £5 billion in GVA. But we are at a flex point at the beginning of the next information revolution. If exploited effectively this would expand the industry's value enormously.

Ensuring a competitive environment that will foster the industry is pivotal to unlocking this exceptional potential for continued expansion and greater export activity.   Key to this are :

- ▶ World class connectivity
- ▶ A plentiful and growing supply of skilled talent
- ▶ Fostering cluster growth
- ▶ Access to growth capital

- ▶ Research excellence
- ▶ A supportive and innovative public sector
- ▶ A holistic approach to cybersecurity
- ▶ Meaningful digital inclusion

The wider economy...

The world is changing and the importance of the digital economy is increasingly recognised across Scotland. In industries as varied as retail and engineering the impact of digitisation is sweeping away old ways of working and old economic models. Jobs in insurance, accountancy, law, banking, marketing and finance are increasingly being automated through artificial intelligence (AI), analytics and big data. As Boston Consulting Group's report[1] on the 'Future of productivity and growth in manufacturing industries' highlights *"advances in technology ... will transform production: isolated, optimized cells will come together as a fully integrated, automated, and optimized production flow, leading to greater efficiencies and changing traditional production relationships among suppliers, producers, and customers—as well as between human and machine."*

As other businesses become more digitised, ecommerce also enables a more effective method of transacting with customers. Through utilising more detailed analysis of customer data and market trends, ecommerce allows firms to tailor their products much more effectively for customers, whether businesses or consumers, as well as driving innovation in logistics, supply chain management and payment systems.

Within Scotland, several recent authoritative reports reinforce the opportunities, the accompanying challenges that have to be overcome and the actions required to realise this shared vision. Rather than repeat the content of these reports, we have referred to them where relevant.

Amongst these, a recent study by Deloitte[2], commissioned by the Scottish Futures Trust, concludes that if the optimum scenario were to be realised Scotland could add over £13 billion of GDP by 2030, including over £2 billion in additional export income, an increase of almost 10% from 2014. This would generate 120,000 new jobs across the economy.

Connectivity

Connectivity underpins all elements of a digital economy and society. It also fuels innovation, through the creation of new products and services, allows for the harnessing of big data and enables the movement of large data sets within and across organisations, with services delivered in 'the Cloud'. Considerable progress has been made in delivering access to broadband in all parts of Scotland, but there is still major work to be done to make the communications infrastructure world-class. Significant anomalies still exist whereby the Auctioned Mobile Licencees can achieve their licence obligations without providing coverage in remote and rural Scotland. Consideration should be given to ensuring that an alternative operator, willing to invest in these areas, can do so on a stand-alone or sub-licence basis. The sharing of infrastructure, frequencies and roaming must be a stimulant to a more cost effective & swifter access/ delivery method.

In parallel, the pace of technological advancement means that in the period since the Broadband 2020

targets were originally established expectations of acceptable connectivity levels have increased. This is reflected, for example, in the European Commission's targets[3].

There should be two key areas of focus :

First, there are still areas of the country where both broadband and mobile network access is limited. This acts as a brake on economic growth and undermines the productivity benefits that digital communications enable, creating an increasing economic divide. Continued priority should be given to ensuring that the timetable for the Broadband 2020 roll out is accelerated. Even in major urban conurbations mobile access continues to be inconsistent.

Second, the speed with which the technology underpinning today's communications networks is changing creates a need to future-proof national infrastructure as far as is feasible. This is not an easy task and will require government, business and technology suppliers to work together to develop a road map.

As an initial step, ScotlandIS supports a universal service obligation where everyone should have access to a minimum broadband speed of 10Mbit/s and 4G mobile coverage, and download. In addition, download speeds (5:1 as a minimum) and contention ratios (<50:1) must become part of the stated standards.

After the current programmes, the minimum target should be to deliver ultrafast broadband at 500Mbit/s and 5G mobile by 2025, with market demand dictating the delivery of minimum 1Gbit/s in key economic locations.

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WE RECOMMEND

Immediately
- ☐ mandating roaming between networks, and the sharing of masts and other capital infrastructure
- ☐ ensuring world-class broadband connectivity is built into all planning applications
- ☐ providing for Sub-Mobile Network Operators to access mobile frequencies in un/underused areas such as rural communities
- ☐ combining the collective work being undertaken through the smart cities initiatives into a pan Scotland initiative
- ☐ mandating SWAN and other public services networks to provide backhaul access at public sector tariffs for community schemes
- ☐ extending the current work of the Scottish Futures Trust to create a detailed roadmap for delivery

Within one to two years
- ☐ free wifi access should become the norm in towns and cities - opening up wifi infrastructure funded by the public sector eg government offices, education campus wide networks, libraries etc to be freely available to citizens, would be a good first step
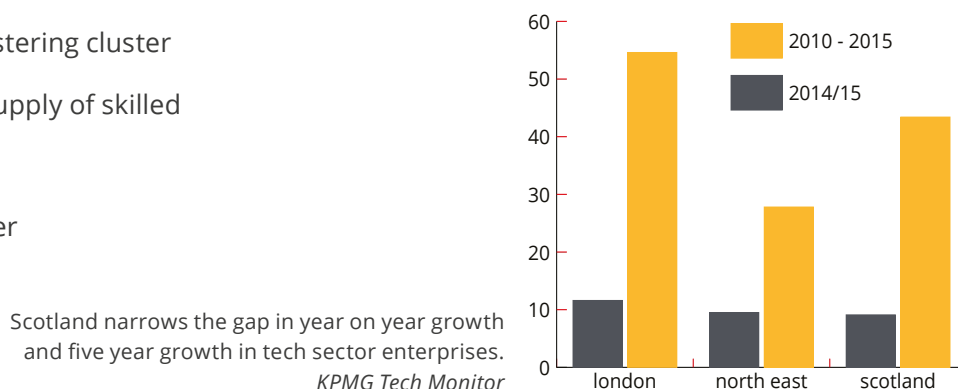
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Fuelling Industry Growth

KPMG's authoritative Tech Monitor[4] highlights that 'since the end of the financial crisis the tech sector across the UK has delivered six years of continuous growth and created jobs at a faster and higher rate than the rest of the economy". It further reports that the number of tech enterprises has grown by a third since 2010, double the rate of all other private sectors, underlining the value of the industry. Tech City's Tech Nation 2015 report reinforces this, finding that 'digital companies are growing faster than the average rate of business growth across the economy. Companies from our sample large enough to report data have seen turnover rise by an average of 6% per annum between 2006 and 2013.' This echoes our own research into Scottish technology businesses, indicating year on year growth of c 10% over the last five years.

According to Tech Monitor's analysis the growth of Scotland's tech sector lags some of the best performing regions of the UK. If Scotland were to match these, it would result in a doubling of the value of the industry to the Scottish economy. (For example, in Reading (which ranks as the number one UK Tech cluster) 22% of all business are tech businesses - in comparison Edinburgh leads the Scottish table at 12.0%).

However Scotland appears to be narrowing the gap, ranking 3rd in terms of year on year growth over the 12 months Q4 2014 to Q3 2015 at +9.1% (behind Greater London +11.6% and the North East + 9.5%). During the period 2010 to 2015 growth in the number of tech sector enterprises in Scotland at +43.4% is second only to London (+54.6%) in percentage terms but from a much lower base - so there are clear indicators that Scotland could improve its position significantly, given the right operating environment.

To realise this ambition a number of factors need to be addressed :

- ▶ A focussed approach - fostering cluster growth
- ▶ A plentiful and growing supply of skilled talent
- ▶ Access to growth capital
- ▶ Reseach and innovation
- ▶ Public sector as an enabler

Scotland narrows the gap in year on year growth and five year growth in tech sector enterprises.
KPMG Tech Monitor

A focussed approach - fostering cluster growth

"

There is a strong relationship between company size and capabilities; firms with capabilities in data science, network infrastructure or cyber security are twice as likely to employ over 100 people as those in visual design and content.

"

Tech City Tech Nation report

According to TechCity's 2015 Tech Nation[5] report 98% of all 47,200 UK technology businesses fall into the small business category. Digital businesses are increasingly choosing to work near each other, creating dynamic tech clusters. 50% of all UK tech companies were formed in the period since 2008 and 51% of all tech businesses are in 21 clusters, including Glasgow, Edinburgh and Dundee which rank 13th, 14th and 21st respectively, based on cluster employment. Whilst many of the highest performing clusters are in the south of England both Greater Manchester (4th) and Belfast (6th) are outstripping other clusters, with Belfast having the fastest growing 'knowledge economy' in Britain. At a European[6] level Stockholm and Berlin compete with London for No 1 Tech City, but face strong competition from Helsinki, Amsterdam and Paris.

From a Scottish perspective, the recent growth in the number of new tech businesses in central Edinburgh has created a recognised technology cluster, benefitting from the city's four universities and the incubation facilities at TechCube and Codebase. The development agencies and the universities (EPIS, Launch.ed, Aspekt, Informatics Ventures and the Bright Red Triangle) have between them acted as a catalyst for start-up activity, with company development and spinout support.

Glasgow has similar levels of tech industry employment but has fewer SME's and a larger number of major employers, creating a different company size profile. New initiatives such as Rookie Oven[7] start-up space, the Tontine Building and Strathclyde University's

Dynamic technology clusters across Scotland

Technology Innovation Centre could provide some of the building blocks for the development of more vibrant high growth cluster to match Edinburgh. Dundee has an international reputation for games development, and although the company base and the numbers employed are small they make a valuable contribution to the economy as successful games companies generate significant export income.

If we are to leverage the potential of the digital economy effectively, we should concentrate on helping the startup community to scale their businesses quickly, thereby developing a 'digital mittelstand' of larger sme's with the aspiration to be global players, building on the success of Axios, Craneware, iomart, KAL, and Petrotechnics, and emulating the growth of Skyscanner and FanDuel. Edinburgh and Glasgow should plan to outperform cities such as Stockholm, Belfast and Manchester. Clusters in the Central Belt must be fostered and new ones encouraged, for example in Aberdeen and Inverness, through supporting not just the development of startups, but helping these businesses to scale up and grow successfully.

The TechNation report highlights Edinburgh's top sectors as software development, fintech, and edtech. It recognises 5 key capabilities - software engineering, m2m communication, machine learning, artificial intelligence and data science. The report identified the importance of the University of Edinburgh as "Its computer science research budget is one of the largest in the world and has helped accelerate growth of the cluster". According

to the Tech Nation report "There is also a strong relationship between company size and capabilities; firms with capabilities in data science, network infrastructure or cyber security are twice as likely to employ over 100 people as those in visual design and content."

A recent MIT REAP report "Increasing Innovation driven entrepreneurship in Scotland"[8] viewed the lack of 'Effective Connections' as a critical issue, ie. a failing to develop and build necessary business networks. An economy wide report found that despite the growth of entrepreneurial activity in Scotland few businesses have fully exploited the opportunities offered by the London market, particularly compared to countries such as Ireland, which have successfully exploited the diaspora networks within the London business community.

The type of analysis created by these reports is useful in helping to develop local growth strategies, however a more detailed analysis of Glasgow, Dundee, Aberdeen and other locations would complete the picture in a Scottish context and inform decision makers, ambitious businesses and start-up communities.

Essential elements of a tech eco-system include low cost, flexible work space/incubators, good connectivity, access to start-up and scale-up funding, a ready supply of skilled creative people, entrepreneurial flair, experienced mentors and senior management, an understanding of how to scale businesses and access to local business opportunities. Ensuring the right mix of these factors is essential.

WE RECOMMEND

Immediately
- Commissioning a detailed analysis of Scotland's digital technologies communities to provide a baseline for local growth strategies.
- Promotion and support for initiatives such as The Scottish London Business Network
- Showcasing in-depth case studies of successful digital businesses created from Scotland

Within one to two years
- Supporting the development and expansion of a range of business incubators and accelerators
- Creating an increased focus on key capabilities
- Addressing missing elements of the cluster mix eg encouraging successful technology business people to return to Scotland, both to start new businesses and act as mentors to existing businesses.

A plentiful and growing supply

A significantly increased supply of talented individuals is critical to the continued growth of the digital technologies industry. Scotland has been impacted by the well documented skills shortage currently experienced across the UK, Europe and the US. Firms have struggled to recruit the staff needed to build and deliver their products and services and salary levels are rapidly increasing, disadvantaging smaller companies and particularly the startup community.

This situation is being made more acute by the growing demand for specialist digital skills from non-technology businesses as digital increasingly pervades all aspects of the economy. This new source of demand will continue to grow, adding to the pressure the industry faces.

The skills shortage is exacerbated by a failure to attract sufficient women into the workforce over successive years, resulting in gender balance being a

major challenge for the industry with women making up less than 15% of all IT and Telecoms professionals. Whilst many women work in other commercial roles within the industry the overall numbers at around 26% of the workforce are exceptionally low, and in addition very few women hold senior roles and board positions.

According to Deloitte's Technology Media and Telecommunications 2016 Predictions[9] by the end of 2016 fewer than 25% of information technology jobs in developed countries will be held by women ie women working in IT roles. Lack of gender diversity in digital technologies is both a social and economic issue - global costs may be in the tens of millions of dollars. A study for HR Magazine[10] in April 2014 estimated that this gender gap costs the UK alone £2.6bn annually. As the Deloitte report highlights a range of initiatives has been underway for at least ten years to reverse the declining number of women in the technology workforce so it is all the more surprising that the position has not improved.

In Scotland, the ICT & Digital Technologies Skills Investment Plan[11], published in 2014, has provided a much needed framework to address many of these skills challenges; from early years teaching within primary schools, through an increasing range of apprenticeships and adult training, to encouraging diversity and the creation of a significantly enhanced sector profile.

Delivery of the plan has now begun and a number of initiatives are underway, complementing work being undertaken particularly in primary and secondary education, but it is essential that sufficient resources continue to be made available to enable the plan to be implemented in full over the next ten years. This is key to the continued success of the industry and failure to address the sector's skills issues will damage the international competitiveness of the whole Scottish economy.

Specific focus is required on
- engaging and exciting young people through the both the curriculum and extra-curricular activities
- primary and secondary school teaching through upskilling/capacity building of all teachers, including ongoing CPD
- increasing sector attractiveness, with a particular focus on attracting women into the industry at all levels
- ensuring MA's, college and university provision meets industry's needs,
- reskilling the current workforce - including addressing those digitally excluded - through initiatives such as CodeClan
- addressing emerging skills needs, for example in the areas of data science/analytics and cyber security

One area outside the remit of the Skills Investment Plan is the limit on access to overseas talent created by the current UK visa restrictions, which is not helpful to our industry. Scotland has attracted many highly talented people to study at post graduate level in our universities and this pool of skilled individuals would be a great addition to our workforce.

WE RECOMMEND

Immediately
- Continuing investment in the roll out of the Skills Investment Plan. This has a ten year horizon and must be properly resourced throughout that time.
- Appointing a Technology Schools Ambassador responsible for driving the technology agenda for schools/young people
- Equipping schools with devices that encourage the development of skills, such as the Raspberry Pi, Jaguar Board.
- Continuing to increase the number of college and university places for computing and mathematics (with no student to be turned away from a course for funding reasons)
- Developing and delivering a gender balance campaign
- Reinstating post study work visas for non EU graduates

Within one to two years
- Reassessing how computer science is taught in schools, especially understanding the role of digital technologies in all subjects and offering learning opportunities for parents
- Introducing a fast track policy like "teach first"[12] to recruit new computing teachers
- Coordination with the wider education promotion campaigns taking place in other STEM subjects such as mathematical sciences
- Developing new models of workforce development, training people in digital technologies skills to enable them to move into higher value roles.
- Addressing missing elements of the cluster mix eg encouraging successful technology business people to return to Scotland, both to start new businesses and act as mentors to existing businesses.

Accessing growth capital

Increasingly Scottish based digital technology businesses are creating and delivering products and services for an international marketplace. Whilst a number of established businesses have grown significantly, scaling up a technology business in the way achieved by US based companies is extremely challenging. Many will instead choose to sell their business to a larger company, gaining access to global marketing channels and giving the founders and their investors a return on their capital.

Such exits via trade sale are not a particularly Scottish problem, and are a relatively common exit for technology companies worldwide. What may be more of an issue is that Scottish companies are rarely purchasers of innovative businesses although there are recent signs that this is changing (for example recent acquisitions by Skyscanner, FanDuel and iomart).

Scotland benefits from a relatively sophisticated seed-level start-up funding environment, with an exceptional business angel network, a number of knowledgeable tech sector investors, additional finance available through the Scottish Investment Bank's (SIB) Co-investment Fund, Scottish Enterprise's High-Growth Start-up unit and proof of concept funding from research grants.
Much of Scotland's risk capital climate has been

encouraged by the presence of SIB's co-investment fund and that has led to a very substantial community of Business Angel Syndicates. However SIB's reluctance to take cornerstone stakes in Venture Capital Funds (with the exception of life-science fund Epidarex) is one factor in the lack of Scottish based VC funds. Also, the difficulty of designing a suitable co-investment vehicle for crowd funding means that Scotland has a smaller share of that market compared to the rest of the UK.

The recent exceptional growth of FanDuel and Skyscanner provides a template for the next generation of tech companies. Their success in raising venture capital (VC) in other markets highlights

the under-representation of VC and private equity funders in Scotland compared with (for example) Ireland, which has taken action to create a Venture Capital community. Companies therefore need to use the London capital markets or seek funding from US and European VC's. Harnessing the expertise of experienced financial advisors is key in this regard, and attracting investors and advisors to Scotland through mechanisms such as as the Engage, Invest, Exploit[13] conference should be encouraged.
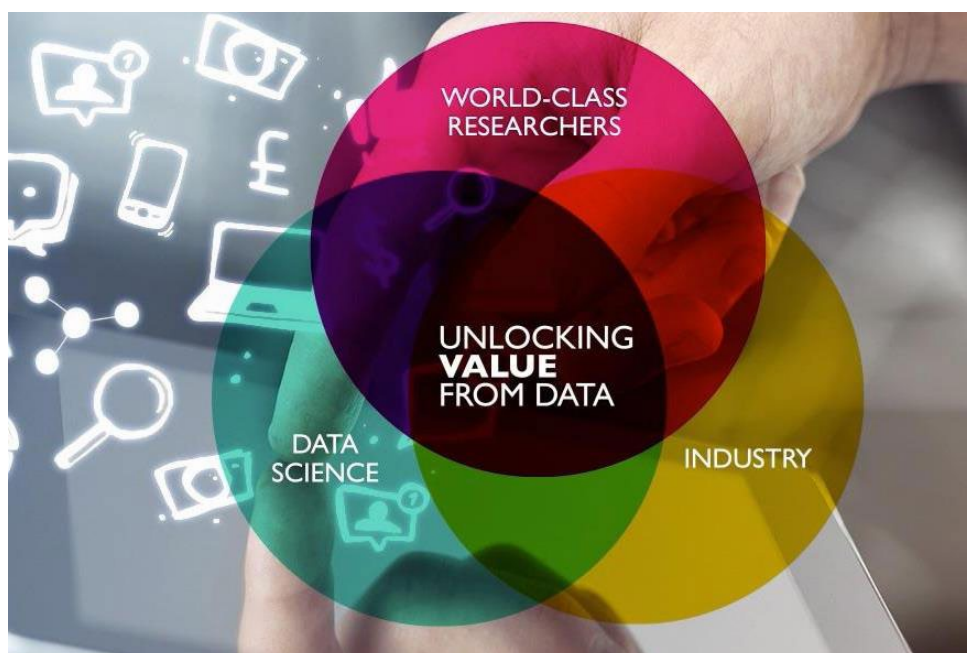
WE RECOMMEND

Immediately
- providing cornerstone funding in new VC funds
- finding mechanisms to encourage crowdfunding

Within one to two years
- attracting local offices from international VC companies

Research excellence and innovation

Scotland (and the wider UK) underperforms on the traditional measures of innovation as identified in the Lisbon Strategy. This has been a major concern for policy makers over the last fifteen years and is seen as holding back growth and improvements in productivity. There is a strong counterargument that the exceptional growth evidenced in the Silicon Roundabout area of London has been due to the juxtaposition of technologists, creatives, and young entrepreneurs, very often from immigrant populations, who have developed a wave of innovative internet, ecommerce and web-based products and services but in areas that traditional indices don't measure. Arguably, digital technologies drive this new form of innovation, and this is echoed in the new generation of technology companies developing in Scotland.

Scotland's universities provide an exceptional research base in computer science, software engineering and informatics, underpinning the digital technologies industry. This research excellence has a positive impact on undergraduate and postgraduate teaching, and offers significant opportunity for commercial exploitation.

The Scottish Informatics & Computer Science Alliance (SICSA), is a collaboration which represents all the Scottish universities to develop and extend Scotland's position as a world leader in Informatics and Computer Science research and education. SICSA is responsible for attracting 16% of all UK public research funding for computing.

However industry locally has been slow to engage with the research base as a means of creating competitive advantage. Academia's research horizon is often much longer term than industry which naturally concentrates on near to market commercial opportunities. It is now critical to build a bridge that enables industry and

academia to work together to leverage this research excellence, to generate internationally competitive goods and services for the greater benefit of the Scottish economy.

An industry focus on graduate recruitment needs to be matched with a focus on developing ways to engage the current generation of MSc, PhD and postdoctoral research associates in their research questions and challenges.

The recently established innovation centres provide a nascent platform for greater industry engagement with a practical focus on opportunities such as data science, stratified medicine and sensors and on markets such as aquaculture. They are at an early stage but the focus must continue to be on engaging the Scottish SME base to work with industry and academia to deliver world class and innovative solutions. Ensuring projects provide a long-term platform for engagement and growth, instead of simply short term consultancy, is a key challenge for all the innovation centres.

For our industry there are significant synergies to be gained by bringing together the capabilities of the sensor and imaging systems innovation centre, CENSIS, The Data Lab, and the digital health institute, DHI, in joint projects. Whilst we recognise a number of initial collaborations are underway, active encouragement should be given to stimulating and growing the developing collaboration between the centres.

To be internationally competitive, continued and increased funding for applied research activities is required for these centres as competitor economies such as Ireland are investing significantly larger sums in their equivalent centres.

WE RECOMMEND

Immediately
- Stimulating and growing the developing collaboration between the innovation centres
- Renewing SFC funding for PhD students. This lack of funding risks stifling future research, invention and industrial innovation.

Within one to two years
- Mechanisms to encourage the flow of staff and students between industry and the academia
- Supporting industry to establish visiting scientist, researcher and research fellow programmes as a gateway to connect and draw in the local research talent in SICSA to engage in basic and applied research
- Creating mechanisms to connect research and innovation in industry with academia (such as enhanced CASE studentship)

Within five years
- Supporting activities at earlier technology readiness levels
- Ensuring continued funding to maintain and grow Scotland's international reputation for research

Public Sector as an enabler

Despite a stated political commitment in Scotland to deliver a new generation of digital public services, this is proving difficult to deliver quickly and at scale and Scotland risks being uncompetitive with respect to competitor nations.

That commitment needs to be driven through to the delivery organisations and effective adoption will deliver significant efficiencies and cost savings, enabling citizens to interact with government, as they do with the private sector, at a time and place of their choosing.

Technology and the use of advanced data analytics will also enable better management of front-line health and welfare services with vulnerable and at risk citizens being kept safe and secure in their own homes for longer.

The Digital Transformation Service being developed within Scottish Government is a promising initiative which would be strengthened by developing a close relationship with the private sector to deliver additional talent and accelerate delivery. The focus needs to be on the needs of the citizen and not the service provider.

As this new generation of services is developed, utilising the large number of small and medium sized (SME) digital companies in Scotland with innovative ideas could be of real benefit to the public sector. If encouraged and supported they can deliver fresh ideas quickly and at lower cost. The public sector has made great progress in engaging with the SME community and that relationship now needs to move to the next level.

A recurring refrain amongst ScotlandIS members is their ability to sell to the Public Sector in other geographies but not in their home market - with an impact on local added value and employment. Further research into this would be of value.

WE RECOMMEND

Immediately
- Appointing a public sector Chief Digital Officer with the responsibility and authority to reduce costs, coordinate activity and invest in innovative services.
- Developing a specialist operational research and process improver department with Scottish Government to drive efficiency and transformation
- Government leading by example in ensuring digital literacy across its own staff at all levels
- Accelerating the utilisation of cloud services across the public sector, providing strong leadership for the adoption of cloud based strategies and benefitting from the associated cost savings.

Within one to two years
- Promoting exemplars to share benefits and opportunities and aligning procurement to make replication easy rather than reinventing wheels

Opportunities

> ❝
>
> We have... many of the key assets, in terms of knowledge, technologies and experienced individuals, needed to play a major role as leading nations move to exploit an increasingly information-driven global economy.
>
> ❞
>
> *Royal Academy of Engineering*

Digital technologies are currently at a flex point. This new phase of the digital revolution offers an immeasurable wealth of opportunity, and as the Royal Academy of Engineering states we have "... many of the key assets, in terms of knowledge, technologies and experienced individuals, needed to play a major role as leading nations move to exploit an increasingly information-driven global economy."

Just as companies such as Skyscanner and FanDuel have developed in non-traditional industries, we will continue to see new players emerge with unanticipated specialities. However there are several areas of expertise within Scotland which with greater focus could be leveraged for increased economic benefit, both within domestic markets and internationally.

These include

- ▶ market sectors such as financial services, energy (both carbon based and renewables), health and tourism
- ▶ specialities such as informatics, natural language processing, machine learning
- ▶ current global challenges such as cyber security and data science

Exports

Many companies across the industry are already involved in international markets, generating export income for the Scottish economy. Most of this is through intentional plans to access overseas markets, but part is also due to 'happenstance' where sales are generated through online activity when a business's presence on the web has been discovered by overseas buyers. It is currently difficult to measure the value of exports the industry earns at a Scottish level.

Other industries have developed ambitious export targets which the tech sector could emulate, by creating a formal plan for exports. The Scottish Technology Industry Survey[15] suggests that there is a significant appetite to expand international sales, and this should be encouraged, increasing the number of companies who understand how to export successfully. The development agencies already

provide a range of services available to companies wishing to export, but an audit should be undertaken to identify any possible gaps.

Creating expertise in online and digital exporting will not only benefit the digital technologies industry but can be extended across the economy to other industries, enabling companies to enter and expand export markets in a cost effective manner. There are a number of excellent exemplars of Scottish businesses who have used the internet as their channel to overseas customers. (eg Toolstop, Eteaket, Fine Coffee Company). Harnessing online trading, or e-commerce, is a very effective methodology as businesses and consumers increasingly buy products and services online.

WE RECOMMEND

Immediately
- developing reliable metrics for the value of Scottish digital technology industry exports, and tracking performance improvements
- working with the industry to create an ambitious plan for growing export incomes
- identifying and addressing gaps in support services
- developing an education programme, supported by an industry led mentoring scheme
- promoting the benefits of ecommerce as an enabler for international sales
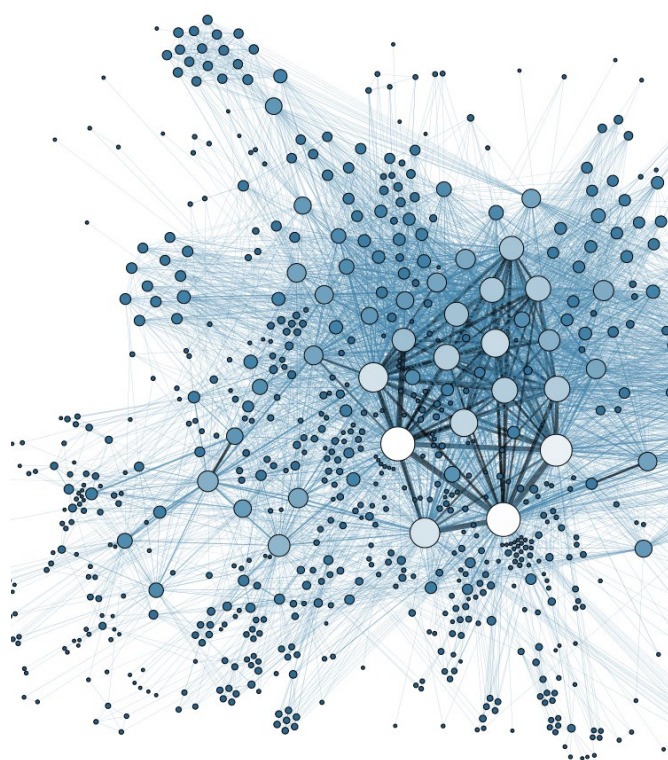

Data science

There is general recognition of the huge potential data science offers to create new products and services with international markets, and deliver a 'data-enabled' economy. The use of analytics, visualisation and advanced data connectivity, will develop new value from the volumes of highly detailed, real-time data now generated across society and the economy.

This offers opportunities for individual organisations and sectors to transform the way that they provide products and services. As reflected in the Connecting Data report[16] 'many of the applications that have emerged so far are single sector, but in the future, new opportunities will arise as a result of combining data across sectors in innovative ways. There are opportunities to drive innovation by combining open data and proprietary data shared between organisations, along with novel types of unstructured data such as social media and crowdsourced data.'

The Centre for Economics and Business Research (CEBR) estimates that the Data Science marketplace could see 58,000 net new jobs created within the UK alone and the benefits to the economy are estimated at £216bn.

Scotland is well placed to take advantage of this high value growth market. We are world-leaders in informatics and computer science research and teaching, and have access to exceptional open data sets, particularly in health.

There is a small but growing number of specialist analytics companies already established in Scotland, and a new generation of companies building their business on combining datasets to provide clients with smarter solutions. Harnessing the expertise in machine learning, analytics and natural language processing in our universities could provide the basis for a complete new wave of technology businesses.

However data science skills are in short supply worldwide so it is essential that we develop these skills as quickly as possible.

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> A unanimous concern across all the sectors researched was the dearth of the multi-skilled workforce required to convert data analytics theory into genuine business practice and performance.
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> **"**
>
> *Royal Academy of Engineering*

The skills needed combine computing, mathematics and statistical analysis. Considerable focus is already being given to data science with the development of specialist MSc's and modern apprenticeships in data curation, but considerations should also be given to including elements of data science in Mathematics degrees.

The Data Lab, as a hub for data science in Scotland, has the opportunity to build a data science community in the country that brings together universities, industry and the public sector in such a way that it becomes an asset and differentiator at a national level.

WE RECOMMEND

Immediately
- Increasing support for the specialist data science masters and other postgraduate courses being developed across Scottish universities and by the Data Lab
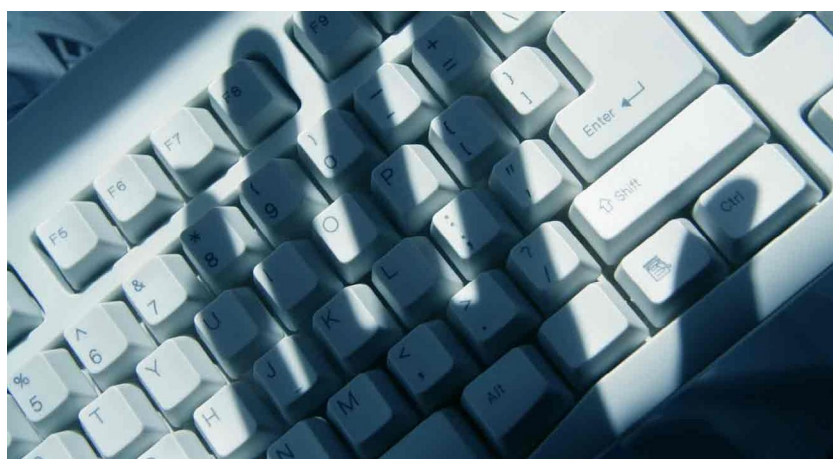- Rapidly identifying and deploying exemplar projects to develop capability and build reputation

Within one to two years
- Embedding data science modules in mathematics courses
- Continuing development of specialist data management, data science and analytics qualifications at modern apprenticeship, college and university level

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Cyber security

Cyber security has always created challenges for businesses and individuals, but the scale of these challenges has increased dramatically over the last few years. Juniper Research recently predicted that the rapid digitisation of consumers' lives and enterprise records will increase the cost of data breaches to $2.1 trillion globally by 2019, increasing to almost four times the estimated cost of breaches in 2015[17].

As we move to a significantly more connected world with the proliferation of sensors and software systems, there

is an increasing need for a whole system approach to security, assuring the environments in which we operate at home, at work and socially. As the RAE/EIT report[16] proposes this involves the development of "a coherent suite of technology-independent codes, guides and specifications ... that provide rigorous performance, compliance and resilience frameworks both for the implementation of new infrastructure and for the phased improvement in the resilience of legacy systems".

These requirements offer major opportunities for Scottish companies to develop market leading expertise in a range of areas, such as consultancy, penetration testing, secure system design and development, and the creation of new product solutions.

The current systems and threats must also be addressed; many of which are related to business process invasion, inexperience and social engineering. As a practical set of guidelines, we welcome the strategy set out recently by Scottish Government and the Scottish Business Resilience Centre offering a set of measures to help protect individuals and organisations.

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a coherent suite of technology-independent codes,
guides and specifications is needed… that provides rigorous performance,
compliance and resilience frameworks both for the implementation of new
infrastructure and for the phased improvement in the
resilience of legacy systems

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Royal Academy of Engineering

WE RECOMMEND

Immediately
- Industry and the public sector giving continued support to the recommendations of the Scottish Business Resilience Centre
- continuing the development of specialist modern apprenticeships, college and university modules in cybersecurity

Within one to two years
- retraining appropriately skilled and motivated staff across a wider range of security disciplines. The CodeClan model may provide some guidance on how that might be achieved

Productivity

ScotlandIS worked with SCDI, the Royal Society of Edinburgh and BT Scotland to produce SCDI's Digital and Productivity strategy, 'Digital solutions to the productivity puzzle'[18] outlining in detail some of the key measures required across the economy. To deliver real productivity gains digital must become integral to all aspects of strategy and delivery in government, business and public services.   Harnessing data to make smarter decisions that reduce cost and increase productivity should become 'business as usual'.

"

Digital skills can encourage innovation, boost productivity and deliver sustainable economic growth

Nicola Sturgeon MSP, First Minister

Digital solutions to the productivity puzzle

What could digital technology deliver for productivity growth?

scdi Scottish Council for Development and Industry

Engaging Civic Scotland: Driving Economic Growth

BT at the heart of Scotland | THE ROYAL SOCIETY OF EDINBURGH | ScotlandIS

scdi.org.uk

SCDI RECOMMEND[18]

ScotlandIS fully supports the key recommendations on economic transformation which are summarised below:

Immediately
▫ Creating clear targets to develop businesses towards the upper end of the Digital Economy Maturity Index. The aiming point should be for all businesses in Scotland to be at "Enthusiastic Explorer" level or above,
▫ Enhancing the role of the Digital Scotland Business Excellence Partnership (DSBEP) to identify and drive areas where smart utilisation of digital technology can increase productivity across all sectors and sizes of business (whether private or public sector)

Within one to two years
▫ Establishing a Scottish Productivity Commission, modelled on the international best practice such as those in Australia and New Zealand, to provide independent research, advice and performance monitoring to government and all sectors, under the direction of the Council of Economic Advisers
▫ Appointing Digital Champions to all the Scottish Enterprise's Industry Leadership Groups.

Within five years
▫ Ensuring as business models change, services are redesigned and there is an understanding of the technology and leadership at the most senior levels. Scottish Government's Digital Champions Programme is an example of one such initiative aimed at developing a new cadre of digital leaders.

Digital inclusion

There are more than 1.6 million Scots under the age of 26, many of whom voted for the very first time in the 2014 independence referendum. Whatever their politics, all of these young people have one thing in common: none of them has ever known a world without the internet.

Scotland is on the way to being a digital nation. However 800,000 citizens are still digitally excluded, with one in five households without an internet connection:only four in ten have a tablet computer. 40 per cent of the population doesn't yet use a smartphone. For those who have the access, motivation and skills to get things done online, life is immeasurably enhanced. But still far too many people risk being left behind.

If this were just a case of missing out on a few distracting websites and celebrity tweets then we might think nothing more of it. But the stakes are so much higher. The internet helps people keep in touch, gather information, learn new skills, save money, find work and stay healthy. For some people it's been a genuine life saver. Increasingly services such as banking, NHS24, and local authority information are exclusively online. These things matter to everyone, and they should be for everyone.

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The internet is the organising principle of our age,
touching all our lives, every day.

*Martha Lane Fox, Baroness
Lane-Fox of Soho, CBE*

However, for Scotland to be a truly digital nation we need to do more than simply help more people access the internet or increase the use of technology to keep our citizens safe, secure and healthy in their own homes. It means that we need to find ways to utilise the skills and talent inherent in many of the 800,000 citizens who are digitally excluded in some way. That will help fill the skills gap and offer opportunities to develop new and exciting businesses and services.

Digital inclusion is an essential foundation for achieving all the benefits of a truly digital Scotland. Having made essential investments in digital infrastructure and digital public services, Scottish Government must now make a significant and sustained investment to ensure everyone in Scotland has the basic digital skills required to participate online. The many initiatives already running across Scotland, coordinated and supported by SCVO and its partners, provide a strong foundation for this - and with the right support can be accelerated and scaled to make digital exclusion a thing of the past.

WE RECOMMEND

Immediately
- Building on the work undertaken by SCVO and others to create a Scotland wide public education programme
- Extending the Digital Economy Maturity Index established by the Digital Scotland Business Excellence Partnership to cover digital inclusion

Delivering culture change

Much of the technology and the systems needed to deliver the advances highlighted in the opening section of this paper already exists. However we should not underestimate the scale of the cultural change required to encourage the whole population to embrace and take advantage of the digital revolution.

In any area of activity from public services, in education, through work and in leisure and recreation, well-designed systems can easily be undermined by people's cultural preferences and traditional ways of working — for example, when employees are intimidated by the new practices required by digital technologies, due to a lack of experience. We need to address this recognising that individuals may fall into one of several categories, from digitally adept through those reluctant to change to citizens who are currently digitally excluded through financial, age and geographic barriers.

The issues are succinctly summarised by the MIT Sloan School of Management : While digital technologies are rapidly transforming both business practices and societies and are integral to the innovation driven economies of the future, they are also the core driver of the great economic paradox of our time. Rapid advances in technology are creating unprecedented benefits and efficiencies, but there is no economic law that says everyone, or even a majority of people, will share in these gains[19].

While technology is advancing rapidly, organizations and skills advance slowly. What's more, the gap between swiftly evolving technology and the slower pace of human development will grow quickly in the coming decades, as exponential improvements in artificial intelligence, robotics, networks, analytics, and digitization affect more and more of the economy and society. Inventing effective organizations and institutions for the digital economy is the grand challenge for our time."

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> Inventing effective organizations and institutions for the digital economy is the grand challenge for our time."
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> **MIT Sloan School of Management**

This is partly about digital inclusion but also involves creating a common understanding and shared vision of the benefits that will accrue to individuals, society and the economy which will only happen if we can plan for and motivate everyone to be involved. It will also need a more equitable distribution of resources and wealth. As a society we should prepare for this by for example introducing a shorter working week and encouraging more sabbatical leave.

WE RECOMMEND

Immediately
- Extending the business pledge to include a target for reducing the working week to 30 hours by 2025
- Ensuring all MSPs and Councillors attend 'technology training sessions'
- Commissioning BBC Scotland in its role as public service broadcaster to create a series about the benefits to be gained from a digital world, the accelerating pace of change and the impact this will have on everyone

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References

□ 1 - Page 5 - *bcg perspectives, 9th April 2015,* Industry 4.0: the Future of Productivity and Growth in Manufacturing Industries

□ 2 -Page 2, Pg 5 - *Scottish Futures Trust/Deloitte, July 2015,* The economic and social impacts of enchances digitalisation in Scotland

□ 3 - Page 6 - *Digital Agenda for Europe,* Broadband Strategy & Policy

□ 4 - Page 7 - *KPMG, December 2015,* KPMG Tech Monitor

□ 5 - Page 8 - *Tech City UK, February 2015,* Tech City Tech Nation

□ 6 - Page 8 - *Wauters, R., Tech.eu, 21st October 2015,* European Digital City Index

□ 7 - Page 8 - *Rookie Oven, website,* Rookie Oven

□ 8 - Page 9 - *REAP Scotland, 2014,* Increasing Innovation driven entrepreneurship in Scotland

□ 9 - Page 9 - *Deloitte, 2016,* Deloitte Technology, Media and Telecommunications 2016 Predictions

□ 10 - Page 10 - *Roberts, H., HR Magazine, 28th April 2014,* Lack of women in IT costing UK £2.6 billion a year

□ 11 - Page 10 - *Skills Development Scotland, ScotlandIS and the Scottish Government, March 2014,* Skills Investment Plan for Scotland's ICT & Digital Technology sector

□ 12 - Page 10 - *Teach First, website,* Teach First

□ 13 - Page 11 - *Engage, Invest, Exploit, website,* Engage, Invest, Exploit

□ 14 - Page 12 - *CORDIS, 20th July 2005, Journal Ref. 2005- of 2005-07-20, Legislative Ref. COM(2005) 330 final of 2005-07-20, OTH LISBON STRATEGY -* The Lisbon Strategy for growth and jobs

□ 15 - Page 14 - *ScotlandIS, 2008 - 2005,* Scottish Technology Industry Survey

□ 16 - Page 15, Pg 16 - *Royal Academy of Engineering, November 2015,* Connecting data driving productivity and innovation

□ 17 - Page 16 - *Juniper Research, 12th May 2015,* Cybercrime will cost businesses over $2 trillion by 2019

□ 18 - Page 18 - *Scottish Council for Development and Industry, January 2016,* Digital solutions to the productivity puzzle

□ 19 - Page 20 - *MIT Sloan School of Management, website,* The New Initiative on the Digital Economy

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