

Industry 4.0 – the future of Wales

August 2018



The National Assembly for Wales is the democratically elected body that represents the interests of Wales and its people, makes laws for Wales, agrees Welsh taxes and holds the Welsh Government to account.

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About the Committee

The Committee was established on 28 June 2016 to examine legislation and hold the Welsh Government to account by scrutinising expenditure, administration and policy matters, encompassing (but not restricted to): economic development; transport; infrastructure; employment; skills; and research and development, including technology and science.

Committee Chair:



Russell George AM
Welsh Conservatives
Montgomeryshire

Current Committee membership:



Hefin David AM
Welsh Labour
Caerphilly



Vikki Howells AM
Welsh Labour
Cynon Valley



Mark Isherwood AM
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David J Rowlands AM
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South Wales East



Lee Waters AM
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Joyce Watson AM
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Contents

Chair's foreword	5
Recommendations	6
Themes for future work.....	8
1. Introduction.....	10
2. New possibilities	13
Opportunities.....	14
Challenges.....	17
Proactive Wales	19
Themes for future work	22
3. Precision Agriculture	23
Opportunities.....	23
Challenges.....	26
Themes for future work	30
4. Connected and Autonomous Vehicles	31
Opportunities.....	33
Challenges.....	35
Themes for future work	40
5. Future Skills	41
Opportunities.....	41
Challenges.....	44
Education, education, education.....	47
Themes for future work	51
6. Next Steps.....	52

Chair's foreword

The Welsh economy is facing the challenge of a lifetime. As in previous industrial revolutions, there is an opportunity for transformation – both positive and negative. For every prediction that tens of thousands of jobs could be lost, there is another study talking up the positives of robots taking the drudgery from our work lives.

This inquiry has not followed the normal path – and this report is a beginning rather than an end. The Committee has sought to raise awareness of some key ideas and concepts, and engage a discussion about how Wales is preparing for 4.0. This report makes recommendations to the government, but it also poses six questions for all of us with an interest in Wales' economic prosperity. The Committee will be doing further work in this area to pursue these.

The growing body of studies and reports concerning automation and AI give a range of outcomes. It is clear that failure to prepare will be preparing to fail in this brave new world.

We hope this report generates discussion – not just in the corridors of power, but among a wide range of businesses, across sectors and out in the streets of Wales.

The Committee will be undertaking further work in this area looking more closely at specific sectors over the coming months, and eagerly anticipating the report of the Welsh Government's review led by Professor Phil Brown.

The challenges of automation and artificial intelligence have the potential to dominate the next 30-40 years. It is vital Wales is ready not merely to respond, but able to shape the debate so that rather than being blown away by strong winds of change, we can harness them to propel our sails.

Russell George AM
Chair, Economy, Infrastructure and Skills Committee

Recommendations

Recommendation 1. The Committee considers it imperative that further work is carried out to ensure Wales is the provider, not just the consumer of emerging technologies. The Welsh Government should carry out work to:

- identify the expertise and commercial strengths that exists in Wales, for example, in compound semi-conductors, insurance and healthcare;
- identify Wales’ competitive advantages in the anticipated growth areas;
- Where strengths and competitive advantage aligns with predicted future growth, support those sectors to position themselves at the forefront of global industry. Page 21

Recommendation 2. The Welsh Government should carry out a review of its support to companies in Wales who are seeking support from the UK Research, Development and Innovation Fund. The review should identify where its support could be strengthened. In addition, the Welsh Government should ensure that organisations representing businesses are aware of the support available in Wales when applying to the UK fund.....Page 21

Recommendation 3. The Welsh Government should consider what more it could do to harness the expertise and contacts of the widest group of experts currently working in Wales, and among the Welsh diaspora. As part of that work, the Welsh Government should encourage universities to strengthen their alumni networks and create key links with alumni and other stakeholders to ensure that where expert links with Wales exist, opportunities to engage are not lost.....Page 21

Recommendation 4. In order to help ensure Wales is at the forefront of emerging technologies, The Welsh Government should carry out a cost-benefit analysis of developing a model community in Wales, encouraging inward investment from big businesses wishing to pressure test emerging technologies and their effects on communities.....Page 21

Recommendation 5. The Welsh Government should share the findings of the Farming Connect review of its demonstration innovation and focus sites, setting out clear and measurable actions it intends to take as a result of its findings. The actions should include the steps it will take to work with FE and HE to grow the demonstration sites to support the development, as well as the roll out, of new technologies..... Page 30

Recommendation 6. The Welsh Government should work in collaboration with FE and HE to develop made-in-Wales precision agriculture software and hardware suitable for Wales’ small farms. Such innovation would not only benefit Welsh farms, but would have strong potential to create attractive exportable products.

..... Page 30

Recommendation 7. The Welsh Government should consider what role it could play in encouraging connected and autonomous vehicle (CAV) companies to share pre-crash data to accelerate learning and safety across the industry.

..... Page 39

Recommendation 8. The Welsh Government should carry out a cost benefit analysis of the creation of a 5G test bed CAV centre in Wales to support home grown industry and inward investment..... Page 40

Recommendation 9. In developing its vision for post compulsory education, the Welsh Government should refocus and redevelop its support for lifelong learning, creating new and accessible ways for workers at risk of displacement by automation in the first waves to retrain and upskill.....Page 51

Recommendation 10. The Welsh Government should review how it can upskill and build confidence in the teaching workforce to incorporate digital tools into learning, ahead of the introduction of the new curriculum.....Page 51

Recommendation 11. The Welsh Government should establish a scheme to fund further Post-Doctoral learning in automation and AI-related fields, with the intention of retaining those skills in Wales.....Page 51

Recommendation 12. The three Regional Skills Partnerships should review their plans for future requirements in light of the opportunities and challenges anticipated as a result of automation and AI.Page 51

Themes for future work

Informed action

In discussing the issues, many witnesses told the Committee there is an ongoing need to better understand the issues, including who would be impacted by Industry 4.0 and where.

When considering how best to gather and share information, witnesses called for asset maps to be developed, reliable, open data to be shared and for a model rural community to be developed.

How can information be gathered and shared to ensure emerging issues and opportunities are understood and acted on in a timely and appropriate way?
.....Page 22

Reducing inequality

If Industry 4.0 has the potential to accelerate inequalities, what social and political response should be taken to avoid this? Discussions around benefits and universal basic income are interesting, but the issue is not devolved.

What policy response could Wales take to ensure that Industry 4.0 presents an opportunity to reduce inequality rather than widen the gap? How should we encourage ethical employment practices around automation and AI without stifling the positive possibilities Industry 4.0 may provide?.....Page 22

Data is the new steam

If data is to Industry 4.0 as steam was to the first then ownership of data as a commodity will be a key part in determining who profits from the change, and who does not.

What should be done to ensure that data is used ethically in a way that benefits the whole of society and not just those who have the resource to gather it through foul means or fair?.....Page 30

Balancing innovation and regulation

Witnesses were clear on the need for strong cyber security to avoid potentially tragic circumstances arising from cyber attacks. The entry points to access CAVs are potentially multiple, with those intent on doing harm needing only to find the weakest chain in the link.

Witnesses were also clear that over regulation could sound the death knell for emerging technologies and leave Wales far behind its competitors elsewhere.

Where should the balance be struck between regulating the standards of cyber security necessary, and enabling innovation and disruptive technologies to emerge?..... Page 40

Avoiding the WALL-E effect

Witnesses suggested that CAVs could provide cheap, door-to-door transport across cities and regions. There are clear benefits to connecting people in new ways and enabling disabled or older people to stay mobile and connected.

However, in its previous report on active travel, the Committee also recognised the health benefits of walking and cycling more. The 2008 futuristic Pixar film, WALL-E, depicted humans’ over-reliance on automation leading to grossly inactive lifestyles and mass obesity. In the UK 60 percent of adults are overweight and a quarter obese.

What more can be done to encourage people to recognise the benefits of active travel, if door-to-door transport in CAVs becomes such a cheap and easy option? Page 40

Lifelong Learning

We know that a significant number of jobs will be displaced by automation in the coming decades. People effected will need access to good quality, relevant adult education to upskill and access the higher-level roles that might emerge.

We are also aware of the challenges in delivering lifelong learning in a time when funding cuts have reduced participation in adult education by nearly half, and the challenges of making that education accessible to the least mobile members of our society.

How can lifelong learning be re-imagined to meet the changing demands of Industry 4.0?.....Page 51

1. Introduction

- 1.** The First Industrial Revolution used water and steam power to mechanise production. The Second used electric power to create mass production. The Third used electronics and information technology to automate production. Klaus Schwab, founder and Executive Chairman of the World Economic Forum, argued in 2016 that the world is on the brink of the Fourth Industrial Revolution - a range of new technologies that bring together the physical, digital and biological spheres.
- 2.** Examples of these are advances emerging from automation, artificial intelligence (AI), autonomous vehicles, energy storage and the Internet of Things (the interconnection of computing devices from everyday objects via the internet). Schwab states that the speed, scope and impact on systems across nations, industries and society of these changes mean that this represents a distinct Fourth Industrial Revolution rather than an extension of the Third Industrial Revolution.
- 3.** Given the anticipated scale and speed of the change, the Economy, Infrastructure and Skills Committee undertook a broad, high-level inquiry into industry 4.0, as the Fourth Industrial Revolution is sometimes known, to consider how it might affect Wales in the future, and what we should be doing to prepare.
- 4.** In May 2018, the Committee visited Swansea's Amazon distribution centre to hear about how the global internet retailer uses automation and AI in its operations, and Swansea University College of Engineering to explore the cutting edge research being carried out there.
- 5.** The Committee then invited four panels of experts to discuss the following areas:

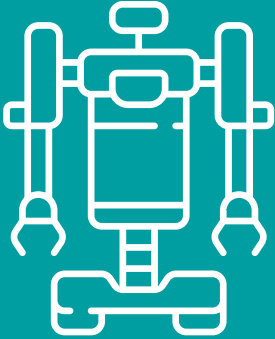
 - Overview
 - Precision agriculture
 - Future of skills
 - Connected and automated vehicles
- 6.** The Inquiry represented the start of further work in this area and this report is a snapshot of our findings so far. Although some immediate calls to action emerged and are included in this report as recommendations, there are more areas where further consideration is needed. These are included as discussion

points and will feed in to the future work this Committee has planned on Industry 4.0 in the autumn term.

7. Deeper studies will be required, and in some cases are underway, before the Welsh Government can develop a meaningful long-term strategy to manage the change. The Committee inquiry is not intended to second-guess the outcomes of those studies, but instead seeks to create space for discussion on this key area, and to highlight some of the opportunities and challenges that lay ahead in the Welsh context.

8. The Committee thanks the experts who so kindly gave their time to the inquiry to consider the key issues that Industry 4.0 could present.

AUTOMATION AND AI IN WALES: THE FUTURE OF SKILLS



It has been estimated that 65% of children entering primary school today will ultimately end up working in completely new job types that don't yet exist.

It has also been estimated that 1 in 3 Welsh jobs were at risk of being automated by early 2030s. But there are also new opportunities and new jobs that are likely to arise in the economy of the future, for those with the right skills.



WHAT THE WITNESS SAID



We are going to have a lot of unbalancing things going on here. We've got to create an environment where a lot of things happen fast. This is unplannable.

There is no magic bullet.

Professor Richard B Davies

Vice Chancellor, Swansea University - Universities Wales



There has been a real lack of urgency in the response to this.

David Hagendyk

Director for Wales, Learning and Work Institute



FURTHER READING

- ◆ **The risk of automation for jobs in OECD countries. A comparative analysis**
OECD
- ◆ **The Future of Work in Wales**
Wales Centre for Public Policy
- ◆ **The Impact of AI in Welsh Constituencies**
The Future Generations Commissioner for Wales
- ◆ **Megatrends: the trends shaping work and working lives**
The Chartered Institute for Personnel and Development (CIPD)

THE WITNESSES CALLED FOR:

- ◆ Careers advice for adults effected by change.
- ◆ Targeted support and investment in lifelong learning and education, with a focus on those most at risk.
- ◆ Better Welsh labour market intelligence, and wider research on the effects of automation in Wales.



For more information about the Economy, Infrastructure and Skills Committee and its work on automation in Wales visit: www.assembly.wales/seneddeis

2. New possibilities

9. Technology is developing apace. From self-service supermarket checkouts to an Artificial Intelligence (AI) machine arguing convincingly with a human debating champion,¹ robotics and automation are our current reality. But, as Professor Calvin Jones of Cardiff Business School points out, “it’s the social context of that technology that will determine where the threats and the resistance or resilience arises”² in the future.

10. Experts speaking to the Committee inquiry were clear that change is coming. William Sachiti, founder of a Welsh company that designs and builds fully autonomous vehicles felt the change was inevitable, but said, “the world adapts, we adapt”.³

11. Professor Richard Davies, Vice Chancellor of Swansea University agreed that we would adapt, but was clear that “it’s about pace of change, because we’re facing an unprecedented rate of change, with huge adjustments to be made”⁴. He predicted that we would see “dramatic changes”⁵ within the next 20 years.

12. Science fiction has frequently portrayed a future of flying cars and robots that are as capable as humans, if not more so. But the Committee sought more tangible evidence of what Industry 4.0 might look like. Matt Fenech, AI research and advocacy consultant at Future Advocacy, told the Committee about an AI machine that in 2016 was predicted to beat a human expert-players of ‘Go’ within ten years. It actually achieved its aim less than one year later. But that achievement does not mean we are close to creating artificial general intelligence. Mr Fenech pointed out that the impressive game-playing machine “will never be able to make a cup of tea, so there’s no transferability of very narrow intelligence”.⁶

13. Although it is difficult to predict the future, witnesses agreed that the change would be disruptive. Job losses are expected in large numbers as autonomous processes and robots are introduced in new and broader fields to perform routine and predictable tasks. The need to support people through rapid changes to the

¹ www.bbc.co.uk/news/technology-44531132

² [Para 15. Economy, Infrastructure and Skills Committee, 9 May 2018](#)

³ [Para 46. Economy, Infrastructure and Skills Committee, 23 May 2018](#)

⁴ [Para 12 Economy, Infrastructure and Skills Committee, 17 May 2018](#)

⁵ [Para 21 Economy, Infrastructure and Skills Committee, 17 May 2018](#)

⁶ [Para 61 Economy, Infrastructure and Skills Committee, 9 May 2018](#)

workplace is clear, with a focus on re-skilling and up-skilling. The Committee does not underestimate the scale of the challenge ahead. Wales is considered to be at particular risk of the impacts of Industry 4.0, but there are opportunities too, and this report seeks to take a balanced look at both the positive and negative, drawing out key areas for further consideration.

Opportunities

14. Matt Fenech, AI research and advocacy consultant at Future Advocacy, told the Committee:

“there’s a real opportunity here – wouldn’t it be great if more dangerous or more routine and repetitive aspects of our work could be automated, freeing us up to do potentially more rewarding, fulfilling work that involved interacting with other people?”⁷

15. Dr Wolfgang Schuster, Intelligent Mobility Technical Director at Atkins, agreed that there are significant opportunities. He felt that “at the core should be the social benefits and the individual human benefits that we can get from this,” and advocated a holistic approach to change.⁸

16. This report explores the opportunities, and challenges, relating to precision agriculture, connected and autonomous vehicles, and the future of skills in more detail in later chapters. This chapter considers some of the high-level possibilities that Industry 4.0 might present to us.

17. Matt Fenech described practical applications of AI in healthcare that could improve diagnostics, pre-clinical pathways and the patient experience. He told the Committee of one such application being used now in Alder Hay Hospital where “a chatbot is being used to help children and their relatives to ask questions about their hospital stay, such as, ‘where is this particular ward’, or, ‘what will a blood test feel like?’”⁹

18. Catherine Phillips, Senior Corporate Advisor, Business in the Community Wales, told the Committee about a project that analysed open data from a healthcare trust to identify where branded statins were being used, as opposed to generic statins. The project identified potential savings of £27 million a month .

⁷ Para 29, Economy, Infrastructure and Skills Committee, 9 May 2018

⁸ Para 164, Economy, Infrastructure and Skills Committee, 23 May 2018

⁹ Para 69, Economy, Infrastructure and Skills Committee, 9 May 2018

19. Use of open data in this way clearly presents a positive opportunity, but the question of data ownership is an important one, particularly where the technology is being developed in the private sector and the data is in the public sector, for example the NHS. Matt Fenech recalled interviews he had carried out with NHS patients on this issue. He told the Committee:

“The strong message we got was that, as long as the benefits are clearly outlined of data sharing, and as long as it’s clear that people will not come to any harm, for example, by unauthorised sharing of their data with health insurance companies, then people are very happy to share their healthcare data, as long as they know it’s going to help either them or people with similar conditions or their children in the future.”¹⁰

20. The Welsh Government’s Director of Business and Regions, Mick McGuire, told the Committee that two of the biggest care companies in the world, Johnson and Johnson and Pfizer, consider Wales to be the best place in the world for research and development. This was attributed primarily to “the willingness of the national health service in Wales to share and explore its issues with industry and academia to accelerate, using the big data—the patient data—better patient outcomes and more cost-effective healthcare solutions”.¹¹

21. Catherine Phillips suggested that the fact that general AI does not yet exist means that the opportunities for us now are in finding “specific solutions that help us tackle key issues in our businesses and in our societies”.¹² She argued that the initial challenge was to identify “where there are very practical and tangible actions” and decide “which are the biggest and most important for you”¹³ in order to focus on solutions that will bring most value.

22. Industry 4.0 will clearly bring with it the risks of job losses. That scenario, along with the mitigations that could be put in place, are considered throughout this report. Leighton Jenkins, Assistant Director, CBI Wales, told the Committee that there were opportunities too. He cited the German approach bringing in robots alongside workers.

“They understood that there were highly skilled people in their workplace and they developed it in a way that repurposed those

¹⁰ [Para 79, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

¹¹ [Para 130, Economy, Infrastructure and Skills Committee, 7 June 2018](#)

¹² [Para 119, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

¹³ [Para 123, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

individuals and had a situation where there were cobots, so you had a worker and the robotics systems working in unison.”¹⁴

23. Professor Calvin Jones agreed that the augmented working approach was a positive one. He told the Committee about the Raspberry Pi manufacturing experience in which there are “hundreds of people” working in Sony Bridgend to make the computers, but none of them touch a Raspberry Pi. He said “it’s about understanding this kind of labour-augmenting automation in combination with the moving of people away from ‘manual tasks’, repetitive tasks, into things that are more creative”.¹⁵

24. Professor Richard Davies, Vice Chancellor, Swansea University, agreed that there would be job losses, but also highlighted the need to “talk about the whole new jobs that will be appearing as well”.¹⁶

25. Catherine Phillips told the Committee that “65 per cent of primary school children will end up in jobs that don’t exist yet today”¹⁷ so although there is a challenge to prepare those young people for an unknown future, there is some confidence that new roles will develop.

26. Throughout the inquiry, the Committee heard about opportunities to develop new industries in Wales. These opportunities are explored in more detail throughout this report, and are key to ensuring the future prosperity of Wales.

27. The Committee considered where the opportunities might lie for disabled people as a result on Industry 4.0. There are already a number of technological aids that aim to reduce the barriers disabled people face, and there could be additional opportunities for people to be productive closer to home in the future and so present more easy access the workplace.¹⁸

28. The Committee also considered whether there might also be opportunities for the workplace to better access the highly relevant skill sets that many people, particularly on the autism spectrum, have, which are applicable to this very agenda.¹⁹ The experts we spoke to had not considered that aspect.

¹⁴ [Para 132, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

¹⁵ [Para 185, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

¹⁶ [Para 12, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁷ [Para 47, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

¹⁸ [Para 193, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

¹⁹ [Para 190, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

Challenges

29. The Committee heard about a number of challenges that are anticipated as a result of Industry 4.0. The biggest of those challenges is the impact on jobs. Professor Calvin Jones spoke to the Committee about the impact that would be felt when companies decide to automate and cut staff numbers as a result. The Professor told the Committee that although Wales was vulnerable to job losses as a result of automation, “those decisions won’t be made in Wales, where the company automates, and how—they won’t be made here”.²⁰

30. Witnesses tried to quantify the number of job losses that may come about in Wales as a result of Industry 4.0. Matt Fenech told the Committee that a survey had found that the perceptions of the public were that “it might happen, but it won’t happen to me”.²¹

31. However, while there is discussion and disagreement about the number of job losses, experts agree that changes would be significant.

32. Catherine Phillips cited forecasts that “automation could displace around 10 million people, meaning that 35 per cent of the UK’s workforce could be displaced and seeking new jobs”.²²

33. Matt Fenech told the Committee about his research that suggested:

“the headline figure for risk of automation of jobs in the UK is about 30 per cent. Looking at Wales, that range is about 26 to 36 per cent, and what we found is that large employers in particular areas tend to skew the risk of automation in those particular areas. So, when you look at the map of Wales and look at the constituencies that are most likely to be impacted, they are concentrated around the economic heartlands in the north and in the south, where there are these large manufacturers.”²³

34. Eluned Morgan AM, Minister for Welsh Language and Skills, told the Committee that she disagreed with the Bank of England, which suggested that 700,000 jobs in Wales could be impacted. The Minister told the Committee

²⁰ [Para 21, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

²¹ [Para 62, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

²² [Para 46, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

²³ [Para 30, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

“that’s certainly not the kind of estimate that someone like Professor Phil Brown, who is, of course, leading for us on the automation agenda, would subscribe to”.²⁴

35. Ken Skates AM, Cabinet Secretary for Economy and Infrastructure also disagreed with the Bank of England estimate, which he called “alarmist” and, he felt, failed to recognise the huge opportunities that could come from automation. The Cabinet Secretary told the Committee “automation can actually contribute to us improving—massively contribute to us improving—our productivity rates. I see that as a central benefit of the move toward automation”.²⁵

Who will buy your cars, Mr Ford?

36. Matt Fenech told the Committee that there is the “potential for AI and automation to ramp up and to accelerate inequalities”.²⁶ To manage that, he called for a better understanding of who and where the impacts would be felt in order for local solutions to be developed.²⁷

37. Professor Calvin Jones told the Committee it was impossible to say at this stage if the change would bring a net job loss or gain as “it will absolutely depend on how the value created by machines, algorithms, is or is not redistributed”.²⁸ He argued that without the redistribution of that value, “what you would find is that there would be not enough money for poorer people to spend to support jobs in the wider creative economy, or leisure economy, or whatever economy might survive automation”.²⁹

38. Leighton Jenkins suggested an element be added to the Welsh Government’s economic contract around ethical employment practices relating to AI.³⁰

39. Matt Fenech recommended the consideration of “alternative income models, such as, for example, universal basic income”³¹ to tackle the redistribution of increased productivity.

²⁴ [Para 8, Economy, Infrastructure and Skills Committee, 7 June 2018](#)

²⁵ [Para 110, Economy, Infrastructure and Skills Committee, 7 June 2018](#)

²⁶ [Para 126, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

²⁷ [Para 126, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

²⁸ [Para 41, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

²⁹ [Para 41, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

³⁰ [Para 131, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

³¹ [Para 210, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

40. The Cabinet Secretary told the Committee that while he loved the idea, trials of universal basic income in Finland had been brought to an end and “The OECD have said that actually it could contribute to widening economic inequalities, rather than closing them, and that it may not reduce poverty rates”. He added that the OCED have found more recently that “the system that the UK Government is seeking to introduce, if it’s introduced correctly, with the right degree of support, could actually offer more benefits in the long term than the implementation of a universal basic income”.³²

Proactive Wales

41. Leighton Jenkins, Assistant Director, CBI Wales, told the Committee Wales should recognise the assets it already has in places, but also seek to make the most of the resources available to it. He told the Committee that the “industrial strategy at a UK level has various challenge funds” with the latest challenge in AI announced recently.

42. Leighton Jenkins also suggested that Wales could do more to speak to the AI experts living and working in Wales to ask how we can support this area of work,³³ and to reach out to the network of former students. He said, “there are world leaders in this area across the UK and across the world who we never speak to. Why? We could ask them to contribute something back to Wales”.³⁴

43. Professor Calvin Jones told the Committee that proactive work could be done to create “Cyber Wales” as there are already “a large number of smaller companies looking at cyber security, cyber defence, with the Wales network”.³⁵ He further suggested that there is an opportunity now to “explicitly fashion policy and explicitly fashion...regional funds in order to incentivise behaviours that develop resilience insofar as we know how to do that”.³⁶

44. The Cabinet Secretary for Economy and Infrastructure told the Committee “the amount of funding won by Wales from Innovate UK has been increasing year on year with over £88m won since 2010/11 and at least another £48m confirmed but not drawn down”. He added that, “Wales has also been successful in the GovTech award competitions with Welsh organisations securing £2.5m (40%) of

³² [Para 186, Economy, Infrastructure and Skills Committee, 7 June 2018](#)

³³ [Para 66, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

³⁴ [Para 203, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

³⁵ [Para 87, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

³⁶ [Para 88, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

first call budget for digital projects”.³⁷ The Cabinet Secretary also told the Committee that Welsh Government recently ran a Launchpad for Cyber security companies, as part of its work to support access to UK Research, Development and Innovation funds.³⁸

45. Professor Calvin Jones suggested there was an opportunity to create in Wales, the kind of facilities for rural communities test bed that already exists for urban communities in Silicon Valley or Toronto.

“...nobody, as far as I know, anywhere in the world, is envisaging, let alone seeking to build, a small rural community that is connected, progressive, inclusive, e-connected, has employment, has social opportunities for people, creative opportunities”.³⁹

46. William Sachiti felt that Welsh topography and rural roads could combine to create an ideal test bed for connected and autonomous cars. Dr Wolfgang Schuster agreed, saying:

“I think there’s an opportunity here to invest in some fundamental research associated with the core technologies, smart technologies that are associated with autonomous vehicles as well as the communication infrastructure, as well as also focusing on the wider operational environmental impacts that need to be considered as part of this development. Then, there’s also something around focusing on the social and human factors questions that need to be addressed, which are specific to areas as well.”⁴⁰

47. However, the Cabinet Secretary for Economy and Infrastructure told the Committee that creating test sites would be “incredibly costly” and may not “actually reap the sort of benefits that some believe it would”.⁴¹

48. The Cabinet Secretary for Economy and Infrastructure told the Committee that he felt that, to a certain extent, automation negated the competition from cheap labour abroad. The Cabinet Secretary said:

“The reshoring opportunities are considerable, particularly in terms of customer service and finance. We’re actively engaged in discussions

³⁷ Further evidence from Cabinet Secretary for Economy and Transport, 25 June 2018

³⁸ Further evidence from Cabinet Secretary for Economy and Transport, 25 June 2018

³⁹ Para 89, Economy, Infrastructure and Skills Committee, 9 May 2018

⁴⁰ Para 51, Economy, Infrastructure and Skills Committee, 23 May 2018

⁴¹ Para 182, Economy, Infrastructure and Skills Committee, 7 June 2018

with a number of businesses with a view of bringing back jobs, and in doing so raising the quality of employment as well. That's why fair work is so important and integral to the economic action plan."⁴²

Recommendation 1. The Committee considers it imperative that further work is carried out to ensure Wales is the provider, not just the consumer of emerging technologies. The Welsh Government should carry out work to:

- identify the expertise and commercial strengths that exists in Wales, for example, in compound semi-conductors, insurance and healthcare;
- identify Wales' competitive advantages in the anticipated growth areas;
- Where strengths and competitive advantage aligns with predicted future growth, support those sectors to position themselves at the forefront of global industry.

Recommendation 2. The Welsh Government should carry out a review of its support to companies in Wales who are seeking support from the UK Research, Development and Innovation Fund. The review should identify where its support could be strengthened. In addition, the Welsh Government should ensure that organisations representing businesses are aware of the support available in Wales when applying to the UK fund.

Recommendation 3. The Welsh Government should consider what more it could do to harness the expertise and contacts of the widest group of experts currently working in Wales, and among the Welsh diaspora. As part of that work, the Welsh Government should encourage universities to strengthen their alumni networks and create key links with alumni and other stakeholders to ensure that where expert links with Wales exist, opportunities to engage are not lost.

Recommendation 4. In order to help ensure Wales is at the forefront of emerging technologies, The Welsh Government should carry out a cost-benefit analysis of developing a model community in Wales, encouraging inward investment from big businesses wishing to pressure test emerging technologies and their effects on communities.

⁴² Para 148, Economy, Infrastructure and Skills Committee, 7 June 2018

Themes for future work

Informed action

In discussing the issues, many witnesses told the Committee there is an ongoing need to better understand the issues, including who would be impacted by Industry 4.0 and where⁴³.

When considering how best to gather and share information, witnesses called for asset maps⁴⁴ to be developed, reliable, open data to be shared⁴⁵ and for a model rural community to be developed.⁴⁶

How can information be gathered and shared to ensure emerging issues and opportunities are understood and acted on in a timely and appropriate way?

Reducing inequality

If Industry 4.0 has the potential to accelerate inequalities, what social and political response should be taken to avoid this? Discussions around benefits and universal basic income are interesting, but the issue is not devolved.

What policy response could Wales take to ensure that Industry 4.0 presents an opportunity to reduce inequality rather than widen the gap? How should we encourage ethical employment practices around automation and AI without stifling the positive possibilities Industry 4.0 may provide?

⁴³ Para 126, Economy, Infrastructure and Skills Committee, 9 May 2018

⁴⁴ Para 206, Economy, Infrastructure and Skills Committee, 9 May 2018

⁴⁵ Para 100, Economy, Infrastructure and Skills Committee, 9 May 2018

⁴⁶ Para 212, Economy, Infrastructure and Skills Committee, 9 May 2018

3. Precision Agriculture

49. Precision agriculture uses technology to improve the efficiency and therefore sustainability of farming systems. It uses technologies such as sensors, drones, GPS systems and enhanced autonomous machinery to optimise production.

50. Professor Simon Blackmore, Head of Agricultural Robotics, Harper Adams University, described precision farming as “very disruptive”. He suggested there would be a change in the way farming machinery is developed in the future, with the trend to build bigger farming machines to create economies of scale “coming to an end”. Professor Blackmore described Wales as “disenfranchised from the use of these big machines, because predominantly you’ve got small and medium-sized farms and small and medium-sized fields”. However, new developments are delivering small machines that are better suited to farms in Wales.⁴⁷

Opportunities

51. Professor Blackmore told the Committee the UK was in a good position to lead in the robotic agriculture industry, saying, “The technology that we’ve got in the UK is as good as anywhere else in the world, if not better. We’re one of the leading areas”.⁴⁸ He added, “it’s going to be the start-ups that are going to have the major impact now”⁴⁹ as they are not committed to the linear development of bigger and bigger machines, which is the approach of the larger companies.

52. The Cabinet Secretary for Economy and Transport told the Committee:

“we’ve developed a new economic strategy that’s designed to supercharge those industries of tomorrow, but also futureproof areas of the economy that need to transition in the age of automation.”⁵⁰

53. Witnesses told the Committee about the opportunities precision agriculture presents to improve the environment. Jason Llewellyn, an arable farmer in Pembrokeshire, was clear that “there are definitely soil and water benefits from using precision technology”.⁵¹ He told the Committee how his farm uses precision farming to benefit the environment:

⁴⁷ [Para 227 - 228, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁴⁸ [Para 231, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁴⁹ [Para 282, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁵⁰ [Para 116, Economy, Infrastructure and Skills Committee, 7 June 2018](#)

⁵¹ [Para 246, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

AUTOMATION AND AI IN WALES: PRECISION AGRICULTURE



New and emerging farming technology is disrupting the way farmers monitor and manage the land

Precision agriculture could help biodiversity, with new weedkiller technology vastly reducing the amount of weedkiller used through micro-droplet application onto identified weeds, and using lasers to heat and destroy weeds.



WHAT THE WITNESS SAID



The technology that we've got in the UK is as good as anywhere else in the world, if not better. We're one of the leading areas.

Professor Simon Blackmore

Head of Agricultural Robotics,
Harper Adams University



FURTHER READING

◆ **Drones, robots and satellites: the future of Welsh agriculture?**

Research Service Blog

◆ **Precision farming**

Parliamentary Office of Science and Technology

◆ **Precision Agriculture: separating the wheat from the chaff**

Nesta

THE WITNESSES CALLED FOR:

- ◆ Good, reliable broadband in rural areas
- ◆ Demonstration farms across Wales to showcase cutting edge technology
- ◆ Support for start ups, which have the potential to make major impacts in this area



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“We resist the use of insecticides immensely and, on certain crops, we don’t use them. We believe that our biodiversity is increasing. We have quite a lot of margins about the place, which, again, we’ve been able to manage properly because we have a defined boundary within the GPS systems that don’t encroach on those, which help our biodiversity.”⁵²

54. Professor Blackmore described the precision agriculture techniques that could be used to vastly reduce or eliminate the use of herbicides:

“We can just put chemical directly onto the leaf of the weed, and we can save 99.9 per cent of the chemical straight away.

Another project we’ve just finished is called laser weeding, so we can use the cameras to identify the weed, so, identify the meristem of the weed, heat the meristem up to 95 degrees Celsius, cell walls then rupture and the plant then either goes dormant or dies. It takes about 7W of energy to do that—no chemicals at all.”⁵³

55. Jason Llewellyn told the Committee that he had seen crops becoming “more consistent”. He felt that the better crops had resulted in less run-off and erosion in poorer soil areas.⁵⁴

56. Professor Blackmore told the Committee that in addition to the environmental and economic benefits of precision agriculture, there were social benefits too. He referred to young people who were facing the decision to stay on the family farm or find work elsewhere, to whom automation provided welcome assistance. He said:

“the idea of having robotic milking—even just a single day on a small farm—is becoming quite prevalent now. And so the use of this technology is enabling people to remain in the rural areas rather than having to go elsewhere.”⁵⁵

57. Professor Blackmore identified an opportunity for tracking food from farm to fork, and identifying what had happened to the food along the way. He described using real-time kinematic GPS (RTK GPS) to identify the location of each plant, enabling the identification of “what has been applied to it and what hasn’t been

⁵² [Para 332, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁵³ [Para 234 – 244, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁵⁴ [Para 246, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁵⁵ [Para 258, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

applied”⁵⁶ opening up the possibility of consumers accessing that information through smartphones in the supermarket.

Challenges

58. The Committee heard that although the technology has “been developed to such a level of maturity that it meets our needs and our requirements”⁵⁷ and is therefore user friendly, there is still a need to interpret the data it provides.⁵⁸

59. Jason Llewellyn suggested that some people will not want to use new technologies, but for those who do, “there is a certain amount of training and skilling that is needed”.⁵⁹

60. Professor Blackmore suggested that the universities and colleges are “responsive” to the changing training needs created by emerging technologies and no Government intervention is needed.⁶⁰

61. However, the Minister for Welsh Language and Lifelong Learning told the Committee “I think there’s probably a lot of work to do in relation to precision agriculture” and upskilling the farming sector.⁶¹

62. Jason Llewellyn identified another potential barrier to the take-up of precision farming in the “extra management time”, especially when “everybody is busy or working against the weather”.⁶² He also stated that the extra time was a worthwhile investment.

63. Christopher Hoskins, SoilQuest Commercial Manager told the Committee that the perception that precision farming is expensive was incorrect.⁶³ Jason Llewellyn agreed, saying, “you can spend as much as you like, but you can also just do simple things relatively cheaply”.⁶⁴

64. The Committee heard that funding made available for precision farming can be too “prescriptive”. Jason Llewellyn told the Committee that when extending the

⁵⁶ [Para 261, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁵⁷ [Para 302, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁵⁸ [Para 293, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁵⁹ [Para 298, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁶⁰ [Para 307, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁶¹ [Para 71, Economy, Infrastructure and Skills Committee, 7 June 2018](#)

⁶² [Para 347, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁶³ [Para 252, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁶⁴ [Para 352, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

technologies used on his farm, six hundred soil tests were required. He was able to secure Welsh Government funding for ten of them. He felt that although there were some small grants available, if farmers had the basics in place there was no real “route to go on to the next level”.⁶⁵ He called for grant flexibility as “no two farms are the same”.⁶⁶

65. Christopher Hoskins called for “grants towards more basic elements, whether it’s basic soil sampling or soil health auditing” as the information on soil health was an important part of precision farming.⁶⁷

66. The Cabinet Secretary for Energy, Planning and Rural Affairs told the Committee:

“I continue to make available the Farm Business Grant for farmers to access up to £12,000 of grant to make relatively small investments in their farm. There are a number of items relating to precision agriculture on the list that have been pre-identified as being relevant to modern agriculture, a number of which relate to precision agriculture. The items have been specified and costed to simplify the grant application process while offering the maximum flexibility to the farmer. My officials continue to work closely with the industry to ensure these items offer a step change to our agriculture sector in order to increase productivity.”⁶⁸

67. Professor Blackmore told the Committee there was not always a clear financial benefit to adopting precision farming as how the technologies are used determine “whether you make any money out of it”.⁶⁹ Christopher Hoskins agreed, identifying the difficulty of quantifying the “advantages of precision from a financial perspective” as a barrier to accessing funding from banks.⁷⁰

68. Jason LLewellin is an advocate for precision farming, but recognised that “if there is a barrier in the way to it being used, it’s reliable, good broadband and

⁶⁵ [Para 314 - 315, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁶⁶ [Para 379, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁶⁷ [Para 377, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁶⁸ [Letter to Chair from Cabinet Secretary for Energy, Planning and Rural Affairs, 19 June 2018](#)

⁶⁹ [Para 346, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁷⁰ [Para 354, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

4G”.⁷¹ Professor Blackmore agreed, telling the Committee that without good 4G coverage “you can’t use the technology”.⁷²

69. The Minister for Welsh Language and Lifelong Learning acknowledged that “one of the biggest problems that I think we have” in creating precision agriculture industry in Wales, is the need for good 5G and broadband coverage, but “I think we’ve got to appreciate that there are still gaps in some areas. So, that is a problem we have to address as well”.⁷³

70. The Cabinet Secretary for Energy, Planning and Rural Affairs agreed that coverage needed to improve, telling the Committee “the Welsh Government has developed a mobile action plan with the mobile phone industry and other partners including the farming unions and CLA Cymru”.⁷⁴

71. As farming increases its use of automation and robotics, it would be easy to anticipate an impact on employment. However, Professor Blackmore told the Committee that “the big tractors have already displaced much of the rural population” so where ten or twenty people might have worked on a farm, now you would have only one or two. He suggested that automation might help offset the effects of Brexit which he anticipated would reduce the availability of seasonal labour.⁷⁵

72. The Committee heard about the “ethical issue” of who owns data and who has a right to manipulate it and potentially profit from it.⁷⁶ Professor Blackmore recognised that in certain circumstances, “there is more value in the data about [a] piece of broccoli than the piece of broccoli that is actually sold from the farm”.⁷⁷ However, although he was aware that there was huge value in data, “safeguarding it and controlling it, and who has access to it, is another issue and I don’t have any simple answers to that”.⁷⁸

73. Professor Blackmore suggested that although the UK is leading the way in developing precision agriculture, there was a role for the Welsh Government to

⁷¹ [Para 256, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁷² [Para 265, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁷³ [Para 76, Economy, Infrastructure and Skills Committee, 7 June 2018](#)

⁷⁴ [Letter to Chair from Cabinet Secretary for Energy, Planning and Rural Affairs, 19 June 2018](#)

⁷⁵ [Para 321, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁷⁶ [Para 287, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁷⁷ [Para 289, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁷⁸ [Para 291, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

demonstrate the new technologies and help develop them for the Welsh environment.⁷⁹ He called for the Welsh Government to:

“fund or partially fund or co-fund one farm in north Wales, one farm in south Wales, or different sectors, where it could be offering the framework to the universities and research sectors to come and trial this work or to demonstrate these types of machines, or even private industry to actually come and show how it can be done. But it’s to take the risk out of it to allow private money to lever up that initial investment.”⁸⁰

74. Jason Llewellyn suggested that the Welsh Government could better encourage the take up of precision agriculture techniques, particularly where there are environmental issues such as nitrate vulnerable zones.⁸¹

75. The Cabinet Secretary for Energy, Planning and Skills told the Committee she already showcases “a number of technologies, processes and practices which demonstrate the benefits of precision agriculture in real-farm situations”. In response to a letter from the Committee on precision agriculture, she has asked Farming Connect to review “its demonstration, innovation and focus sites to ensure they are at the cutting edge of farming practices to inspire other farmers to adopt these techniques”.⁸² However, the Committee is unclear if such sites are full-scale farms or smaller, demonstration areas with just a few acres set aside.

76. The Cabinet Secretary’s letter refers to the Farm Business Grant which supports farms to purchase “GPS technology for the targeted application of fertilisers and pesticides”.⁸³ However, given the importance of precision agriculture to the eco and species survival agenda, the Committee was concerned to hear that Welsh Government seemed focused on the provision of “kit” and seeks assurances that the grants will be flexible enough in the future to enable precision agriculture in broader terms.

77. The Committee was also concerned that the Cabinet Secretary’s letter to the Committee failed to recognise the importance of Wales placing itself at the forefront of developing new technologies for the smaller farms that are typical to Wales and will be the focus of the next wave of innovation.

⁷⁹ [Para 229, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁸⁰ [Para 371, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁸¹ [Para 293, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

⁸² [Letter to Chair from Cabinet Secretary for Energy, Planning and Rural Affairs, 19 June 2018](#)

⁸³ [Letter to Chair from Cabinet Secretary for Energy, Planning and Rural Affairs, 19 June 2018](#)

78. The Minister for Welsh Language and Lifelong Skills told the Committee “I think there’s probably a lot of work to do in relation to precision agriculture” and committed to agreeing proposals “in the next few weeks”.⁸⁴

Recommendation 5. The Welsh Government should share the findings of the Farming Connect review of its demonstration innovation and focus sites, setting out clear and measurable actions it intends to take as a result of its findings. The actions should include the steps it will take to work with FE and HE to grow the demonstration sites to support the development, as well as the roll out, of new technologies.

Recommendation 6. The Welsh Government should work in collaboration with FE and HE to develop made-in-Wales precision agriculture software and hardware suitable for Wales’ small farms. Such innovation would not only benefit Welsh farms, but would have strong potential to create attractive exportable products.

Themes for future work

Data is the new steam

If data is to Industry 4.0 as steam was to the first then ownership of data as a commodity will be a key part in determining who profits from the change, and who does not.

What should be done to ensure that data is used ethically in a way that benefits the whole of society and not just those who have the resource to gather it through foul means or fair?

⁸⁴ Para 71, Economy, Infrastructure and Skills Committee, 7 June 2018

4. Connected and Autonomous Vehicles

79. The future of road transport is rapidly evolving, and both the UK and Welsh Government want to be leaders in the development of connected and autonomous vehicles (CAVs).

80. Connected vehicle technologies allow vehicles to connect with each other and the wider world. These are already common on Welsh roads, with connectivity such as GPS and eCall, which automatically connects a driver to help after an accident. Autonomous vehicles are vehicles that can drive by themselves, without any reliance on external input except for their own on-board sensors. Connected and autonomous vehicles (CAV) combine the two technologies.

81. Autonomous vehicles are categorised into five levels, with level one having minimal automation such as driver assist brakes, and five being fully automated with no need for a steering wheel or other controls for human use. Dr Paul Nieuwenhuis told the Committee that “at the moment, the industry is probably at about level 2, perhaps moving towards level 3”.⁸⁵

82. William Sachiti told the Committee that “it’s going to take about 20 years for us to see autonomous cars everywhere, because this is the life cycle of a car”.⁸⁶

83. Dr Nieuwenhuis told the Committee that some experts in the field are considering the benefits of three revolutions in transport: “electrification, automation and shared use, that cuts out the privately owned car”.⁸⁷ Although he did not anticipate a future in which cars are no longer privately owned, he could anticipate a future in which the demand for car ownership was reduced. He said:

“Privately owned vehicles will obviously go down as people will use autonomous vehicles more, but they won’t disappear. If you look at the introduction of new technologies historically, old technologies don’t disappear; they persist. We still ride horses, we still have sailing boats and things like that, and the same will be the case here. So, the vision that’s often presented that we will all be driving around in automated pods is very unlikely. There is no historic precedent for that sort of change.”⁸⁸

⁸⁵ Para 7, Economy, Infrastructure and Skills Committee, 23 May 2018

⁸⁶ Para 68, Economy, Infrastructure and Skills Committee, 23 May 2018

⁸⁷ Para 43, Economy, Infrastructure and Skills Committee, 23 May 2018

⁸⁸ Para 20, Economy, Infrastructure and Skills Committee, 23 May 2018

CONNECTED AND AUTONOMOUS VEHICLES



WHAT THE WITNESS SAID

“

Most people in a big city today would rather use a taxi app than they would public transport. The reason they don't is because it's more expensive, isn't it? If it was cheaper, which it would be with an autonomous vehicle, then it's logical to assume all people would want to use them because the cost isn't an issue.

William Sachiti
CEO, Academy of Robotics

”

“

Obviously, looking back at history, as we develop technologies and we are challenged to develop more advanced technologies, there have always been people on the other side trying to interfere with these technologies. That becomes all the more relevant where we are developing fully autonomous vehicles that have had no human input and no capability to control the vehicle.

Dr Wolfgang Schuster
Technical Director, Atkins

”

“

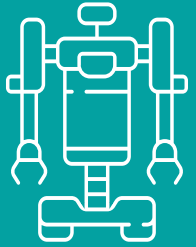
Where it's no longer viable to run busses on a regular basis with a driver, to run a smaller autonomous vehicle without a driver may suddenly become cost effective. So, it may well enhance a public transport function in rural areas.

Dr Paul Nieuwenhuis
Director for Wales, Senior Lecturer in Logistics and Operations, Cardiff University

”

Connected and Autonomous Vehicles (CAVs) have the potential to provide safer, cheaper and more convenient transport in the future, with vehicles that scan 40,000 times a second in all directions to see ahead and avoid danger.

Wales has the potential to be at the heart of this new industry but there is still much work to do in building public trust and acceptance of the technologies.



FURTHER READING

◆ **Connected and Autonomous Vehicles: The future?**

House of Lords Science and Technology Select Committee Report

◆ **Briefing Paper**

House of Commons' briefing paper on the Automated and Electric Vehicles Bill 2017-2019

THE WITNESSES CALLED FOR:

- ◆ Pre-crash data to be shared between all CAV developers
- ◆ Welsh Government to act as an enabler, facilitator and co-ordinator for CAV, including the creation of a 5G test bed CAV centre in Wales
- ◆ Caution when regulating on emerging technologies



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Opportunities

84. Dr Wolfgang Schuster identified a clear benefit of autonomous vehicles, telling the Committee that driverless vehicles were far less likely to be in an accident “because it has its eyes on the road all the time and further ahead than a human being would do”.⁸⁹

85. William Sachiti agreed with Dr Schuster, saying:

“to give you an idea of the extent of how well these cars can predict futures or see ahead, we have, let’s say, four different types of scanners, which each take 40,000 scans a second, which is—what is it—1.6 million scans a second, and then all this data is then used to be able to predict what’s going to happen. This is per second. It can see 100m in any direction at all times, 1.2 million times per second. So, it’s predicting ability is so much better than a human.”⁹⁰

86. Dr Schuster suggested that CAV technologies could reduce congestion as “vehicles could drive closer together, which would increase roadway capacity without impacting safety since machines can help maintain much shorter minimum distances between vehicles compared to human drivers and still be safe”.⁹¹

87. Dr Schuster also suggested that the anonymised data gathered by the CAV could be fed back to transport planners to help understanding of how people interact with the network. The Dr told the Committee that the information “could result in optimised networks which directly respond to travel trends and demands or could help members of the public with improved travel information about their journeys”.⁹²

88. A further benefit to CAV is reduced emissions. Dr Nieuwenhuis told the Committee of the anticipated “transformation from internal combustion engine vehicles to electric vehicles”⁹³ Dr Schuster added that vehicle platooning, when CAV closely follow each other at high speeds in a connected and safe way, has the option to optimise vehicle speeds and movements to reduce emissions further.⁹⁴

⁸⁹ [Para 150, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

⁹⁰ [Para 153 Economy, Infrastructure and Skills Committee, 23 May 2018](#)

⁹¹ [Dr Schuster written evidence 23 May 2018](#)

⁹² [Dr Schuster written evidence 23 May 2018](#)

⁹³ [Para 70, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

⁹⁴ [Dr Schuster written evidence 23 May 2018](#)

89. Dr Nieuwenhuis told the Committee that in rural areas, CAV's:

“could enhance the public transport function. Where it's no longer viable to run buses on a regular basis with a driver, to run a smaller autonomous vehicle without a driver may suddenly become cost-effective. So, it may well enhance a public transport function in rural areas.”⁹⁵

90. William Sachiti told the Committee that CAVs could change our conception of public transport as, rather than walking to the bus then train to get to your destination, it could be cheaper and easier to use a taxi style app to bring an autonomous vehicle to your door.⁹⁶

91. Dr Schuster described the wider effects this could have, saying:

“I think autonomous vehicles have the potential to enhance inclusivity, essentially, because people, such as disabled people and the elderly who can't drive, would be able to have access to vehicles. That would bring them closer to society.”⁹⁷

92. The Cabinet Secretary described a potential future where everyone could move around with incredible ease. He said:

“it may well be that you, in the future, will be sitting on your made-in-Wales gaming chair in your lounge, and you will be able to call for a robotic taxi, and the chair will lift up and take you out, and you can move from that into a train and into a plane.”⁹⁸

93. Dr Schuster suggested that “if humans are not driving, they can be working or relaxing. Stress levels will be reduced overall, which will positively impact health and can lead to increased productivity at work”.⁹⁹

94. The Committee considered if Industry 4.0 presented an opportunity to redesign cities to better meet the needs of the people who live and work in them. Dr Schuster agreed that there was a need to link future technologies and developments “with other kinds of issues that we're facing, not only social inclusion, but accessibility, congestion, air quality, and trying to look at it from a

⁹⁵ [Para 95, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

⁹⁶ [Para 103, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

⁹⁷ [Para 119, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

⁹⁸ [Para 264, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

⁹⁹ [Dr Schuster written evidence 23 May 2018](#)

holistic perspective and see where we can address these problems and how we can address those problems”.¹⁰⁰ However, Dr Nieuwenhuis pointed out that “The only problem is that we are where we are, and certain things cannot be uninvented”¹⁰¹ and so decisions and leadership would be needed to make such a fundamental and far-reaching change.

95. Witnesses also told the Committee that Wales has the opportunity to be at the forefront of new industry. William Sachiti said his firm developed automated delivery vehicles in Wales because of the challenges of the topography and the sparseness of rural roads. The challenges of making the technology work in Wales can, in effect, ensure that it will work anywhere.¹⁰²

96. The Cabinet Secretary told the Committee that there were other economic opportunities for Wales. He told the Committee:

“it’s predicted that the roll-out of autonomous vehicles will lead to lower levels of car ownership but higher levels of usage of vehicles. That means that component parts of the interior will wear out faster, because, essentially, you’re just going to strip out the interior every five to 10 years and renew it, because cars will also have a greater degree of longevity. We have a number of major businesses in Wales that are particularly strong in terms of supplying components for the interiors of vehicles at the moment, and that’s why I think we’ve got a very strong opportunity, a very good opportunity, to capitalise from autonomous vehicle manufacturing.”¹⁰³

Challenges

97. Alongside the many opportunities are a number of challenges. The Committee considered the ethics of handing control of a vehicle over to a machine. Dr Nieuwenhuis asked the Committee, “will we accept machines going around killing people?”¹⁰⁴ Experts agreed that a fatal accident in a CAV would be far less common than in cars with human drivers, but it may be less socially acceptable for machines to make the same mistakes people make.¹⁰⁵ Dr Schuster suggested that “ethics will also be brought into question with a rules engine being

¹⁰⁰ [Para 164, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

¹⁰¹ [Para 163, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

¹⁰² [Para 47 – 50, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

¹⁰³ [Para 262, Economy, Infrastructure and Skills Committee, 7 June 2018](#)

¹⁰⁴ [Para 150, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

¹⁰⁵ [Para 151, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

used to make decisions which a human mind may be in a better position to judge”.¹⁰⁶

98. Liability and insurance are called into question in the case of such an accident. Dr Schuster asked the Committee:

“who is responsible, who is liable, in the case of an accident—is it the vehicle manufacturer, is it the software provider, is it the individual inside the vehicle who didn’t press the right button, or is it the telecoms provider because there was an interruption in the service of the download to the vehicle at the time?”¹⁰⁷

99. Cyber security will be another key challenge for CAV. Dr Nieuwenhuis told the Committee that because the ICT industry has a better understanding of car industry:

“a lot of cars out there are probably hackable today; in fact, some of them have been hacked. So, what we need to avoid is a scenario whereby somebody with evil intent could suddenly hack tens of thousands of cars and use them to run over people in cities or something like that, which, theoretically, would be possible.”¹⁰⁸

100. William Sachiti was optimistic that cyber security would be developed once the cars were developed to a point that they could be considered valid working products.¹⁰⁹

101. However, Dr Nieuwenhuis gave a further note of caution, telling the Committee that autonomous cars “will eventually be delivered by companies whose primary priority is saving money and optimising profits”¹¹⁰ and so Government intervention may be necessary to ensure minimum standards are met.

102. The Committee heard that although autonomous cars do not require connectivity, CAVs do. This presents the challenge of delivering appropriate digital infrastructure. Dr Schuster told the Committee that while it was commercially viable to roll out and upgrade digital networks in cities, that would not be the

¹⁰⁶ [Dr Schuster written evidence 23 May 2018](#)

¹⁰⁷ [Para 8, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

¹⁰⁸ [Para 32, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

¹⁰⁹ [Para 36, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

¹¹⁰ [Para 37, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

case in more rural areas and a regulatory framework may be needed to address that.¹¹¹

103. William Sachiti told the Committee that the cars his company makes are designed to work with the current physical infrastructure.¹¹² However, the Minister for Welsh Language and Skills told the Committee that her conversations with Tesla had suggested that changes would have to be made, for example the painting of white lines to enable cars to read the edges of the road.¹¹³

104. The Committee also considered the need for charging points for electric vehicles. Dr Schuster said there was a need to put in place “the right charging infrastructure”.¹¹⁴ The Committee’s autumn term work programme will consider this in more detail.

105. Alongside the digital and physical infrastructure needed for CAV sits the need to integrate autonomous vehicles with heritage vehicles. Dr Schuster said that a level of cautiousness should be anticipated when introducing “strict rule-based vehicles with human-driven vehicles that are not necessarily always following all the rules”.¹¹⁵

106. Dr Nieuwenhuis told the Committee that he felt CAV and human driven cars will always be mixed as he considered the continued use of heritage vehicles as inevitable, but the advantage of that is that it provides resilience in the case of unexpected infrastructure changes, for example after a natural disaster.¹¹⁶ However, he anticipated that most journeys would be in CAVs.

107. As already discussed, the Cabinet Secretary described a future in which people might go from their home to a CAV to a train without leaving their seat. While that could be very attractive to people with limited mobility, Dr Schuster told the Committee that “there is a danger that you end up with a system where people will only and exclusively use wheeled mobility as opposed to using their feet-or to cycle”.¹¹⁷ The positive impacts of active travel are well known, as the Committee has previously reported, and the potential for reduced physical activity is concerning.

¹¹¹ [Para 80, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

¹¹² [Para 15, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

¹¹³ [Para 67, Economy, Infrastructure and Skills Committee, 7 June 2018](#)

¹¹⁴ [Para 16, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

¹¹⁵ [Para 19, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

¹¹⁶ [Para 53 - 55, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

¹¹⁷ [Para 124, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

108. The Committee heard that there might be a challenge to garner public acceptance for the new vehicles. Dr Schuster considered it necessary to design systems around humans rather than expecting humans to adapt. He suggested that “it is this co-evolutionary process that will generate the trust and that will generate the acceptability”.¹¹⁸

109. Witnesses also told the Committee that nervousness about new approaches and technologies could lead to overcautious regulation, especially when the regulators do not understand the tech and risk shutting down future possibilities.¹¹⁹ William Sachiti gave an illustration of the point:

“in 1876 in the UK, the first cars came from a city of horses and carts, and at the time people were scared—‘What are these giant steam engine things?’—and so Government legislated that from this day forth, there shall be a man with a red flag waving down, walking in front of each car, saying that there’s a car or vehicle coming. The result was that for 30 years, we were stuck behind a red flag and 4 mph, whilst Germany, Italy and France had booming car industries, and some say this is why we’re still behind. So, it’s important that we don’t over-panic and legislate to be stuck behind a red flag.”¹²⁰

110. William Sachiti told the Committee that there was an opportunity to accelerate improvements that could be made to increase safety in autonomous cars. Although the number of autonomous car crashes is far lower than the number of crashes involving drivers, when such accidents do occur, manufacturers will check the data collected in the run up to the incident to analyse what went wrong and address any issues they identify. William Sachiti told the Committee that he would like to see a law requiring companies to share the data collected 10 seconds before the crash so that “we all learn, rather than we all have to repeat the same mistake over and over”.¹²¹

111. Dr Schuster told the Committee “it is anticipated that most, if not all, CAVs will be powered electronically” and so “as EV numbers increase, so does the need for more rapid ‘on demand’ charging points”.¹²² The Minister for Welsh Language

¹¹⁸ [Para 167, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

¹¹⁹ [Para 84, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

¹²⁰ [Para 170, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

¹²¹ [Para 138, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

¹²² [Dr Schuster written evidence, 23 May 2018](#)

and Skills told the Committee that she had “spoken to Tesla on quite a few occasions and tried to get them to put in charging stations around rural Wales”.¹²³

112. The Committee intends to do a focused piece of work in this area in the Autumn term.

113. William Sachiti told the Committee that there was a need to support small companies like his to enable them to grow and develop.¹²⁴ Dr Schuster added that he saw “an opportunity here to invest in some fundamental research associated with the core technologies, smart technologies that are associated with autonomous vehicles...Then there’s also something about focusing on the social and human factors questions that need to be addressed, which are specific to areas as well”.¹²⁵

114. Dr Schuster told the Committee that there was a need to bring a diverse range of stakeholders together who would not normally collaborate. He referenced projects being delivered by Intelligent Mobility with Atkins which saw “academics via small tech companies, large industry, charities, insurance and legal companies, governmental entities, all working together as one” to achieve a goal. He felt it “is absolutely vital is that Government facilitates collaboration and information sharing between all these different stakeholders” in order to bring together learning from different projects and ensure a consistent roll out of the solutions.¹²⁶

115. William Sachiti told the Committee about the difficulties small start-ups have in seeking Government grants. He said “the problem is the way it’s structured is, you would need to have a team of grant writers to be able to ever win a grant as a small company”.¹²⁷ Dr Nieuwenhuis reflected that universities applying for grants also had to use a lot of resource “that’s often wasted”.¹²⁸

Recommendation 7. The Welsh Government should consider what role it could play in encouraging connected and autonomous vehicle (CAV) companies to share pre-crash data to accelerate learning and safety across the industry.

¹²³ Para 67, Economy, Infrastructure and Skills Committee, 7 June 2018

¹²⁴ Para 46, Economy, Infrastructure and Skills Committee, 23 May 2018

¹²⁵ Para 51, Economy, Infrastructure and Skills Committee, 23 May 2018

¹²⁶ Para 183, Economy, Infrastructure and Skills Committee, 23 May 2018

¹²⁷ Para 179, Economy, Infrastructure and Skills Committee, 23 May 2018

¹²⁸ Para 182, Economy, Infrastructure and Skills Committee, 23 May 2018

Recommendation 8. The Welsh Government should carry out a cost benefit analysis of the creation of a 5G test bed CAV centre in Wales to support home grown industry and inward investment.

Themes for future work

Balancing innovation and regulation

Witnesses were clear on the need for strong cyber security to avoid potentially tragic circumstances arising from cyber attacks. The entry points to access CAVs are potentially multiple, with those intent on doing harm needing only to find the weakest chain in the link.

Witnesses were also clear that over regulation could sound the death knell for emerging technologies and leave Wales far behind its competitors elsewhere.

Where should the balance be struck between regulating the standards of cyber security necessary, and enabling innovation and disruptive technologies to emerge?

Avoiding the WALL-E effect

Witnesses suggested that CAVs could provide cheap, door-to-door transport across cities and regions. There are clear benefits to connecting people in new ways and enabling disabled or older people to stay mobile and connected.

However, in its previous report on active travel, the Committee also recognised the health benefits of walking and cycling more. The 2008 futuristic Pixar film, WALL-E, depicted humans' over-reliance on automation leading to grossly inactive lifestyles and mass obesity. In the UK 60 percent of adults are overweight and a quarter obese.

What more can be done to encourage people to recognise the benefits of active travel, if door-to-door transport in CAVs becomes such a cheap and easy option?

5. Future Skills

116. Witnesses all agreed that Industry 4.0 will create the need for a workforce skills refresh. Professor Richard B Davies, Vice Chancellor, Swansea University, told the Committee “we’re facing an unprecedented rate of change, with huge adjustments to be made”.¹²⁹ The Professor explained:

“we’re talking about within the next 20 years, dramatic changes. Not just a continuation of the current trend, which we already see in retailing and service and the online work, rather than person-to-person work, but moving into automation, moving into artificial intelligence, where processes within which people are employed are going to change and adapt. So, we’ve got to be thinking of transformation—technological and social transformation within 20 years. This totally exceeds anything, for example, that we saw in the coalfields over a limited period.”¹³⁰

117. Leighton Jenkins spoke about a World Economic Forum study that set out a realistic skills pathway for people effected by the first wave of automation. He argued that “we are nowhere near prepared” for retraining people into jobs with similar pay that are not at risk of second wave automation.¹³¹

Opportunities

118. The number of anticipated jobs being lost is substantial and the Committee does not underestimate the challenges of supporting people through the changes ahead, but witnesses also anticipated an opportunity in the new industries that will be created in the autonomous future. David Hagendyk , Director for Wales, Learning and Work Institute, told the Committee:

“If we do respond appropriately, then I think there are opportunities for us to create new industries and new jobs, but what are the risks and opportunities almost depends entirely on how the Government help business and help providers respond to that.”¹³²

¹²⁹ [Para 12, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹³⁰ [Para 21, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

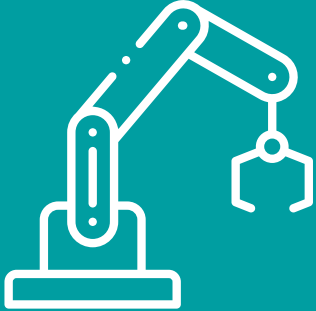
¹³¹ [Para 27, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

¹³² [Para 14, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

AUTOMATION AND AI IN WALES

UK GDP will be up to 10.3% higher in 2030 as a result of AI – the equivalent of an additional £232bn – making it one of the biggest commercial opportunities in today's fast-changing economy * (PwC).

Just 7% of people think automation will affect them. Yet, according to Future Advocacy 'the proportion of jobs at high risk of automation by the early 2030s varies from 22% to over 39%'.



In Wales Alyn and Deeside was ranked the most vulnerable area, with other strong manufacturing areas also featuring heavily.

The Welsh Government has commissioned a Digital Innovation review, led by Professor Phil Brown of Cardiff University, to look at these issues. Its final report is expected early in 2019.



WHAT THE WITNESS SAID



In Wales, the problem is that the vast majority, particularly of SMEs, are completely unengaged with the automation agenda. When we talk to businesses...this is just not on anybody's radar, and it's much the same in the public sector.

Professor Calvin Jones
Cardiff University



Most primary school children will end up in jobs that don't yet exist today. So, how do we start encouraging businesses to think about that kind of longer term planning and engagement with their communities?

Catherine Phillips
Business in the Community



FURTHER READING

- ◆ **The Future of employment**
Carl Benedikt Frey† and Michael A. Osborne
- ◆ **The Impact of AI in UK Constituencies: Where will automation hit hardest?**
Future Advocacy
- ◆ **The economic impact of artificial intelligence on the UK economy**
PWC
- ◆ **A Brave New World**
Business in the Community

WITNESSES TOLD US THE WELSH GOVERNMENT SHOULD:

- ◆ Ensure the education system supports life-long learning
- ◆ Harness the skills of World-leading experts based in Wales
- ◆ Develop a strategy to reap the benefits and minimise the risks from automation.



For more information about the Economy, Infrastructure and Skills Committee and its work on automation in Wales visit: www.assembly.wales/seneddeis

119. Professor Richard Davies suggested that rather than disappearing altogether, some roles will initially “change and modify”¹³³ as they will need “something other than artificial intelligence for the foreseeable future”.¹³⁴

120. Dr Rachel Bowen, Director of Policy and Development, Colleges Wales, told the Committee “the demands of the future aren’t always to do with tech”, identifying heritage building skills as one example of a sector with a shortage of skills.¹³⁵

121. Professor Davies said that his University is already:

“investing very heavily around professions allied to medicine, because the personal care stuff is never going to be automated to the extent that some other areas are going to be, and it’s the human contact and the human dimension that are really important.”¹³⁶

122. Dr Bowen felt there was an opportunity for us to reconsider “how we value those human skills” and how we organise the care industries and support workers to progress.¹³⁷

123. Dr Bowen also recognised that in the current education system, “it’s those customer care skills – that ability to deal with people – that are lacking sometimes in what’s being produced”.¹³⁸

124. Professor Richard Davies told the Committee “people tend to think it’s all technology that changes the world; it’s not, it’s management and leadership, which is about 50 per cent of that”.¹³⁹ He felt there was an opportunity to refocus on those skills within professions that had made time efficiencies due to automation.

125. During the Committee’s visit to The Number Hub – an accountancy business based in Taff’s Well – Founder and CEO Marsha Ward told Members how automation of data entry had freed up accounting staff to spend more time focusing on customers, and less copying digits from paper to screen.

¹³³ [Para 25, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹³⁴ [Para 27, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹³⁵ [Para 56, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹³⁶ [Para 29, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹³⁷ [Para 81, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹³⁸ [Para 154, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹³⁹ [Para 30, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

126. Automation also gives an opportunity in some professions to change the focus of the work and improve job satisfaction. Dr Bowen reflected on the changes electronic marking could make to the teaching profession. She felt that if marking could be automated in a way that is fair to learners, it could create “a chance for teachers, for lecturers, to spend more time on those aspects of learning and delivering the curriculum and delivering skills that are fulfilling”.¹⁴⁰

127. Dr Bowen told the Committee that automation could result in the mainstreaming of learning support for disabled people. She said:

“Some of the aids that have been developed to support learners with additional learning needs are now being rebranded and remarketed as productivity tools, with a focus on how these systems can improve things for everybody.”¹⁴¹

128. David Hagendyk agreed that there were opportunities to be explored, saying “there’s a huge opportunity if we get this right. If we use technology and different forms of working, we can actually really open up opportunities for disabled people”.¹⁴²

Challenges

129. Throughout the inquiry, it was clear that supporting the workforce to upskill in preparation for a future that is not yet entirely understood is a key challenge.

130. Leighton Jenkins called on the Welsh Government to assess the current skills gaps across Wales and create asset maps to help us match our strengths and skills to opportunities as they emerge and prepare for the challenges we identify.¹⁴³

131. David Hagendyk told the Committee that a sector-based approach was necessary. He recognised that retail was likely to experience job losses and called for a meaningful response to up-skilling those affected, saying:

“We know that low-skilled workers will be the most affected by automation and artificial intelligence, so if we don’t respond properly with lifelong learning and investing in their skills, then that’s the risk.”¹⁴⁴

¹⁴⁰ Para 65, Economy, Infrastructure and Skills Committee, 17 May 2018

¹⁴¹ Para 80, Economy, Infrastructure and Skills Committee, 17 May 2018

¹⁴² Para 79, Economy, Infrastructure and Skills Committee, 17 May 2018

¹⁴³ Para 206, Economy, Infrastructure and Skills Committee, 9 May 2018

¹⁴⁴ Para 14, Economy, Infrastructure and Skills Committee, 17 May 2018

132. Rachel Bowen highlighted that women were most at risk of losing their jobs in the short term. She told the Committee “if the evidence suggests, as it does, that retail and other industries that are female dominated are the most at risk, then we need to target support at where we know the problems are likely to occur”.¹⁴⁵

133. Leighton Jenkins agreed, saying:

“the largest three private sector employers in Wales are all retailers—Asda, Sainsbury’s, Tesco. They are predominantly low-skill women who work part-time in their communities to support their families.”¹⁴⁶

134. Matt Fenech cited a PricewaterhouseCooper report¹⁴⁷ “which divided automation into three phases and suggested that women are more likely to be impacted in the initial stages of automation” and suggested that men would be more likely to be impacted from around 2025 to 2030.¹⁴⁸

135. Mair Bell, Senior Research Officer, Wales Centre for Public Scrutiny, told the Committee that consideration needed to be given to how to support older people who will need to work longer before they can afford to retire. She suggested that there was a “need to be thinking about workplaces and dynamics within workplaces and people really learning right throughout their lives and opportunities to retrain”.¹⁴⁹

136. David Hagendyk referenced a survey by the Learning and Work Institute that showed “the older you are, the least likely you are to be involved in learning”. He also felt that there is currently nowhere to go in the public sector to find careers advice as an adult, which could impact the redeployment of dispersed workers into suitable new roles.¹⁵⁰

137. Professor Richard Davies told the Committee that there was need to consider the higher skills too, saying:

“When you’re facing the transformational demands that we’ve got, in terms of skills, it’s a matter of moving everybody up the skills ladder. And there’s plenty of space there for everybody because we have a

¹⁴⁵ [Para 116, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁴⁶ [Para 27, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

¹⁴⁷ www.pwc.co.uk/services/economics-policy/insights/the-impact-of-automation-on-jobs.html

¹⁴⁸ [Para 174, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

¹⁴⁹ [Para 82, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁵⁰ [Para 87, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

ridiculously large proportion of our young people emerging from schools with no skills at all. So, that's the big effort.”¹⁵¹

138. The Professor also said that the Welsh Government “has been very, very good in supporting and part-funding big schemes for large numbers of EngD students, or PhD students, around technological requirements” and called for that support to continue and transfer into new fields.¹⁵²

139. Witnesses recognised the financial implications of providing learning opportunities in the right way to so many people, but Dr Rachel Bowen highlighted the importance of doing so, noting that the costs arising from not investing in education might be even greater. Lifelong learning is considered in more detail later in this chapter.

140. Mair Bell called for “a lot of further research and evidence” as we are currently “speculating quite a lot”¹⁵³ about what skills are needed in the future. Ms Bell also noted that there was further need to look at demand and to consider what jobs might be emerging in any given locality to inform a local response.¹⁵⁴

141. Professor Richard Davies agreed that to successfully identify demand there should be clear links between the wider education sector and industry. He spoke of a ‘triangle’ between HE, FE and employers, although he added that:

“We have relatively few large companies in Wales who are willing to invest and support in this sort of triangle, and we have vastly too many SMEs who need skilled people but haven’t got the resources to be able to put in”.¹⁵⁵

142. Regional Skills Partnerships seem the natural vehicle to build these links, although their capacity to engage with SMEs is limited. Furthermore, as only one Regional Skills Partnership identified automation as an issue, the Committee is unconvinced that they are sufficiently sighted on the challenges and opportunities related to automation and AI, and the skills that will be required as a result.

143. Professor Davies also said that multinational companies were often attracted to Wales as it is considered a “manageable country” in which companies can

¹⁵¹ [Para 70, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁵² [Para 163, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁵³ [Para 194, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁵⁴ [Para 53, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁵⁵ [Para 71, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

easily access politicians and universities to plan, invest and assess the results.¹⁵⁶ The Committee considers it of vital importance that investors, HE and the Welsh Government learn lessons throughout the planning, investment and assessment process.

Education, education, education

144. Dr Rachel Bowen agreed that joint working within the education sector could be improved, saying, “collaboration is a process, not an event, and we are getting better at that”.¹⁵⁷ She told the Committee that the focus on post-compulsory education and training and the new body for post-compulsory education meant that FE and HE were working “more closely than ever before”.¹⁵⁸

145. Professor Richard Davies told the Committee that he felt there was a need for change at the earlier educational level. Dr Bowen agreed and supported the curriculum change resulting from the Donaldson review, saying

“If we get Donaldson right, then we’ve got the chance to create learners who are more independent, who are more resilient, who are more geared up to deal with the challenges of the twenty-first century.”¹⁵⁹

146. Professor Davies agreed with the Donaldson report recommendations that are anticipated to support young people to thrive in a digital world, but he also asked “are the teachers creating the aspirations in the young people to make progress?”.¹⁶⁰

147. Professor Davies also felt there was a need to look at the way we “stereotype people at a very early stage, partly by gender” resulting in young people being “already set off in different directions by the time they leave school”.¹⁶¹

148. Dr Rachel Bowen told the Committee that there was further need to create a culture of aspiration in all families in Wales, where children spend the “vast majority of their time, especially in the early years”.¹⁶²

¹⁵⁶ [Para 147, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁵⁷ [Para 74, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁵⁸ [Para 74, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁵⁹ [Para 64, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁶⁰ [Para 60, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁶¹ [Para 112, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁶² [Para 172, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

149. David Hagendyk raised a question about the quality of teaching across the education, asking, “do we have the time and the money to invest in the quality of the teaching to deliver the new curriculum?”¹⁶³

150. Mair Bell raised concerns about the “false distinction between the creative and critical thinking skills and, on the other side STEM subjects” and argued that science and maths could be taught in creative and critical ways. She told the Committee that the experience children and young people have of school has the potential to raise barriers to lifelong learning as they would not want to re-enter education as an adult if they had negative experiences associated with learning.¹⁶⁴

151. Professor Calvin Jones told the Committee that he felt it important not to teach young people coding skills that would be out of date in a few years. He argued instead that the new curriculum should focus on “teaching the principles of coding and the idea of how intelligence works without locking students into a particular language”.¹⁶⁵

152. Dr Bowen shared concerns about delivering the new curriculum as she felt there is an issue with consistency across schools. She said:

“We know that there are some schools or some institutions doing a really good job, with access to really great facilities, but that’s not the case across the whole of Wales; that’s not where we need it to be.”¹⁶⁶

153. Professor Richard Davies raised concerns about the number of young people leaving school and entering Higher education. He told the Committee that the percentages of young people going to HE was much lower in Wales, with about 32 percent of young people aspiring to go to university while “in the south-east of England, it’s nearly 50 per cent. Korea is up to 70 per cent”.¹⁶⁷

154. The Committee notes the ongoing scrutiny of reforms to the education curriculum following the Donaldson Review, being carried out by the Children, Young People and Education Committee.

155. William Sachiti told the Committee about his experience of university as a mature student. He said:

¹⁶³ [Para 62, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁶⁴ [Para 63, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁶⁵ [Para 163, Economy, Infrastructure and Skills Committee, 9 May 2018](#)

¹⁶⁶ [Para 124, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁶⁷ [Para 38, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

“As someone who’d come from the corporate world as an entrepreneur, it was quite interesting to learn how so many people have degrees, or are studying degrees rather, which won’t have as much value for them in the future and they have no idea, and then here we are looking for graduates in computer vision and computer science and there are too few.”¹⁶⁸

156. Professor Richard Davies told the Committee that universities are adjusting and are “way ahead of the discussion” in terms of the types of the courses and content available.¹⁶⁹

157. Dr Rachel Bowen told the Committee that “It isn’t just about driving people towards university” and that the divide between vocational and academic education needed to be addressed.

158. The Minister for Welsh Language and Lifelong Learning told the Committee that she has set up a new £10 million fund to ensure FE courses are responsive to employers’ needs. The Minister said FE “won’t get access to that fund unless they are responding to the requirements of the regional skills partnerships”,¹⁷⁰ although the Committee has raised its concerns on the preparedness of those partnerships earlier in this report.

159. The Committee considered the re-training needs of people already in the workforce. David Hagendyk felt that “At the moment, we cram all the investment into the start of someone’s life, and then we don’t invest anywhere near enough throughout the life cycle”.¹⁷¹ He quoted Wales Audit Office figures that suggest there has been a “70 per cent cut in the last five years in part-time funding for further education”, and in that time, participation in FE and adult community learning, has reduced by 40 to 50 per cent.¹⁷² David Hagendyk told the Committee that:

“evidence shows that the lowest skilled workers will travel a maximum of 2 km for jobs, and it’s the same for learning as well. I think it’s one of the challenges that we’ve lost a lot of the community learning provision.”

¹⁶⁸ [Para 64, Economy, Infrastructure and Skills Committee, 23 May 2018](#)

¹⁶⁹ [Para 23, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁷⁰ [Para 39, Economy, Infrastructure and Skills Committee, 7 June 2018](#)

¹⁷¹ [Para 42, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁷² [Para 44, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

160. The Minister for Welsh Language and Lifelong Learning told the Committee “we’ve had to focus our attention within adult education on key skills, on basic skills, on digital skills as well”.¹⁷³ She added, “I regret the fact that we’ve had to make those very austere cuts in that area”.¹⁷⁴

161. Mr Hagendyk told the Committee that research has shown there is a tipping point for adults returning to learning, but “you have to get the marketing right” and show that the learning will protect people from the risks.¹⁷⁵ He argued that access to lifelong learning should be improved and individual learning accounts should be created as a pilot to encourage people to reskill for the challenges automation will bring.¹⁷⁶ Professor Richard Davies argued, “Most learning should be at work”.¹⁷⁷

162. The Minister for Welsh Language and Lifelong Learning told the Committee that the current model for supporting employers would have to change post Brexit. She said:

“I think what’s been really interesting in the past few years is that a lot of the funding we’ve had through the European social fund has underpinned and paid for a lot of that upskilling for employers. So, there’s a dependency that has developed, I think, amongst some companies, where there’s an expectation that, effectively, Government funding will be responsible for that upskilling within the workplace. We’re going to have to wean companies off that understanding as Brexit kicks in.”¹⁷⁸

163. However, the Minister also notes employers’ willingness to retrain staff affected by automation. She referred to one employer in Wales who was automating a call centre, but planned to upskill staff displaced “so that they can take more sophisticated, complex phone calls”.¹⁷⁹

164. Creating opportunities for lifelong learning, will be a vital aspect of reducing the risks to individuals whose jobs are at risk due to automation. The Welsh Government has been clear on the impacts austerity has had in this area, but

¹⁷³ [Para 21, Economy, Infrastructure and Skills Committee, 7 June 2018](#)

¹⁷⁴ [Para 37, Economy, Infrastructure and Skills Committee, 7 June 2018](#)

¹⁷⁵ [Para 169 - 170, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁷⁶ [Para 50, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁷⁷ [Para 180, Economy, Infrastructure and Skills Committee, 17 May 2018](#)

¹⁷⁸ [Para 23, Economy, Infrastructure and Skills Committee, 7 June 2018](#)

¹⁷⁹ [Para 69, Economy, Infrastructure and Skills Committee, 7 June 2018](#)

there is now a clear and pressing need to reinvigorate the lifelong learning infrastructure.

Recommendation 9. In developing its vision for post compulsory education, the Welsh Government should refocus and redevelop its support for lifelong learning, creating new and accessible ways for workers at risk of displacement by automation in the first waves to retrain and upskill.

Recommendation 10. The Welsh Government should review how it can upskill and build confidence in the teaching workforce to incorporate digital tools into learning, ahead of the introduction of the new curriculum.

Recommendation 11. The Welsh Government should establish a scheme to fund further Post-Doctoral learning in automation and AI-related fields, with the intention of retaining those skills in Wales.

Recommendation 12. The three Regional Skills Partnerships should review their plans for future requirements in light of the opportunities and challenges anticipated as a result of automation and AI.

Themes for future work

Lifelong Learning

We know that a significant number of jobs will be displaced by automation in the coming decades. People effected will need access to good quality, relevant adult education to upskill and access the higher-level roles that might emerge.

We are also aware of the challenges in delivering lifelong learning in a time when funding cuts have reduced participation in adult education by nearly half, and the challenges of making that education accessible to the least mobile members of our society.

How can lifelong learning be re-imagined to meet the changing demands of Industry 4.0?

6. Next Steps

165. This report represents the start of the Committee's work in this area which is likely to be one of the key challenges of the coming decades. Further inquiries focused on specific sectors are planned for the autumn term and issues relating to Industry 4.0 will be considered as part of our wider work on other matters relating to our portfolio.

Further information about the Committee's work can be seen on the website www.assembly.wales/SeneddEIS