East of England Science and Innovation Audit

Appendix 4 – ICT

ICT Theme Steering Group

Name	Organisation	Role
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1.　Introduction

This appendix captures supporting evidence used in the development of the main report but not presented in detail. It does not provide additional commentary on the conclusions of the Science & Innovation Audit and hence does not have a narrative of its own.

The material has been organised according to the most directly relevant section of the SIA report

2.　Approach

The ICT sector has seen rapid growth in the East of England and benefits from a very strong scientific asset base with a number of recognised ICT clusters. The market is evolving quickly and the demand for digital innovation is relentless. The rate of change in the sector however also makes it difficult to categorise and quantify; Standard Industry Classification codes are a poor approximation for the industry as it is today. Also, ICT is so intrinsic to the development of many other sectors, for example agritech, gaming and fintech, that separating out core assets between sectors can become counter-productive.

This audit therefore placed a strong emphasis on gathering first-hand opinions. Over 40 interviews and online surveys were completed by stakeholders across the region. Similarly, a structured workshop ("hot house") approach, which was open to all stakeholders, was used to review evidence and develop the initial conclusions.

It is from this that we determined both the wide range of strengths across the region and their complementarity. It also became readily apparent that the key opportunity for the Region lies not a particular location or sub-sector but the interconnection between the key clusters. Not only for the ICT sector itself but for the region's other key sectors of agritech, advanced manufacturing and materials and life-sciences.

3.　Local science and innovation assets

Further details provided by the region's Universities:

3.1　Anglia Ruskin University

Investing in Science and Innovation Research Infrastructure
Anglia Ruskin University (ARU) has invested over £100 million, in recent years to build research infrastructure and business networks in ICT, Deeptech and Digital Creative areas to support the

future needs of the regional economy and offer excellent employment prospects for its graduates. For instance, the new £45 million investment in new Science Centre (Cambridge), opening early 2018, will offer students and researchers in computing and technology, psychology, animal biology, and biomedical science and forensics research infrastructure.

The Medtech Campus (Chelmsford) is one of the world's largest health innovation spaces, including several MedBic innovation centres (Chelmsford, Harlow, Southend). It will be a leading growth hub to the medtech sector and its supply chains in the region. An additional £19.89m has been awarded to build medtech site in Southend to support the prototyping, development and testing of new medtech products, including via the Anglia Ruskin Clinical Trials Unit and research facilities e.g. Gait Analysis Lab and Simulation Suites.

Cross-disciplinary Teaching and Research
The Department of Computing and Technology (CAT) offers undergraduate and MSc courses related to computer science, audio and music technology, electronics, gaming technologies, business technology with close links to various industries and research on Informatics, Computing and Electronics (ICE), Sound and Game Engineering (SAGE), and Virtualisation, Simulation and Infrastructure (VSI).

Anglia Ruskin IT Research Institute (ARITI) researches intelligent decision support systems, data mining, machine learning, image processing, real-time big data processing, digital diagnosis, optimisation, data fusion and mobile solutions in areas of medical informatics, big data & cyber security and intelligent systems and gaming; whilst the Cambridge School of Art, the Cultures of Digital Economy Research Institute and PIER (a Policing Institute for the Eastern Region) works in transdisciplinary ways to address the fundamental challenge of how we use "technology to make us more human" be this through design thinking creative practice, policing, or virtual reality storytelling through film, music technology, wearables, and gamification.

Supporting Regional Development and SME Innovation
Anglia Ruskin has a long track record of proving support to SMEs through delivering successful ERDF projects and proactively linking them to our research capabilities. ARU was awarded Entrepreneurial University of the Year in the 2014/2015 title at Times Higher Education (THE) Awards for strategic approach to entrepreneurship and business support. Sector Strategy is to help drive innovation in the region by bringing together owners of societal challenges in the public sector with our academics and businesses from various cross disciplinary domains: Medical Technologies, Smart and Assisted Living, Future Cities, Blue Lights Services, and Digital and Creative.

The REACTOR project (£1m 2016-19) is at the crux of this, as is the new Innovation Hub project for cross-disciplinary technology enabled innovation practice between Science, the Arts and Business. In so doing ARU is working with national and international partners in Northern Europe/Scandinavia, North America and China, including Tsinghua. Against this ARU is leading on the KEEP+ ERDF project-focused around developing local innovation in collaboration with regional businesses and start-ups. Taken together ARU is a 'global' prospect, entering the world's top 350 Universities in this Year's Times Higher ratings, and immersing itself in rich creative technology ecosystems via direct partnership, research bridges (e.g. Marie Curie, Newton Fellowships in legal digital economy), collaborations (the Mayo Clinic, Wellcome Trust, AHRC) and innovation events (the annual Brains Eden Games Festival, Europe's largest University live games jam, this year with teams from Chengdu, China as well as Europe).

3.2 Cambridge University – Computer Lab
(Note that this account is based on interviews and background research, rather than being directly provided by the University)

The role of the Cambridge Computers Laboratory in the Cambridge cluster

Brief History of the Cambridge Cluster and the Computer Labs
The Modern Cambridge Cluster was founded in 1960, with the creation of Cambridge Consultants, which was formed to "put the brains of Cambridge University at the disposal of industry." The cluster has been incredibly successful, creating more than 4300 knowledge intensive firms and employing over 58000 people, with a total turnover of 11 billion pounds. Founded in 1937 for work on mechanical calculators and analogue computers, the laboratory became involved in digital computing from 1945 under the guidance of Professor Maurice Wilkes. Research at this time contributed to the basic stock of computing knowledge, such as the ideas of subroutines and microprocessors, leading to creating workable computer systems (hardware and software) and new computer application techniques. This developed to work in building complete computers (EDSAC, 1949 and EDSAC 2 in 1958). Giving way to the development of operating systems and programming laboratories.

The world class expertise of the Computer Lab
The Lab is a bastion of academic excellence currently consisting of 44 academic staff, 30 support staff, 7 research fellows, 102 post-doctoral research workers and 121 PhD students. Over 300 undergraduates studying for Part I, II and III of the Computer Science Tripos and 36 graduate students studying for the MPhil in Advanced Computer Science. The staff and students both provide excellent resources for the cluster. Graduates of the Laboratories are highly sought after, so much so that in the yearly recruitment fairs there is almost a 1 to 1 ratio between graduates and companies.

The staff and researchers contribute to the cluster through collaboration work with industry. Specifically using consultancy to provide short term solutions and creating research projects for more long-term industry needs. The academics provide consultancy not just in the region but across the globe, Roger Needham was an excellent example of this, as he spent several weeks of each year working as a paid consultant for Xerox Parc in the USA. Bringing back with him fresh ideas and expertise to the Computer Lab. In turn bringing more expertise and ideas to the cluster.

Business founded by the Computer Lab
256 companies have been founded by Computer Laboratory graduates and staff. Forming a sizeable chunk of the companies in the Cambridge cluster. Most the companies are based on software products or consultancy services. Software products can be sold globally and are often far quicker in turning a profit than hardware.

The most successful company in the entire Cambridge cluster was founded in the Cambridge Labs. This of course is ARM holdings founded in 1990, however ARM would not have been able to exist without Acorn Computers Ltd a company founded in 1978, who created the Acorn RISC machine and collaborated with Apple Computers in the US, leading to the eventual formation of ARM. ARM is phenomenally successful, working through its partners they have shipped more than 100 billion chips, reaching more than 80% of the global population. This success has attracted the attention of the world and it was sold in 2016 for 24 billion pounds to Japan firm SoftBank.

The Lab continues to develop world class businesses, so much so that they often quickly bought out by global companies. For example, the purchase of DeepMind Technologies in 2014 by

Google for a reported 400 million dollars. This not only bring capital into the cluster, but also bring global companies such as Google and Microsoft into the region.

The Raspberry Pi Foundation although not a business but a charity has great implication for the cluster. The charity was formed to further the advancement of education in computer science in both adults and children. By designing and releasing a low-cost computer, which enabled people to experiment with programming and electronics, over 10 million computers have been sold through the Raspberry Pi foundation. The cluster will greatly benefit from the increased number of computer scientist who are only around due to the work of the Raspberry Pi Foundation.

Future Role of Cambridge Computer Lab in the Cambridge cluster
The Computer Lab will continue to draw in experts from all around the world, enabling world class consultancy and research to occur. It will continue to create the bleeding edge technology firms, securing the future of the cluster. It is an integral part of the cluster and provides unquantifiable resources to the region.

3.3 University of East Anglia

UEA has a range of collaborations with other universities and businesses in areas such as Data Analytics Research. For example:

- A four year sponsorship from the Institute and Faculty of Actuaries will use 'Big Data' to predict life expectancy – and particularly how various chronic diseases and their treatments impact longevity. https://www.uea.ac.uk/about/-/could-a-computer-tell-you-when-your-time-is-up-
- UEA has a direct collaboration with global insurance giant Aviva to support their degree in Actuarial Sciences. Students will engage with real-world business problems and have the opportunity to be taught by professional Actuaries from Aviva. https://www.uea.ac.uk/actuarial-sciences
- Data experts at the University of East Anglia are collaborating the University of Essex and University of Kent to help businesses, healthcare providers and council services better understand the goldmine of information they collect. The Data Research Centre for Smart Analytics is being led by the University of Essex on behalf of the Eastern Academic Research Consortium (ARC) and is funded by the Economic and Social Research Council (ESRC). https://www.uea.ac.uk/about/media-room/press-release-archive/-/asset_publisher/a2jEGMiFHPhv/content/getting-smart-with-big-data-uea-partner-for-flagship-new-research-centre
- UEA is working on Data Analytics for prediction of Faults in Telecommunications Networks and also to help plan for better resource utilisation and capacity planning in Cloud Computing Environments. The latter areas are linked to work with BT at Adastral Park and EBTIC in the United Arab Emirates.

3.4 University of Essex

Institute of Analytics and Data Science (IADS)
We bring together academic experts in analytics and data science from across our University to offer cutting-edge research, specialist courses and vital insights for business. We makes sense of data, derive new insights and support better decisions. This requires not just new methods and techniques but also posing smarter questions. We look beyond the hype and focus on the real challenges, opportunities, commercialisation and social use of data.
https://www.essex.ac.uk/iads/

Business and Local Government Data Research Centre

The Business and Local Government Data Research Centre is leading the way in advanced analytics to help companies, local authorities and academics use data more effectively. Funded by the Economic and Social Research Council (ESRC), the Centre provides unique data services and a world-class facility that brings together the expertise of academic researchers, social scientists, data scientists and statisticians across universities in the East of England to enable better decision making and help organisations solve real issues.
http://www.blgdataresearch.org/

Human Rights, Big Data and Technology Project
This £5 million Economic and Social Research Council-funded project based at the University of Essex's Human Rights Centre, maps and analyses the challenges and opportunities presented by the use of technology and big data from a human rights perspective. https://www.hrbdt.ac.uk/

Knowledge Gateway
The Knowledge Gateway research and technology park at the University of Essex is set to become the location of choice in the eastern region for knowledge-based enterprises in science, technology and the creative sector. It draws on the University's global reputation for analytics and data science and outstanding support for SMEs, it's set to employ more than 2,000 people

The Knowledge Gateway had an initial investment in 2010 of £12m to build roads, landscaping and other infrastructure. It's the location of Parkside Office Village, which has become a hotspot for small businesses, and also the carbon-neutral, state-of-the-art Essex Business School which opened in 2015. Planning has also been approved to build a major 38,000 sq ft £10 million Innovation Centre, at the heart of the Knowledge Gateway, that will accommodate more than 50 growing start-ups with work anticipated to start on-site as early as summer 2016. The latest phase of Parkside Office Village opened on September 2016 and is already at full occupancy.

Start-up Hub: On site, recognising the increased importance of entrepreneurship within the student body and the fact that many indicate they would like to start their own business, the University has established a Start-Up Hub. Effectively an incubator providing support not just to the student body but also to the surrounding community. The support covers business advice through mentoring and connecting, work space in the form of co-working, hot desking and virtual tenancies and networking. Crucially the University has established an investment fund to support the early stage businesses – this can be accessed via grants, convertible loans and through the University's own crowd funding network

Gameshub
The Games Hub is a multi-award-winning co-working digital space, supporting and growing the app and games industry in Essex and East Anglia. In its first two years, The Games Hub has helped establish 5 companies developing titles in a wide range of digital platforms from smart phone to console, as well as working on emerging technologies such as VR/AR (virtual and augmented reality), AI (artificial intelligence) and Amazon Alexa. It is now on track to help two more companies set up and to open more studios in the region. The Games Hub works not only in close partnership with leading digital platform holders, publishers, developers and distributers such as Microsoft, Unity and Amazon

Colchester
Colchester is the oldest recorded town in Britain and as such, has a wealth of heritage. Its unique cultural assets provide a vibrant and cultural offering to both visitors and residents alike. Firstsite contemporary arts gallery, Mercury Theatre, Colchester Arts Centre and the recently renovated Colchester Castle and Museums have also proved a draw for creative businesses. This has allowed Colchester to emerge as an important sector hub. Indeed, the town has the largest concentration of creative businesses in Essex and the Haven Gateway, with over 3,500 people

employed in this sector across more than 600 companies. The total turnover of the creative and digital industries in Colchester was £290million in 2012, with a GVA of £165million. With the emergence of creative and digital centres such as Tech City, Shoreditch and recently Stratford (40mins by train), London is moving Eastward. In light of this, Colchester would like to develop stronger connections with London, including the generation of a strong, local digital and creative economy for jobs-led growth.

3.5 University of Hertfordshire

This section identifies the University's science and innovation assets, and its regional, national and international partnerships with industry and academia, across key ICT sub themes: software development, electronics, telecommunications, data science, digital creative and smart technology. It outlines how these assets could be further exploited to accelerate innovation across a range of ICT sectors.

Research excellence

Strong interdisciplinary research collaboration across engineering, computer science and creative arts underpins UH's partnerships with the ICT industry. In REF 2014, 82% of academic outputs from the University's Centre for Engineering Research were rated 'internationally excellent'. The Centre has received large-scale funding from the likes of EPSRC, Home Office, DSTL and BT Labs, accruing £3.6m in research income since 2014 and investing in over 4000m2 of laboratory space and state-of-the art test facilities. The Centre has a significant research track record in converged optical and wireless networks for 5G, software defined networking (SDN) and biometrics.

Half of UH's research outputs in computer science were rated 'internationally excellent' or 'world leading' in the last REF exercise. Computer science has generated £4.7m in research income since 2014 across its key themes of adaptive systems and human-robot interaction, algorithms, cyber security and biocomputation. Visual effects and gamification are core strengths of the University's creative arts faculty. More than half of its research was assessed as 'internationally excellent' or 'world-leading' in REF 2014. The Games & Visual Effects Research Lab investigates novel applications for the techniques and technologies of virtual reality and gaming, and enables teams of multi-disciplinary researchers to advance R&D for industry.

Innovation in telecoms networks software development

UH's Optical Network Research Group has aligned its research and expertise developed over 15 years with one of the biggest challenges facing the telecoms industry: the rollout of 5G networks to meet global demand. Funded by the European Space Agency, UH is partnering with Global Invacom (GIL), one of the world's largest manufacturers of satellite communications equipment, to develop and patent SDN-enabled Cellular and Satellite IP networks and Sat>IP Multicast WIFI Hotspot technologies. These hotspots will allow operators to reach large audiences far more cost effectively and reliably than through expensive unicast broadband delivery (see case study below).

The current collaboration with GIL is informed by knowledge UH developed through its leading role in the €3.5m EU-funded study ACCORDANCE. Backed by industry leaders that included Deutsche Telekom, Alcatel Lucent and Telefonica, it was one of the first projects in Europe to achieve convergence of the optical infrastructure with standard wireless solutions in order to support seamless ubiquitous broadband services.

The UH Smart Systems Lab: regional collaboration to create smart cities

UH's Smart Systems Lab, sponsored by Samsung and supported by companies such as Microsoft, Gemalto, Mitsubishi and BRE, has developed a range of smart technologies to power our future cities, from Internet of Things embedded systems to smart energy applications. The Lab has created InterHome, an intelligent platform that reduces energy usage, and InterLiving, an

assisted living platform that supports older people by employing technologies such as smart door locks and health monitors.

The Lab has inspired collaborations between UH and 30 companies across the EoE through several Innovate UK-funded projects. Longstanding partner BRE has integrated the InterHome platform into its Innovation Park in Watford, where it showcases new technologies (see case study below). The Lab works with Trust Renewables, based at BT's Adastral Park research centre, to integrate smart meters into systems for smart homes. Hatfield-based Mitsubishi Electric collaborates with UH to develop real-time control of robots using mobile devices, and has certified UH as a robot specialist. Letchworth Garden City's Altro Ltd has a £170,000 KTP with UH to develop new smart floor systems. UH and local technology company OM Interactive have a KTP project to develop sensory software for children with learning difficulties. And UH has worked with Luton-based Anritsu to demonstrate IoT applications for commercial vehicles and connected homes at the World Mobile Congress. The Lab links the EoE smart tech sector with China, having established partnership with a new Smart Systems Lab and research team at Changzhou Institute of Technology in Jiangsu.

Robot-human interaction for smart living: a new regional technology asset
Twelve years ago the University purchased a typical semi-detached home in Hatfield and named it the Robot House. Researchers in the Adaptive Systems Research Group used it to observe how people get along with machines in everyday life. A recent £600k infrastructure grant from EPSRC recognises it as a national facility and unique resource. It will be upgraded to Robot House 2.0 through the installation of new state-of the-art robots and a range of sensors to turn it into a smart home. Under the terms of the grant agreement, UH will make the facility available to other universities and companies to use for research and development in smart home and robotics technology. The Adaptive Systems Group has a long-standing history of collaborating with robotics companies across Europe, and also with NHS trusts and local authorities. It is involved in a £250k clinical study, funded by the NIHR, to evaluate the efficacy of UH's own social robot Kaspar in supporting children with autism, and is working with Hertfordshire County Council to develop novel home-based assistive technologies for older people.

Keeping the East of England region cyber secure
According to the National Fraud Intelligence Bureau, fraud and cybercrime costs the UK £11bn a year – and that figure only represents reported cases. The Cyber Security Centre at UH was founded to provide a centre of expertise in the technology and management of cyber security and cyber crime. The Centre works with the local Chamber of Commerce and SMEs to provide security advice, understand the issues faced by local enterprise and undertake research to address these challenges. The Centre is currently working with a local SME Service Provider to enable the transfer of security knowledge to other SMEs in the region. It is developing new cyber security training protocols for police forces and government agencies at regional, national and international level. Targeted investment could unlock opportunities for UH to work more closely with the University of Cambridge's Security Group and Anglia Ruskin University's Cyber Security Research Area to deliver benefits to a greater number of SMEs in the East of England.

Driving advances in data science, machine learning and biometrics
UH collaborates with a wide range of European academic institutions and industrial partners in the field of multimodal biometrics. Alongside security software company Validsoft, the University represents the UK in the Horizon 2020 OCTAVE project, which seeks to develop new robust automatic speaker verification systems that are less vulnerable to spoofing. It has entered a three-year knowledge transfer partnership with IDscan Biometrics worth £195k. IDscan faced a skills shortage in the market when searching for in-depth knowledge of advanced biometrics techniques, most notably automated face recognition. UH worked with the company to introduce a face recognition capability into IDscan's new products for automated identity authentication. A patent application has been submitted for this new system developed through

fusion of machine learning techniques and the collaboration has gone on to produce the first prototype of a face recognition system based on deep learning.

The Biocomputation Research Group collaborates with top academic institutions (UCL, Cambridge, Sanger Institute, Max Planck Institute) and industry partners to develop computational models to study biological systems, and apply biologically inspired machine learning algorithms to the analysis of big data. Its exploration of machine learning techniques has benefited Tesco, Sky and pharmaceutical company MedPharm.

Expertise in electronics and components research

UH was the first UK university to be awarded 'University Partner' status with RS Components. The partnership programme provides academia with industry-focused teaching tools (e.g. for PCB and 3D mechanical parts design) to support the next generation of engineers, and promotes new technological solutions and their uptake by local industries. RS has directly supported the UH Smart Systems Lab on various projects with commercial partners. UH has collaborated closely with nine electronic components companies mostly based in East Anglia, supporting them in the design and assembly of their components and embedded boards, which are used for IoT applications, smart communications systems and smart sockets.

Supporting the development of the region's digital creative industries

The Games & Visual Effects Research Lab (G+VERL) at UH uses advanced technology to develop new techniques, workflows and synergies for the games and visual effects industries. Housed in the purpose-built Film, Music and Media Building, it offers local SMEs use of its facilities, including a fully equipped motion capture studio and 4K cameras, and its research expertise in software tools like Maya, Nuke and Oculus Rift. It has worked with St Albans companies Firepanda and Rewind FX to apply virtual reality techniques to medical imaging. It has created media content and 360-degree virtual tours for Elstree Film Studios, and worked with British artist Darren Johnston to construct an immersive virtual reality experience investigating the concept of Zen at the Barbican Theatre in London.

4. Local science and innovation talent

The region relies primarily on attracting top talent from the rest of the country and abroad. In 2016 there were over 3,100 job postings for graduate programmers and software development professionals alone (Source: Labour Insight Jobs, Burning Glass Technologies). This contrasts with 260 2014/15 graduates who were employed within the region 6 months from graduation (Figure 1 – ICT employment in the East of England). Whilst the number of students in Computer Science and Electronic Engineering from the Universities is increasing steadily (Table 1 - CS&EE undergraduates in East of England) it is clear that this will continue in the short-term.

		Academic Year							
		2011/12		2012/13		2013/14		2014/15	
Provider name	Location of employment (region) ..	FPE	%	FPE	%	FPE	%	FPE	%
Anglia Ruskin University	East of England	55	44.9%	90	51.9%	65	46.5%	65	49.6%
	Elsewhere	35	29.7%	35	19.7%	35	23.2%	40	29.0%
	Not in employment	30	25.4%	50	28.4%	45	30.3%	30	21.4%
Cranfield University	East of England					0			
	Elsewhere	15		5		15		10	
	Not in employment					0			
The University of Cambridge	East of England	15	22.5%	20	24.4%	20	24.0%	15	14.8%
	Elsewhere	35	55.3%	45	49.6%	50	58.6%	45	49.5%
	Not in employment	15	22.2%	25	26.0%	15	17.4%	35	35.8%
The University of East Anglia	East of England	45	47.5%	35	48.6%	30	50.7%	30	52.2%
	Elsewhere	20	20.6%	20	29.8%	20	29.2%	20	35.7%
	Not in employment	30	31.9%	15	21.6%	10	20.2%	5	12.2%
The University of Essex	East of England	30	33.1%	35	42.6%	45	39.8%	40	41.0%
	Elsewhere	25	30.8%	15	20.1%	30	27.1%	25	24.3%
	Not in employment	30	36.0%	30	37.4%	35	33.1%	30	34.8%
The University of Northampton	East of England	10	10.5%	5	5.0%	5	6.7%	5	9.0%
	Elsewhere	60	71.9%	55	66.0%	50	68.0%	45	59.6%
	Not in employment	15	17.5%	25	28.9%	20	25.3%	25	31.4%
University Campus Suffolk	East of England	35	53.3%	40	54.1%	55	73.9%	40	68.4%
	Elsewhere	5	4.9%	5	9.5%	10	14.1%	0	1.8%
	Not in employment	25	41.8%	25	36.5%	10	12.0%	15	29.8%
University of Hertfordshire	East of England	60	23.2%	70	27.6%	70	32.3%	65	29.8%
	Elsewhere	80	31.2%	90	34.9%	95	43.6%	110	49.4%
	Not in employment	120	45.5%	100	37.6%	50	24.1%	45	20.7%

FPE and % broken down by Academic Year vs. Provider name and Location of employment (region) (group). The data is filtered on JACS subject area v3 and Provider short name. The JACS subject area v3 filter keeps (8) Computer science. The Provider short name filter keeps 8 of 165 members.

Figure 1 – ICT employment in the East of England

Year	2013	2014	2015	2016
CS&EE undergraduates	805	975	1070	1155

Table 1 - CS&EE undergraduates in East of England (Source: UCAS 2017)

Evidence from stakeholders reveals that Cambridge is recognised by many companies as a draw in its own right for national and international talent, and BT also recruits the majority of its graduates from outside the region. However the proximity to London and limited national

transport links to the rest of the UK make it difficult to attract top talent into the rest of the region.

The skills challenge is widely recognised however and regional initiatives include Accelerate EAST and, more specifically, the New Anglia LEP's Digital Skills strategy have been put in place to address the requirements.

Central to the Accelerate EAST strategy is the development of the Accelerate EAST Pathway, a map of activities and opportunities within the region related to skills and employability, with clear and easy-to-navigate entry points and progression pathways. It will enable individuals to quickly and easily identify what is available, how to get there, and what the onward routes might be, and will be used to frame education and employment-related discussions with individuals, providers and businesses.

In parallel, will be the development of the Accelerate EAST Passport, an eligibility voucher for free or subsidised access to training opportunities on the Pathway. Employers will play an integral part in identifying which opportunities should be supported in this way, in order to meet their current and future skills requirements. The Passport will also provide subsidised transport to the relevant provider, ensuring that infrastructure is not a barrier to realising ambition.

More specifically to ICT, the New Anglia LEP Digital Skills Plan will address three priorities: closer increase collaboration between skills providers and employers; stimulating effective career choice through schools for entry into the sector, including alternative pathways for graduate-level talent; a bespoke approach to continuous professional development for ICT & digital skills. The strategy will play a pivotal role in driving the growth of the overall digital economy across New Anglia and the East of England's key sectors.

In addition, our universities are fully engaged with degree apprenticeships and have or are developing propositions for Level 6 (Honours Degrees), Level 7 (MSc) and Level 8 (PhD).

5.   Local industrial strengths and capacities

Overall there are approximately 16,500 companies who self-describe themselves as ICT (Table 2 – ICT companies in the East of England) with a number of identifiable clusters across the region in addition to the main three.

Industry type present in the region according to 2007 SIC codes

Industry types	ICT Companies founded in the region
Computer audit consultancy services	6816
Computer related activities (other)	3265
Business and domestic software development	1905
Information search services on a fee or contract basis	790
Communications telemetry	687
Batch processing	283
Computer games design	276
Web search portals	211
Cable service	201
Computer facilities management activities	198
Blank audio and video tapes and diskettes, magnetic and optical disks (CDs, DVDs) (wholesale)	181
Licensing for the right to reproduce, distribute and use computer software	171
Repair and maintenance of automatic teller machines (ATMs)	163

Cellular network operations	158
Amplifying valve (manufacture)	148
Aluminium coating inside pc cases (manufacture)	80
Advisory, conciliation and arbitration service	73
Computers and peripheral equipment (wholesale)	69
Amplifier for audio separates (manufacture)	58
Computer games publishing	42
News agency activities	39
Controllers interface cards (manufacture)	38
Satellite circuit rental services	33
Agricultural showground	30
Internet auctions (retail)	28
Aerial (domestic) (manufacture)	26
Advertising material publishing	24
Bells for telephones (manufacture)	22
Repair and maintenance of carrier equipment modems	20
Agricultural research (other than biotechnological)	15
Aerial erection (domestic)	15
Compact disc sound recording publishing	13
Calculating machines (retail)	12
Advertising video production	12
Architectural drawing publishing	11
Auction houses (except antiques and second hand goods) (retail)	11
Art expert	10
Less than 10 companies with the same sic code in the region	386

Table 2 – ICT companies in the East of England

Total turnover	4,789,173,000
Number of Employees	29,224
Turnover per employee	163878.0797

Table 3 – Totals for top 30 companies

Figures 2 & 3 show four major clusters and eight smaller clusters[1] in the East of England Region. The major clusters are identified by their abundant number of ICT companies, these four are Cambridge, Ipswich, Norwich and South-End-On-Sea. There are also a number of smaller clusters across the region including Colchester, Harlow and Peterborough (these were considered to exist

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[1] The data was collected from company house based on companies using the following UK Sic (2007) Codes: 261 - Manufacture of electronic components and boards, 262 - Manufacture of computers and peripheral equipment, 263 - Manufacture of communication equipment, 264 - Manufacture of consumer electronics, 268 - Manufacture of magnetic and optical media, 465 - Wholesale of information and communication equipment, 582 - Software publishing, 61 - Telecommunications, 62 - Computer programming, consultancy and related activities, 63 - Information service activities, 951 - Repair of computers and communication equipment

if there was at least one ICT company with a turnover greater than 7.94 million pounds, and at least 10 ICT companies with turnovers greater than 35 thousand pounds).
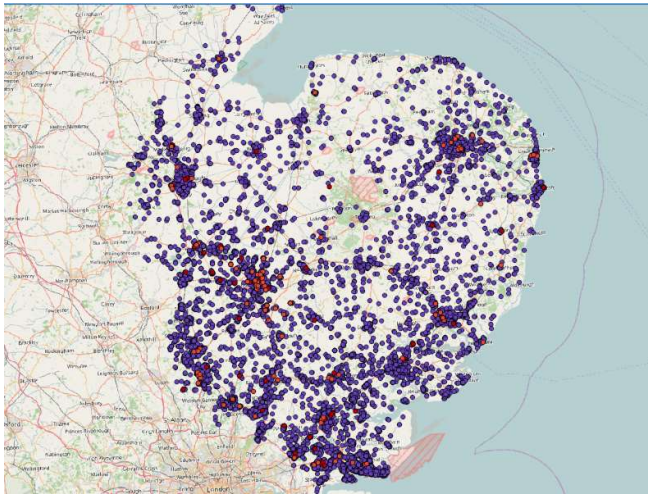

Figure 3 - Major and micro clusters in the East of England
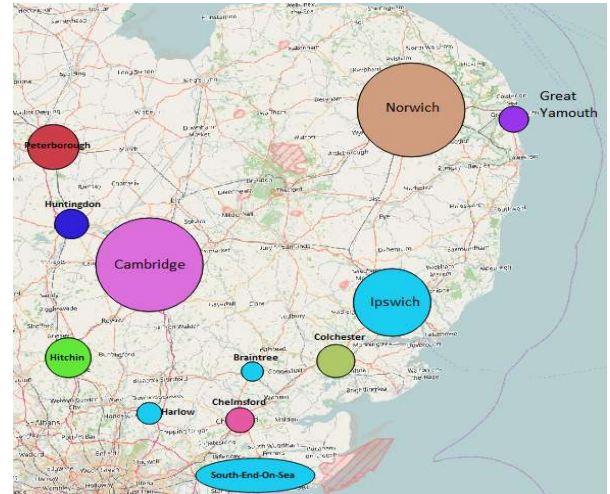

Figure 2 - Distribution of ICT companies in the East of England

It also worth noting that the larger clusters comprise multiple different types of sub-clusters, for example in the Cambridge cluster which includes a creative tech cluster.

6. National and international engagement

ICT businesses in the East of England are enabled by a strong network of supporting organisations and functions, Including:

HackSpaces https://www.hackspace.org.uk/
A hackerspace (also referred to as a hacklab, makerspace or hackspace) is a community-operated, often Not For Profit, workspace where people can meet, socialize and collaborate. Hackspaces in the East of England include:

● Cambridge Makespace
● Hitchin Hackspace
● Ipswich Makerspace
● Norwich Hackspace

Startup Incubators and Accelerators
Incubators and accelerators typically focus on providing a facilities and knowledge platform for new ICT initiatives that allow access to infrastructure, investors, mentors and influencers. Examples across the East of England include:

● White Space, Norwich (http://whitespacenorwich.com/)
● The Enterprise Centre, Norwich (https://www.uea.ac.uk/adapt/the-enterprise-centre)
● Ideas Factory Incubation Centre (http://www.nua.ac.uk/ideasfactory/incubation-centre/)
● The Cambridge Network (https://www.cambridgenetwork.co.uk/home/)
● Qi3 Accelerator Cambridge (http://www.qi3.co.uk/accelerator/)

- University of Suffolk Business Incubator (https://www.uos.ac.uk/content/university-suffolk-business-incubator)
- InnovationNewAnglia, Norwich Research Park (http://www.innovationnewanglia.com)
- Ipswich Waterfront Innovation Centre (https://www.uos.ac.uk/content/ipswich-waterfront-innovation-centre)
- Enterprise Incubation Centre, University of Hertfordshire (http://www.herts.ac.uk/university-life/careers-and-recruitment/careers/enterprise/launch-your-idea/enterprise-incubation-centre)
- Innovation Martlesham Incubator Facility, Adastral Park (http://www.atadastral.co.uk)
- My Incubator, Potters Bar (http://www.wenta.co.uk)
- My Incubator, Stevenage (http://www.wenta.co.uk)
- Essex Innovation Program (http://essexinnovation.co.uk/)
- Business Incubation Centre Southend (https://www.essex.ac.uk/business/base/incubation/)
- Future Business Centre Peterborough (https://www.essex.ac.uk/business/base/incubation/)
- Peterborough Innovation Cluster (http://www.innovationcluster.ca/)
- Thurrock Business Support (https://www.thurrock.gov.uk/how-we-can-help-your-business/support-for-business)
- Hethel Engineering Centre (http://hethelcentre.com/)
- King's Lynn Innovation Centre (https://www.nwes.org.uk/workspace/spaces/kings-lynn-innovation-centre-klic/)
- St John's Innovation Centre, Cambridge (http://stjohns.co.uk/)
- Knowledge Gateway, Colchester (http://www.essex.ac.uk/business/knowledge-gateway/default.aspx)
- Ideas Factory, Norwich (http://www.nua.ac.uk/ideasfactory/incubation-centre/)
- Norwich Research Park Accelerator (http://www.norwichresearchpark.com/space/accelerator.aspx)
- Ideation Incubator, Saffron Walden (http://ideationincubator.com)

Meetup and Knowledge Exchange Communities
In addition to these there are many ICT meetup and knowledge exchange communities that are used for further education but also explicitly for networking, identifying available positions and potential employees, etc. Many of these interact beyond their direct locality, furthering the integration of the region. Among the most well-known of these are:

- Cambridge Wireless
- SyncNorwich
- SyncDevelopHer
- Norfolk Developers
- Hot Source
- SyncIpswich
- Cambridge Spark
- Software East Cambridge
- DevOps Cambridge
- BioCoders Cambridge
- Suffolk Developers
- PhP Essex

- SouthendTechMeet
- Essex Programmer Meetup
- Essex User Experience Meetup
- Agile Peterborough
- Digital people in Peterborough

In terms of business-university engagements, the Knowledge Transfer Partnership (KTP) scheme helps businesses to innovate and grow linking them with a university and a graduate to work on a specific project. From 2012 – 2016 InnovateUK allocated £2,944,418 for KTPs with universities in the region; the University of Essex has the largest number of KTPs in the region (source: Gateway to Research).

More generally, the Cambridge cluster embodies a wide range of national and international collaborations. Many national and international companies have research departments based in Cambridge and Cambridge Wireless Ltd in particular is a global community of 400 companies.

BT also has a wide range of national and international collaborations with approx. 40 university and 200 company research partnerships.

7. Case Studies

Additional case studies not included in the main report.

CASE STUDY – University of Hertfordshire

Advancing satellite communications for global suppliers and the BBC

The challenge: A surge in Internet video traffic is stretching broadband networks to breaking point. The satellite communications industry is searching for new, cost-effective ways to overcome capacity constraints and reach audiences in high-density areas without needing to resort to expensive unicast broadband delivery. However there is a recognised skills shortage in this field of research and development.

The opportunity: Stevenage-based Global Invacom (GIL) is one of seven companies worldwide involved in R&D, design and supply of satellite communications products to large-scale broadcasters. A KTP, funded by Innovate UK, gave GIL the opportunity to work with UH to develop new products. The collaboration generated more than £400k in grants and consultancy, and led to funding from the European Space Agency to explore the development of a Sat>IP Multicast WiFi Hotspot. This technology, which resulted in a patent application, enables satellite operators to increase the reach of its satellite and bypass congested broadband networks.

The impact: The technology has generated much interest from content providers, who see it as an opportunity to improve the end-user experience by offering live satellite TV channels to devices not usually within reach of broadcast content. The BBC has asked GIL and UH to support a series of trials for potential end customers. The broadcaster is planning a full public trial of the system at the Edinburgh Fringe Festival in August 2017. The estimated cost of follow-on development is £1.2M.

CASE STUDY - University of Hertfordshire

Partnering with BRE to create smart homes of the future

The challenge: There is a growing need to adapt our built environment to meet key challenges of the future: climate change, dwindling energy resources and ageing populations. Smart homes are seen as the solution to delivering energy efficient houses that have a low carbon footprint and can meet older people's needs. However, the integration of applications from different service providers to provide a single integrated system represents an extremely difficult software engineering challenge.

The opportunity: BRE supports innovation in the built environment sector. Its flagship Innovation Park in Watford features full-scale demonstration buildings and attracts 20,000 visitors each year. BRE recognised the opportunity to develop its fully integrated smart home on site. Through £500k in Innovate UK grants, it partnered with UH to access its expertise in developing new theories on smart local networks and localisation, smart meters and smart grids for renewable energy and storage.

The impact: BRE applied UH research to software deployed in their systems to create an integrated platform that linked devices across its smart home facility. It incorporated an 'electronic control ecosystem' to capture information from electricity generation, monitoring and consumption devices to optimise building performance. Companies around the region benefit from access to the demonstration technology. Collaboration between UH and BRE continues to strengthen. BRE is backing a new study programme in civil engineering at UH and sponsors a civil engineering professorship. UH is one of only a few BRE Trusted Partners in Connected Systems.