

## **Universities Wales response to Welsh Government's 'Review of digital innovation: call for evidence'**

### **About Universities Wales**

Universities Wales represents the interests of universities in Wales. Our mission is to support a university education system that transforms lives through the work Welsh universities do with the people and places of Wales and the wider world.

### **Summary**

1. Universities are well-placed at the forefront of digital technological change. Through their role in delivering higher level skills and their research and innovation activity, universities are essential to maximising Wales' ability to make the most of the opportunities of digital innovation.
2. Although estimates of the proportion of jobs 'at risk' vary greatly, Wales nevertheless has a high proportion of jobs in occupations deemed most at risk. Jobs held by graduates are less at risk of automation and demand for higher level skills in Wales continues to grow. Labour market projections suggest the number of people in the workforce in Wales qualified at level 6 or above will have increased by 150,037 between 2014 and 2024.
3. Welsh universities have significant strengths in digital innovation including cyber security, quantum technologies, data science, smart energy, and creative industries. Wales also has a strong track record of graduate entrepreneurship in these areas.
4. With an ageing workforce and increasing demand for higher level skills, opportunities for people to reskill or upskill are increasingly important. Key features of Wales' response to the challenges of automation must include work-based routes to a degree, such as degree apprenticeships, and the full implementation of the sustainable long-term higher education settlement recommended by the Diamond Review, which includes support for a long-term sustainable HE system, and part-time and postgraduate study.
5. Investment in research and innovation will also be critical to shaping the future of the Welsh economy and how people work. Professor Graeme Reid's review proposed action to deal with the shortfall in research capacity in Wales and we strongly recommend that the Welsh Government urgently implements the recommendations of the Reid review.
6. We believe there are benefits to be gained from the technological advancements of the next ten to twenty years. The potential for increased productivity, as is historically associated with increased automation, as well as the opportunity for better kinds of work for people in Wales. To make the most of these opportunities, and minimise the disruptive risks of automation, will mean addressing the levels of investment in research and innovation in Wales, and the ways in which universities are enabled to respond to the higher skills needs of Wales.
7. At the heart of Wales' response to these challenges must be the recognition of the importance of student choice and interdisciplinarity. Any attempt to constrict student choice would limit the responsiveness and adaptability of our education system.

## 1. What do you think are Wales' current strengths when it comes to digital innovation?

- 1.1. The research and innovation activity carried out by Welsh universities provides Wales with significant strengths when it comes to digital innovation. We have provided a number of examples below, but due to the breadth of digital innovation in Wales, this response is not intended to provide a full picture.
- 1.2. Welsh universities are a leading academic destination for world class research. In the Research Excellence Framework 2014, Welsh universities were found to have the highest percentage of world-leading research in terms of its impact of any part of the UK<sup>1</sup> and, in 2014, 46% of Welsh publications were internationally co-authored<sup>2</sup>.
- 1.3. It is important to recognise the considerable interdisciplinarity of research in Wales. A study by King's College London, commissioned by the Learned Society for Wales, found that the impact of Welsh research showed considerable interdisciplinarity<sup>3</sup>. For example, 12 different research disciplines contributed to the research topic of 'Business and Industry'.
- 1.4. A number of science and innovation audits have taken place, or are taking place, in Wales and should provide a useful summary of some of Wales' strengths in digital innovation. The South West England and South East Wales Science and Innovation Audit<sup>4</sup> included a focus on compound semiconductor work being carried out in Cardiff, and hydrogen/fuel cells referencing the University of South Wales' research centre in Baglan.
- 1.5. Welsh universities are involved in the third wave of Science and Innovation Audits being carried out including one led by Swansea University (the South Wales Crucible) and another led by Bangor University (North West Nuclear Arc Consortium).
- 1.6. Welsh universities have a number of pronounced strengths in the area of digital innovation. Further detailed case studies are included in the appendix, but areas of strength include:

**Cyber security:** Welsh universities are prominent in the area of cyber security.

Cardiff University hosts the [Airbus Centre of Excellence in Cyber Security Analytics](#) which, in August 2018, was named an Academic Centre of Excellence in Cyber Security Research by the UK's National Cyber Security Centre. The centre includes an interdisciplinary research team of technical and social researchers and has received funding from both the Engineering and Physical Sciences Research Council and the Economic and Social Research Council.

The University of South Wales has established an international reputation in the areas of network security, computer forensics and threat analysis with its Information Security Research Group. Welcoming its first students in October 2016, the [National Cyber Security Academy](#) sees students work on real-world projects set by the Academy partners, identifying new challenges in the cyber security environment. The university collaborates with a wide range of partners including the Ministry of Defence, Airbus, BT

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<sup>1</sup> <https://www.bbc.co.uk/news/uk-wales-30524940>

<sup>2</sup> <https://www.learnedsociety.wales/wp-content/uploads/2017/09/REF15186-Times-Higher-Publication-Online-PDF.pdf>

<sup>3</sup> <https://www.learnedsociety.wales/wp-content/uploads/2017/06/The-impacts-of-academic-research-from-Welsh-universities.pdf>

<sup>4</sup> <http://gw4.ac.uk/wp-content/uploads/2017/11/SWW-SIA-MainReport-Final.pdf>

and Northrop Grumman.

- 1.6.1. **Data:** There is expertise in data science across a number of Welsh universities. This includes [Swansea University's Data Science building](#) which brings together two Centres of Excellence – the Farr Institute of Health Informatics Research and the Administrative Data Research Centre Wales – and the Data Innovation Accelerator at Cardiff University which aims to transfer data science and analytics knowledge from Cardiff University to SMEs.

There are also areas of work such as Aberystwyth University's 'Living Wales' project which aims to make Wales the global leader in the integrated use of digital, high-resolution earth observation data: data that has the potential to transform how we manage our environment and society.

- 1.6.2. **5G Development:** Monmouthshire is part of the UK Government's 5G rural testbed. The Swansea Bay Region City Deal includes ambitions to create a 5G test hub for digital innovation in Swansea. As part of this, Swansea University's Institute of Life Science is leading research into the trial of bandages which use real-time 5G technology to monitor how a wound is healing and help doctors keep track of the patient's activity levels.

- 1.6.3. **Compound Semiconductors:** Wales is home to Europe's first compound semiconductor cluster which positions Cardiff as the UK and European leader in the field. Part of this cluster is the Institute of Compound Semiconductors at Cardiff University which includes Cardiff University's new Translational Research Facility, due to open in 2021. The Institute was formed following a joint venture between Cardiff University and IQE plc.

The vision is for Cardiff University to be a founding and key partner in the development of the first compound semiconductor cluster in Europe. Providing the small to medium scale fabrication capacity to complement activity at other cluster partners, with the expertise and capability to translate academic excellence through to practical, manufacturable devices and integrated subsystems with the ultimate aim of generating economic impact through commercial and academic exploitation of compound semiconductor technologies.

- 1.6.4. **Smart and flexible energy:** The SPECIFIC Innovation and Knowledge Centre at Swansea University is an upscale functional coatings research centre working with the steel industry and supply chain to develop new technologies and storage of energy so that buildings can become power stations.

Flexible Integrated Energy Systems, led by Cardiff University, Swansea University and the University of South Wales, is a £24.5m pan Wales project bringing together expertise from universities, industry and local government to facilitate a transition to a low carbon future. The research operation is designed to develop an energy systems research capability in Wales which will build on the world-class capability that already exists in Welsh universities.

1.6.5. **Manufacturing:** ASTUTE 2020 is a project delivered by Swansea University, Cardiff University, Aberystwyth University, and University of Wales Trinity Saint David. ASTUTE 2020 will support industrial research, development and innovation through world-class academics and a team of highly qualified technical experts and project managers.

ASTUTE 2020 is designed to stimulate growth in West Wales and the Valleys by applying advanced engineering technologies to manufacturing challenges, driving cutting-edge research, development and innovation. ASTUTE 2020 collaborates with the high-value manufacturing industry to stimulate transformational and sustainable growth by facilitating and de-risking the development and adoption of advanced technologies, increasing competitiveness and future proofing. In the first phase of the project, it created £200m of economic impact success in West Wales and the Valleys. The project was shortlisted in the Smart Industrial Transition category at the EU's RegioStars awards.

The Wales Centre for Advanced Batch Manufacture, known as CBM and established by the University of Wales Trinity Saint David, is a commercially focussed advance research and batch manufacturing facility whose work has included the use of 3D printing to produce a prosthetic leg for a rescue dog.

1.6.6. **Creative Industries:** Wales has strengths in creative fields such as film, computer gaming, art & design. Creative industries, an important component of the digital economy, grew twice as fast as other industry sectors between 2011-14 and 2015-16. The creative industries make up 5.7% of the Welsh economy and 9.2% of the Welsh workforce are employed in creative or high-tech industries<sup>5</sup>. In particular, Cardiff and the Vale of Glamorgan has been identified as a 'creative hotspot' by NESTA<sup>6</sup>.

1.7. To capitalise on Wales' digital innovation strengths it is vitally important that the recommendations of the Diamond and Reid reviews are implemented and that overall investment in research and innovation in Wales is increased – both for universities and for businesses. This is explored further in our response to question 8.

1.8. Another important feature of strength for Wales in this area is Wales' success in encouraging entrepreneurship and graduate start-ups. Despite having 5% of the UK higher education sector, Wales has 12.4% of the UK's graduate start-ups. As of 2016-17, there are 1,543 active graduate start-ups in Wales.

## 2. Are there specific digital technologies or capabilities where Wales is particularly strong compared to other parts of the UK or to other countries?

2.1. The breadth of the capabilities of Welsh universities in this area is significant and would be beyond the scope of this response to outline in full. We have touched upon some of the areas of particular strength for Wales above, including:

2.1.1. Cyber security

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<sup>5</sup> <https://www.nesta.org.uk/report/the-geography-of-the-uks-creative-and-hightech-economies/>

<sup>6</sup> <https://www.nesta.org.uk/report/creative-clusters-and-innovation-report/>

- 2.1.2. Data
- 2.1.3. 5G development
- 2.1.4. Compound semiconductors
- 2.1.5. Smart and flexible energy
- 2.1.6. Manufacturing
- 2.1.7. Creative industries

**2.2.** Annexed to this response are a selection of case studies outlining some of these areas of strength.

**3. Which parts of the Welsh economy have found it relatively easy to adapt to digital technological change and which parts have found it relatively difficult?**

- 3.1. The university sector in Wales is well-placed at the forefront of digital technological change. Through the provision of higher level skills and the research and innovation activity carried out at universities, Welsh universities have a key role to play in ensuring Wales is well-positioned to respond to and make the most of the opportunities presented by digital technological change.
- 3.2. Research and innovation activity is a key way in which universities contribute to the Welsh economy. Detailed analysis of productivity in the UK suggests that there is a link between public investment in R&D and growth<sup>7</sup>. Expenditure on research and development (R&D) is a key indicator of countries' innovative efforts.
- 3.3. The overall level of investment in R&D in Wales is low and has been for some time, as recognised by Welsh Government. This overall low level of investment makes it difficult for parts of the Welsh economy to adapt to technological change. The Reid Review states that 'this shortage of research capacity along with other factors, contributes to low levels of productivity in Wales compared to the UK and many other OECD countries'.
- 3.4. Our members report that there has been increasing demand for higher level skills among employers and individuals in Wales. This increasing demand presents both a challenge and opportunity for Wales and is explored further in our response to question 4.

**4. How do you think jobs and skills have changed, or need to change, to complement the use of new digital technologies?**

- 4.1. Although estimates of the proportion of jobs 'at risk' vary greatly, Wales nevertheless has a high proportion of jobs in occupations deemed most at risk in areas such as customer service, elementary storage occupations and administrative occupations. The Centre for Cities found that an estimated 112,000 jobs in Swansea, Cardiff and Newport will be at risk of automation by 2030<sup>8</sup> and work by Nesta estimated that a third of the Welsh workforce is employed in the least productive, lowest paid and most generic industries that often

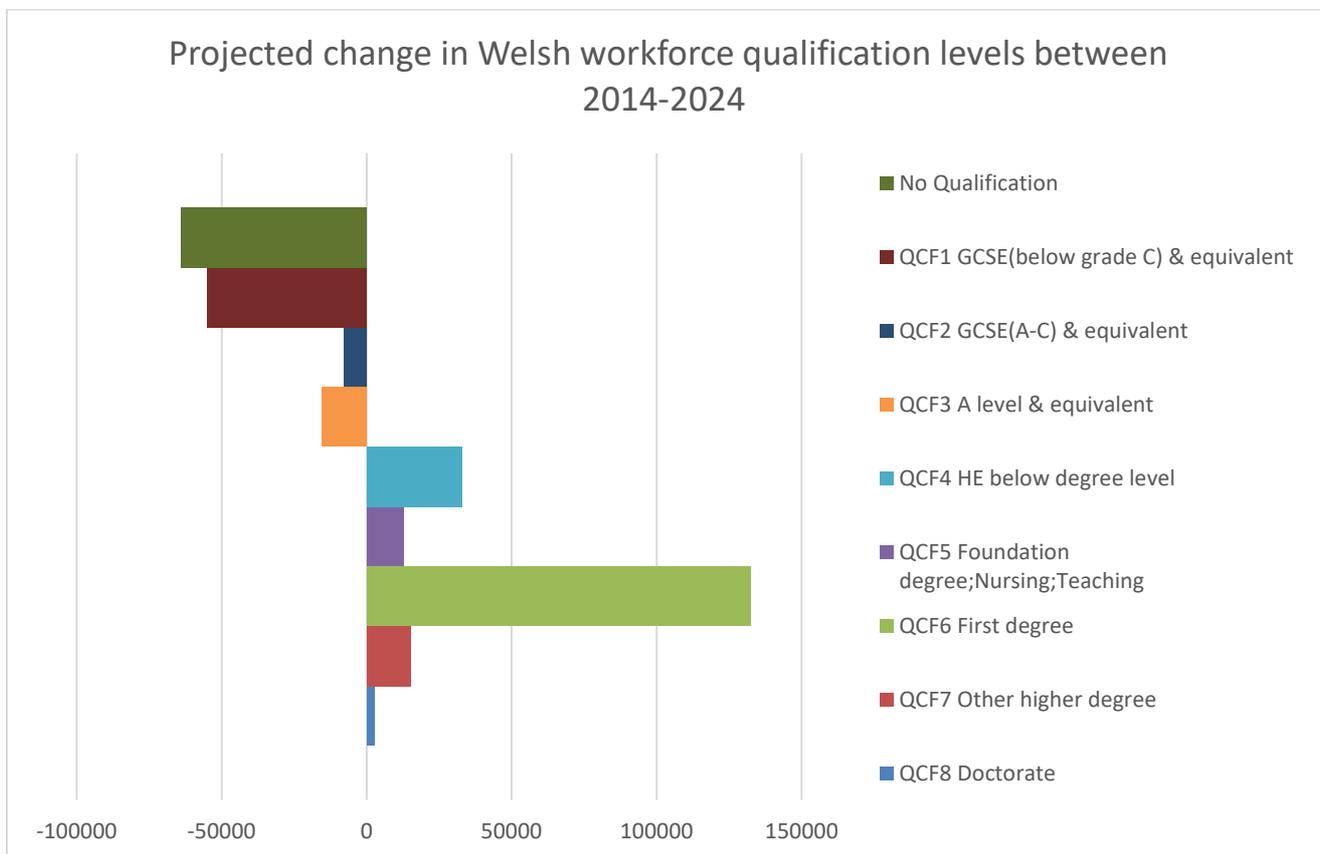
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<sup>7</sup> A [detailed analysis of productivity](#) by Goodridge, Haskel and Wallis concluded that the UK's productivity problem is a problem of 'total factor productivity'. A [separate piece of work](#) suggests that a 10% rise in public R&D would raise private total factor productivity growth.

<sup>8</sup> <http://www.centreforcities.org/wp-content/uploads/2018/01/18-01-12-Final-Full-Cities-Outlook-2018.pdf>

considered at highest risk of automation<sup>9</sup>.

- 4.2. Jobs held by graduates appear to be less at risk to automation. PricewaterhouseCoopers found that, in the UK, the estimated risks of automation to those qualified to level 2 are as high as 44% but this falls to only around 11% for those educated to degree level<sup>10</sup>. The Centre for Cities found that cities with a higher risk of job losses also tend to have a lower share of high-skilled workers.
- 4.3. Demand for higher level skills in Wales, and across the UK, has been consistently increasing. Labour market projections by the UKCES Working Futures Programme, published in 2016, suggest that between 2014 and 2024 the number of people in the workforce in Wales qualified at level 3 or below will reduce by 142,109 while the number of people qualified at level 6 or above will increase by 150,037.



Source: UKCES 2016<sup>11</sup>

- 4.4. Similarly, work by the CBI has found that 81% of businesses in Wales are already maintaining or increasing graduate recruitment, with one in five businesses increasing graduate recruitment<sup>12</sup>.
- 4.5. Jobs are no longer stable, mono-disciplinary and long-lasting, and so education providers preparing the workers of the future need to educate with this in mind.

<sup>9</sup> Pg 4, [https://docs.wixstatic.com/ugd/f06571\\_4282ca3827a749b1a187a7bce3db7adf.pdf](https://docs.wixstatic.com/ugd/f06571_4282ca3827a749b1a187a7bce3db7adf.pdf)

<sup>10</sup> <https://www.pwc.co.uk/economic-services/assets/international-impact-of-automation-feb-2018.pdf>

<sup>11</sup> <https://www.gov.uk/government/publications/ukces-employer-skills-survey-2015-wales-toolkit>

<sup>12</sup> <http://www.cbi.org.uk/index.cfm/?api/render/file/?method=inline&fileID=DB1A9FE5-5459-4AA2-8B44798DD5B15E77>

4.6. This means:

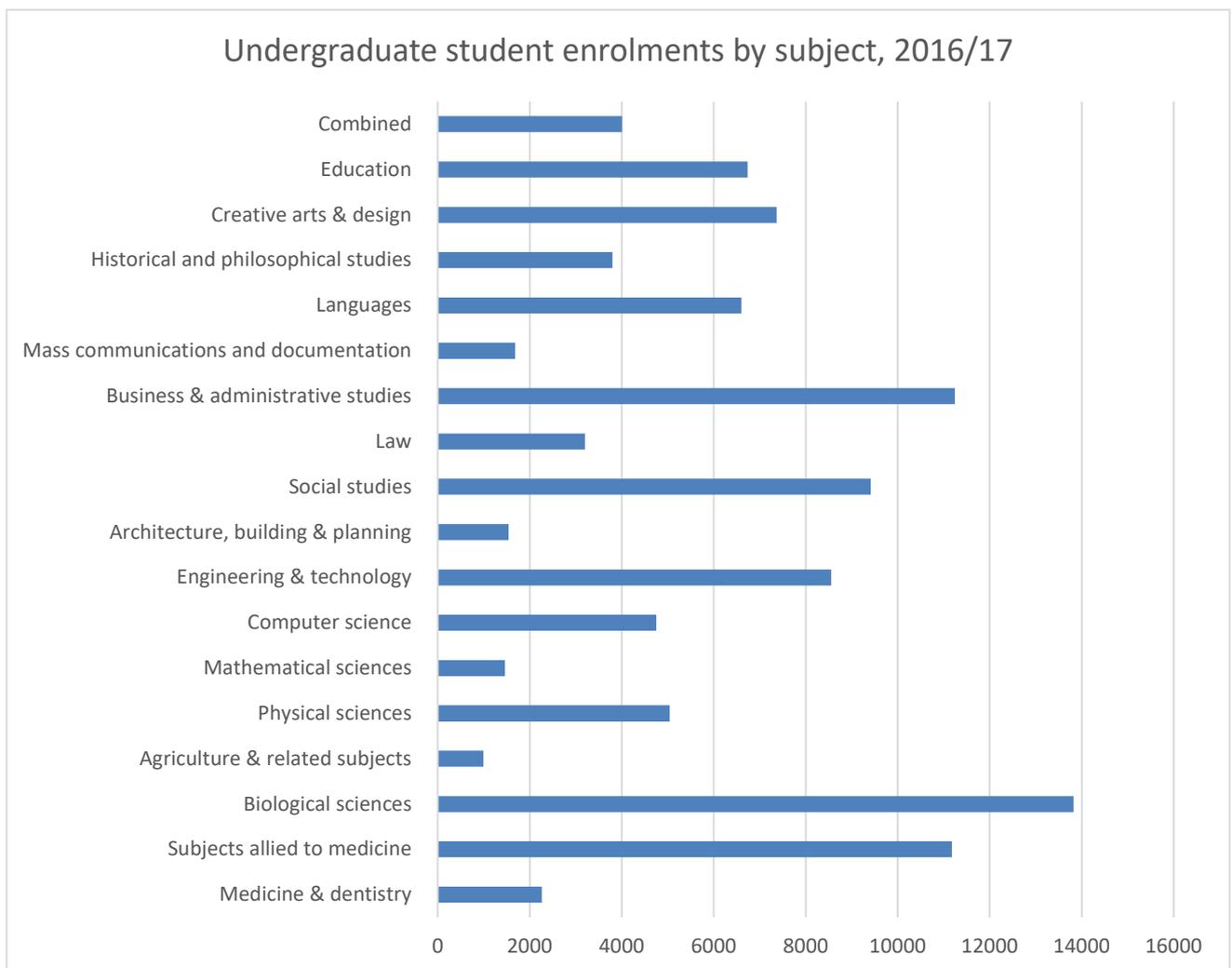
4.6.1. Taking creativity seriously

4.6.2. Recognising the need for a broader multi-disciplinary approach to skills development, promoting STEM but also other subject areas.

4.6.3. Creating broad, flexible interdisciplinary curricula in schools, FE colleges and universities that include creative thinking, skills in problem-solving, analytical thinking, manual dexterity and soft skills

4.6.4. Adopting a serious and coordinated approach to active learning and life-long learning.

4.7. It should be noted that there is a wide spread of subject-specific skills currently being delivered by Welsh universities and that a slightly higher proportion of undergraduates in Wales study science subject areas (48%) than in England (46%).



Source: StatsWales, 2018

4.8. Universities play a crucial role not only in the employability of their students but also in enhancing the employability prospects of the broader community. Through partnerships with employers, universities delivered nearly a quarter of a million learner days of CPD in Wales

in 2015-16<sup>13</sup>.

- 4.9. Welsh universities have also been finding new ways to create links between students and industry. An example of this is the University of South Wales' Faculty of Creative Industries. This a 'porous facility' a space where the 'front door is always open to industry' where professionals can come, use facilities, share their ideas and demonstrate how they work. Creative industries, an important component of the digital economy, grew twice as fast as other industry sectors between 2011-14 and 2015-16.
- 4.10. Wales already punches above its weight for entrepreneurship. The higher education sector in Wales represents around 5% of the UK sector but Wales had 12.4% of the UK's graduate start-ups and 14.6% of the UK's staff start-ups that have survived for three years or more<sup>14</sup>.
- 4.11. In September 2018, Universities Wales hosted a roundtable with a group graduate start-ups and the Minister for Welsh Language and Lifelong Learning, Eluned Morgan AM. One of the key messages from the roundtable was the importance of those start-ups having access to talented young graduates or undergraduates from a wide range of subject areas.
- 4.12. There is the potential to explore how programmes such as KESS II can meet this need. KESS II is an EU-funded programme led by Bangor University which supports collaborative research projects. The programme increases the research capacity of small to medium sized enterprises (SMEs) by linking with a PhD or research master's projects. The key objectives of KESS II include encouraging SMEs to undertake research and recruit research and to promote higher level skills development<sup>15</sup>.
- 4.13. Due to the demographics of Wales with an ageing and, comparatively, low skilled workforce, it is likely that opportunities to reskill or upskill will become increasingly important. Welsh universities have begun delivery of degree apprenticeships – a work-based learning route that leads to the award of a degree – and are interested in delivering a wide-range of degree apprenticeships at both bachelor's and master's level. At the time of writing, Welsh Government has made funding available for degree apprenticeships in two subject areas and only at level 6 - digital/computing with engineering/advanced manufacturing.
- 4.14. Welsh universities are keen to increase the number of degree apprenticeships available in Wales and report significant demand among employers. For example, every university in Wales has expressed an interest in developing degree apprenticeships in the area of business and management. It is worth noting that work by McKinsey in conjunction with LSE and Stanford on the link between management practices and firm-level productivity found that well-managed firms have higher productivity, market value, and growth<sup>16</sup>.

## The challenges and opportunities of digital technologies

### 5. What do you see as the major challenges presented by digital technologies? [Please list up to 5]

- 5.1. Exacerbating regional disparity:** The development of new digital technologies has the potential to exacerbate existing regional disparities across the UK. According to ONS

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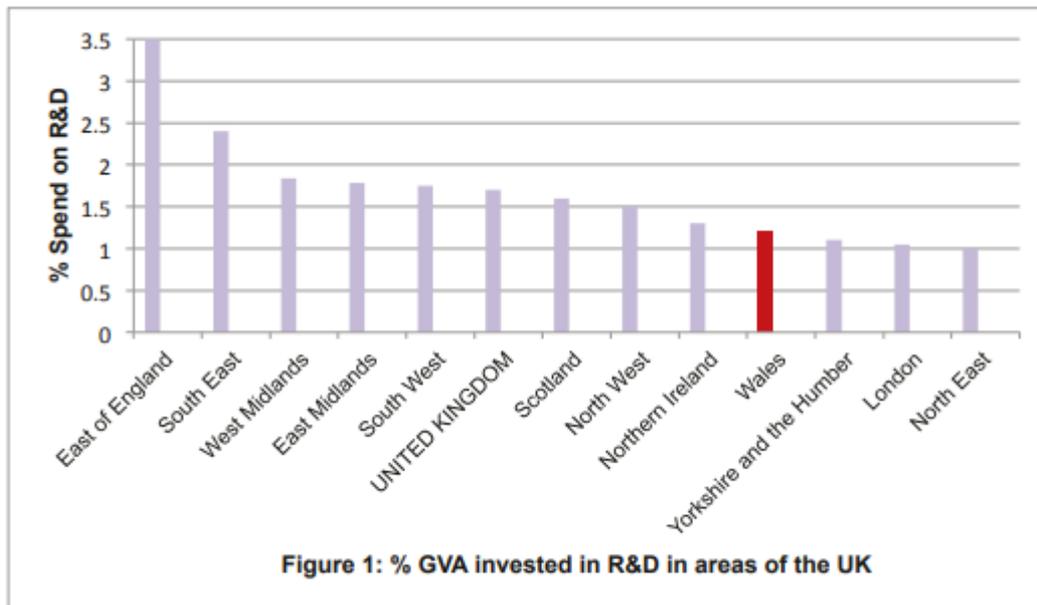
<sup>13</sup> [HESA](#), 2017

<sup>14</sup> [HESA](#)-, 2017

<sup>15</sup> <http://kess2.ac.uk/about/>

<sup>16</sup> [http://www.growingjobs.org/downloads/management\\_practice.pdf](http://www.growingjobs.org/downloads/management_practice.pdf)

productivity figures, Wales continues to have the lowest labour productivity in the UK<sup>17</sup>. Similarly, as outlined in Professor Graeme Reid's review of Government-funded research and innovation, Wales has comparatively low levels of investment into R&D.



Source: Professor Graeme Reid's review of Government-funded research and innovation, 2018<sup>18</sup>

**5.2. Occupation shrinkage:** although there is disagreement over the extent to which jobs will be lost and new jobs will be created, there is a consensus that there will be disruption to the make-up of employment in the UK. The risks for Wales include direct job loss in areas of high employment in Wales such as customer service and administrative occupations. Similarly, there is a risk that the new 'replacement' jobs generated from technological change are not generated in Wales but in other areas of the UK. Neither job losses or job gains will necessarily affect all regions evenly.

**5.3. Research and innovation:** There is set to be a large increase in the amount of research and innovation investment available UK-wide – cited in the Reid review as a £2bn yearly increase in the budget of UK Research and Innovation. If Wales does not make the most of these opportunities, then we risk widening the investment gap between Wales and the rest of the UK and, as such, potentially widening the productivity gap. This risk is even more pronounced given the reliance research and innovation in Wales has had on European Structural Funds, the contribution of which is around £65m yearly for innovation. Without adequate investment in research and innovation, the disruptive impact of technological advancement is likely to be exacerbated.

<sup>17</sup>

<https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/labourproductivity/articles/regionalandsubregionalproductivityintheuk/february2018#results-for-nuts1-regions-and-countries>

<sup>18</sup> <https://gov.wales/docs/det/publications/reid-review-en.pdf>

**6. What do you perceive to be the biggest opportunities presented by digital technologies? [Please list up to 5]**

- 6.1. Productivity gains and the benefits for people in Wales:** Automation has historically made a positive contribution to productivity. Scenario modelling by McKinsey estimates automation could raise productivity globally by 0.8 to 1.4% annually<sup>19</sup>. Similarly, work by PricewaterhouseCoopers suggests UK GDP could be up to 10.3% higher in 2030 as a result of artificial intelligence and automation<sup>20</sup>. The benefits of this could include lower prices for consumers, and additional resource for investment in important public services such as health, education, and social care.
- 6.2. Wales and the world:** The development of digital technologies has the potential to place Wales in a prominent, leading place in the world. We have highlighted above the research and innovation strengths of Wales and the international dimension to Wales' activity in this area. By ensuring the full implementation of the recommendations of the Diamond and Reid Reviews, we can help build upon this position to the benefit of the people and places in Wales. This could include the opportunity for digital technology to offer a radically different approach to manufacturing that re-emphasises local manufacturing and enables a less carbon hungry approach to transport and manufacturing.
- 6.3. A skilled workforce:** As well as the potential benefits for productivity and the economy, the delivery of higher level skills to the workforce in preparation for technological advancements in Wales would also benefit individuals. Providing for a higher skilled workforce would ensure that people are empowered to develop to their full capacities and to seize employment and social opportunities. When good education and training opportunities are broadly accessible, they typically expand labour market opportunities and reduce social inequalities<sup>21</sup>.

### The future of digital innovation in Wales

**7. What would you identify as the major drivers of digital innovation which will be critical in shaping the future of the Welsh economy and how people work? [Please list up to 5]**

- 7.1. Investment in research and innovation:** Investment in research and innovation will be a key driver of digital innovation and will be absolutely critical to shaping the future of the Welsh economy and how people work. As outlined above, there is a large amount of UK-wide research and innovation funding currently available with the budget for UK Research and Innovation set to increase by £2bn yearly. Positioning Wales to take advantage of this opportunity will help ensure Wales is at the forefront of new developments in digital innovation.
- 7.2.** Research in Wales is diverse and interdisciplinary research is key to solving the big global challenges. Unhypothecated funding is crucial as it plays an important role in underpinning the sector as a whole, allowing for investment in inter-disciplinary and experimental research. [A recent report by the Learned Society for Wales](#) found considerable research interdisciplinarity in Wales and corresponding impact topics in Welsh research e.g. Business

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<sup>19</sup> McKinsey, [‘A future that works: automation, employment, and productivity’](#)

<sup>20</sup> PwC, [‘The economic impact of artificial intelligence on the UK economy’](#)

<sup>21</sup> International Labour Office, [‘A Skilled Workforce for Strong, Sustainable and Balanced Growth’](#)

and Industry impact originated from research disciplines in life sciences, engineering and physical sciences, social sciences and arts and humanities.

7.3. **Higher level skills:** There is a body of evidence, including work by [PwC](#), the [Centre for Cities](#) and [McKinsey](#), that suggest that higher level skills will be both less exposed to the risks of automation and increasingly important in ensuring that Wales is able to make the most of the opportunities afforded by technological change and automation. In particular, work by PwC suggests that those who have a first degree are significantly less exposed to the risks of automation.

7.4. The Welsh Government and other stakeholders in Wales will need to ensure that people have access to opportunities to develop higher level skills and that people are able to do so at different points in their life and in different ways. Lifelong learning and opportunities such as work-based learning routes to a degree (like degree apprenticeships) will form a substantive part of this. We have highlighted elsewhere in this response the importance of interdisciplinary education and research, it will be important to ensure that higher skills development in Wales is across a wide-range of subject areas and not limited to STEM.

## 8. What actions are needed to future proof Wales' workforce in response to changes presented by digital technologies?

8.1. We believe that the most important part of enabling the Welsh workforce to respond to changes presented by digital technologies is to provide a system which is adaptive and responsive to change. This will require:

8.1.1. sufficient investment in research and innovation to ensure that the Welsh economy is able to continue to grow and provide individuals with the benefits of growth.

8.1.2. an education and training system that provides for student choice and enables individuals to access higher level skills throughout their life

### 8.2. Research and innovation

8.3. Expenditure on research and development (R&D) is a key indicator of a countries' innovation efforts. The overall level of investment in R&D in Wales is low and has been for some time, as recognised by Welsh Government.<sup>22</sup> The most recent figures for Wales show that Welsh Government's net expenditure on R&D, not including funding to universities via HEFCW, was £12m in 2016. Scotland's equivalent net expenditure on R&D, based on the relative size of its population, was £95m.<sup>23</sup>

8.4. Quality-related (QR) research funding, which is 'core' funding from Welsh Government and distributed by HEFCW, is un-hypothecated research funding, and is fundamental to achieving a healthy and progressive research and innovation system. Contrary to the frequently-mentioned reference that QR funds 'blue skies research', QR underpins a system that is stable, sustainable, competitive and transforms society. QR funding funds basic research infrastructure and investment, including the salary costs of permanent high-quality academic researchers, support staff, equipment, facilities and libraries.

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<sup>22</sup> Welsh Gov publication 'Innovation Wales' 2014

<sup>23</sup> Analysis of UK Government net expenditure on R&D by flow of funds and department 2016 from ONS

- 8.5. HEFCW estimate that QR investment facilitates the capture of more than 60% more funding from the UK Research Councils and around 180% more funding from other sources including UK industry, UK central government and the EU.<sup>24</sup>
- 8.6. QR bridges the gap between project income and Full Economic Costs (FEC) on competitive funding streams and enables universities in Wales to compete on more equal terms with other universities in the UK and overseas. Grants provided by the Research Councils, for instance, are expected to meet 80% of the FEC of the research undertaken. The QR funding provided by the HE Funding Bodies helps institutions meet the remaining 20% of the costs of research funded by the Research Councils.<sup>25</sup>
- 8.7. The stability and resilience of QR funding that cannot be provided by unpredictable and time-limited funding competitions allows universities to retain academic and other support staff.
- 8.8. The implications of a reduction – and even just maintenance - of QR funding in Wales were summed up in the Reid Review:
- “Stagnation or reduction of core QR funding in Wales unavoidably undermines research competitiveness and brings consequent reductions in funding leveraged from UK-wide and international sources. In turn that dilutes the attractiveness of Wales to the most talented researchers, risking a spiral of decline. Only Welsh Government can provide this underpinning resource: no alternative source of core funding for university research is available”.*
- 8.9. QR funding in Wales was effectively £71m (after taking into account HEFCW’s funding adjustment) for 2018/19. The pro-rata equivalent allocations for research and innovation funding, scaled by population size (as used in the Barnett formula) are £117m in England and £164m in Scotland i.e. For a university in Scotland, their funding council is allocating more than twice as much funding for R&I than HEFCW will be pro-rata in Wales. Scotland and England also continued to have higher pro-rata levels of capital funding.
- 8.10. Universities already help businesses use the knowledge gained from research activity and turn it into marketable products or improved services, but could do much more with the reintroduction of HEFCW’s Innovation and Engagement fund, as recommended by the Diamond and Reid Reviews
- 8.11. Universities Wales strongly recommends that overall investment in R&I Wales is increased – both for universities and for businesses. We fully support the Welsh Government’s commitment to the recommendations given in the Diamond Review to maintain QR funding at 2016 levels in real terms and re-introduce innovation funding in Wales,<sup>26</sup> and their ‘in principle’ commitment to the Reid Review’s recommendations that

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<sup>24</sup> HEFCW Response to the consultation on the Welsh Government Budget 2016/17

<sup>25</sup> See HEFCW Circular W16/42HE [here](#).

<sup>26</sup> 2016 levels: QR £71.1 million; PGR £5.2 million. Reductions to HEFCW budgets means that that a continuation in real terms was not achieved in either 2016/17 or 2017/18 (a pro rata reduction of £15.4 million

further funds should be made available for both universities and businesses for additional R&I activities.

## 8.12. Higher level skills

- 8.13. As outlined above, graduates are less exposed to the risks of automation and the need for individuals qualified at level 6 or above in Wales is set to increase. As such, the delivery of higher level skills is one of the key ways in which we are able to futureproof the workforce to changes presented by digital technologies.
- 8.14. Recent research by Universities UK and the CBI found that financial concerns were cited frequently as reasons why ‘lost learners’ chose not to take up part-time higher education. This included the cost of living being cited by 42% of respondents<sup>27</sup>. The recommendations of the Diamond Review include maintenance support for part-time and postgraduate students, and a long-term sustainable funding settlement for higher education. Implementing the Diamond Review in full will help ensure opportunities for people to upskill and reskill throughout their career. For example, although it is too early to share final figures, we understand that in the first year of the Diamond student support package being in place, part-time numbers have risen in Wales. This is contrary to the ongoing stagnation, and in some cases the steep decline, in part-time numbers seen elsewhere in the UK.
- 8.15. Similarly, Welsh universities report significant appetite among employers and individuals for access to a wide-range of degree apprenticeships at both bachelor’s and master’s level. Degree apprenticeships offer a work-based route to a degree and have the potential to provide an important opportunity to those already in the workforce.
- 8.16. At the moment, Welsh Government has limited funding for the development of degree apprenticeships in Wales to bachelor’s level apprenticeships in digital, engineering and advanced manufacturing. For comparison, in England there are 35 degree apprenticeship standards approved for delivery with a further 81 in development across bachelor’s and master’s level.
- 8.17. Welsh universities are keen to increase the number of degree apprenticeships in Wales and we would recommend that universities be empowered to develop degree apprenticeships that meet employer and individual need in a wide range of subject areas at both level 6 and level 7.
- 8.18. As discussed in our response to question 4, students in Wales study a wide range of subject areas. A study by King’s College London, commissioned by the Learned Society for Wales, found that the impact of Welsh research showed considerable interdisciplinarity<sup>28</sup>. Due to the limits of any planning capacity to plan and predict for changing markets and requirements, any attempts to constrict student choice would stifle growth and creativity. Any approach to higher level skills must recognise the importance of student choice and interdisciplinarity.

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to QR/PGR in 2016/17; and a reduction £8.6 million to QR/PGR in 2017/18).

<sup>27</sup> <https://www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/2018/uuk-lost-learners.pdf>

<sup>28</sup> <https://www.learnedsociety.wales/wp-content/uploads/2017/06/The-impacts-of-academic-research-from-Welsh-universities.pdf>

## **9. Looking forward, what actions does Wales need to take to make the most of the advancements being made in digital technologies now and in the next ten-twenty years?**

### **9.1. Research and innovation**

9.1.1. As outlined above, investment levels in research and innovation in Wales are comparatively low compared to the rest of the UK. Universities Wales strongly recommends that overall investment in research and innovation in Wales is increased – both for universities and for businesses. We fully support the recommendations in the Diamond Review and the Reid Review on research and innovation funding. Their implementation is crucial to growing Wales' productivity.

### **9.2. Higher level skills**

9.2.1. To ensure that the people of Wales are able to make the most of the opportunities presented by advancements in digital technologies, and that Wales is able to benefit from the new jobs generated in the light of these advancements, it is essential that people in Wales have access to higher-level skills.

9.2.2. Implementing the Diamond Review in full is one way to support this. The support for postgraduate and part-time students, including support for living costs, will make upskilling or reskilling easier for those already in the workforce. Similarly, the funding for provision outlined in the Diamond Review recommendations will ensure a long-term sustainable higher education system in Wales.

9.2.3. There is a large appetite among employers and individuals for work-based learning routes to achieving a degree. Degree apprenticeships offer a way of delivering this and Welsh universities are keen to increase the number of degree apprenticeships available in Wales and we have our first degree apprentices starting this year. Degree apprenticeships have been available in England since 2015 and HEFCE estimated that in 2017/18 England had around 11,600 degree apprentices. As detailed above, we would recommend that the Welsh Government explore supporting the delivery of a wide range of degree apprenticeships at both level 6 and 7.

## **10. How do you think the interests of the workforce can be heard in the pursuit of greater digital innovation?**

10.1. As well as listening to employers and the workforce, we also think it is important that the voices of students are heard in the pursuit of greater digital innovation and that student choice is provided for. For example, the voice of students can be taken into account at a national level through the National Union for Students Wales and at a local level through the representatives at providers' own students' unions.

## **11. How might the current strategy and policy approach in Wales need to change:**

- **in light of the opportunities and challenges posed by digital innovation; and,**
- **to ensure that digital innovation supports Fair Work and social and economic inclusion?**

11.1. As outlined above, Universities Wales strongly believes that the most important policy approach for responding to the opportunities and challenges posed by digital

innovation is the implementation of the recommendations of the Diamond and Reid reviews.

- 11.2. A key factor in Wales' success in responding to the opportunities and challenges posed by digital innovation is the extent to which we are able to build upon and grow the successful research and innovation activity delivered in Wales and the extent to which we are able to support people in Wales to access higher level skills.
- 11.3. As such, we strongly recommend that the Welsh Government continues to fully implement the recommendation of the Diamond review and urgently implements the recommendations of the Reid review.
- 11.4. It should be noted that the Reid Review recommendations were designed to ensure that our ambitions should not be limited to playing catch up with the competition in the rest of the UK but to also enable Wales to "leap-frog" levels of investment in research and innovation elsewhere, and reap corresponding levels of economic and societal impact as a result.
- 11.5. It will also be vital that any approach recognises the considerable interdisciplinarity of research in Wales. A study by King's College London, commissioned by the Learned Society for Wales, found that the impact of Welsh research showed considerable interdisciplinarity<sup>29</sup>. For example, 12 different research disciplines contributed to the research topic of 'Business and Industry'. The impact topics with the greatest diversity of research disciplines included:
  - 11.5.1. Informing Government Policy
  - 11.5.2. Parliamentary Scrutiny
  - 11.5.3. Media
  - 11.5.4. Community and Local Government
  - 11.5.5. Business and Industry

## **12. How could the public and private sectors in Wales work together to harness the benefits of digital innovation?**

- 12.1. Although not strictly public and private sector, there are many types of university and business collaboration, the benefits of which are wide ranging. The CBI guide to business-university collaboration outlines the benefits for business, which can be summarised as:
  - Reduced cost and risk
  - Access to new ideas and horizon scanning
  - Support in developing research skills, capability and profile
- 12.2. Universities also benefit in many ways, for example:
  - Enhanced impact of research

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<sup>29</sup> <https://www.learnedsociety.wales/wp-content/uploads/2017/06/The-impacts-of-academic-research-from-Welsh-universities.pdf>

- Enhanced education opportunities for students
- Access to specialist or industrial scale facilities and equipment

12.3. Practically, the types of collaboration can range from the simple sharing of resources to the creation of complex multi-partner programmes. At its simplest, collaboration can encompass the provision or sharing of equipment, knowledge or other resources. It also includes Knowledge Transfer Partnerships, contract research (where a business commissions research from a university) and collaborative research projects that involves an element of funding from a Research Council, Innovate UK, the EU or other public sector source.

12.4. Our universities also make a vital contribution to ensuring that Welsh businesses and public sector organisations are staffed and supported by highly skilled individuals, and collaboration on skills can include working directly with students, offering placements and sponsored doctorates, sponsoring degree courses and developing workforce skills through bespoke programmes and professional development.

12.5. Our universities play a central role in the City and Growth Deals and regional partnerships in Wales, committing to boost the impact of their research activity through these highly valuable collaborations.

12.6. Of course the benefits of university-business collaboration go beyond their own interests, with significant benefits for Wales, including:

- Attracting foreign investment
- Job creation – both directly and indirectly through their supply chains
- Developing new products and services that change people's lives, benefitting communities e.g. making more efficient use of public resources, and growing regional economies.

## Final thoughts

13. In your opinion do technological advancements pose a greater threat or opportunity to the work you deliver? [Please state one]

14. In your opinion do technological advancements pose a greater threat or opportunity to your current workforce? [Please state one]

## 15. Do you have any other comments or areas relating to digital technology you would like to add?

15.1. This review is timely and we believe that the outcome of this review should not be a separate strand of work. We strongly believe that much of the work currently in motion in Wales – including the recommendations of Diamond and Reid, and developments like degree apprenticeships – provide a way forward for how we can be responsive to Wales'

needs as we go through a period of rapid and radical change. The responsiveness and flexibility of our system are absolutely key to responding to the challenges and opportunities of automation.

**16. Finally, if there is one issue relating to digital innovation which has the potential to keep you awake at night, what would it be?**

- 16.1. We would be concerned about any approach that will try to plan a system and deliver it in a way that is neither responsive or flexible.

## Appendix – Case studies

### Case study 1: Aberystwyth University

#### Living Wales: Providing access to Earth Observation data and state of the art monitoring methods for local, national and global industries



- Aberystwyth University working Welsh Government to make Wales the global leader in the integrated use of digital, high-resolution earth observation data.
- *Living Wales* will grow an important new area of science and economy in Wales, for the benefit of Wales and to be exported to the world.
- The project will build on existing capability, work with relevant national and international organisations and significantly strengthen Wales' research capacity and reputation in earth observation and related technologies.

In the past two decades, measurement of the earth from digital sensors mounted on spacecraft and aircraft has undergone a technological revolution comparable with that observed in molecular biology, and with just as much potential to transform society.

*Living Wales* is a unique and novel world-first concept that aims to capture the state and dynamics of Wales's landscape, in near real time, historically (since 1985) and into the future, through integration of multi-scale optical, radar and lidar earth observation data and supportive ground measurements. Through this concept Aberystwyth University will work with Welsh Government on this project to make Wales the global leader in the integrated use of digital, high-resolution earth observation data: data that has the potential to transform how we manage our environment and society.

*Living Wales* will grow an important new area of science and economy in Wales, both for our own benefit and to be exported to the world.

*Living Wales* will build on existing capability, work with relevant national and international organisations in the field, and significantly strengthen Wales' research capacity and reputation in earth observation and related technologies. Benefits will include:

- definitive state of the art support for government policies and initiatives;

- world-leading skills and knowledge that expand and give competitive advantage to the commercial (especially space-based industries) and academic sectors and attract investment into Wales (e.g., based on technology-driven industries);
- evidence for improved, sustainable use of the Welsh landscape and its resources over short to long time scales; and
- publicly and freely available data, software, information and insights.

## Case study 2: Bangor University leading for all Welsh universities Knowledge Economy Skills Scholarships: Developing and retaining research and development skills to strengthen the Welsh knowledge economy



- A major European Convergence programme led by Bangor University which supports collaborative research projects with external partners based in the West Wales and the Valleys.
- Received £73 million to support the programme.
- Increasing the research capacity of small to medium-sized enterprises (SMEs) by linking with a PhD or research master's projects.
- Promotes higher-level skills development.

Knowledge Economy Skills Scholarship (Kess) is a major European Convergence programme led by Bangor University on behalf of the higher education sector in Wales. The programme benefits from European Social Funds, KESS supports collaborative research projects (research master's students and PhD) with external partners based in the West Wales and the Valleys. It has an integrated higher-level skills training and development programme, leading to a Postgraduate Skills Development Award. The first phase of KESS received £33 million and provided 453 PhD and master's degree places (230 PhD and 223 research master's degrees) with Welsh organisations, of which 61% were SMEs.

Following the highly successful KESS I programme (2009-2014), KESS II is now running, a major pan-Wales programme developing and retaining the research and development skills needed to strengthen the knowledge economy in Wales, which will provide 645 scholarships over the course of six years. It will enable over 500 businesses to work with academics and postgraduate research students on innovative research projects aimed at driving business growth. The key objectives of KESS II are to:

- Increase the research capacity of small to medium enterprises (SMEs) by linking with a PhD or research master's project;
- Encourage SMEs to undertake research and recruit researchers;
- Prepare and train individuals to contribute to research as professionals;
- Support the development of key technologies in the Convergence Area of Wales; and
- Promote higher-level skills development.

KESS II aims to increase the number of individuals with higher level skills in research and innovation working within knowledge-based businesses in Wales.

Led by Bangor University, eight Welsh universities participate in KESS II. The partners range from SMEs to large companies, social enterprises and public bodies. Examples include Tenovus Cancer Care, Natural Resources Wales, Tata Steel, S4C, National Botanic Garden of Wales, Mencap Cymru, Halen Môn, Qioptiq Ltd., P&S Nano Ltd. and the Tidal Lagoon Swansea Bay. KESS II projects keep the needs of the participating businesses at their heart. The programme offers a low

cost means by which a company can engage in a research project, together with the opportunity to develop a long-term relationship with a university. KESS II also provides a platform to access the latest academic developments and a chance to develop in-house research and development activities.

KESS II is part of a transnational network. Students benefit from dynamic interactions with other research students and their industrial partners at some of Europe's leading universities. Collaborations between businesses and universities contribute significantly to the future employability of students, and the students value the experience of the company context. The majority of KESS graduates are now working in industry.

'The KESS II scheme has been an amazing opportunity for Tenovus Cancer Care. It has given us the opportunity to be a much more active partner in the research and really make sure that the outcomes of it are implemented and widely disseminated.' Dr Ian Lewis, Tenovus Cancer Care.

'I realised that KESS catalysed the perfect relationship between me, the academic environment and the industrial needs of the real world. I learnt that the work that I am doing is not about me anymore or just for knowledge expansion purposes but that it contributes to the development of industry in a real setting.'

Adrian Mironas, KESS II PhD student, Aberystwyth University.

For further information see <http://kess2.ac.uk/>.

### **Case study 3: Cardiff Metropolitan University**

#### **Perceptual Experience Lab**

The newly installed Perception Experience Laboratory (PEL) – which uses Fovography™ enabled technology to simulate real world environments through the use of immersive sound, smell, temperature and vision – will enable Professors [Robert Pepperell](#) and [Steve Gill](#), [Dr. Gareth Loudon](#) and [Bethan Gordon](#) to develop research and enterprise opportunities. This unique resource, which is available to CSAD students to use, has already attracted the commercial attention of major design consultancies and Jaguar Land Rover, and secured two interdisciplinary research projects.

The first, is entitled *Thought for Food: A research-led approach to improved Welsh food industry competitiveness* and is a PhD study supported by Professor Steve Gill, Professor Robert Pepperell and Dr. Gareth Loudon in association with Cardiff Met's [Food Industry Centre](#). It will assess whether data gathered in a simulated environment – in this instance, around food retail, branding and packaging – can reliably inform existing theories; plus whether these insights could be substantial enough to influence the trajectory of SMEs in the Welsh food industry.

The second sees the same team collaborating with Cardiff School of Management's Tourism department and Cardiff School of Sport & Health Sciences on a project around workplace stress: why do so many employees fail to take the full leave they are entitled to? The study, led by Professor Annette Pritchard, with contributions from sport psychologists Dr. Stephen Mellalieu and Dr. Richard Neil, will utilise the PEL to identify links between stress and tourism experiences.

### **Case study 4: Cardiff Metropolitan University**

#### **PDR (International Centre for Design and Research): Innovative and ground-breaking designs**



- PDR is at the cutting-edge of knowledge and practice and a world-leading design consultancy and applied research centre.
- PDR undertakes pioneering work through applied research projects in partnership with industry to build capacity and ensure knowledge remains relevant.
- Projects are many and varied; work includes diverse creations such as developing restaurant chain Las Iguanas' fajita stack through to creating the next generation handheld medical ultrasound dopplers for use in both vascular and obstetric medical practice.

PDR is a world-leading design consultancy and applied research centre. It has a unique approach, blending leading, high quality research activity alongside award winning, proven and highly experienced consultancy practice. For over two decades this perspective and the culture, knowledge and capabilities built around it have generated world-leading results and outcomes for the companies and organisations PDR work with.

Located within Cardiff Metropolitan University PDR is organised across eight groups, each a leading exponent in its field with an extensive history and back catalogue of projects, innovations and ground-breaking knowledge. Each group is a globally renowned source of expertise and practice in its field. Together, under one roof, the capabilities, knowledge and expertise are unprecedented and maintain PDR at the cutting-edge of knowledge and practice, making PDR a world-leading centre in design and innovation.

In 2015 Cardiff Metropolitan University was awarded the prestigious Queen's Anniversary Prize for PDR's use of design and related 3D digital scanning technologies applied to maxillofacial reconstructive surgery following disease or trauma. PDR's work has led to better, safer, faster, more accurate and less intrusive reconstructive surgical procedures. Direct impacts of the research include improved dignity, comfort and quality of life for thousands of people and significant savings for the UK taxpayer.

PDR works with many blue chip companies, leading universities and research groups and government departments. It also works with innovative start-ups and manufacturing based SMEs, life science companies and public sector bodies.

For further information see <http://pdronline.co.uk/>

### Case study 5: Cardiff University

#### **Airbus Centre of Excellence in Cyber Security Analytics: £5 million partnership between Airbus and Cardiff University to tackle global cyber security**



- Airbus Group's initiative with Cardiff University and Welsh Government aims to boost innovation across Wales.
- Received more than £5 million in funding from UK Research Councils, Welsh Government and industry.
- The Centre is the first of its kind in Europe, working across industry, academia and government to provide a focus for cyber security analytics in the UK.

Cyber security is a priority research area at Cardiff University, supported with strategic investment. Since 2012 Cardiff has established an interdisciplinary research team of technical and social researchers. Collaborative projects have received more than £5 million in funding from UK Research Councils (Engineering and Physical Sciences Research Council and Economic and Social Research Council), Welsh Government (Endeavr Wales) and industry (Airbus).

The collaboration has led to the development of the Airbus Centre of Excellence in Cyber Security Analytics. Cardiff University researchers partner experts from Airbus to carry out world-leading studies into machine learning, data analytics, and artificial intelligence for cyber-attack detection.

The centre works across industry, academia and government to provide a focus for cyber security analytics in the UK. As the first centre of its kind in Europe, the aim is to strategically position the UK as a leader in cyber security analytics. Addressing emerging challenges to cyber security by combining:

- computational and mathematical methods, drawing on technical expertise in machine learning, artificial intelligence and big data analytics
- criminological expertise in cyber crime
- international relations expertise in communication and governance.

Collaboration covers areas of mutual interest to the Cyber Operations Team at Airbus and Cardiff University, including data science, big data analytics, machine learning and artificial intelligence. AI and data economy is one of the four grand challenge areas identified in the Industrial Strategy. A significant focus of the work is on the interpretation and effective communication of automated algorithmic data analytics to support decision making and policy surrounding cyber security issues of national importance. Participation in the collaborative program is not limited by the organisational affiliation of scientists and will be determined by individuals' ability to contribute to the mutual objectives of the participating organisations.

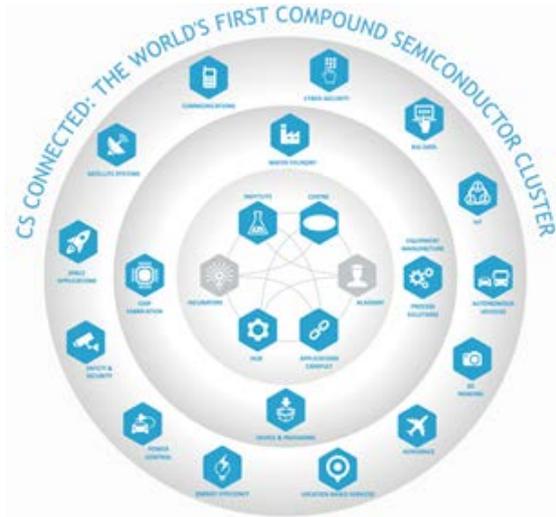
The Centre opened in 2017 and builds on a mutual agreement to develop industry-relevant academic programmes in cybersecurity at the University, to fill the skills gap that currently exists in the field. Knowledge sharing between Airbus and the University is also supported, with opportunities for secondments and industrial placements for researchers and students.

In August 2018 it was named as an Academic Centre of Excellence in Cyber Security Research by the UK's National Cyber Security Centre, becoming the first institution in Wales to be given this

status. The award is in recognition of the internationally excellent research developed at the University over a number of years and will allow academics to feed directly into the UK Government's strategy of making the UK more resilient to cyber-attacks.

### Case study 6: Cardiff University

#### Developing a Compound Semiconductor Cluster: Partnership between Cardiff University and IQE



- Aim is to establish Europe's first cluster for compound semiconductors and position Cardiff as the UK and European leader in the field.
- Provide cutting-edge facilities that will help researchers and industry work together.
- A unique facility in the UK, fabricating and testing technology for realistic industrial application.
- Provide the expertise and capability to translate academic excellence through to practical, manufacturable devices to generate economic impact through commercial and academic exploitation of compound semiconductor technologies.

The Institute of Compound Semiconductors at Cardiff University is part of a multi-million-pound development to create Europe's first cluster for compound semiconductors and position Cardiff as the UK and European leader in the field.

The Institute has benefitted from several large-scale investments including £13 million from European Structural Funds, £17.3 million from the UK Research Partnership Investment Fund and £12 million from the Welsh Government. All of which will help fund the University's new Translational Research Facility, due to open in 2021, on its Innovation Campus.

The Institute was formed following the joint venture between Cardiff University and IQE which was established in 2015 to create the Centre for Compound Semiconductors which focusses on materials and commercial development.

The vision is for Cardiff University to be a founding and key partner in the development of the first compound semiconductor cluster in Europe. Providing the small to medium scale fabrication capacity to complement activity at other cluster partners, with the expertise and capability to translate academic excellence through to practical, manufacturable devices and integrated subsystems with the ultimate aim of generating economic impact through commercial and academic exploitation of compound semiconductor technologies.

In August 2018 the UK Government announced funding to expand the catapult centres developing a range of cutting edge new technologies across the UK which included further funding of £51.3 million for the compound semiconductor catapult in Cardiff. The catapult vision is to bridge the gap between ambitious businesses and the academic expertise of the UK's world-class research communities and will support the development of the compound semiconductor cluster.

### Case study 7: Swansea University - Creating a 21<sup>st</sup> Century Steel Industry



- Swansea University was founded by industry for industry in 1920 and has worked in partnership with the steel industry to develop the UK's first regional centre of excellence for steel innovation.
- The Centre has attracted over £100 million worth of funding and has extensive cutting-edge facilities.
- Partners with industry, UK Research Councils, Welsh Government and the European Union. Engaged with over 150,000 people.

Swansea University was founded by industry for industry in 1920 and has worked in partnership with the steel industry to develop the UK's first regional centre of excellence for steel innovation creating a high-tech research cluster that links the local supply chain in new research projects, commercial opportunities, funded projects, training and further co-operation and collaborations.

The SPECIFIC Innovation and Knowledge Centre is an upscale functional coatings research centre working with the steel industry and supply chain to develop new technologies and storage of energy so that buildings can become power stations. The project will create a test bed for Homes as Power Stations as part of the Swansea Bay City Deal.

The establishment of a Steel Science Centre, which will be known as the National Steel Innovation Centre and preceded by the Steel and Metals Institute, will build on regional centres of excellence and the industrial capabilities at Tata's Port Talbot Steel Works, to address the current and future challenges of sustaining primary steel-making capacity in the region and the UK. The project provides a pipeline of talented researchers engaged in collaborative projects for the steel and metals industry.

A number of additional impacts have been delivered within the College of Engineering, providing upskilling, doctoral training and work-based learning. This includes the leverage of £8.6 million funding from the Wales European Funding Office for a work-based learning project entitled METaL that provides professional skills modules for workforce staff both within the coating and other manufacturing sectors in Wales.

Researchers within the College have taken part in a number of community initiatives through 'Materials Live'; a Swansea University led outreach programme engaging with over 150,000 people at events such as the British Science Festival held in Swansea in September 2016.

#### University assets:

- Steel and Metals Institute (SaMI) – established by donation of equipment from Tata Steel UK and £2 million Welsh Government funding. Additional support of £3 million for new state of the art equipment from the Higher Education Funding Council for Wales and recently awarded £7 million from EPSRC to enable the Prosperity Partnership with Tata Steel and Warwick University.
- National Steel Innovation Centre (NSIC) – following and building on from SaMI. £20 million for steel science centre awarded via the Swansea Bay City Deal.
- Institute of Structural Materials – £30 million EPSRC Innovate Gas Turbine and high temperature Materials testing.
- Advanced Imaging of Materials – £14.4 million microscopy suite that enables analysis and advanced characterisation of materials.

- M2A Manufacturing and Materials Academy – industry sponsored doctoral training programme for 24 students per annum - £14 million WG funded.
- SPECIFIC IKC – £47 million EPSRC Industry WG Building as Powerstation

### Key partners



Innovate UK



Rolls-Royce



Johnson Matthey



specific



BAE SYSTEMS

SONY



### Case study 8: University of South Wales

#### Creation of the National Cyber Security Academy to address a skills shortage



- The University of South Wales and Welsh Government innovative project to help address a shortage of cyber security skills
- Developed the programme with major industrial partners such as Airbus and General Dynamics UK to close the skills gap
- Will provide the next generation of cyber security experts

The University of South Wales has established an international reputation in the areas of network security, computer forensics and threat analysis. With its Information Security Research Group leading on the design and development of early warning systems that can detect and respond to a variety of cyber based attacks and on computer forensics.

By 2019 is forecast that an additional 4.5 million personnel will be needed worldwide. The University of South Wales and Welsh Government joined forces to launch the National Cyber Security Academy, the first of its kind in Wales and a major UK initiative. It has been specifically designed to develop the next generation of cyber security experts to help fill a skills gap.

Established at the University's Newport City Centre Campus, the Academy welcomed its first students in October 2016. Students work on real-world projects set by the Academy partners, identifying new challenges in the cyber security environment. The University collaborates with a wide range of partners including the Ministry of Defence, Airbus, BT and Northrop Grumman. The programme allows industry to have direct access to a pool of graduates trained to the highest standards and with a clear understanding of cyber threats. The University of South Wales' expertise was recognised in May 2016 when it received formal accreditation from GCHQ for its Master's course in computer forensics.

The Academy also enables the University to offer high standard bespoke solutions to organisations as well as providing a steady stream of trained cyber security professionals.

Cyber security is ranked by the UK Government alongside terrorism, military crises, and natural disasters as major national security threats, and it costs private businesses many millions each year.

Airbus Defence and Space's Andy Love, of Strategic Business Development, said: 'There is an emerging eco system around cyber technology that is based in South Wales and Airbus is proud to be part of it. Our involvement with the course and the curriculum is an exciting opportunity for business and academia to influence the next generation of cyber security specialists.'

### Case study 9: University of South Wales Industrial collaborating on electric vehicle battery systems development



- The University and Ricardo collaboration to develop electric vehicle battery systems.
- Working with some of the world's leading automakers.
- Enable Ricardo to access the facilities and the support of the major investment in battery systems development by the University's Centre for Automotive and Power System Engineering.

The University of South Wales' [Centre for Automotive and Power System Engineering](#) and Ricardo are collaborating on electric vehicle battery systems research and development.

The Centre is based within the Faculty of Computing, Engineering and Science at the University. Already a nationally recognised independent research, development, test and certification house in the UK – with a reputation for cutting-edge research and knowledge transfer activities – the Centre is in the process of further expansion.

Ricardo is an international leader in the development of electric vehicle battery systems, and works with some of the world's leading automakers – from mainstream original equipment manufacturer to electric vehicle specialists. The company has extensive experience in the research and application of new and novel battery cell chemistries, as well as in the product development, engineering, and vehicle integration of production-ready battery packs and battery management systems.

The collaboration provides Ricardo with access to the facilities and the support of the major investment in battery systems development by [Centre for Automotive and Power System Engineering](#), while enabling the University to benefit from Ricardo's knowledge and experience of the challenges of both research and production-intent programmes.

Ricardo Automotive Managing Director, Rory Fisher commented: 'I am pleased to be able to sign this MoU with the University of South Wales Centre for Automotive and Power System Engineering. Ricardo is already a global leader in both vehicle electrification and in the development and application of electric vehicle battery systems and technology ... [the Centre] is an important element of the UK's electrified vehicle development capacity. We look forward to collaborating with ... for the mutual benefit of the University and of Ricardo and its electric vehicle customers.'

### Case study 10: University of Wales Trinity Saint David

### University research centre creates new leg for rescue dog



- Rescue dog has bespoke leg printed by University Research Centre
- CBM designed the prosthesis and used a 3D printer to create the new leg.
- The team worked with the dog's owner and a consultant orthopaedic surgeon on the design.

Rescue dog Duke, an Irish retriever, was born with a birth defect in his front right leg and faced having it amputated. But thanks to CBM he is now running around after CBM printed him a bespoke prosthesis, similar to blades used by Paralympians.

The Wales Centre for Advanced Batch Manufacture (CBM) is a research centre established by the University of Wales Trinity Saint David, which specialises in advanced manufacturing technologies and their novel application to the manufacturing and other sectors of the economy.

When Duke was found abandoned in Ireland in 2016, his paw was deformed and he could not walk on all fours. He was taken to the pound and rehomed. After a massive fundraising campaign Duke has been fitted with a state-of-the-art prosthetic by CBM, after narrowly avoiding having his foot amputated.

His new owner said Duke, who is now three, was delighted by his new 'super leg' which meant he was walking on four paws for the first time. The three-dimensional leg was about a year in a making, and a few months down the line Duke is getting so much use out of it he has already had to have it refurbished.

The leg was entirely printed out of a machine apart from a rubber foot, some Velcro and foam at the top to make it more comfortable for Duke.

A spokesperson for the University said creating Duke's leg was a real challenge for the team, who worked with his new owner and a consultant orthopaedic surgeon on the design. The team had to assess Duke and take into consideration such things as the thickness of the hairs as the smallest details need to be taken into account.

### **Case study 11: Wrexham Glyndŵr University FinTech (Financial Technology): Driving transformation in financial services**



- FinTech (Financial Technology) is a cross-disciplinary area that combines Finance, Technology and Innovation Management.
- Driving transformation in financial services and bringing convenience to people across the world.
- Conducts research, consultancy and training projects for the industry, provide support to start-ups, facilitate exchanges among local and overseas.

FinTech (Financial Technology) is a cross-disciplinary area that combines Finance, Technology and Innovation Management. FinTech has been one of the most revolutionary forces for driving transformation in financial services and bringing convenience to people across the world.

In 2017 Wrexham Glyndŵr University was proud to launch the UK's first Financial Technology Management undergraduate programme.

Right in the heart of the Wrexham campus, the FinTech Innovation Centre aims to enhance Wales' capabilities to be an international and leading FinTech hub in the world. The Centre conducts FinTech related research, consultancy and training projects for the industry, provides support to start-ups, facilitates exchanges among local and overseas experts, and offer FinTech education for students, financial personnel and the public.

The FinTech Innovation Centre works closely with various strategic partners, such as Finexkap in France. Founded in 2012, Finexkap had raised £19.85 million in finance for small and medium-sized enterprises (SMEs) in its first two years. The company was the fastest growing start up in France and one of the five fastest growing start-ups in Europe in terms of revenue in 2016, seeing a 3,500 per cent growth. Cedric Teissier, Finexkap's co-founder, is well-known in the field and is a member of the Fintech Advisory Group in the World Economic Forum and a founding member and Vice President of France Fintech.

Another strategic partner is FinTECHTalents, organiser of the annual biggest and most important FinTech festival in the country.

The FinTech Innovation Centre has received sponsorship from parties including the Association of Chartered Certified Accountants (ACCA). In addition, the centre is also a training centre of Sage courses - Sage is the third largest ERP system provider in the world.

<https://www.glyndwr.ac.uk/en/Business/FinTechInnovativeCentre/>

**Case study 12: Cardiff University, Swansea University and the University of South Wales Flexible Integrated Energy Systems: Building on the world-class capability that exists in Welsh universities**



- £24.5 million pan Wales project bringing together expertise from universities, industry and local government to facilitate a transition to a low carbon future.
- A five-year EU-backed project working with local communities to transform smart energy use.
- Using real-data from a real-world demonstration area.
- De-risking decarbonisation.

Flexible Integrated Energy Systems (FLEXIS) is a £24.5 million research operation designed to develop an energy systems research capability in Wales which will build on the world-class capability that already exists in Welsh universities.

The FLEXIS project, led by Cardiff University, Swansea University and the University of South Wales, brings together expertise from across these universities to facilitate an affordable, sustainable, and socially acceptable transition to a low carbon future. The five-year EU-backed project will look to solve a diverse, complex and inter-dependent set of challenges, ranging from energy storage, to decarbonisation and fuel poverty. By 2020, over £20 million of additional competitive research income is expected to be secured in Wales as a result of FLEXIS.

The operation will be delivered in two geographical areas: West Wales and the Valleys; and East Wales. FLEXIS has received £15 million in funding support through the Welsh European Funding Office. The project will focus on developing flexible energy systems, which is an urgent priority in energy generation and supply. It will make a significant economic impact through supporting and developing the internationally renowned research in this area, and more specifically through the new technologies and new jobs that will follow this work.

Its aim is to create a culture of research and innovation across Wales so that Wales becomes known across the world as a leader in energy systems technology. Part of the activity will also include driving innovation to create jobs and produce real economic impact. One of the key FLEXIS objectives is to create significant critical mass and attract new researchers to Wales. Embedding excellent researchers within research led companies in Wales, and we will be working to attract new companies to locate here, thus supporting the Welsh economy and creating jobs.

FLEXIS partners support cluster development through collaboration with private and public sector research organisations in Wales, throughout Europe, and worldwide to promote the products of Welsh research, the professional training courses that will result from this activity, and produce the graduate research engineers that are needed to make Wales one of the global leaders in energy research.

All of the research to be performed will focus on, and be applied at, a Welsh 'place based' demonstrator which is located at the Tata Steels works in Port Talbot.

For further information see <http://www.flexis.wales/>.

**Case study 13: Swansea University, Cardiff University, Aberystwyth University and the University of Wales Trinity Saint David  
Advanced Sustainable Manufacturing Technologies: Embedding advanced and sustainable technologies into Welsh manufacturing**



- Supporting the stimulation of ideas in the Welsh manufacturing sector exploiting the wealth of world-class research in Welsh universities in close research collaborations with industry.
- Project supported more than 250 Welsh enterprises in West Wales and the Valleys in 2010-2015, with stage two running until 2020.
- Created economic impact excess of £200 million in West Wales and the Valleys showing that for each £1 invested an outstanding return of over £8 of economic impact was achieved.

Advanced Sustainable Manufacturing Technologies (ASTUTE) supports the stimulation of ideas in the Welsh manufacturing sector through provision of resources, facilities, advice and guidance exploiting the wealth of world-class research in Welsh universities in close research collaborations with industry. It is a collaboration of four Welsh universities; Swansea University, Cardiff University, Aberystwyth University and the University of Wales Trinity Saint David.

In its first round of funding (2010-2015), the project supported more than 250 Welsh enterprises in West Wales and the Valleys, supporting them towards long term sustainability and competitiveness, the most evident improvements experienced by companies were improved processes, accelerated research and development, improved growth prospects and new product developments. The final evaluation of the first phase of ASTUTE concluded that its work created economic impact of well in excess of £200 million in West Wales and the Valleys showing that for each £1 invested an outstanding return of over £8 of economic impact was achieved.

Phase 2 (2015-2020) has been part-funded by the EU through the Welsh Government

ASTUTE 2020, the five-year operation, will support industrial research, development and innovation through world-class academics and a team of highly qualified technical experts and project managers.

ASTUTE 2020 is designed to stimulate growth in West Wales and the Valleys by applying advanced engineering technologies to manufacturing challenges, driving cutting-edge research, development and innovation. ASTUTE 2020 will collaborate with the high-value manufacturing industry to stimulate transformational and sustainable growth by facilitating and de-risking the development and adoption of advanced technologies, increasing competitiveness and future proofing.

Demand-led by industry, ASTUTE 2020's focus is on collaborative industrial projects with a research challenge that will bring economic benefit to the area. ASTUTE 2020 will focus only on where it can specifically contribute established world-leading and internationally excellent expertise found across the Welsh universities' partnership to address the industrial research, development and innovation needs:

- Advanced Materials Technology
- Computational Engineering Modelling
- Manufacturing Systems Engineering

ASTUTE 2020 builds on the most successful aspects of the previous ASTUTE project from 2010 to 2015. ASTUTE has successfully demonstrated that it is in an excellent position to support companies via knowledge exchange and intensive collaborative research, development and

innovation projects in manufacturing technology. Over 250 Welsh small to medium-sized enterprises (SMEs) benefited from ASTUTE's assistance helping generate more than £9 million in increased manufacturing investment for Wales, stimulated the creation of 174 new jobs and initiated the set-up of ten new enterprises.

For further information see <https://www.astutewales.com/en/>.