Welsh Economy Research Unit

Yr Uned Ymchwil i Economi Cymru

Superfast Broadband Business Exploitation: Horizon Scanning

AI and automation: Examining the future implications for business and employment in Wales

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Summary

The key findings of this report can be summarised as follows:

- Artificial Intelligence (AI) is a rapidly evolving technology that is currently at the forefront of innovation, and the introduction of new applications for business. While AI has, until recently, been the preserve of larger, innovative businesses, the paper focuses on the opportunity for smaller businesses.
- The findings suggest that the majority of applications for AI are supervised and structured. That is, they require large structured datasets. Other forms of unsupervised learning are being developed by larger technology companies, and are likely to form part of their future services to business.
- AI applications are particularly relevant for the customer interface, and can benefit from extensive datasets on customer purchases and behaviour. Here, AI applications are becoming integrated into existing CRM packages, notably SalesForce's Einstein application. Chat bots are also becoming available 'off the shelf', with companies emerging to supply and programme these for businesses.
- The impact of AI is likely to be felt on all business, to a certain degree, as well as innovative businesses who are developing new AI applications. Businesses will need to ensure that the introduction of AI applications maintains and supports customer trust, and issues such as data privacy.
- The automation effects of AI technologies on regional economies is difficult to predict with certainty. Estimates suggest that 30-50% of jobs are automatable as a result of digital technologies, with the largest impacts felt on lower qualified, service workers. New business creation, however, is expected to replace existing jobs.
- Evidence from WERU's Vulnerability Index suggests that both East Wales and West Wales and the Valleys are comparatively more vulnerable to AI automation than other parts of the UK. This model highlights challenges with respect to both the exposure of the economy, but also its ability to cope. This includes skills, R&D and enterprise weaknesses – all of which have been linked to productivity and the ability of a region to adapt to technological change.
- Policy makers and analysts are beginning to take a keen interest in AI and its implications, as evidenced by the publication of high level reviews surrounding AI in the media. Businesses are likely to ask questions of the Superfast Business Wales service in the near future, and there will be the need to respond with a balanced and evidence based guidance to SMEs.

1. Introduction

Artificial Intelligence (AI) and automation are at the forefront of technologies that are benefiting from the emergence of digital networks and innovations in hardware and software. These technologies offer businesses the potential to harness large datasets, improve business efficiency, and introduce new services to customers. Such developments have led to much debate and discussion about their potential implications, for both business and work, and have been widely discussed in the media.

Given the hype associated with these technologies many businesses are likely to find it difficult to assess the precise nature of the opportunity, and its relevance to them. This horizon scanning paper addresses these issues by reviewing the current state of AI applications for SMEs, and examining the potential impacts on Wales and the business support activities of Welsh Government.

This paper forms part of a series of Horizon Scanning reports which are available on the Cardiff Business School website: http://www.cardiff.ac.uk/superfast-broadband-project/horizon-scanning

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2. The current position of AI

AI is defined by the OECD (2017) as 'machines performing human-like cognitive functions'. While developments in this area have been underway since the 1950s and 1960s, the arrival of increased computing power, cloud technologies and big data have enabled researchers to explore the practical applications more fully. These technologies draw on complex statistical tools (algorithms) and are already in use by many large companies to aid pattern matching, speech recognition and translation, as well as in search engines and spam filters (Government Office for Science, 2016).

While AI seeks to replicate human cognition, its convergence with robotics has introduced the possibility of AI replicating physical or behavioural capabilities, alongside cognitive functions. This provides the basis for industrial applications to learn from AI, and is already evident in areas such as self-driving cars and humanoid robots. Applications can also be seen in machine learning services available through public cloud services such as Amazon Web Services, Google Cloud, IBM Bluemix, and Microsoft Azure (Azoff, 2017). Such developments have led to claims that AI is starting to enter the 'business mainstream' (OECD, 2017).

The current applications of AI are primarily 'narrow' in their focus. That is, they require human 'supervision' to solve pre-specified questions / challenges. This is achieved through identifying patterns in large data sets (for example, digital text, pictures, sound and so on). Yet, despite the emergence of these new technologies, recent assessments indicate that there is a 'gap between ambition and execution' in most companies (Ransbotham et al., 2017). Furthermore, the development of more advanced forms of AI - 'Applied General Intelligence' - which simulate more complex human attributes such as intuition, associative memory, and perception - are still some way from matching human attributes (OECD, 2017; Williams, 2017).

The emergence of AI, as noted in the introduction, has seen much discussion about its potential impacts on business and society. Here, some have argued that AI may lead to significant job losses in areas where skills are easily automated (Osborne and Frey, 2013). For others, however, businesses are more likely to integrate AI technologies into repetitive tasks undertaken by humans (Arntz et al, 2016). This implies that new skills may be needed to ensure coordination between work and AI technology.

Much of the commentary on AI is characterised by forecasts of future potential costs / benefits, rather than an assessment of what is currently available. More cautious commentators, for example, point out that the hype surrounding AI applications hides the early stage nature of much development, even in its use by larger companies. These limitations relate to the inability of AI to truly mimic key human cabilities such as language, empathy and morals.

3. AI and the customer interface

The customer relationship represents an area where AI business applications are emerging at a rapid rate in areas such as the prediction of customer needs / preferences and personalisation (Bennett, 2017). Many customer focused AI applications draw on large datasets held on customers, including information needs and purchasing preferences. Other business processes are equally data intensive, for example, human resources, or supplier relationships, suggesting further areas for the application of AI.

The use of Chatbots to aid e-commerce / customer interactions represents an area where applications are now available for both text- and voice-based customer services. Such applications have been used to automate services in both the provision of basic customer information, as well as access to more specialised customer services staff. These systems rely on a structured approach in which potential customer queries are pre-mapped onto responses. This allows Chatbots to respond to queries, based on data collected from previous customer interactions, and forward queries to other parts of the website.

Standalone Chatbots can now be purchased from specialised suppliers, who are able to mine relevant data (e.g. social media and customer chat history) and ensure that applications are able to understand a wide range of queries. Chatbots can also be purchased 'off the shelf', to allow businesses to experiment at a low cost. These approaches are increasingly adopting AI technologies such as natural language processing (Nguyen, 2017).

More ambitious 'unsupervised' Chatbots are starting to emerge. These technologies seek to understand and process free text, and rely heavily on machine learning queries and responses. Large technology businesses such as Microsoft and Google have been at the forefront of such developments. Early experiments, however, have produced a mixed response[1]. Indeed some researchers advocate a 'start small and simple approach', to avoid such problems (Ransbotham, 2017).

[1] https://www.theguardian.com/technology/2016/mar/30/microsoft-racist-sexist-chatbot-twitter-drugs

Many of the commercially available applications are targeted at IT-intensive businesses with appropriate coding skills. Examples of customer relationship-focused applications are, however, beginning to be integrated in platform products. Salesforce is one such example, integrating its 'Einstein' machine learning software into its core CRM product[2]. Facebook's Messenger service has also integrated AI technologies, enabling businesses to add digital personal assistant services. Such developments are in their early stages at present, and the expectation is that more capable services, alongside the emergence of expert service providers, will see such applications used more extensively by business in future years.

[2] https://www.salesforce.com/uk/products/einstein/features/

4. Implications for business

As a rapidly developing technology, AI's initial business applications have been adopted and developed by large businesses with the scale and capability to take full advantage. Despite the uneven use of AI, the long term prospects for adoption are said to be positive (McAfee and Brynjolfsson, 2017). Indeed, some have claimed that SMEs will gain most from AI as a result of their ability to gain 'first mover' benefits (Bennett, 2017).

The impact of AI is likely to be felt on all business, to a certain degree, as well as innovative businesses who are developing new AI applications. In both groups AI has the potential to improve business efficiency, reduce costs and improve resource allocation through the automation of tasks. This could include allocation of staff to more productive areas, or utilising AI technologies to assist workers. This integrative model is one that research suggests may take more than five years to emerge fully (Ransbotham et al, 2017).

While applications of AI are becoming more accessible to businesses, the question of capability to absorb the new technologies is an important one. Here, AI technologies are coming into the reach of more SMEs as a result of cost reductions (utilising open-source components) and off-the-shelf packages. Technology service providers are also beginning to offer specialist AI expertise and support services (e.g. webuildbots.ai in Cardiff). This means that businesses will not necessarily need extensive technical expertise in-house. Such solutions, however, are likely to be of most relevance to businesses that receive a large volume of standardised queries from customers, providing the basis for Chatbots to respond effectively to queries.

Businesses will also need to ensure that the introduction of AI applications maintains and supports customer trust. At present concerns are being raised about key issues such as data privacy, and the appropriateness of applying AI to all business processes. Care is therefore needed to closely monitor AI applications, ensuring that they meet the needs of customers.

5. Assessing the potential impacts on Wales

The effects of AI technologies on regional economies are difficult to predict with certainty. Despite the current hype associated with AI, current business adoption is at an early stage for many, with most applications currently employed by larger businesses.

The scale of impact from automation is likely to be influenced by a complex range of factors, for example:

- The presence of sectors with the potential to be automated by AI (e.g. customer services, retail etc.).
- The capacity of businesses in Wales to absorb AI technologies (i.e. the speed at which new technologies are adopted).
- The propensity of entrepreneurs / new business starts to replace sectors disrupted by AI technology developments.
- The number of jobs and tasks that have the potential to be automated by AI.

The true scale of impact is also likely to depend on whether whole jobs are fully automated. Here, some argue that tasks, rather than jobs, will be automated, and this will offer the potential for workers to be allocated to other more productive activities. Similar uncertainty exists in relation to the potential for new jobs to be created as a result of AI. Estimates suggest that 30-50% of jobs are automatable as a result of digital technologies such as AI (Frey and Osborne, 2013; PWC, 2017), with the former industrial areas in South and North Wales facing particularly high risks of job losses by the early 2030s (FutureAdvocacy, 2017).

In relation to occupational characteristics, lower qualified and paid service workers are said to be most likely to see their roles impacted by automation (Artnz et al, 2017). This has implications for sectors in Wales and beyond, with a focus on those roles that require repetitive manual tasks. This is highlighted at the customer interface, where automation technologies discussed in section 3 are already starting to impact on sectors (Business Reporter, 2016). Least at risk are those occupations that require intuition, manipulation, creativity or social intelligence (Frey and Osborne, 2013).

Job losses as a result of AI are likely to be tempered by new business and job creation (Office of the White House, 2016). Recent research by Tech City (2017), for example, suggests that Wales has a vibrant digital technology sector based around Cardiff and Swansea, with examples of AI businesses beginning to emerge (for example, Amplify in Cardiff). Key challenges, however, relate to the need for more digital skills, investment, awareness, and digital infrastructure (Tech City, 2017). Yet, while AI business activity is relatively small at present, its emergence highlights the potential for providers to create jobs and satisfy the needs of those businesses lacking specialised skills.

6. Modelling regional vulnerability to AI in Wales and the wider Great Britain

In this section the potential impact of AI and automation technologies in Wales are assessed with reference to a composite Index. The Index considers the potential vulnerability of a region, and its constituent workers and businesses, to AI, and makes use of a basket of indicators for two main aspects of vulnerability:

- *Exposure* – refers to the extent to which regions are likely to experience the effects of stimulus (automation), and is related to the scale of a stimulus, its spread, and speed of spread, across different places. The metrics adopted for the model include industries at high risk and vulnerable occupations, the diversity of the economy (Concentration of business activities), and wages (Compensation of employees). These factors illustrate the aspects of the regional economy that research suggests will be most influenced by exposure.
- *Coping* – refers to the presence of factors that may mitigate the effects of AI and automation, and provide the basis for it to respond positively to the stimulus. The metrics adopted for the model consider the skills base (Post 16 qualifications), business R&D, ownership of capital (GFCA – Gross Capital Fixed Formation), and business entrepreneurship (Businesses per 1,000 full-time equivalent workers, FTEs). These factors have been identified as contributors towards opportunity for a region to adapt, providing resilience and capacity to resist and benefit from new technology developments.

A summary of the metrics, sources, and year/s the data corresponds to, can be found in Table 6-1 below.

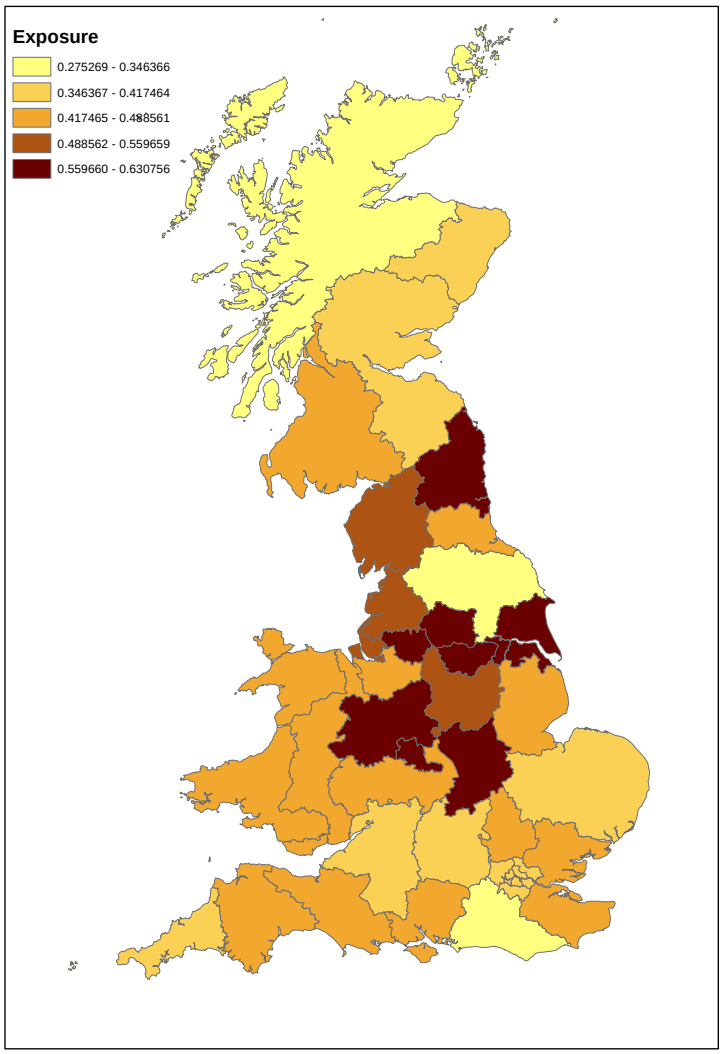
Table 6-1 A composite model of vulnerabiliity to AI and automation

	Metric	Source	Year
Exposure	Industries at High Risk	OECD / PWC & ONS BRES	2016
	Routine Occupations	ONS Labour Force Survey	Average 2006/11/17
	Compensation of Employees as a % of GVA	ONS Regional Accounts	2016
	Concentration (Herfindahl) Index	ONS BRES	2016
Coping	Percent with post-16 Qualifications	ONS Labour Force Survey	2017
	R&D Spend per inhabitant	EUROSTAT	Average 2012-15
	GFCF as % of GVA	ONS Regional Accounts (experimental)	Average 2014-16
	Businesses per 1000FTEs	ONS Business Demography	2016

Index scores were calculated for the 39 NUTS2[3] regions of Great Britain. The higher the index score, the more vulnerable the region.

The Exposure index (Figure 6-1) shows that the West Wales and the Valleys and East Wales regions are moderately exposed to the effects of AI and automation technologies, with index scores of 0.43 and 0.45 respectively. Both regions are below the Great Britain average of 0.46.

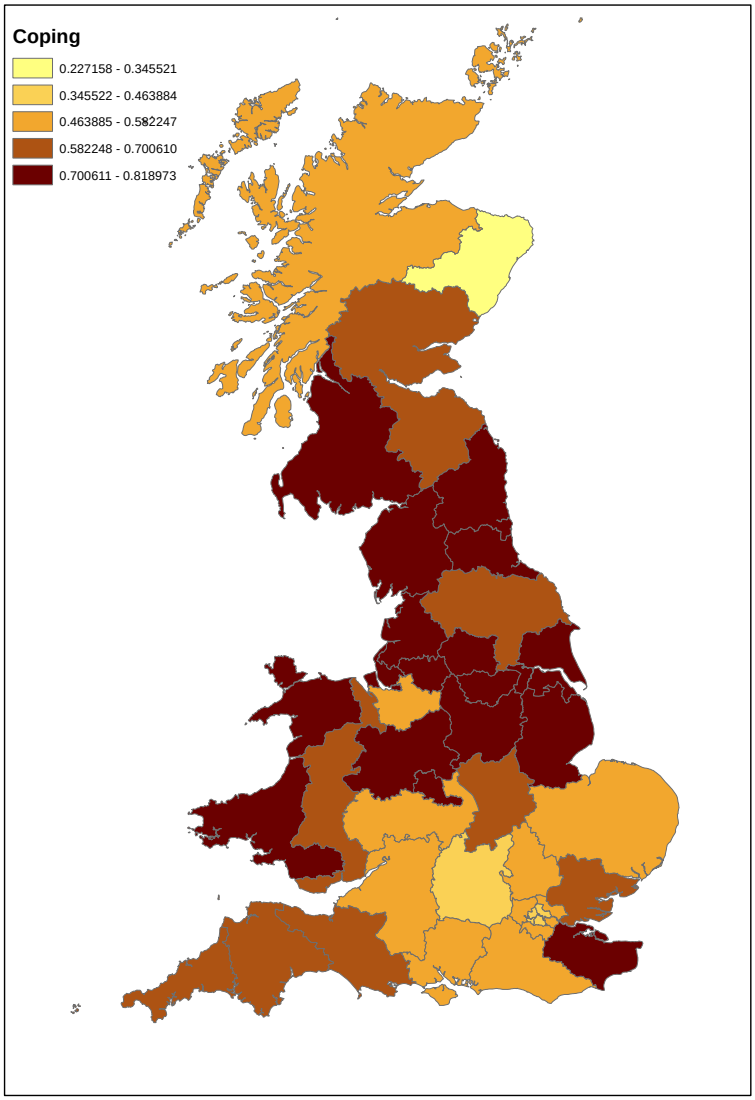
Figure 6-1 Propensity of regions in Great Britain to be exposed to the risks of automation



[3] Nomenclature of Territorial Units for Statistics

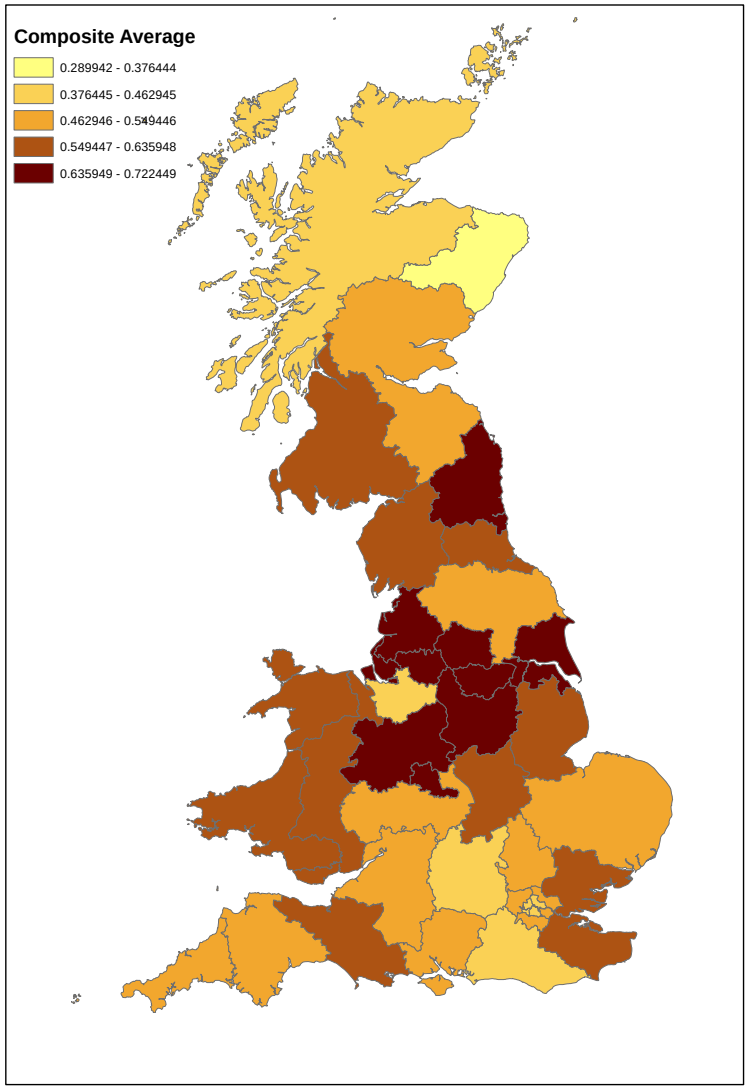
The Coping index (Figure 6-2) suggests that West Wales and the Valleys falls into the highest grouping of risk, with its score of 0.79. East Wales performs bettter (0.68), however both regions are above Great Britain's average of 0.65. This coping pattern is linked to Wales' comparatively lower proportion of post 16 skills and businesses per 100 thousand FTEs, as well as its lower than average R&D spend. These factors have been found to underpin productivity, and the ability of a region to adapt to the stimulus of new technologies.

Figure 6-2 Propensity of regions in Great Britain to cope with the risks of automation



The composite index (Figure 6-3) shows that both regions in Wales are above average[4], with scores of 0.61 for West Wales and the Valleys, and 0.57 for East Wales (as compared to 0.56 for Great Britain as a whole). This suggests that Wales faces challenges relating to both its existing industry and occupational factors as well as its longstanding issues of low business and R&D capacity. This raises questions about Wales' preparedness and ability to respond to the challenges of AI and automation.

Figure 6-3 Regional vulnerability to automation composite index



[4] The composite index is based on the eight variables (V), as set out in Table 6-1.

7. Lessons for the Welsh Government and Superfast Business Wales

The findings in this report indicate that AI business applications are a rapidly developing area. Policy makers and analysts are beginning to take a keen interest in AI and its implications, as evidenced by the publication of high level reviews (see, for example, Office of the White House, 2016; UK Government Office of Science, 2016; and OECD, 2017). Given the potential implications for business and Welsh society more generally, this will be an important debate for Wales in the coming years (Jones, 2017).

The growing interest in AI is likely to drive greater business interest in this topic. This suggests that Welsh Government will need not only to keep a watching brief, but be willing to provide realistic and practical information, when appropriate. Elsewhere, the Welsh Government's Advisory network will need to be sufficiently informed and educated with respect to potential AI applications to SMEs. This will require sober and realistic assessments of the technology's potential, business capabilities to absorb AI, and signposting to sources of support for those IT intensive SMEs willing to become first movers.

More generally the results of this paper highlight the importance of preparing for the transition towards new AI and automation technologies. Wales faces particular vulnerabilities, as identified in WERU's Vulnerability Index (Section 6). These point towards the need for a cross-governmental policy response targeting key weaknesses such as policies for entrepreneurship, innovation (R&D) and skills. The findings also suggest the need for the Vulnerability Index to be refreshed over time, to monitor the evolution of the potential impact of technology development on Wales.

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