

Building a World-Leading AI and Data Strategy for an Inclusive Scotland

Foreword

One year ago, SCDI, BT Scotland, ScotlandIS and the RSE published *Automatic...For the people?*

Our report asked how Scotland can harness the technologies of the Fourth Industrial Revolution to increase economic and social prosperity. We drew inspiration from the progressive ethos of the Scottish Enlightenment and how this sparked Scottish leadership in the First Industrial Revolution.

We suggested that an increase in and democratisation of knowledge has been a key feature of each industrial revolution, and that Scotland has progressed through eras of economic change with wider access to education and better technologies and networks. But there is another side of the story in the origins of the Information Society – one told by US historian James Beniger in *The Control Revolution* (1986) in which he described how a need to manage and control the increasing production from each industrial revolution required a corresponding growth in the exploitation of information.

With the invention of the internet in the early 1990s both the access to information for people and the need and capacity of industry to manage and control information increased exponentially¹. Digital connectivity became the most powerful medium of globalisation. The world's most valuable companies became those most proficient in global exploitation of data and information technologies.

In its *Global Competitiveness Report*², Klaus Schwab, the World Economic Forum's Chair, said: "Embracing the Fourth Industrial Revolution has become a defining factor for competitiveness...I foresee a new global divide between countries who understand innovative transformations and those that don't. Only those economies that recognise [its] importance...will be able to expand opportunities for their people."

The different business models that have emerged have allowed global oligopolies to arise, public trust has been dented by recent data scandals in Big Tech and more traditional industries along with deepening concerns about what Shoshana Zuboff calls 'surveillance capitalism'³. It is arguable that in the race to exploit data and achieve scale, global digital platforms in particular have not yet developed a corporate moral model, with strong checks and balances, recognising the individual's rights to control their data.

Amid such change and uncertainty it may be small wonder that some people want to take back control. Formal institutional structures have been challenged by the spread of information and misinformation, and content and malcontent. Throughout 2018, issues of democracy, disruptive change and data control became pervasive.

In such a febrile time in politics, there could be an understandable, though regressive, instinct among policy-makers, struggling with the complexities of digital technologies, to shut down innovation and avoid both opportunities and risks that are available through the Fourth Industrial Revolution.

While this remains possible, recent developments continue to demonstrate a more positive approach:

The EU, Norway and Switzerland have agreed a coordinated plan on AI⁴.

Following the AI Review and the identification of AI and data as 1 of 4 Grand Challenges in the UK Industrial Strategy, the UK Government and industry agreed the AI Sector Deal⁵.

Building on the ambitions in recent Programmes for Government, the Scottish Government's Economic Action Plan⁶ and the Enterprise and Skills Board's Strategic plan⁷ set out new measures to increase productivity through leadership in technological and social innovation.

The Edinburgh and South East Scotland City Region Deal⁸ has been signed, committing the UK and Scottish governments, 6 member authorities, universities and colleges, and the private and third sectors, to the vision of establishing the city region as the data capital of Europe.

We summarise and welcome these and other examples of progress in relation to our strategic recommendations in each section of this report. But we have been challenged to go beyond *Automatic... For the people?* and help to define a Scottish Fourth Industrial Revolution action plan.

In creating this report, three workshops were arranged on the themes of:

Innovative and Ethical Data

Business Growth

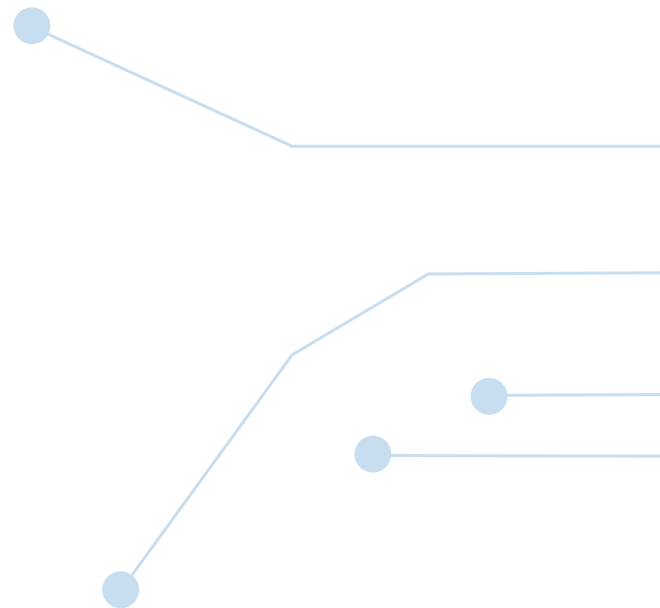
Employment, Skills and Education

To involve policy-makers more closely in the development of our thinking, we also led discussions at the Business in the Parliament conference and with the Cross Party Group on Science and Technology. We are very grateful to all those who participated in these conversations or spoke with us separately.

In a globalised world, there is a limit to what any nation state, let alone a small country such as Scotland, can do to 'control' this technological revolution. However, Scotland is not powerless and can take actions to produce better outcomes and, moreover, through its enlightened approach, to influence and lead, with partner countries, in key areas at an international level.

To do so, Scotland needs to be at the frontier of academic and industrial excellence, but as importantly of civic participation, drawing on our collective values of, and learning in, rationalism and humanism.

In the Fourth Industrial Revolution, weaving innovation and ethics throughout Scotland's policy-making, businesses and society can be a competitive advantage. This report recommends actions – but Scotland's aim, as an agile country and community, should be to develop a gold standard for bringing together society with fourth industrial revolution businesses to articulate a shared values-based vision and agenda.



¹<https://www2.deloitte.com/content/dam/Deloitte/ch/Documents/manufacturing/ch-en-manufacturing-industry-4-0-24102014.pdf> : https://www.ey.com/Publication/vwLUAssets/The_digitisation_of_everything_-_How_organisations_must_adapt_to_changing_consumer_behaviour/%24FILE/EY_Digitisation_of_everything.pdf etc

² <https://www.weforum.org/reports/the-global-competitiveness-report-2018>

³ www.shoshanazuboff.com/new/recent-publications-and-interviews/big-other-surveillance-capitalism-and-the-prospects-of-an-information-civilization/

⁴ <https://ec.europa.eu/digital-single-market/en/news/coordinated-plan-artificial-intelligence>

⁵ <https://www.gov.uk/government/publications/artificial-intelligence-sector-deal/ai-sector-deal>

⁶ <https://economicactionplan.mygov.scot/>

⁷ <https://www.gov.scot/publications/working-collaboratively-better-scotland/>

⁸ <https://www.gov.uk/government/publications/city-deal-heads-of-terms-for-edinburgh-and-south-east-scotland>

Introduction & Contents



Following a summary of the strategic themes and recommendations from the Automatic... For the people? report and an 'at a glance' update on progress in relation to them over the last 12 months, each section includes the policy context and the actions which are being proposed in this report.

The full strategic themes and recommendations from Automatic...For the People? can be found at:

scdi.org.uk/policy/automatic-for-the-people

In the section on Business Growth, the report provides an update on the delivery of digital infrastructure and connectivity, and the transition to investment in full fibre and 5G infrastructure.

Automatic...For the people? also included case studies by Albyn Housing Society Ltd on 'Health, Care and the Fit Home' and the Scottish Towns Partnership on 'Digital Towns'. These were intended to show the opportunities and challenges for sectors, services and places. We have included brief updates from each of them. We would, once again, like to thank those organisations for their input into our reports.

Contents

National Strategy	_____	6 - 11
Innovative and Ethical Data	_____	12 - 19
Business Growth	_____	20 - 31
Case Studies Update		21
Delivering Digital Infrastructure		30
Employment, Skills and Education	_____	32 - 39

Types of cognitive technologies

An important message from our discussions was that when people talk about AI they often do not differentiate between a range of cognitive technologies. These are at different stages of maturity and levels of sophistication. Glossing over these distinctions reduces our understanding of the opportunities and challenges with each of them, and can create a false impression of the capabilities or readiness of technologies, increasing concerns among the public. Deloitte⁹ offers these types:

Rules-based systems capture and use experts' knowledge to provide answers to tricky but routine problems. As this decades-old form of AI grows more sophisticated, users may forget they aren't conversing with a real person.

Speech recognition transcribes human speech automatically and accurately. The technology is improving as machines collect more examples of conversation. This has obvious value for dictation, phone assistance, and much more.

Machine translation, as the name indicates, translates text or speech from one language to another. Significant advances have been made in this field in only the past year. Machine translation has obvious implications for international relations, defence, and intelligence as well as, in our multilingual society, numerous domestic applications.

Computer vision is the ability to identify objects, scenes, and activities in naturally occurring images. It's how Facebook sorts millions of users' photos, but it can also scan medical images for indications of disease and identify criminals from surveillance footage. Soon it will allow law enforcement to quickly scan license plate numbers of vehicles stopped at red lights, identifying suspects' cars in real time.

Machine learning takes place without explicit programming. By trial and error, computers learn how to learn, mining information to discover patterns in data that can help predict future events. The larger the datasets, the easier it is to accurately gauge normal or abnormal behaviour. When your email program flags a message as spam, or your credit card company warns you of a potentially fraudulent use of your card, machine learning may be involved. Deep learning is a branch of machine learning involving artificial neural networks inspired by the brain's structure and function.

Robotics is the creation and use of machines to perform automated physical functions. The integration of cognitive technologies such as computer vision with sensors and other sophisticated hardware has given rise to a new generation of robots that can work alongside people and perform many tasks in unpredictable environments. Examples include drones, robots used for disaster response, and robot assistants in home health care.

Natural language processing refers to the complex and difficult task of organising and understanding language in a human way. This goes far beyond interpreting search queries, or translating between Mandarin and English text. Combined with machine learning, a system can scan websites for discussions of specific topics even if the user didn't input precise search terms. Computers can identify all the people and places mentioned in a document or extract terms and conditions from contracts. As with all AI-enabled technology, these become smarter as they consume more accurate data—and as developers integrate complementary technologies such as machine translation and natural language processing.

⁹ <https://www2.deloitte.com/insights/us/en/focus/cognitive-technologies/artificial-intelligence-government.html>

National Strategy

At a glance...progress since Automatic... For the people?

EU, Norway and Switzerland Coordinated Plan on Artificial Intelligence¹⁰ (see p8)

UK Industrial Strategy AI Sector Deal¹¹, Office for AI and AI Council etc

Scottish Government Economic Action Plan¹² – including investments in innovative industries, delivering a 5G strategy, supporting data driven innovation, investing in AI technologies etc

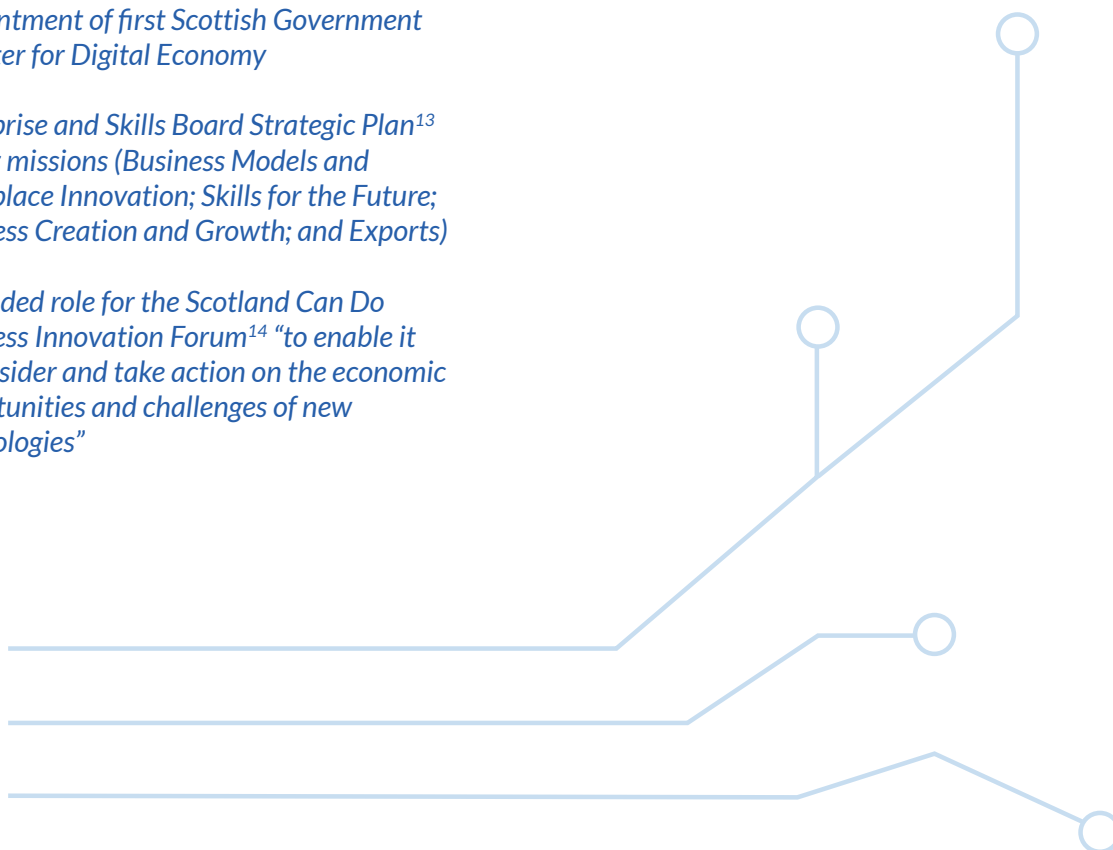
Appointment of first Scottish Government Minister for Digital Economy

Enterprise and Skills Board Strategic Plan¹³ – Four missions (Business Models and Workplace Innovation; Skills for the Future; Business Creation and Growth; and Exports)

Expanded role for the Scotland Can Do Business Innovation Forum¹⁴ “to enable it to consider and take action on the economic opportunities and challenges of new technologies”

Policy Context

A growing number of countries have published national strategies for AI technologies¹⁵. Currently, these total over 20, including the UK. These typically cover economic, social and environmental opportunities and challenges, as well as key issues such as data ethics. According to PwC, “Perhaps no other emerging technology has inspired such scrutiny and discussion”¹⁶. The World Economic Forum states that the Fourth Industrial Revolution marks a transition in the components of global competitiveness on which government, businesses and all parts of society must focus (see next page).



¹⁰ <https://ec.europa.eu/digital-single-market/en/news/coordinated-plan-artificial-intelligence>

¹¹ <https://www.gov.uk/government/publications/artificial-intelligence-sector-deal/ai-sector-deal>

¹² <https://economicactionplan.mygov.scot>

¹³ <https://www.gov.scot/publications/working-collaboratively-better-scotland/>

¹⁴ <https://www.gov.scot/groups/scotland-can-do-business-innovation-forum>

¹⁵ <https://futureoflife.org/national-international-ai-strategies/?cn-reloaded=1&cn-reloaded=1>

¹⁶ <https://www.strategy-business.com/blog/Is-AI-the-Next-Frontier-for-National-Competitive-Advantage?gko=9bfef>

New Defining Features of Global Competitiveness

In its The Global Competitiveness 2018 report¹⁷, The World Economic Forum introduced its new Global Competitiveness Index 4.0. This described four meta-concepts as not only drivers of economic success in the Fourth Industrial Revolution but also defining features. These are:

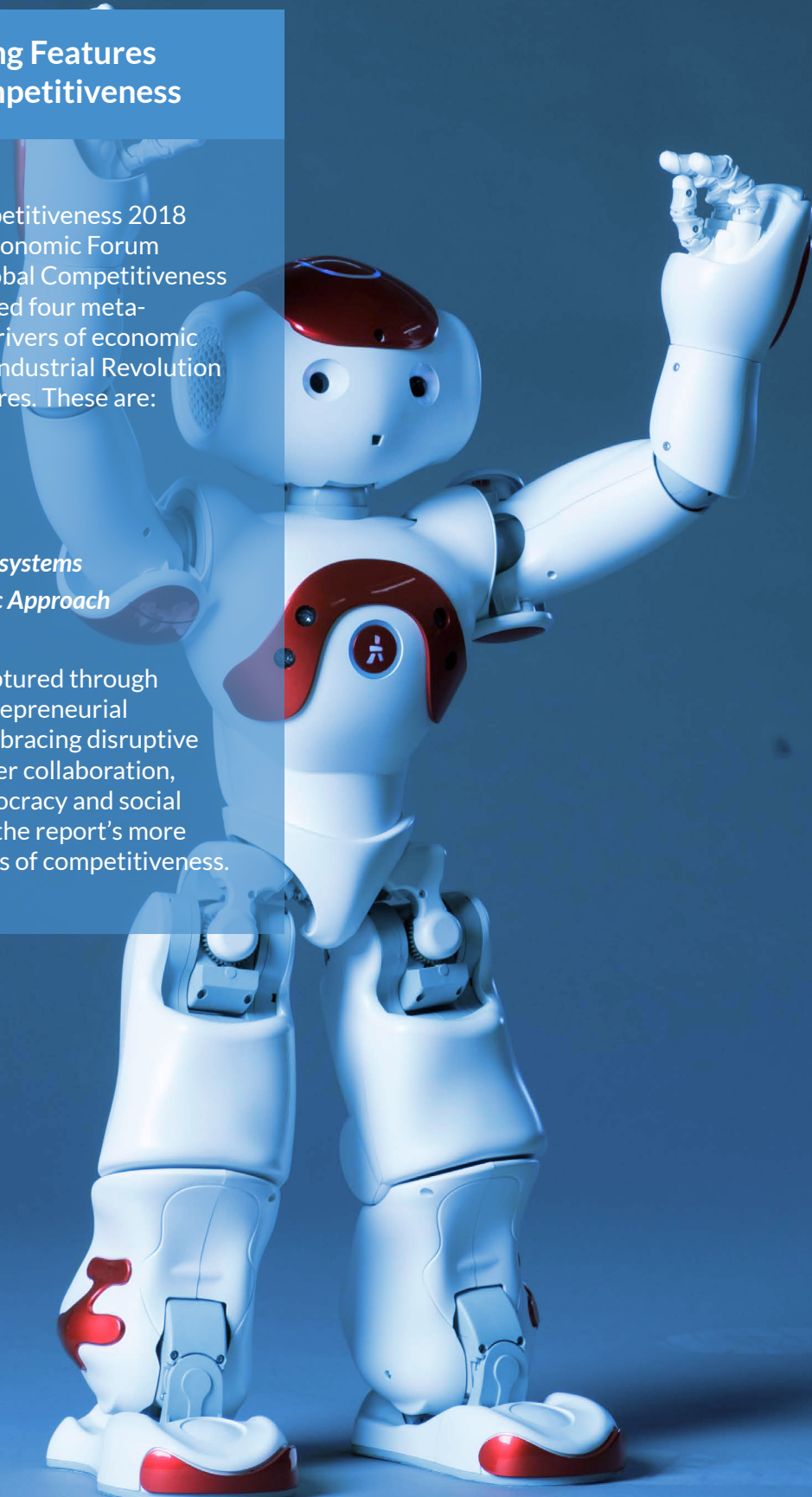
Resilience

Agility

Innovative Ecosystems

Human-centric Approach

These qualities are captured through indicators such as entrepreneurial culture, companies embracing disruptive ideas, multi-stakeholder collaboration, critical thinking, meritocracy and social trust, complementing the report's more traditional components of competitiveness.



¹⁷ <http://www3.weforum.org/docs/GCR2018/05FullReport/TheGlobal-CompetitivenessReport2018.pdf>

International organisations have also published strategies, including the EU with Norway and Switzerland (see below), as have international partnerships such as the Nordic-Baltic region. The EU has said that by the middle of this year all Member States should have their own strategies.

EU, Norway and Switzerland Coordinated Plan on Artificial Intelligence

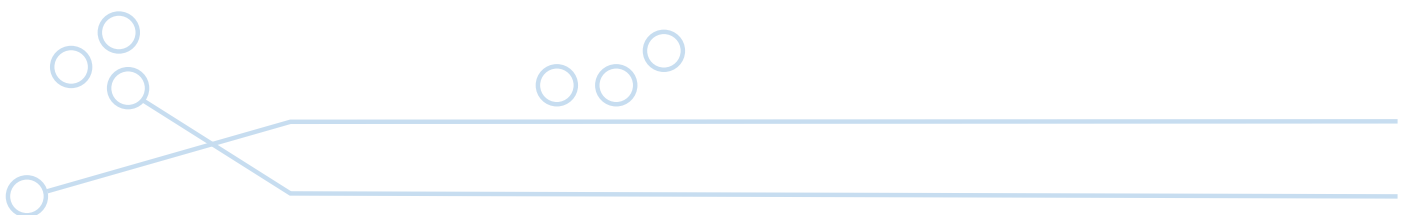
Following the publication earlier in the year of a strategy on AI, in December 2018 the EU, Norway and Switzerland presented a co-ordinated plan for 'ethical, secure and cutting-edge AI made in Europe'. This details actions at EU, national and regional levels, and rests on three pillars:

Boosting the EU's [with Norway's and Switzerland's] technological and industrial capacity and AI uptake across the economy, both by the private and public sectors

Preparing for socio-economic changes brought about by AI

Ensuring an appropriate ethical and legal framework, based on the Union's values and in line with the Charter of Fundamental Rights of the European Union

By mid-2019 all Member States should have their own strategies in place outlining investment levels and implementation measures, with common indicators to monitor AI uptake and development. A High-Level Expert Group on the impact of digital transformation on EU labour markets will deliver a report addressing strategies to deal with employment disruption in Spring 2019. A High-Level Expert Group on AI has recently consulted on draft AI ethics guidelines¹⁸.



Finland, a similar-sized country to Scotland, will hold the EU Presidency from 1 July 2019 and has said that it wants in its term to influence the EU agenda for AI based on its national AI strategy (see below), within the context of its main goal for its Presidency of advancing human rights¹⁹.

Finland's Age of Artificial Intelligence²⁰

Finland was the first country in Europe to publish a national AI strategy, in October 2017. It published a second report²¹, on work, in June 2018 and will publish a final one, on SMEs, this April. Finland, Sweden and Estonia plan to partner to become Europe's No.1 laboratory for AI test trials.

Starting as a small private initiative, a key part of the strategy has become the "1%" AI scheme. This will teach non-technology experts the basics of AI technologies, their opportunities and risks, starting with 1% of the population then expanding. With support from the Finnish Government and over 250 businesses, which will train their own staff, it is being extended nationwide.

In Automatic...For the people? we recommended that an inclusive Fourth Industrial Revolution Commission should be established to develop a strategy for Scotland. This has not yet been accepted, but we do welcome the increasing national focus over the last year by the Scottish Government. The refreshed Ministerial Team is bringing a renewed priority to innovation, including digital technologies: it has been building up its understanding of digital technology

trends and has initiated a strategic programme of work around the opportunities and risks for Scotland. The Scotland Can Do Business Innovation Forum has an expanded role, remit and membership. The Scottish Government has recently announced that it will develop a data and informatics partnership with business and academia to support Scotland as a global centre of excellence²², and it is creating a Data Delivery Group.

¹⁸ <https://ec.europa.eu/digital-single-market/en/news/draft-ethics-guide-lines-trustworthy-ai>

¹⁹ <https://um.fi/documents/35732/0/EN+pj-kauden+ohjelma+EN+FI-NAI+%281%29.pdf/7ec9bd79-b48c-431c-e260-6e7c83d93894>

²⁰ http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/160391/TEMrap_47_2017_verkkojulkaisu.pdf?sequence=1&isAllowed=y

²¹ <https://tem.fi/en/publication?pubid=URN:ISBN:978-952-327-313-9>

²² <https://www.gov.scot/publications/scottish-budget-2019-20/pages/9/>

Recommended Actions

1

Scotland should have a national strategy for AI technologies and data, building on recent progress.

This should:

Map onto its new National Performance Framework (see next page)²³.

Identify opportunities for Scotland to be at the forefront of global best practice.

Set out Scotland's approach to increasing participation, engaging and influencing in the UK, EU and global structures and networks, and explore opportunities for international partnerships.

Comments

Scotland's National Performance Framework now incorporates the UN Sustainable Development Goals²⁴. The EU's High-Level Expert Group on Artificial Intelligence has said that AI is key to addressing many of the grand challenges in the UK Sustainable Development Goals and McKinsey has analysed potential applications²⁵.

National strategies for AI often include similar policies and the growing number make differentiation more difficult to achieve. But there are opportunities to build excellence and articulate an ethos for ethical data. In some areas Scotland may be an agile adapter and adopter; in others, such as a fair work strategy for new technologies, Scotland can take a lead.

We believe that Scotland and the UK should continue to work closely with the EU, Norway and Switzerland on the Coordinated Plan on Artificial Intelligence. Scotland should also develop alliances with other small countries (e.g. Nordic-Baltic, Ireland etc) with shared goals and values. These partnerships could seek to increase the influence of the countries on tech and its global regulation, or offer attractive propositions for investment.

Scotland's National Performance Framework



²³ <https://nationalperformance.gov.scot/>

²⁴ https://ec.europa.eu/futurium/en/system/files/ged/ai_hleg_draft_ethics_guidelines_18_december.pdf

²⁵ <https://www.mckinsey.com/featured-insights/artificial-intelligence/applying-artificial-intelligence-for-social-good>

²⁶ <https://nationalperformance.gov.scot/>

Innovative & Ethical Data

Summary of Automatic...For the people Recommendation

Take a global lead in developing safe, innovative and ethical data strategy

At a glance...progress since Automatic...For the people?

*UK Industrial Strategy AI Sector Deal²⁷
- plan for new Centre for Data Ethics and Innovation²⁸*

*New funding for Innovation Centres,
including The Data Lab²⁹ and CENSIS³⁰*

*Edinburgh and South East Scotland City
Region Deal³¹- £350m over 15 years to
support the development of data-driven
research partnerships and an increase in
graduate data skills*

*Unicef Data for Children Hub to be based
in Edinburgh*

*Edinburgh Futures Institute chair and research
programme into data and AI ethics³²*

*Reforms to the governance of UK technological
innovation³³*

*Scottish Digital Health and Care strategy³⁴
and funding for clinical imaging data resource*

*Scottish Cyber Resilience Economic
Opportunity action plan³⁵*

*New promotional strategy for Digital
Scotland to be launched*

Policy Context

Large quantities of high-quality data are fundamental to how the latest wave of AI technologies function, providing the information from which machine

learning and performance can improve.

Digital platforms and aggregators have become exceptionally popular, offering data-based services, often at no cost, which many people value and infrastructure on which the modern economy runs – such as search services, social sharing services and marketplaces for sellers³⁶.

However, political and public concerns about the exploitation and security of data are at a heightened state. This not just due to examples of bad practice and behaviours in the past and present, but because a small number of big tech companies - with their large scales, datasets and balance sheets - may be able to dominate the emerging market for AI technologies for an indefinite period, creating unfair advantage in these markets³⁷. This is leading to a plethora of proposals from governments, political parties and civil society for how to reform regulation within and across the multiple jurisdictions which big tech companies and their services span.

International and national strategies for AI technologies must therefore start to address both competitive advantage and the public interest (see p14). Countries want AI technologies to stimulate innovation, grow domestic industries and increase national productivity - and deliver societal benefits and social good. While the debate on innovative and ethical data is coalescing, this has not negated the opportunity for Scotland to gain a first mover advantage with the right strategy and delivery.

As a small country, it should be more straightforward to consult widely, agree and deliver a strategy. There is a critical mass of organisations in the private, public and social economy sectors interested in the theme who would work together – and with a strong sense of urgency. Scotland does not have ‘superstar’ digital platform companies and, therefore, has an opportunity to embed ethics at an earlier stage in its own tech businesses. Its more mature businesses and sectors, such as financial services, need to consider ethics and how this will benefit business partners and customers. Scotland also has a sense of community and an ability to articulate some widely shared values.

Taking this forward will, however, require a fresh approach by the Scottish Government, which thinks population-wide, engages people alongside politicians and is highly participative. Tech companies are also

different in character from traditional companies - for example, due to their business models, workforce demographics and disintermediated access to global customers and audiences - and need to be engaged in a different way.

The additional benefit, key to the next stage of the strategy, would be deepening familiarisation with AI technologies and data among the public and policy-makers. An informed population with higher levels of trust will be better placed, for example, to be able to explain and understand automated decision-making, embrace AI technologies alongside collective intelligence to improve rather than replace

human decision-making, and give consent to data sharing which is essential to the development of data commons from which new insights and innovative services can be formulated.

The strategy also has to interface with and influence UK and international strategies because both companies and consumers operate in a global market. An approach which is not exclusive to individual organisations or countries will, for example, reduce confusion for the public, make it less complex for people moving between jobs in multi-job careers, and support investment in Scotland and trade.



²⁷ <https://www.gov.uk/government/publications/artificial-intelligence-sector-deal/ai-sector-deal>

²⁸ <https://www.gov.uk/government/consultations/consultation-on-the-centre-for-data-ethics-and-innovation/centre-for-data-ethics-and-innovation-consultation>

²⁹ <https://www.thedatalab.com/news/2018/the-data-lab-secures-13-5m-scottish-government-funding>

³⁰ <https://digit.fyi/censis-funding-scottish-government-tech/>

³¹ <https://www.gov.uk/government/publications/city-deal-heads-of-terms-for-edinburgh-and-south-east-scotland>

³² <https://digit.fyi/baillie-gifford-pledges-5m-to-edinburgh-university/>

³³ <https://www.gov.uk/government/publications/reforming-the-governance-of-technological-innovation>

³⁴ <https://www.gov.scot/publications/scotlands-digital-health-care-strategy-enabling-connecting-empowering/>

³⁵ <https://www.gov.scot/publications/cyber-resilience-economic-opportunity-key-actions-2018-2021/>

³⁶ <https://institute.global/insight/renewing-centre/new-deal-big-tech>

³⁷ <https://institute.global/insight/renewing-centre/new-deal-big-tech>

Innovative and Ethical Data in EU, UK, Scottish Edinburgh City Deal Strategies

In May 2019, the EU, Norway and Switzerland's Artificial Intelligence High-Level Expert Group will recommend how to invest around EUR 1.5bn to establish world-leading testing and experimentation sites for AI-powered products and services throughout Europe³⁸. The EU's High-Level Expert Group on Artificial Intelligence will publish its final draft Ethics Guidelines in March 2019.

The UK Government is investing in AI and data innovation through the Industrial Strategy Challenge Fund³⁹. A new Centre for Data Ethics and Innovation will advise on the ethical use of data⁴⁰, a Data Ethics Framework has been published for public sector organisations⁴¹ and pilots have been announced for Data Trusts, which are mechanisms for data sharing⁴². Governance structures have been set up for areas of the Deal, however, representation from Scotland on these appears to be generally low.

The UK Government is also reforming regulation of technologies, including a new

horizon-scanning partnership⁴³, and has agreed a new partnership with the World Economic Forum Centre for the Fourth Industrial Revolution, based in San Francisco, to develop a new approach to regulation⁴⁴.

The Edinburgh and South East Scotland City Region Deal has a vision that in 10 years Edinburgh will be the Data Capital of Europe – known not only for data driven innovation but for 'doing data right'. Investment in data storage and analysis technology, Research, Development and Innovation hubs, and business innovation support will be subject to an ethical charter overseen by a new University AI & Data Ethics Advisory Board (AIDE).

The Scottish Government is currently establishing a Data Delivery Group to review progress with Scotland's Digital Strategy⁴⁵ and to deliver a high-level delivery plan for data innovation. Scotland has strengths such as informatics, cyber security and a relatively well-integrated public sector for data sharing.

Recommended Actions

2

Scotland's national vision and strategy for AI technologies and data should fundamentally increase its population-wide and industry capacity for leadership in 'enlightened automation'.

We propose that:

The Scottish Government has the opportunity to demonstrate innovation and inspire other countries through an inclusive method of building this strategy with the people of Scotland and new industries, in both the online and offline worlds.

The Scottish Government, with support from businesses, should introduce a scheme, inspired by Finland's "1 percent scheme", to teach a growing percentage of citizens the basics of AI.

The Scottish Government, educational institutions and industry should expand opportunities to demonstrate real work AI technologies and data applications in public settings where people of different ages and from different backgrounds can engage with them.

Comments

The Scottish Government should consider applying the Citizens' Assembly model recently established in Ireland to Scotland's national AI strategy.

Politicians, policy-makers, industry leaders and trade unionists should participate alongside other citizens in an AI scheme, and enable and encourage the participation of colleagues and citizens.

The expansion and development of 3D printing in every Scottish public library service is a positive model. Creative tools should be harnessed to engage with the public – for example, an Ethics Game, potentially developed via the RSE's Unlocking Ambition challenge fund – and schools projects.

³⁸<https://ec.europa.eu/digital-single-market/en/news/coordinated-plan-artificial-intelligence>

³⁹<https://www.gov.uk/government/publications/artificial-intelligence-sector-deal/ai-sector-deal>

⁴⁰<https://www.gov.uk/government/consultations/consultation-on-the-centre-for-data-ethics-and-innovation/centre-for-data-ethics-and-innovation-consultation>

⁴¹<https://www.gov.uk/government/publications/data-ethics-framework>

⁴²<https://theodi.org/article/uks-first-data-trust-pilots-to-be-led-by-the-odi-in-partnership-with-central-and-local-government/>

⁴³<https://www.gov.uk/government/news/business-secretary-hosts-first-cross-government-working-group-on-future-regulation>

⁴⁴<https://www.gov.uk/government/news/uk-and-world-economic-forum-to-lead-regulation-revolution-to-foster-industries-of-the-future>

⁴⁵<https://www.gov.scot/publications/realising-scotlands-full-potential-digital-world-digital-strategy-scotland/>

3

The UK and Scottish Governments should continue to increase investment in research in AI technologies and challenge-based funding competitions, such as through the UK Industrial Strategy and CivTech.

Comments

The UK's future relationship with the EU should include strong academic cooperation, collaboration and exchange between the UK and its EU partners, and association with the next EU research and innovation programme, Horizon Europe, due to start in 2021.

Key Performance Indicators for higher and further education institutions should incentivise excellence in blue skies and impactful research.



4

The Scottish Government should establish Future Regulation Scotland, an independent advisory body on innovation, new industries and agile regulation.

This would advise on:

The nature of the evolving regulatory frameworks in the UK and the rest of the world and how they will affect Scotland's capacity to grow innovative industry sectors

Opportunities for Scotland to adapt national and international regulatory systems (e.g. by creative use of standards) to stimulate innovation and attract investment

Examples of legislation which are obsolete and a barrier to beneficial innovation

Comments

Future Regulation Scotland should develop links with the UK Government's emerging regulatory governance landscape, EU, World Economic Forum and the global tech industry. It should be supported by, and build, increased Scottish and/or UK research capacity in Scotland.

5

The Scottish Government, industry, education and civil society should develop clear, collective data ethics standards, which have an influence internationally as a gold standard model.

We recommend that:

A new Responsibility Standard should be developed, including Responsible Innovation and Responsible Engagement.

The Edinburgh Data Driven Innovation initiative should share its ethical framework for investments and continue to develop this iteratively – with a view to the adoption of common standards in Scotland. Fair work should be part of this ethical framework.

Scotland's international marketing campaigns, such as Scotland Is Now, and its Trade and Investment Strategy should promote its reputation for data innovation and ethics.

Comments

Scottish standards should interface with and influence UK and international data ethics frameworks, codes and standards.

Businesses should put in place robust internal or external governance frameworks, codes of conduct, training, Key Performance Indicators, and active customer and social dialogue. Businesses should share and learn from best practice wherever it is to be found. The cluster of Scottish data companies ScotlandIS is starting to develop will explore opportunities to support this. To instil good values in new tech companies in the key start up stages, Scottish tech incubators should consider common standards and shared resources.

Scottish businesses using AI technologies and data analytics should be open and transparent about their applications, and demonstrate strong ethics and trustworthiness. The Scottish Government should include data ethics as part of the refreshed Scottish Business Pledge.

6

The Scottish Government and all public sector organisations should commit to a single data sharing agreement for all public bodies, with a target date for its implementation.

Comments

People's consent for data sharing should be discussed in their touchpoints with public services. The Scottish Government should accelerate adoption of AI technologies and data driven innovation, benchmarking it against comparable private sectors such as finance and professional services, and other countries. Next generation public services should be redesigned around AI technologies and data.

Business Growth

Summary of Automatic...For the people? Recommendations

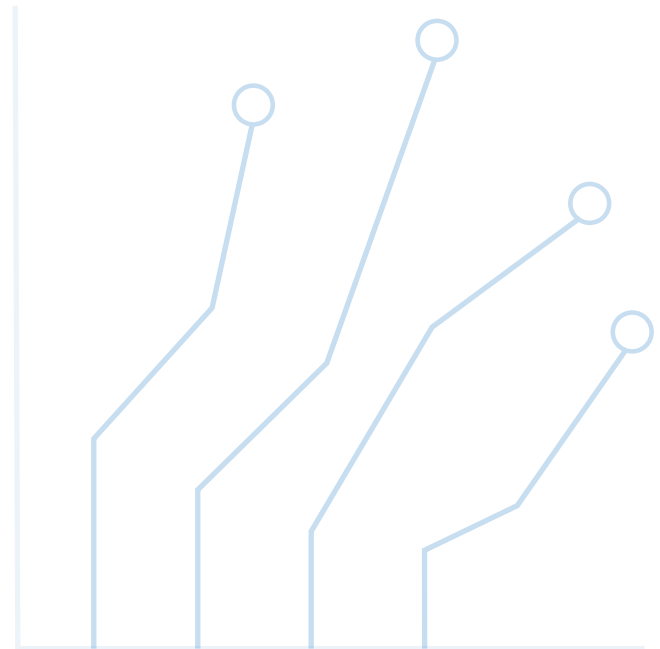
Accelerate investment in blue-skies and applied research, actions to more rapidly diffuse and adopt innovations in the economy, and active participation in the UK Industrial Strategy

Challenge and support businesses

Develop regional opportunities for data driven technological research and innovation

Support local communities, businesses and social enterprises to collaborate and innovate

Develop a 'fit for the Fourth' infrastructure, including digital and smart infrastructure



At a glance...progress since Automatic...For the people?

Scottish National Investment Bank Implementation Plan⁴⁶ and consultation⁴⁷

British Business Bank increasing presence and investment in Scotland⁴⁸

Continued development of National Manufacturing Institute for Scotland⁴⁹

City region and growth deals⁵⁰, including deals in 2018/19 for Stirling and Clackmannanshire⁵¹, Edinburgh and South East Scotland⁵², TayCities⁵³ and Ayrshire⁵⁴

Scottish Cities Alliance Smart Cities programme Phase 1 and Phase 2 announced⁵⁵

Scotland's Towns Partnership Digital Towns Programme Phase 1 leading to development of Cupar Digital Improvement Pilot (see case study)

South of Scotland Enterprise Bill⁵⁶ to create new economic development agency

New local digital strategies e.g. Digital Glasgow Strategy⁵⁷

Third round of CivTech digital accelerator programme⁵⁸

£2m funding from Transport Scotland to pilot Mobility As A Service projects⁵⁹

Digital support programmes for businesses e.g. Digital Growth Fund, DigitalBoost, #HelloDigital, Digital Leaders Scotland programme, Scottish Manufacturing Advisory Service Manufacturing 4.0 diagnostic, pilots of SCDI Productivity Clubs⁶⁰ etc.

NESTA ShareLab Scotland pilot, collaborative platforms to address social challenges⁶¹

In Automatic...For the people? we highlighted that health and social care offer opportunities to locate more data driven technological research and innovation in post-industrial and rural areas. We also highlighted emerging examples of how innovation can be catalysed at a local level through collaborative 'whole-community' approaches.

The Edinburgh Futures Institute is beginning to address societal challenges through data, such as in areas of multiple deprivation and in local healthcare provision⁶². Updates on the case studies in Automatic...For the people? also show progress in relation to these recommendations and illustrate the potential opportunities.

Scotland's Towns Partnership

Scotland's Digital Towns Programme 2017-18 recommended a new Digital Improvement District model and Cupar ('a typical rural town') has been chosen as a demonstration project to prove concept.

Borne out of the successful Kirkcaldy4All, which has seen the town's digital reach more than double in the last two years, CuparNow aims to provide a sustainable, business-led model for free public realm Wi-Fi and the daily management of integrated digital and social media for a range of residents and visitors.

In 28 days, 15,000+ people actively engaged with shared social media

content about the town, businesses and community organisations, and the reach topped 40,000. The project aims to forge new collaborations and early discussions since its launch in November 2018 include reducing plastic waste, engaging with local teenagers, and dementia care⁶³. A CuparNow Ambassador has been appointed to consult intensively with local businesses⁶⁴ which will vote on the proposal on 29th November 2019.

If successful, the network could be enlarged to provide greater support and coverage and a platform for Internet of Things applications, such as traffic flows, air quality and better business intelligence.

⁴⁶ <https://www.gov.scot/publications/scottish-national-investment-bank-implementation-plan/>

⁴⁷ <https://www.gov.scot/publications/scottish-national-investment-bank-consultation-paper-september-2018/>

⁴⁸ <https://www.insider.co.uk/appointments/british-business-bank-ian-mitchellmore-13807498>

⁴⁹ <https://www.gov.scot/publications/national-manufacturing-institute-scotland-nmis-statement-intent/>

⁵⁰ <https://www.gov.scot/policies/cities-regions/city-region-deals/>

⁵¹ <https://www.gov.scot/news/gbp-90-2-million-city-region-deal-for-stirling-and-clackmannanshire/>

⁵² www.acceleratinggrowth.org.uk/new-blog/2018/8/7/historic-13bn-edinburgh-and-south-east-city-region-deal-agreed

⁵³ <https://www.taycities.co.uk/news/heads-terms-signing>

⁵⁴ <https://www.gov.uk/government/news/uk-government-announces-100-million-for-ayrshire-growth-deal>

⁵⁵ <https://www.scottishcities.org.uk/media/press-releases/scottish-cities-alliance-announces-second-round-of-funding-for-smart-cities-programme>

⁵⁶ <https://www.gov.scot/policies/economic-growth/south-of-scotland-enterprise/>

⁵⁷ <https://www.glasgow.gov.uk/CHttpHandler.ashx?id=43572&p=0>

⁵⁸ <https://civitech.atlassian.net/wiki/spaces/CIV/pages/45847042/3.0+challenges>

⁵⁹ <https://maas-scotland.com/scottish-government-commits-to-2m-maas-investment-fund/>

⁶⁰ <https://www.scdi.org.uk/news-item/scdi-to-partner-with-scottish-government-on-productivity-club-pilots/>

⁶¹ <https://www.nesta.org.uk/blog/why-arent-there-more-collaborative-platforms-social-good/>

⁶² <https://efi.ed.ac.uk/news-events/>

⁶³ <http://www.cuparnow.blog/2019/01/28/cupar-dementia-friendly/>

⁶⁴ <http://www.cuparnow.blog/>

Albyn Housing Society Ltd

In response to the growing need for tailored, home-based support for local residents within their communities, Albyn Housing Society (AHS), in collaboration with NHS Highland, has developed a system of ambient monitoring with the overarching goal of enabling people to live safely in their homes for as long as they can.

AHS has delivered the first 16 of these units through the Inverness Highland City Region Deal, and it is on schedule to deliver another 32 in the wider Highland area. At the same time, AHS is partnering with Robert Gordon University to test whether machine learning can analyse the data from these first units to predict potential support need, initially around fall prevention. The Scottish Government's innovation centres, including DataLab, Censis and the Digital Health and Care Institute, are supporting this project.

AHS is also now working with other agencies to expand the test bed, initially

in Glasgow. This will increase the volume of health data being analysed by the machine learning model, which will improve research outcomes and enable further disease prediction. Ultimately, this will allow even more individuals to actively self-manage their own health and wellbeing.

The model driving this initiative includes private, public and third sector bodies, thereby facilitating collaboration driven solutions with a shared reward system. AHS wants to be able to access and collaborate with the best in the field, wherever they may reside commercially and geographically. For example, the AHS team is now having initial discussions with housing associations in England, and working towards expanding the model to include universities and public sector bodies. This is all part of AHS's ambitious to deliver a global initiative with the ability to provide health and care as a human right to all individuals.

Policy Context

Technology Sector

Scotland has a thriving and diverse tech sector⁶⁵, with over 1500 companies. Growth has outpaced the rest of the Scottish economy and this is forecast to continue. However, the sector also faces challenges.

There continues to be a systemic issue about the availability of finance in Scotland for the transition from start-up to scale-up company. In the US, companies can attract major investments in a short time. Here, less finance is available which companies

can quickly burn through. Funders often do not understand the need for speed in decision-making to rapidly gain scale and users. Too many Scottish companies are therefore bought out by international competitors and global technology companies before they have had a chance to grow. There is significant funding available in London, but we have heard that few Scottish companies seem to access it.

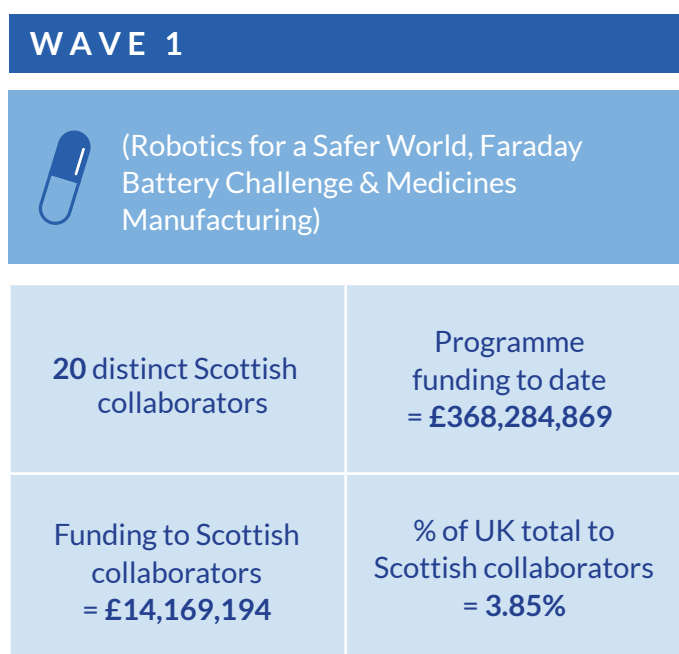
A further barrier to the growth of a self-sustaining tech ecosystem in Scotland is a shortage of available technical skills as well as leaders and managers who understand the tech industry, possess broader commercial, particularly international, skills and want to remain in executive positions within companies.

Scotland has some global centres of research excellence in AI technologies and data in higher education institutions which are key to its tech industry. These are major attractions to investment by global tech companies which become ‘anchor tenants’.

However, when compared with Golden Triangle institutions⁶⁶, Scottish institutions are not

participating to the same extent in the commercial aspects of AI technologies and data-driven innovation. Evidence so far from Waves 1 and 2 of the UK Industrial Strategy, bids for which are industry-led, suggests that Scotland is punching below its weight in winning innovation funding.

UK Industrial Strategy Challenge Funding from Innovate UK for AI and Data Grand Challenge⁶⁷



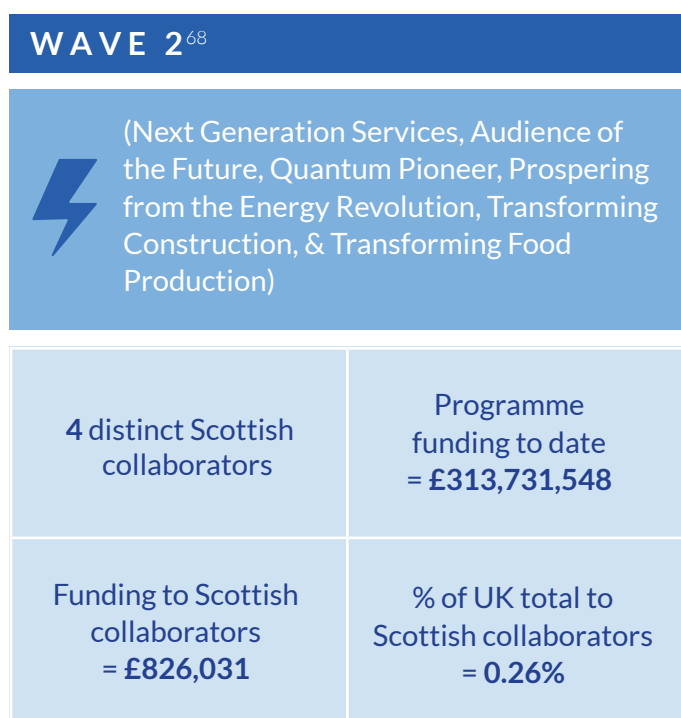
Scottish universities have recently reported that they have met or exceeded their targets to support enterprise and entrepreneurship in their student and staff communities⁶⁹. Student start-up numbers have grown by 53% since 2015, to 661 active companies, against a target of 25% over three years; 17,000 staff and students took part in enterprise and entrepreneurship workshops in 2018, against a goal of 14,000; and from 2015 to 2018 there were 250 applications from postgraduate students to Converge Challenge, Scotland’s leading higher education

⁶⁵ <https://technation.io/insights/report-2018/>

⁶⁶ The University of Cambridge; The University of Oxford; Imperial College London; King’s College London; London School of Economics; and University College London.

⁶⁷ Department for Business, Energy and Industrial Strategy statistics

⁶⁸ Healthy Ageing and Data to Early Diagnosis and Precision Medicine not yet available



company creation competition, with postgraduates making up 30% of all competition applications. To increase the impact of Scotland’s higher and further education institutions further, there is a continuing need to build on these actions and the recommendations of the RSE Economy and Enterprise Committee⁷⁰. Priorities include to connect more projects to commercial and real-world applications, and to engage more students, especially PhD students, in entrepreneurship and developing business skills.

⁶⁹ <https://www.universities-scotland.ac.uk/wp-content/uploads/2018/11/Made-It-Happen-FINAL.pdf>

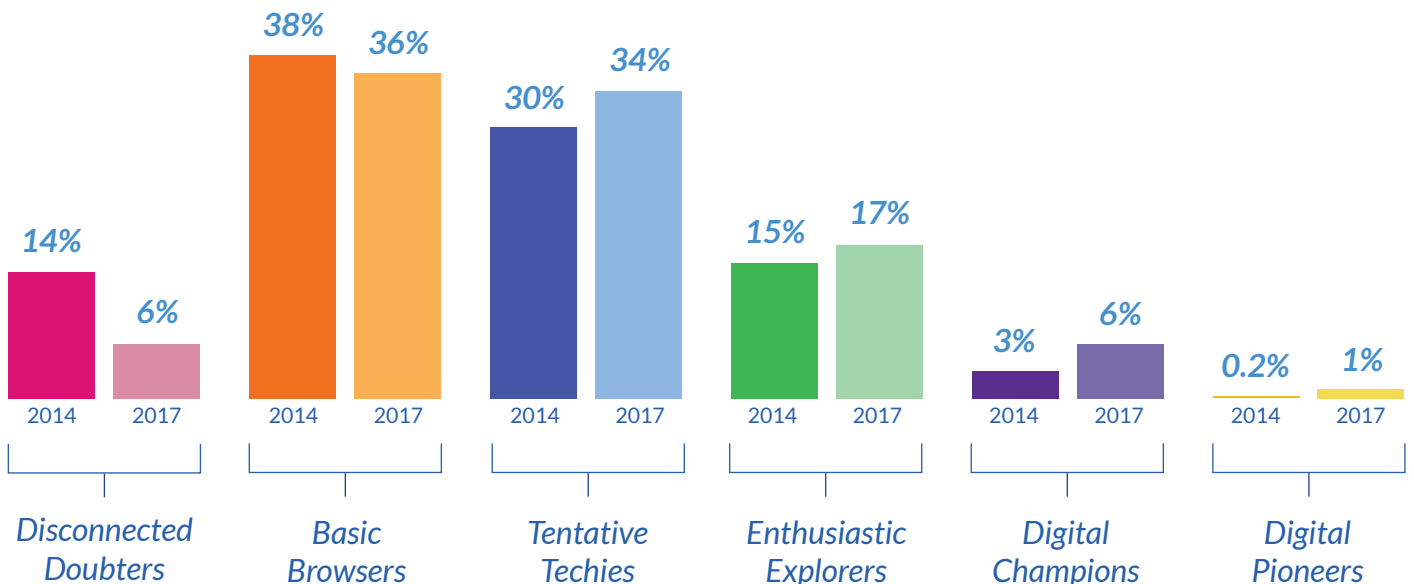
⁷⁰ <https://www.rse.org.uk/advice-papers/entrepreneurial-education-in-scotland/>

Digital Maturity

Scotland's Digital Economy Maturity Index measures the level of digitalisation in businesses. The latest survey (see below) found while there has been a slight upward movement in digital maturity since 2014, most businesses lie within the lower end of the index. Although 40% of businesses were using data analytics, the authors said that there is "still a need to encourage uptake of data analytics, cloud computing, and online collaborative platforms [even] among some...in the most mature groups."⁷¹

The latest figures for the UK Government's Gigabit Broadband Voucher Scheme (see p25), which helps businesses and residential customers pay for full fibre connectivity, suggests that per head demand for this capability in Scotland lags behind England and Northern Ireland, and needs to be increased.

Maturity Segments 2014-2017⁷²



Gigabit Voucher Broadband Scheme

	<i>Business</i>		<i>Residential</i>		<i>Total</i>	
<i>Nation</i>	<i>#</i>	<i>£</i>	<i>#</i>	<i>£</i>	<i>#</i>	<i>£</i>
England	2860	£7,659,451	498	£249,000	3358	£7,908,451
Northern Ireland	107	£309,006			107	£309,006
Scotland	167	£458,107			167	£458,107
Wales	28	£80,879			28	£80,879
Grand Total	3162	£8,507,443	498	£249,000	3660	£8,756,443

Scotland has a range of public sector funds to support businesses with their digital transformation. The Scottish Government created the Digital Scotland Business Excellence Partnership of private and public bodies which has designed and delivered interventions to help businesses increase their digital awareness, use and capability. The public sector has also partnered with private sector projects, such as Google Digital Garage, and the Amazon Academy, to offer workshops to SMEs. However, overall, it is clear that these programmes need greater traction. Many businesses, especially SMEs, lack time and money. There can be a drop-off in participation in programmes

when businesses need to keep pace and constantly refresh knowledge. There is a need to increase businesses' trust in the benefits of tech investments and de-risk them as far as possible. Scotland's tech centres of excellence need to be more accessible to its business base.

The growth rate of the global business-to-consumer ecommerce market is 66.4% and sales hit \$2.1tr in 2018⁷³. The UK is an ecommerce superpower, with regional centres centred around London and the West Midlands⁷⁴, but there is some evidence that Scotland lags behind other parts of the UK⁷⁵.

⁷¹ <https://www.gov.scot/binaries/content/documents/govscot/publications/research-finding/2018/03/digital-economy-business-survey-2017/documents/00533154-pdf/00533154-pdf/govscot:document/>

⁷² <https://www.gov.scot/binaries/content/documents/govscot/publications/research-finding/2018/03/digital-economy-business-survey-2017/documents/00533154-pdf/00533154-pdf/govscot:document/>

⁷³ <https://www.ecommercefoundation.org/free-reports>

⁷⁴ <https://www.indez.com/blog/uk-still-number-one-for-ecommerce/>

⁷⁵ <https://www.indez.com/blog/scottish-ecommerce-performance-update/>

Recommended Actions

7

The Digital Scotland Business Excellence Partnership⁷⁶ should be revitalised and chaired by the Minister for the Digital Economy.

Among the early areas of focus for the group could be:

Messaging for businesses and new tools to make learning more convenient and cost-effective

Increasing access to, and relevance of, research centres for more businesses

Comments

Tools should include one-stop shops, chatbots, 10-minute podcasts, social learning and proven packages and pathways e.g. cloud-delivered productivity technologies.

The Digital Scotland Business Excellence Partnership should monitor and measure the success and sustainability of public and private sector digital support programmes.

8

Scottish businesses should improve their performance in ecommerce. The Scottish Government, public agencies, industry and education should support a pilot of an Institute of Ecommerce.

Comments

A group of business representative organisations and other partners are supporting the development of an Institute of Ecommerce. This will aim to double the online economic performance of 1,000 businesses over five years.

⁷⁶ <https://www.gov.scot/policies/digital/digital-support-for-businesses/>

9

Scotland's higher and further education institutions should agree fresh goals and actions to accelerate enterprise and entrepreneurship among students, and the demand for and delivery of high quality Executive Education and work-based learning, building on recent progress.

We recommend that:

Institutions should further expand and integrate their programmes of support to PhD students who want to create a business from their research, including training, start-up funding, mentorship, assembly of a team, and introductions to potential investors and clients.

Business schools should develop and increase the availability of intensive training programmes for leaders and managers in the tech sector.

Business schools and businesses should consider the creation of an Intrapreneur-In-Residence programme because successful innovation often stems from the workplace.

Comments

Entrepreneurship education should teach a range of business models, such as the option of creating a durable business which they will operate in the long-term, and career paths, and not only the Venture Capital-backed model of scaling and selling the business fast.

Business know-how and entrepreneurship should be encouraged among all students.

The skills needed by leaders and managers in the tech sector may not be available in any one institution, so online learning platforms and institutions should continue to develop tailored training modules into one course with a qualification from them all.

10

The Scottish Government, UK Government, public agencies, industry and education should continue to improve the availability of and access to financing and funding opportunities which support Scottish tech businesses to scale-up.

We recommend that:

The Scottish National Investment Bank (SNIB) should be developed to bridge the investment gap for scale-ups, alongside the British Business Bank. The SNIB can also play a highly positive role in improving commercial funders' understanding about the funding and pace of decision-making required by scale-ups and disruptive business models.

The Scotland House Innovation & Investment Hub should can highlight the opportunity, facilitate introductions to London-based and global finance, and increase know-how.

The Scottish and UK governments and partners should continue to raise awareness of the opportunities in the UK Industrial Strategy AI and Data Grand Challenge and bid know-how.

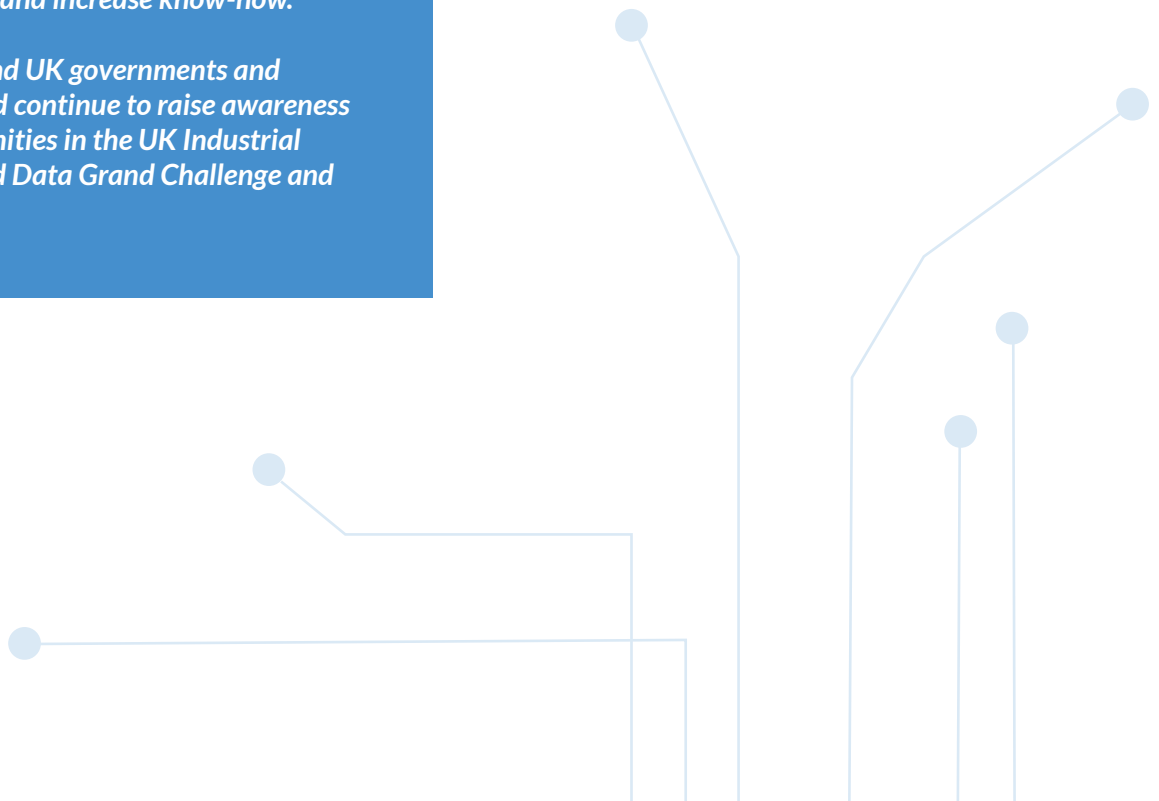
Comments

The EU has recommended that national promotional banks are involved in maximising investment in the scale-up phase of AI technologies.

The opportunities from AI technologies should be understood across each of the missions suggested for the SNIB – low carbon, ageing society and place.

A programme of regular trade visits to the Hub in London would enable peer-to-peer learning, similar to overseas trade missions.

Following FinTech Scotland, there is a need to support the emerging groups for the application of AI technologies in areas of Scottish sectoral strength e.g. LegalTech, AgriTech, EdTech.



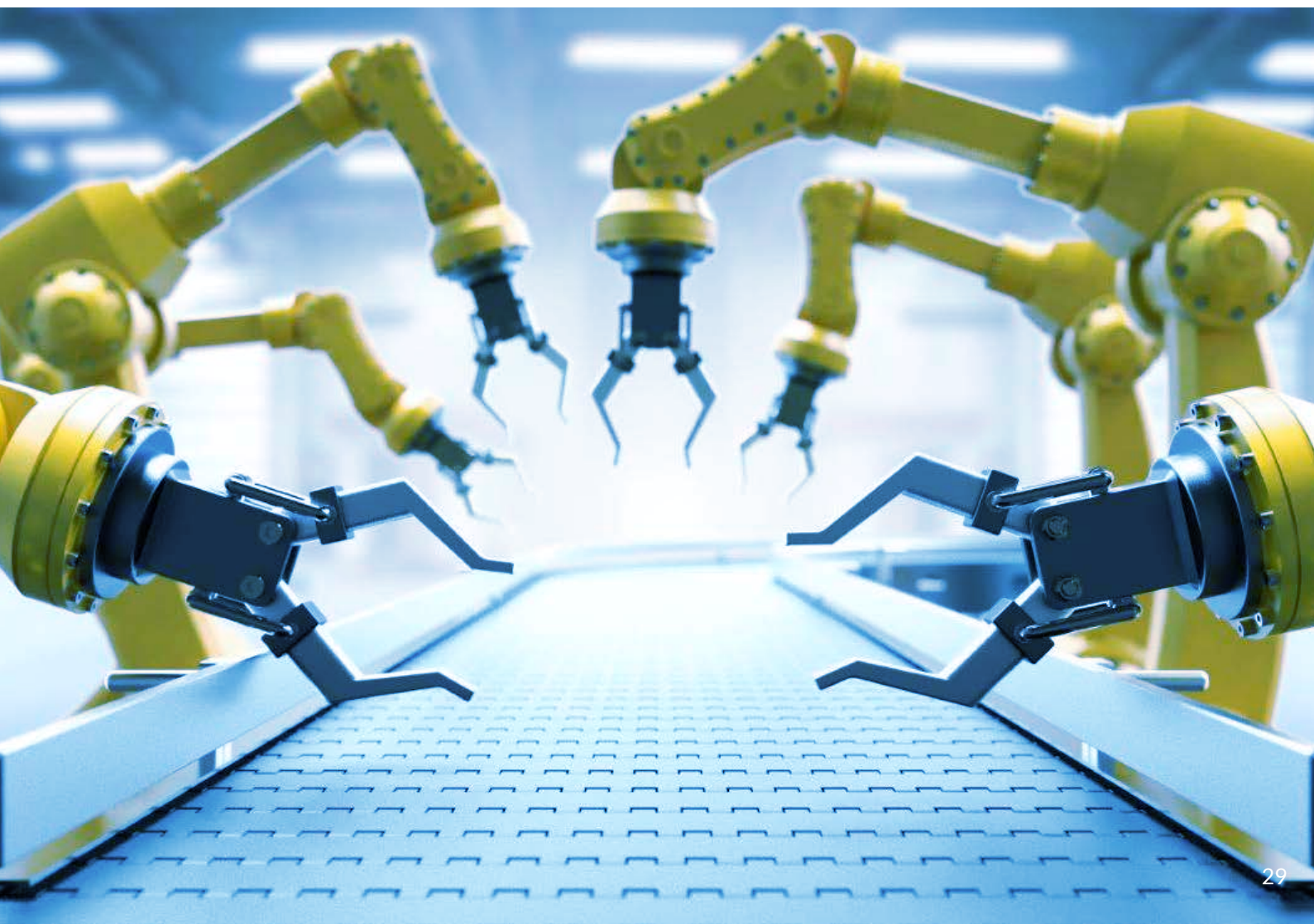
11

The Scottish Government, the Third Sector and the tech sector should tackle barriers to collaborative economy projects for social good.

Comments

The ShareLab Scotland fund, piloted by Nesta and the Scottish Government, has highlighted the need to bridge the finance gap for tech sector projects which cannot be rapidly monetised, and the need for stronger collaborations between data scientists and those who understand social and environmental challenges⁷⁷.

⁷⁷ <https://www.nesta.org.uk/blog/why-arent-there-more-collaborative-platforms-social-good/>



Delivering Digital Infrastructure

A key pillar for harnessing the technologies of the Fourth Industrial Revolution is the infrastructure and digital connectivity that underpins it, in which Scotland has made extensive national progress.

Next Generation Broadband Infrastructure

Due to the two Digital Scotland partnerships in the Highlands & Islands and the rest of Scotland, supported by investment from government and BT Group, over 900,000 more homes and businesses can now connect to fibre broadband. Combined with the commercial rollout, more than 2.5m Scottish premises are able to connect to fibre broadband services, using the service provider of their choice.

To meet the commitment to deliver superfast broadband access to 100% of premises in Scotland by 2021, the Reaching 100% (R100) programme is procuring further coverage, capable of delivering download speeds of at least 30Mbps, in areas where such broadband is currently unavailable.

Mobile Infrastructure

While Scotland's geography and population density continue to be a challenge, especially in rural areas, mobile networks have also made significant progress, particularly on 4G. Through predominantly private investment, the Scottish Government's Mobile Action Plan, has helped investment conditions, seeking to maximise the commercial impact of the Emergency Services Mobile Communications Programme, a world-leading 4G network for 'blue light' services, and ensuring Scotland is 5G-ready.

Towards Full Fibre and 5G

The next stage is the transition to full fibre and 5G technologies. The UK's ambition is full fibre coverage by 2033 and 5G for the majority of the population by 2027⁷⁸, for which the National Infrastructure Commission⁷⁹ has highlighted costs estimated

at around £40bn. The vast majority of funding is expected to come from the private sector so investment conditions will need to be right.

Government and Ofcom recognise that the regulatory, legal and fiscal environment needs to create incentives for competition, infrastructure investment and delivery in the most remote areas. For example, the Scottish Government is extending the business rates relief on new fibre build.

EE will be bringing 5G to Edinburgh and Glasgow in 2019⁸⁰, and it is key that businesses and the public sector seize these significant opportunities to innovate new ways of delivering services and experiences.



Recommended Actions

12

Government at all levels and industry need to work together on the ambition of delivering the world-class digital infrastructure for the Fourth Industrial Revolution.

Comments

How far and fast commercial deployment goes will be dependent on the investment, built environment and market investors face.

Develop a data centres strategy for Scotland, which supports delivery of Fourth Industrial Revolution technology capabilities and is highly connected to global networks.

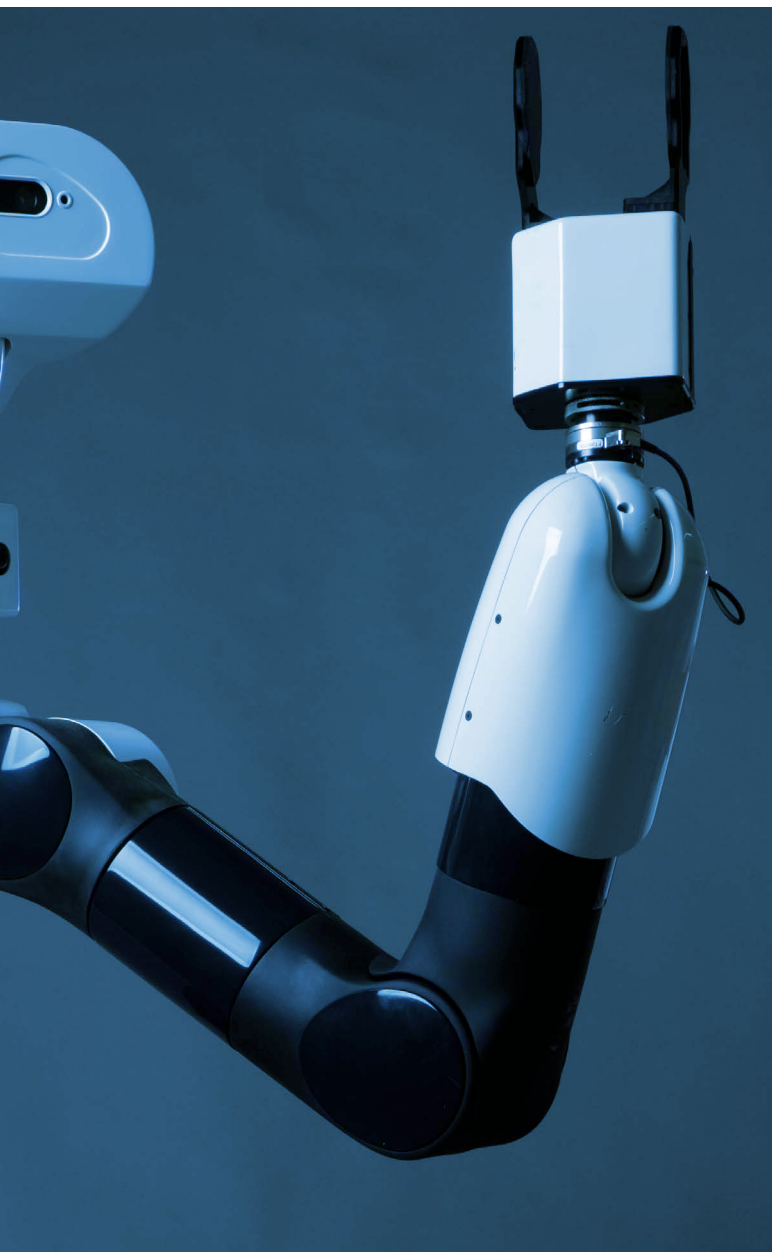
Ensure that national and regional policies offer an integrated approach across all aspects of infrastructure investment including transport, digital, and energy connectivity e.g. in the ongoing review of the National Transport Strategy to be followed by the Strategic Transport Projects Review.

The Scottish Government should continue to embed cyber resilience into critical infrastructure, working with the National Cyber Resilience Leaders' Board, Scottish Business Resilience Centre, public bodies, UK Government, the UK National Cyber Security Centre and the private sector.

⁷⁸ <https://www.gov.uk/government/publications/future-telecoms-infrastructure-review>

⁷⁹ www.nic.org.uk/publications/national-infrastructure-assessment-2018/

⁸⁰ <https://newsroom.ee.co.uk/ee-announces-5g-launch-locations-for-2019/>



Employment, Skills & Education

Summary of Automatic...For the people Recommendations

Redesign education, skills, training, lifelong learning and employment for the new world of work, to equip children from early years onwards and to re-equip the current workforce e.g. digital and data skills, 'meta-skills', work-based learning, re-learning jobs in an AI context and midcareer transitions

Encourage 'Fair Work' technology partnerships for new technologies and data in the workplace

Take immediate action to support "at risk" people and regions

Keep under review and test longer-term policy options for inclusive growth

At a glance...progress since Automatic...For the people?

Following the Enterprise and Skills Board Strategic plan⁸¹, the Scottish Government will publish a Skills Action Plan in the near future and it will establish a National Retraining Partnership

Publication of Scottish Government/STUC report Technological change and the Scottish labour market⁸²

CodeClan, Scotland's digital skills academy, will be expanding to Inverness in Spring 2019

Skills Development Scotland's Competitive Grant Programme for Digital Skills areas of focus included a review of international best practice in upskilling and reskilling; pilot approaches to career conversion into digital roles where their role is at risk due to automation; and pilot approaches to prepare staff for the impact of digitalisation

New Digital Start Fund to retrain up to 150 people on no or very low incomes per year⁸³

UK Government Good work plan⁸⁴ (implementing Taylor Review of Modern Working Practices)

Expert Advisory Panel on the Collaborative Economy report - Scottish Government response⁸⁵

Scottish Government provided £250,000 to Fife Council, City of Edinburgh Council, Glasgow City Council and North Ayrshire Council to undertake a feasibility study on a Citizens Basic Income pilot scheme, reporting by September 2019, with a full business case by March 2020⁸⁶

⁸¹ <https://www.gov.scot/publications/working-collaboratively-better-scotland/>

⁸² <https://www.gov.scot/publications/technological-change-scottish-labour-market/>

⁸³ <https://www.scotlandis.com/news/2018/december/new-fund-for-digital-skills-training-and-other-scottish-budget-news/>

⁸⁴ <https://www.gov.uk/government/publications/good-work-plan>

⁸⁵ <https://www.gov.scot/publications/scottish-government-response-scottish-expert-advisory-panel-collaborative-economy-report/>

⁸⁶ https://d1ssu070pg2v9i.cloudfront.net/pex/carnegie_uk_trust/2019/01/28123244/Exploring-the-practicalities-of-a-Basic-Income-pilot.pdf

⁸⁷ <https://www.pwc.co.uk/who-we-are/regional-sites/scotland/press-releases/More-than-50000-Scottish-jobs-could-be-created-through-Artificial-Intelligence.html>

⁸⁸ <https://ec.europa.eu/digital-single-market/en/news/coordinated-plan-artificial-intelligence>

⁸⁹ <https://www.gov.scot/publications/working-collaboratively-better-scotland/>

⁹⁰ <https://economicactionplan.mygov.scot/fair-work/>

⁹¹ <https://www.gov.scot/publications/working-collaboratively-better-scotland/>

⁹² <https://www.ippr.org/files/2018-11/the-future-is-coming-november18.pdf>

Policy Context

The rapidly increasing and diversifying capabilities of AI technologies has stoked fears that many current jobs will be replaced or fundamentally changed. In *Automatic...For the people?* The Fraser of Allander Institute commented on the need for a more bottom-up approach to understanding which tasks and activities could be impacted, and the impacts on a regional basis. In its *Economic Outlook 2018*⁹⁷, PwC said that AI technologies could lead to the creation of 558,000 jobs and the displacement of 544,000 jobs in Scotland. While this would be a net benefit of 15,000, it would also be “the biggest shake-up in a lifetime” to Scotland’s labour market. Analysis of this change is a priority for many countries. The High-Level Expert Group on the impact of digital transformation on EU labour markets will deliver a report addressing strategies to deal with employment disruption in spring 2019⁹⁸.

The first Mission in the Enterprise and Skills Board’s strategic plan⁸⁹ is Business Models and Workplace Innovation. AI technologies and data-driven innovation can enable Workplace Innovation, but there are concerns about how they are applied and about the emergence of new working practices and business models. The Scottish Government has just published a Fair Work Action Plan⁹⁰.

The second Mission in the strategic plan⁹¹ is Future Skill Needs. This shake-up of the Scottish labour market implies two high-level priorities: retraining for the people in jobs which will be displaced and education and skills development for the jobs of the future. With nearly 60% of the 2040 workforce having already left compulsory education⁹², there will need to be more focus on lifelong learning. Over 100,000 people are employed in Scotland’s digital technologies sector, but there are significant skills shortages and the industry needs 13,000 new entrants per annum to meet ongoing demand⁹³. The EU has said that the skills dimension should be included in national AI strategies by mid-2019⁹⁴.

⁹³ <https://www.skillsdevelopmentscotland.co.uk/news-events/2018/sep-tember/digital-minister-explains-why-digital-skills-are-important-to-scotland/>

⁹⁴ <https://ec.europa.eu/digital-single-market/en/news/coordinated-plan-artificial-intelligence>

⁹⁵ <https://www.mckinsey.com/featured-insights/future-of-work/skill-shift-automation-and-the-future-of-the-workforce>

Analysis by McKinsey of automation and the 2030 workforce found that the fastest rise in demand for workforce skills will be the need for advanced IT and programming skills, albeit that this will be for a minority of people, and basic digital skills will be the second fastest growing category. It also highlighted rapid growth in demand for “finely tuned social and emotional skills”, including entrepreneurship and initiative taking, leadership and managing others, and higher cognitive skills⁹⁵.

The Scottish Government has announced a new National Retraining Partnership with employers, unions, colleges and universities, and training bodies to collaborate on up-skilling and/or retraining.

Skills Development Scotland continues to develop its model of skills for the future, Skills 4.0⁹⁶. These high-order, adaptive skills are termed ‘meta-skills’. They are currently being incorporated into work-based learning programmes as part of a collaborative programme of work with the Scottish Qualifications Authority to develop a Future Standards Architecture for work-based learning.

Digital skills are a key component of Scotland’s Science, Technology, Engineering and Maths Education and Training (STEM) Strategy⁹⁷. Scotland’s higher and further education institutions are centres of excellence for learning digital and data skills, and attract global talent. As part of the Edinburgh and South East Scotland City Region Deal, Edinburgh and Heriot-Watt universities will train 100,000 people across Scotland over the next 10 years in data skills⁹⁸. Further and higher education institutions are also partners in work-based learning, lifelong learning and retraining. For example, SDS, with two Scottish universities and PwC, have developed a new Graduate Apprenticeship in Data Science⁹⁹.

⁹⁶ <https://www.skillsdevelopmentscotland.co.uk/what-we-do/skills-planning/skills4-0/>

⁹⁷ <https://www.gov.scot/policies/science-and-research/stem-education-training/>

⁹⁸ <https://ddi.ac.uk/city-region-deal-universities-set-to-tackle-digital-skills-gap/>

⁹⁹ <https://www.skillsdevelopmentscotland.co.uk/news-events/2018/may/new-graduate-apprenticeships-to-grow-data-science-skills/>

The recently established Digital Skills Partnership¹⁰⁰, led by ScotlandIS, brings together further education, higher education and industry to enhance the quality of existing courses in computing science and software engineering, supporting lecturers to keep their knowledge of industry working practices current, ensuring students have the right blend of technical and interpersonal skills needed by industry, and working on the co-development of new curriculum materials.

The STEM strategy¹⁰¹ includes long-term initiatives like the new Digital Schools Programme and the Digital Xtra Fund to support the teaching of digital skills in schools and beyond. With tech developing so rapidly and heavy workloads, teachers can find it difficult to develop the knowledge, skills and confidence to teach digital literacy, but Scottish Government is expanding the professional learning which the Scottish Schools Education Research Centre offers to include more digital learning¹⁰². Local authority policies also may be risk-averse around data security and software authorisations. Excellent AI technologies are being made available, but tend to be used in extra-curricular clubs rather than classrooms as there are not enough of them, which raises issues of teacher workload and pupil equity. “Unplugged resources”, such as BT’s Barefoot programme¹⁰³, which can be downloaded free-of-charge and used without hardware are highly-regarded, but teachers still need to be trained in them.

The curriculum guidance for technologies was refreshed in 2017¹⁰⁴ and it is being implemented in partnership with teachers. Computing science is critical in teaching the core concepts and disciplinary skills for technologies which are key to an understanding of how they work and, therefore, creativity and adaptability. There continues to be an urgent need to recruit and retain computing science teachers and to upskill existing computing science

teachers for the new curriculum, for example in coding. The Scottish Qualifications Authority and partners are currently developing a new National Progression Award to be offered in Data Science from August 2020, which will include Citizenship¹⁰⁵.

Educational Technology (EdTech) can play a key role in addressing the twin challenges for Scottish Education of excellence through raising attainment and achieving equity. SEEMiSGroup provides a range of products¹⁰⁶, with a new Progress+Achievement application in development. Massive Open Online Courses (MOOCs) have grown rapidly in availability in recent years, with a wide range of providers. These deliver flexible and personalised learning and training, but the completion rate for online courses can be relatively low, especially among more disadvantaged groups. Scotland’s digital learning and teaching strategy acknowledges “Despite the pervasive nature of digital technology, its benefits are not always fully felt within our education establishments”¹⁰⁷. The European Commission will issue a report in early 2020 exploring how AI could be incorporated into the curricula of programmes for secondary and tertiary education, including vocational training. The UK Government is investing £30m to test the use of AI and innovative EdTech in online digital skills courses.

AI technologies could also make labour markets smarter and more efficient, helping people to navigate their way through a life of work in which the opportunities being created and the need for lifelong learning, retraining and career transitions will appear at a faster pace. Nesta’s Open Jobs programme proposes to bring together public and private sector data sources, such as real-time job adverts and future skills demand forecasts, in an accessible tool to create an information-rich labour market for jobs seekers, careers advisers, educational institutions, employers and governments.

¹⁰⁰ <https://www.scotlandis.com/digital-skills-partnership/about-digital-skills-partnership/>

¹⁰¹ <https://www.gov.scot/policies/science-and-research/stem-education-training/>

¹⁰² <https://www2.gov.scot/Resource/0054/00545868.pdf>

¹⁰³ Barefoot helps young pupils develop computational thinking and digital skills and provides free resources that match the Scottish computing curriculum. For further info: <https://www.barefootcomputing.org/curriculum>

¹⁰⁴ <https://education.gov.scot/Documents/Technologies-es-os.pdf>

¹⁰⁵ <https://blogs.sqa.org.uk/computing/npa-data-science-update-2/>

¹⁰⁶ <https://www.seemis.gov.scot/site3/index.php/products-public>

¹⁰⁷ <https://www.gov.scot/binaries/content/documents/govscot/publications/publication/2016/09/enhancing-learning-teaching-through-use-digital-technology/documents/00505855-pdf/00505855-pdf/govscot%3A-document>

Recommended Actions

13

The Scottish Government should commission bespoke estimates and mapping for the Scottish labour market. This would then inform a new early warning system for at-risk firms, sectors and geographies¹⁰⁸.

Comments

This should be informed by the findings and recommendations in the report by the EU's High-Level Expert Group on the impact of digital transformation on EU labour markets.

14

The Scottish Government's Fair Work Action Plan should address how Scotland will learn from the ways in which other countries are developing their ethical guidelines for AI technologies and access to collective data in the workplace, and develop its own policies which fit with Scotland's Fair Work Framework.

Comments

The Scottish Government should keep under review the potential for a four-day working week.

¹⁰⁸ <https://www.ippr.org/files/2018-11/the-future-is-coming-november18.pdf>

15

Scotland should explore the potential for AI technologies, such as chatbots, and open data to support easy to understand information and advice about and increased participation in employment, fair work and skills development opportunities and funding.

Comments

Providers of online learning in Scotland and the Scottish Funding Council should review their potential, working alongside human coaches, to maintain participation in online courses.

The Scottish Government and a Scottish city or region should support a pilot of Nesta's Open Jobs tool, and make public sector data and job opportunities available for the new tools.

16

The Scottish Government's new National Retraining Partnership should inform a positive, evidence-based conversation about the changing workplace and the appropriate commitment to, and investment in, retraining by workers, employers and government.

Comments

A midcareer review(s) should be provided to every worker.

Employability and retraining programmes should be able to demonstrate clear pathways to sustainable work.

While jobs of the future will be the focus, the Partnership should not lose sight of the ongoing demand for and, therefore, job opportunities in traditional skills in traditional industries.

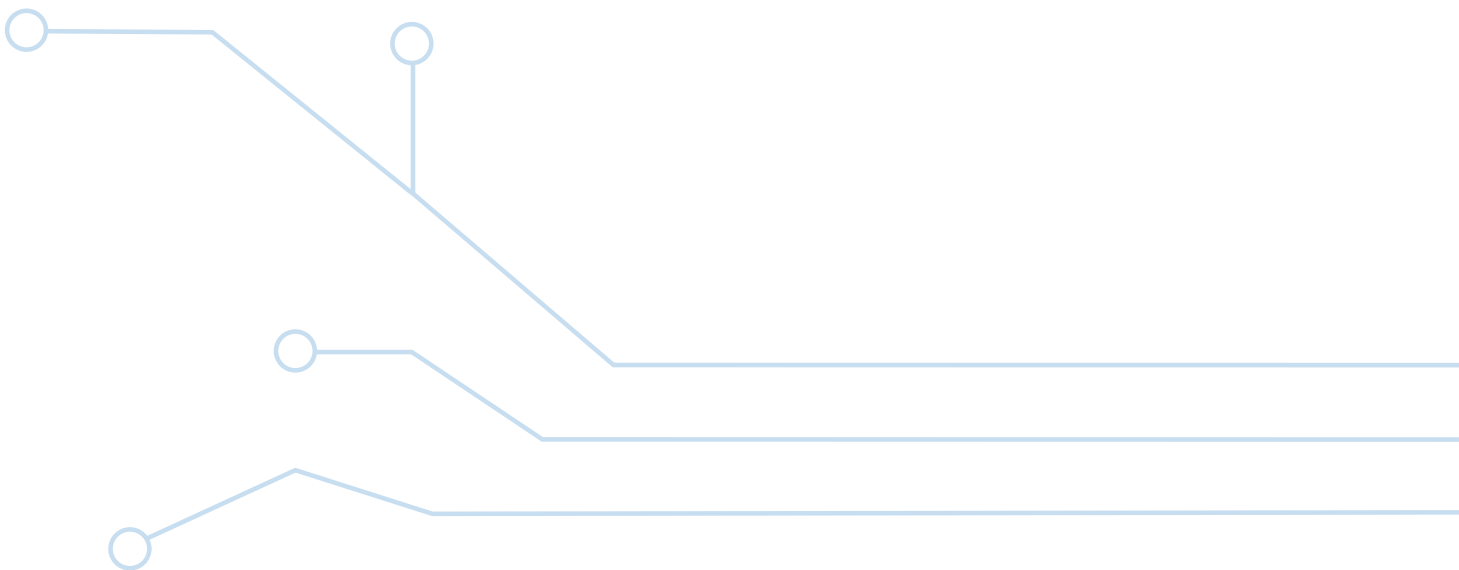
17

The Scottish Government, industry, educational institutions, and skills and training providers should develop new flexible and modular courses and training programmes for workers, including independent workers, to improve their skills, which can be certified digitally. Professions with Continuing Professional Development (CPD) training requirements should regularly review their content to include up-to-date learning on AI technologies and data ethics.

Comments

Skills Development Scotland should develop its 'meta-skills' model and work with partners in industry, training, skills and education to make its attributes integral to the workplace and in learning.

Other professions should consider the need to introduce CPD training requirements.



18

The Scottish Government, industry and education should continue to expand and enhance digital skills and talent programmes to meet industry demand, not only with up-to-date technical content but with wider business skills.

We recommend that:

Scotland's Digital Skills Partnership, which is delivering CPD for higher and further education teaching staff, should discuss incentives for this and new opportunities, such as summer internships in industry.

Scotland's higher and further education institutions and digital skills academies should introduce dedicated and certified courses in ecommerce and its main software platforms.

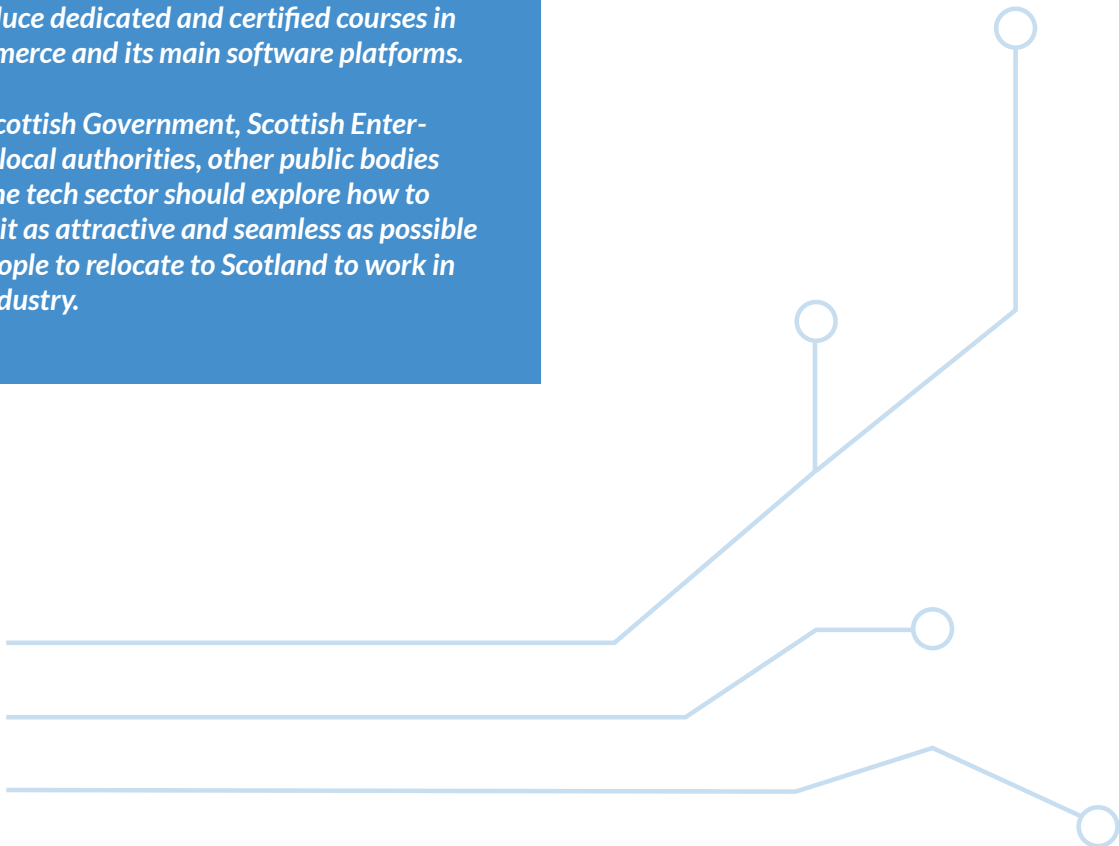
The Scottish Government, Scottish Enterprise, local authorities, other public bodies and the tech sector should explore how to make it as attractive and seamless as possible for people to relocate to Scotland to work in the industry.

Comments

These should develop a more diverse and inclusive workforce.

Scotland's strategy to attract talent should include further support for 'soft-landings' for families, with information on and one-stop shops for housing, services and job opportunities.

Employers should make greater use of TalentScotland's services to support the relocation of staff.



19

The Scottish Government, Education Scotland and local authorities should expand opportunities for young people to engage with real world AI technologies and data applications in schools, and support teachers with digital training. The Scottish Government must continue to invest in and pilot routes to attract people with the necessary digital skills to teach computing science.

Comments

Inter-disciplinary learning and STEAM (Science, Technology, Education, Arts and Mathematics) support the development and application of deeper learning, 'meta-skills' and creativity.

Participants in the Innovative and Ethical Data workshop proposed that a resource could be developed to allow school pupils to work through data ethics and fair work scenarios.

20

The Scottish Government, Education Scotland and local authorities should look at new opportunities for AI technologies to support teachers and learners, and investment in EdTech.

Comments

This should be informed by the EU report on how AI could be incorporated into curricula.

Areas for consideration include the application of machine-learning techniques to personalised learning for students in mixed ability classes, Automated Essay Scoring and Early Warning Systems for pupils at risk of disengaging¹⁰⁹, and in the assessment of National Qualifications.

¹⁰⁹ <https://www.rand.org/pubs/perspectives/PE315.html>

