JustTech Comparator Study

FINAL REPORT

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1 Introduction

Study overview

1.1 ekosgen was commissioned by Scottish Enterprise in December 2017 to undertake a study to help drive the development of the University of Dundee's Forensic Science cluster. The Tay Cities Deal aims to invest in digital Forensic Science at the University of Dundee and the Leverhulme Research Centre for Forensic Science senior management team have prepared a Strategic Outline Case (SOC) for *JustTech*, the university's ambitions for a world-leading Forensic Science cluster, as part of this. ekosgen was commissioned to help the University move to the next stage by developing the thinking and evidence to help build the business case. This report presents the findings from the in-depth research and fieldwork conducted between December 2017 and March 2018. It sets out a compelling model for operation of and funding for the *JustTech* project based on this research.

An increasingly critical sector

1.2 Forensic Science makes a significant contribution to the detection and prevention of crime, including more recently, the investigation of crime in the digital domain. This area in particular encompasses both a dynamic discipline and a dynamic industry with opportunities for a steady flow of new technologies and innovations. Apart from innovations in the technology of crime detection, an important driver of change is that crime is changing – moving from traditional volume crime such as domestic burglary and theft from for example vehicles, towards an increase in crimes with a digital element for example phishing crimes, online fraud, and indecent imagery offences. As the nature of crime begins to move from the physical to the digital domain, this has led to an increase in a demand for digital forensic evidence and appropriate tools to for both preventative and investigative need. At the same time, there have been greater challenges presented to the more traditional types of forensic evidence such as trace evidence (fibres, glass, paint and other particulates) and comparative-based evidence (ballistics, handwriting, footwear, toolmarks, fingerprints and others). There are also challenges to existing technology-driven evidential tools, which have developed to such an extent that they are now difficult to easily interpret within a case context, such as rapid and sensitive DNA testing delivering complex DNA mixtures. The principles of detection, recognition, comparison, interpretation and evaluation and finally communication of any evidence type including digital forensic evidence remains, however, the same.

1.3 Forensic Science covers the application of a wide spectrum of the natural sciences and other disciplines utilised in the service of the legal courts to address specific challenges and questions within the context of an alleged crime. It is invaluable to the investigation of crime and to providing evidence for the criminal justice process. It also provides relatively high value and skilled employment opportunities and has an important economic development role to play.

1.4 Forensic Science is also being used within design concepts for new technologies to 'design out' crime by making detection more likely or criminal activity more difficult. Within more traditional areas of criminal justice, Forensic Science has also experienced growth within the global market, particularly in areas with an emerging criminal justice system.

1.5 As well as digital evidence, particularly within the preventative, security and management roles associated with digital data, other critical areas for the commercial growth of Forensic Science include the development of methods to verify the authenticity and provenance of goods. Examples include

testing the age and authenticity of Scotch whisky, the provenance of Loch Duart salmon, and the authenticity of goods such as Manuka honey and Egyptian cotton.

This study

1.6 The initial aim of the study was to further develop the thinking and evidence needed to build the business case for the University of Dundee's *JustTech* proposal for a significant investment in a forensic science industry cluster. Ultimately, the work has helped to prepare a robust business model for the *JustTech* Forensic Catapult Centre and Innovation Cluster Development activity based on examples of international best practice. This sets out a compelling justification for the resourcing of the *JustTech* project to realise its potential. It also sets out the basis for more detailed assessment work to be undertaken on the potential impact of the *JustTech* Forensic Catapult Centre and Innovation Cluster Development.

1.7 In doing so, we have prepared a number of alterative scenarios to illustrate what could be delivered, and achieved, dependent on the level of funding available from the Tay Cities Deal or other partners.

2 Forensic Science and the University of Dundee

Introduction

2.1 This chapter presents an overview of Forensic Science activity at the University of Dundee particularly focusing on its research, capacity and the JustTech proposal. The University of Dundee has a globally renowned reputation for Forensic Science research. It is home to the largest Forensic Science research group in the UK and in 2016 and 2018 the University of Dundee was ranked as the top university in the UK for Forensic Science. Reflecting this, Prof Nic Daeid and Prof Black made an application to the Leverhulme Trust under a competitive grant scheme and was one of four teams awarded £10 million of funding over 10 years to establish a centre for disruptive research. Through this award they opened the Leverhulme Research Centre for Forensic Science (LRCFS) at the University of Dundee in 2016.

The Forensic Science landscape

2.2 Forensic Science offers sustainable and extensive growth opportunities as it is building on an already existing strength in the region. The University of Dundee is a key global player in the subject and this has been further assured with the opening of the Leverhulme Research Centre for Forensic Science at the university in 2016. Globally there is a growing market, particularly in areas with emerging criminally justice systems and in new areas such as digital evidence, which have opened up new opportunities for the development of Forensic Science research and technology led tools. Other newer commercial areas have included the development of tools to verify the authenticity of goods such as Scotch whisky. Reflecting this, the global market for Forensic Science is projected to grow from $8 billion in 2012 to $18-20 billion by 2019.[1]

2.3 The second annual report of the Government Chief Scientific Adviser (GCSA), Sir Mark Walport, examined the applications of Forensic Science and the power and ability it has to deliver benefits to the Criminal Justice System and wider society. This landmark report highlighted that Forensic Science is a key potential growth sector for the UK. In particular it emphasises the broader use of Forensic Science, beyond the traditional courtroom setting. Important developments include the emergence of new technologies within analytical sciences such as genomic science and data sciences. Cybercrime is also a major emerging area of work within (and alongside) Forensic Science, with increasing demand for tools and technologies that can provide robust identity management and detect and prevent criminal activity, particularly within financial transactions such as bitcoin. The Walport report also highlights the growing role of Forensic Science in “designing out” digital crime by making detection more likely and assuring the authenticity and quality of goods. The key concluding point of the report highlights the need for innovation to move beyond the traditional settings and role of Forensic Science and capture emerging opportunities.[2]

2.4 The University of Dundee is in a particularly good position to exploit such opportunities, not just because of its academic prestige, but also its extensive links with the wider ecosystem through the Leverhulme Research Centre for Forensic Science and focus on the development of new tools that can widen and improve the application of Forensic Science into the criminal justice space and beyond.

[1] University of Dundee (2017) JustTech Strategic Outline Case

[2] Walport, M. / Government Office for Science (2015) *Forensic Science and Beyond: Authenticity, Provenance and Assurance. Annual Report of the Government Chief Scientific Adviser 2015*

Forensic science at the University of Dundee

Research and expertise

2.5 Dundee is a recognised national and international leader in the provision of education, research, innovation and leadership in Forensic practice. It is the only University in the UK to hold a Queen's Anniversary Award for Excellence for its contribution to Forensic Science research. The University of Dundee is highly ranked in university league tables for its excellence in Forensic Science research and teaching. For Forensic Science, the University was ranked first in the UK for 2019 by the Complete University Guide and sixth by the Guardian, and in 2018 the University of Dundee was ranked second in the UK by the Complete University Guide and eighth by the Guardian. In 2017 it was ranked top in the UK by both the Complete University and the Guardian.

2.6 The opening of the Leverhulme Research Centre for Forensic Science at the University of Dundee has cemented its place as a global leader in Forensic Science research.[3] The £10 million grant made to the University to open the centre is the largest ever single grant award made to Forensic Science in the UK. It aims to support the development of disruptive research and technologies that can make fundamental change within Forensic Science in order to address the present crisis within the sector. This crisis has arisen because of the largely stagnant development of new techniques and the lack of a diversification of technological development since the discovery of DNA finger printing in the 1980s. There is also a need to address questions around the quality of science underpinning techniques in order that Forensic Science can continue to be credible and admissible to the courts. Current projects include a study to develop DNA profiling of complex multi-donor samples in response to difficulties defending current analysis systems in court, research developing the use of virtual reality in Forensic Science and the development of novel nanotechnological detectors for drugs, explosives and body fluids.[4]

2.7 Forensic Science research is carried out through LRCFS and key areas for current research include:

- Transfer and persistence of material;
- Development of databases for background persistence of materials;
- Cognitive bias in forensic science;
- Novel DNA detection methods;
- Deconvoluting complex DNA mixtures;
- Development of data visualisation tools for forensic science data;
- The use of virtual and augmented reality in crime scene investigation;
- Review of statistical approaches to forensic science;
- Evaluation of the legal value of experts and expertise;
- Detection of drugs and explosives; and
- Chemical profiling of illicit drugs.

[3] https://www.dundee.ac.uk/leverhulme/

[4] Ibid.

Capacity

2.8 With the opening of the Leverhulme Research Centre for Forensic Science in 2016, the University of Dundee now has one of the largest Forensic Science research groups in the UK and is amongst the largest in Europe. As at 2018, there are 13 full time staff and 10 PhD students, from a range of disciplines who deliver a wide variety of research. In total there have been 15 Forensic Science text books, 55 chapters in leading texts and 360 peer-reviewed articles produced by Forensic Scientists at Dundee. In addition to £10 million funding from Leverhulme, Forensic Science at Dundee has received over £8.5 million in funding from other sources.

2.9 As well as traditional academic research, Forensic Scientists at the University of Dundee take part in casework, amounting to over 75 major forensic operations across the last15 years and over 500 police enquiries annually. Forensic Scientists at Dundee also collaborate with all parts of the Forensic Science ecosystem, including industry, law enforcement and the legal profession. This collaboration has been enhanced through the establishment of the Leverhulme Research Centre for Forensic Science, which has been endorsed as the principal research relationship by the Lord Chief Justice of England and Wales in his Annual Report of 2016.[5] This has put the LRCFS in a unique position with regard to its relationship with the judiciary and ability to shape future markets by determining the court admissibility of new evidence types and techniques. Projects delivered through the LRCFS also include industry and academic collaborators, for example a project exploring the use of virtual reality in Forensic Science involves Leonardo and UT Sydney as partners.

The *JustTech* proposal

Proposal overview

2.10 The *JustTech* proposal looks to build on the University's existing strength and reputation in Forensic Science to create sustainable economic growth within the Tay Cities region through high value jobs that can increase graduate retention and contribute to economic development. The proposed project submitted by the University of Dundee has a total cost of £62.3 million, with an ask of £43 million from the Tay Cities Deal. It is proposed that a further £19.3 million will be provided by the University of Dundee. Over ten years it is estimated that the project could deliver 500 jobs and would be key in developing the Tay City Region's knowledge economy and delivering high value jobs and improved graduate retention, along with talent attraction and new business development.

Phasing activity

2.11 The proposal is based around the following three phases:

- **Phase 1: *JustTech* – The Forensic Science Catapult Centre**: A Forensic Science Catapult Centre will be established at the University of Dundee to build on the Leverhulme Research Centre for Forensic Science. It would be based on the Innovate UK Catapult Centre model and Scottish Funding Council (SFC) funded Innovation Centres. Both Catapult Centres and Innovation Centres bring together industry and academia within a particular sector in order to address market failures, advance innovation and tackle major challenges within an industry. This approach, applied to Forensic Science in Dundee would allow for a step-change in collaboration and innovation between academia and industry, leading to economic growth through the commercialisation of academic research and supporting routes to market for new products, services and ways of working.

[5] University of Dundee (2017) *JustTech Strategic Outline Case*

- **Phase 2: Innovation Cluster Development**: Phase 2 will run concurrently with Phase 1. Funds are sought to build a tech cluster around the Leverhulme Research Centre for Forensic Science at the University of Dundee and the Centre for Cybersecurity at Abertay University. The focus will be on the commercialisation of research and technologies and establishing spin-outs as well as working collaboratively with SMEs and start-ups and providing incubation space. This programme of work will be facilitated by the *JustTech* Forensic Science Catapult Centre.
- **Phase 3: Innovation Communication and Economy**: The third phase will build on the culture of innovation flowing from Phases 1 and 2. It will seek to scale up this work by establishing a new-build facility on the University of Dundee campus. The facility will host LRCFS and JustTech and provide a physical base for the wider industrial engagement activity established in Phases 1 and 2. It will also provide a base for wider entrepreneurial activities and facilities for staff and students. The facility will be a key flagship centre as it will provide a focal point for Forensic Science, which, with JustTech's focus on innovation and new technologies, can prove inspirational. As a hub of new research and innovation, the centre will also help to attract students to the University of Dundee, which is vital to provide the necessary pipeline of talent to drive research and innovation in Forensic Science.

Disrupting Forensic Science techniques

2.12 As identified above, there is increasing acceptance that the usefulness and accepted wisdom of existing forensic science techniques should be challenged. It is widely acknowledged that a crisis has developed within the forensic science domain. In 2009 the US National Academy of Science released a report outlining the difficulties emerging within Forensic Science as much of the underpinning scientific work is badly defined and poorly researched.[6] Difficulties have also emerged due to a lack of focus on tools and techniques other than DNA technologies. This has led to a situation where a fundamental paradigm shift is needed, to develop new techniques for emerging areas such as digital evidence, digital resilience and management of digital security so as to improve the robustness and credibility of current tools to ensure admissibility of evidence in court.[7]

2.13 Following the 2009 report, then USA president, Barack Obama, posed questions to his President's Council of Advisors on Science and Technology (PCAST), regarding the steps that could be taken to ensure the validity of forensic evidence. In responding to the questions PCAST developed a study and report focused on closing two important gaps:

- The need for clarity about the scientific standards for the validity and reliability of forensic methods
- The need to evaluate specific forensic methods to determine whether they have been scientifically established to be valid and reliable

2.14 The report was published in 2016 and made a number of recommendations for actions that could be taken to improve Forensic Science and its validity. These recommendations included the establishment of regular evaluations of the scientific validity of Forensic techniques and the need for transformation within three major areas: DNA analysis of complex mixtures, latent-fingerprint analysis, and firearms analysis in order that analysis can become more objective and less subjective.[8]

[6] https://www.ncjrs.gov/pdffiles1/nij/grants/228091.pdf

[7] University of Dundee (2017) *JustTech Strategic Outline Case*

[8] https://obamawhitehouse.archives.gov/blog/2016/09/20/pcast-releases-report-forensic-science-criminal-courts

2.15 Evidence through consultations, suggests that Forensic Science needs to create new processes, products and tests, including software development. Firstly there is a need to develop more robust and credible tools and techniques in order that Forensic Science evidence can provide robust and scientific assistance to the courts. Further, as noted above, there is a pressing need to develop tools and techniques that can be used to address the challenges presented by the volume and varied nature of digital evidence which is becoming increasingly prevalent in the investigation of all crime.

2.16 Academic rigour will be key to developing tools and technologies that stand up to scrutiny and ensure the credibility required for criminal investigations and court admissibility. In doing so, this can lead a step change in Forensic Science through opening up the potential of the discipline to move into new areas, develop the range and quality of tools and techniques and, in doing so, create new commercial opportunities for industry.

Emerging opportunities

2.17 *JustTech* is in an ideal position to exploit a number of opportunities. The project is particularly well placed as it is building on existing strengths at the University of Dundee within Forensic Science. In particular, the Leverhulme Research Centre for Forensic Science has been established at the university with the specific aim of developing disruptive research and technologies to lead a step change in the domain. *JustTech* is thus well placed to take this academic research forward to be further developed with industry in the commercial sphere. The University of Dundee has also developed two judicial primers around disruptive technologies, dealing specifically with DNA techniques and gait analysis, meaning that *JustTech* is ideally positioned to further develop the university's role of bringing emerging technologies into the judicial sphere.

2.18 It is widely documented that there is a need to make existing technologies more robust as a number of techniques are not sufficiently credible to be admissible in court. With DNA, it is possible to extract DNA from samples recovered from individuals or crime scenes but often difficult to prove association, transfer of persistence. Other areas of forensic evidence which require fundamental scientific concepts to be researched and articulated include ballistics and tool marks, fingerprint comparison and the investigation of new and emerging drug compounds.

2.19 There are also possibilities to repurpose existing technologies into tools that can be used within the criminal investigative process. For example, technology developed for food packaging to measure if the contents degrade could have a similar application on packaging materials used for forensic biological evidence. Our increasing use of digital technologies also means there are major opportunities for Forensic Science in further developing tools and techniques that can turn digital evidence collected during investigations into reliable and credible evidence that can be used in court.

2.20 Crimes involving elements of digital evidence are a major potential breakthrough area for Forensic Science. As noted above, digital technologies can be used by Forensic Scientists to trace and locate potential suspects, but they have also opened up possibilities of a whole new sphere of crime, operating across international borders. Almost all crime now has a digital evidence element and this is a challenging and growing arena where it is vital that Forensic Science tools and techniques are developed that can be effectively used to underpin the use of digital evidence within the Criminal Justice process.[9]

2.21 Another key area, within which the University of Dundee is already working, is the standardisation of algorithms to unmix DNA samples. This is important as the entrance of fast and

[9] Walport, M. (2015) *Forensic Science and Beyond: Authenticity, Provenance and Assurance*

sensitive technologies for the development of DNA profiles into the market has meant the emergence of complex DNA profiles with multiple contributors. To address this problem, there is a need to develop algorithms which can un-mix such complex samples of DNA and minimise variations and errors. Dundee is currently looking to develop an open data base and algorithm using a ground truth database.

2.22 The University of Dundee has also established a pathway for the fast response and rapid development of scientific knowledge relating to new and emerging psychoactive substances. It holds National leadership roles and capabilities relating to knowledge creation and policy development within this area and can scale operations in partnership with industry to create both skills training pipelines and scope for new technological development.

Fit with Tay Cities Deal objectives

2.23 Through *JustTech*, Dundee aims to exploit its global reputation for excellence in Forensic Science. In doing so, it will make a significant contribution to the realisation of Tay Cities Deal objectives. The ambition of the Tay Cities Deal[10] is to tackle the challenges the region faces around innovation, internationalisation and connectivity, through an inclusive growth approach. It has specific objectives of driving productivity, closing the jobs gap, reducing unemployment, and focusing on sectoral strengths and opportunities. Through its *Innovative Tay* priority, the Tay Cities Deal aims to ensure smarter, more competitive growth by investing in science, research and innovation, and increasing the commercialisation of the region's science base to develop new technologies.

2.24 JustTech contributes to these objectives by:

- Working to maximise research commercialisation in one of Scotland's growth sectors;
- Supporting SME start-up and growth around an existing centre of excellence;
- Explicitly focusing on a key sectoral strength and opportunity for the region that presents a considerable opportunity for growth, to position Dundee as a global leader; and
- Capitalising on and enhancing the role that the region's universities and colleges play in supporting economic growth. Part of this is building on the University of Dundee's accolade as Scottish University of the Year in both 2016 and 2017.

Synergies with the *cyberQuarter* project

2.25 The *JustTech* project has synergies with the *cyberQuarter* project being developed by the University of Abertay. The *cyberQuarter* project will catalyse the formation of a cluster of Cybersecurity companies in the Tay Cities Region focused around Abertay University, and establish the Region as the location for the cybersecurity sector in Scotland.

2.26 There are clear commonalities and areas of common focus across the two projects, e.g. digital forensics. This offers considerable scope for both projects to maximise the benefit of complementarity between the two – for JustTech to examine and potentially translate the 'Ethical Hacking' approaches central to the *cyberQuarter* project for use in the field of Forensic Science, but also for the *cyberQuarter* project to draw on the Forensic Science of Dundee and the *JustTech* project to build a comprehensive, Scottish Cybersecurity offer as part of wider project activity.

[10] Tay Cities Region (2017) The Tay Cities Deal: Working towards a smarter and fairer Angus, Dundee, Perth & Kinross and North East Fife

Summary

- There is a growing market for Forensic Science. Globally it is projected that the sector will grow to approximately $18-20 billion by 2019.
- The University of Dundee is a recognised leader within Forensic Science. This has been cemented by the establishment of the Leverhulme Research Centre for Forensic Science (LRCFS) at the university in 2016.
- The focus of the LRCFS and, more widely, Forensic Science at the University of Dundee is on the development of disruptive technologies that can radically alter the discipline.
- The University of Dundee has one of the largest Forensic Science research groups in the UK and is amongst the largest in Europe.
- The *JustTech* proposal is looking to build on the existing strength in Forensic Science at the University of Dundee in order to deliver sustainable economic growth in the Tay Cities region.
- The JustTech Project is also responding to wider issues in the sector as it is widely recognised that there is a developing crisis as certain tools and techniques lack the credibility and robustness to be admissible in court. There is also a need to develop tools and techniques that can respond to the increasing presence of digital evidence.

3 UK and international comparator models

Introduction

3.1 This chapter sets out the findings of the comparator study for the *JustTech* Centre. It examines key areas of learning for the development of the *JustTech* proposition, and specifically the model to be proposed in a more fully developed business case. It draws on learning from eight comparator centres across the UK and elsewhere in the world. These eight centres are summarised in Table 3.1. Full details on each of the eight are presented in Appendices 2 and 3, along with the process for selecting each for consideration in detail.

Table 3.1: Shortlisted comparators reviewed in detail

Comparator	Rationale
UT Sydney, Australia	UT Sydney has leading expertise in Forensic Science. It is a collaborative partner for Dundee. It takes a triple-helix approach to research, and its focus on applied research with real-world uses is core to the centre's purpose. Its links with law enforcement agencies and commercial enterprises can offer lessons for cluster development around the centre.
University of Lausanne, Switzerland	Lausanne is arguably one of the leading European Forensic Science research institutes. Its wide range of activity offers insight into how Dundee can maximise the impact of its research expertise, and work collaboratively to take its output to market. Its existing links with Dundee (as well as UT Sydney) also offer additional channels of learning.
Offshore Renewable Energy Catapult, Glasgow/Blyth/Levenmouth	The ORE Catapult represents a good example of a Catapult-type centre designed to accelerate the development of renewable energy technology. In particular, the *JustTech* Project can potentially learn from the scale of collaborations, and the return on investment that these are realising, as well as how its test facilities are shared with industry, and also how services are provided to commercial organisations.
Centre for Secure Information Technologies, Queens University Belfast	CSIT has a strong commercial and industry focus, with an explicit commercial lead for enterprise and innovation, alongside academic leadership. Its presence at Northern Ireland Science Park aims to provide industry-relevant experience. It is also focused on a dedicated building on which to centre the cluster and its activity. Some notable spin-outs and spin-ins present in the cluster.
Oil and Gas Technology Centre, Aberdeen	The Oil and Gas Technology Centre is an important example of an innovation centre established through City Deal funding. Due to its being part of a City Deal it is a particularly relevant example and important learning can be derived from how the centre has delivered its activity through an innovation hub, working with universities and to support SMEs and collaborative projects.
Bayes Centre, University of Edinburgh	The Bayes Centre is a key example of a university based, City Deal funded innovation hub. In its work to develop data-driven innovation within and beyond the University of Edinburgh, it offers important learning on business models for university based, City Deal funded innovation centres. The opening of a new building in 2018 will also offer key insight into the importance of the built environment for innovation centres.
CENSIS, Glasgow	CENSIS is a key innovation centre that is working to drive innovation within the related fields of sensors and detectors. The work of CENSIS to provide resource and expertise to allow companies to develop and innovate will offer important learning on delivery models for how best to assist industry.

Comparator	Rationale
Digital Catapult	The Digital Catapult is another relevant example of a Catapult centre, working with industry and research to bridge gaps and foster innovation. Its focus across four centres on specific regional development, tapping into existing strengths, offers particularly relevant learning for how *JustTech* can contribute to the Tay Cities region.

Innovation and Forensic Science centres in the UK and worldwide

Positioning the *JustTech* centre

3.2 Through the *JustTech* project, the University of Dundee aims to establish a 'Catapult'-type Centre to stimulate research and innovation in Forensic Science. Through the project, it is intended that the following is achieved:

- Translation and commercialisation of resulting IP to exploit and develop through industry-oriented innovation
- Development of new Forensic techniques and approaches, as well as support technologies/tools, through the centre's research activity
- A state-of-the-art physical centre for research and innovation in Forensic Science through which to anchor the *JustTech* centre in Dundee, and act as a focal point for the cluster's activity

3.3 It is worth noting that the *JustTech* Centre is not formally considered as a Catapult Centre in the existing sense. There are notable differences between the *JustTech* concept and current Catapult Centres across the UK. Catapult Centres were established by the UK Government to explicitly target market failure and address major societal challenges. Not all were set up to operate as a single physical centre, with a number operating according to a dispersed model. For example, the Offshore Renewable Energy Catapult has headquarters in Glasgow, as well as operations in Levenmouth, Fife and Blyth, Northumberland. However, catapult centres represent the closest fit in terms of the intent of the project, and what is anticipated to be delivered through the research.

3.4 By comparison, *JustTech* aims to challenge accepted standards, approaches, etc. with regard to Forensic Science. In doing so, it will address shortcomings in scientific approaches, and develop a geographically-focused innovation cluster to help achieve this. The *JustTech* project is about market creation rather than simply market failure. The University of Dundee's judicial primers set out the 'landscape' of the market for disruptive technologies, and effectively position Dundee as market leaders. As such, *JustTech* is the value proposition. There are of course information failures that will also be addressed through *JustTech*. In essence, organisations have a lack of awareness of shortcomings in existing conventional forensic techniques, e.g. the continued focus on DNA, or the limitations in ballistics or fingerprint techniques. The development of disruptive techniques – and the translation of existing methods available in other fields, such as DNA ancestry, to forensic science – will overcome these failures.

3.5 In comparison to Scottish Innovation Centres, there is some similarity in terms of proposed activity. Innovation Centres have been established to implement innovative new approaches and technology in real-world, commercial settings, and to develop the partnerships to achieve this. Nevertheless, they have been established in response to market failures evident in key sectors in the Scottish economy. Some are not intended to become commercially viable beyond their 10-year lifetime,

such as the Oil & Gas Technology Centre (though it's subsidiary technology accelerators have been established with a view to becoming full commercial entities). Not all Innovation Centres own or occupy their own premises, e.g. CENSIS occupy premises at the Scottish Enterprise-funded Inovo Building.[11]

3.6 It is also important to recognise that research and innovation are two very different processes. At its simplest, research is concerned with establishing new ideas and concepts, often relying on funding to do so. In other words, **turning money into ideas**. Innovation is effectively the reverse of this – validating concepts and intellectual property to prove innovative technology and approaches to generate income, i.e. **turning ideas into money**. In this sense, the *JustTech* Project aims to undertake both of these activities, in contrast to Catapult and Innovation Centres, which focus on the latter. It also aims to exploit a commercial advantage by repurposing existing techniques for new markets, as identified above. Anecdotal evidence suggests that there is considerable interest from companies in entering the forensic science field, and *JustTech* offers such an opportunity.

3.7 The University of Dundee's reputation, as outlined in Chapter 2, is one of global standing. It has well-established international linkages with law enforcement agencies and Forensic Science organisations, collaborative partnerships with universities such as Lausanne and UT Sydney, and also has cross-sector industry links throughout Scotland and the rest of the UK. This means that its potential reach, influence and ability to develop innovative partnerships put it in a strong position. This existing and mature global network offers current and future benefits in the development of the *JustTech* Project. As well as an extensive knowledge exchange network to offer prospective industry partners, there is potential to develop a network or ecosystem of Forensic Science clusters in the longer-term future as and when others develop.

Comparator centres for Forensic Science in the UK

3.8 There is some comparable activity at a UK level at some institutes elsewhere in the UK. For example, King's College London's Forensic Science Programme has strategic partnership with the Metropolitan Police Forensic Services Directorate, as well as commercial research partners. It aims to deliver research that, through collaboration with industry and law enforcement, has effective real-world applications. Cranfield University has particular expertise within ballistics, explosives, materials science, engineering failures and forensic computing, and provides expertise to the archaeological as well as Forensic communities. It offers unique research facilities within the UK, hosting a laboratory that features forensic contamination and audit control capabilities.

3.9 The University of Portsmouth already offers a Forensic Innovation Centre. This was developed in partnership with Hampshire Constabulary, and allows students and academics to work alongside police forensic scientists. Its focus is very much on Forensic Science research, practice and police work. However, the centre is both a research and teaching facility, in contrast to the *JustTech* proposition. Further, it arguably delivers its activity in the fields that the University of Dundee aims to disrupt through the *JustTech* centre.

Exploiting opportunities through *JustTech*

3.10 In many senses, what Dundee is proposing is unique. No Catapult- or Innovation-type Centre currently exists for Forensic Science. Evidence also suggests that no other centre or institute occupies the same research space as the University of Dundee currently. It has already identified disruptive opportunities through the development of two judicial primers, dealing with DNA techniques and gait analysis. These have demonstrated economic opportunities that the *JustTech* Project can capitalise upon. The proposition for Dundee through *JustTech* is to disrupt the industry, demonstrate the scientific

[11] This was previously owned by Scottish Enterprise, but sold in early 2018

validity *and* commercial viability of new techniques, and support the deployment of innovation across judicial functions and industries that rely on Forensic Science to underpin their effective operation.

Learning from comparator centres in the UK and worldwide

3.11 There is arguably more to be learned from Forensic Science centres worldwide, and Catapult and Innovation centres for other sectors, in terms of type of model or approach to adopt to best suit the needs and intended activities of the *JustTech* Project. Below we set out the key areas of learning that can be applied to the development of the model for *JustTech*.

Forensic comparators

3.12 The two key international comparators in the field of Forensic Science are long-term collaborators with the University of Dundee. The University of Lausanne's School of Forensic Science aims to develop Forensic Science through teaching, research and collaboration across academia. A key component of Lausanne's delivery is its commercial consultancy activity. It provides expert services to Swiss and international law enforcement, contributes to training of judicial bodies and participates in pilot projects, e.g. dealing with forensic dating and time issues. In particular, its consultancy service focuses on assessing the reliability of evidence within court settings.

3.13 In Australia, UT Sydney's Centre for Forensic Science is a site for collaborative innovation between researchers, law enforcement and industry. It has an applied research focus, with activity targeted at developing practical solutions to issues in the judiciary process. Like Lausanne, it offers consultancy services to both industry and law enforcement.

3.14 While Dundee already provides expertise to law enforcement and judiciary bodies, the consultancy offer is something that *JustTech* can learn from in terms of commercialising outputs from research into new techniques and the validity of existing ones. Given the focus on the reliability and robustness of evidence, this is particularly the case with Lausanne. Formalising a consultancy service also offers a potential future revenue stream to fund the *JustTech* Centre's activity.

Cross-sector comparators

3.15 Queen's University Belfast's Centre for Secure Information Technologies (CSIT) is arguably the strongest Cyber Security cluster in the UK, and considered to be at the vanguard of research and innovation in Cyber Security. Located in the Northern Ireland Science Park (now Catalyst inc), which is part of the waterfront Titanic Quarter regeneration project in Belfast, it was deliberately moved from the main university campus with a view to driving a much higher level of commercialisation activity, translating research and fostering a high degree of collaboration between academia and industry. In this regard, it is an Innovation and Knowledge Centre (IKC), funded by EPSRC and Innovate UK between March 2009 and March 2020 to foster innovation and entrepreneurship.[12] It has also benefited from the support of Invest NI over a five-year period. To achieve its commercialisation and innovation objectives, CSIT has three core teams across research, engineering and research development. It is led by a commercially focused director, with support from a lead academic investigator. Its set up has allowed it to become a world-leading destination for innovative and collaborative research.

3.16 The Oil and Gas Technology Centre (OGTC) was established in late 2016 with £180 million funding as part of the Aberdeen City Region Deal. It is perhaps unique in that it operates a hub-and-spoke approach, with the OGTC acting as a co-ordinating centre activity across a number of solution centres that look at specific technical challenges. The OGTC is also developing a number of Centres

[12] https://www.epsrc.ac.uk/innovation/business/opportunities/impactschemes/ikcs/

of Excellence, aligned to its solution centres, the first focusing on decommissioning in partnership with the University of Aberdeen and Robert Gordon University. Alongside this, the OGTC operates an Innovation Hub, a state-of-the-art facility for collaboration to drive innovation and accelerate new technologies, as well as delivering a programme of innovation events and workshops for industry and education.[13] The OGTC has also recently launched TechX[14], a technology accelerator and incubator for start-ups and SMEs. It also offers access to business mentoring and partnering, co-working space, rapid prototyping and test facilities, as well as the Pioneer funding programme. This provides up to £100,000 in grant funding to start-ups with new technology ideas.

3.17 The Offshore Renewable Energy (ORE) Catapult[15] is one of ten Catapult Centres in the UK, with operations in Northumberland as well as in Scotland. It fulfils a key role in providing the facilities and expertise necessary to demonstrate the technological validity and capability of marine energy devices and components before commercial deployment. Marine energy, and wave and tidal in particular, suffer from a significant market failure, and despite the success of centres such as the European Marine Energy Centre (EMEC) in Orkney, and the abundant natural wave and tidal resource around Scotland and the UK's coastline, investors are still reluctant to invest in such technology. By testing and validating technology, monitoring operational performance of devices, and supporting disruptive innovation, the ORE aims to overcome this barrier to the development of the offshore renewable sector.

3.18 The Digital Catapult is another of the UK's ten Catapult Centres. It is focused on developing the application of digital research as technological tools to drive economic growth. In this sense, its focus is across the economy, rather than within Digital Technology itself. In line with the approach taken by Catapult centres, it focuses on market failure to drive challenge-led innovation, facilitating collaborative partnerships between academia and industry. However, unlike most Catapult centres, it has five bases across England and Northern Ireland.

3.19 Similar to the Digital Catapult, the University of Edinburgh's Bayes Centre[16] will drive data-driven innovation. Like the proposition for the *JustTech* Centre, it will use academic-industry collaborations to develop and apply new technologies as solution to key challenges, thus driving economic growth and talent attraction. Currently under construction, the Bayes Centre will be based in a new purpose-built facility on the university campus, and draw its expertise from the School of Informatics. However, much of the Centre's activity appears to be linked to the opening of the building. It is arguable that this is a barrier to raising awareness of the Centre's existence and activity, particularly more widely in industry.

3.20 CENSIS is the Scottish Innovation Centre for Sensor and Imaging Systems technologies. Based at the Inovo Building, it has been initially funded with £10 million from SFC over a five year period. It is one of only two Innovation Centres (Datalab being the other) not focused on a vertical industrial problem. Its mission is to identify sensor technology that can be matured and accelerated to develop solutions in all parts of the economy, e.g. in Oil & Gas, or in Aquaculture. In doing so it helps companies to commercialise technologies through collaborative R&D projects. A re-focusing of its activity from 2016 has helped to ramp up CENSIS's activity. Central to this was a greater effort to attract industry collaborators, and actively targeting a select number of technological applications.

3.21 The following sections consider some specific points of learning for the *JustTech* proposal.

[13] http://www.theogtc.com/

[14] http://www.theogtc.com/techx-accelerating-innovation/

[15] https://ore.catapult.org.uk/

[16] https://www.ed.ac.uk/bayes

Delivery models

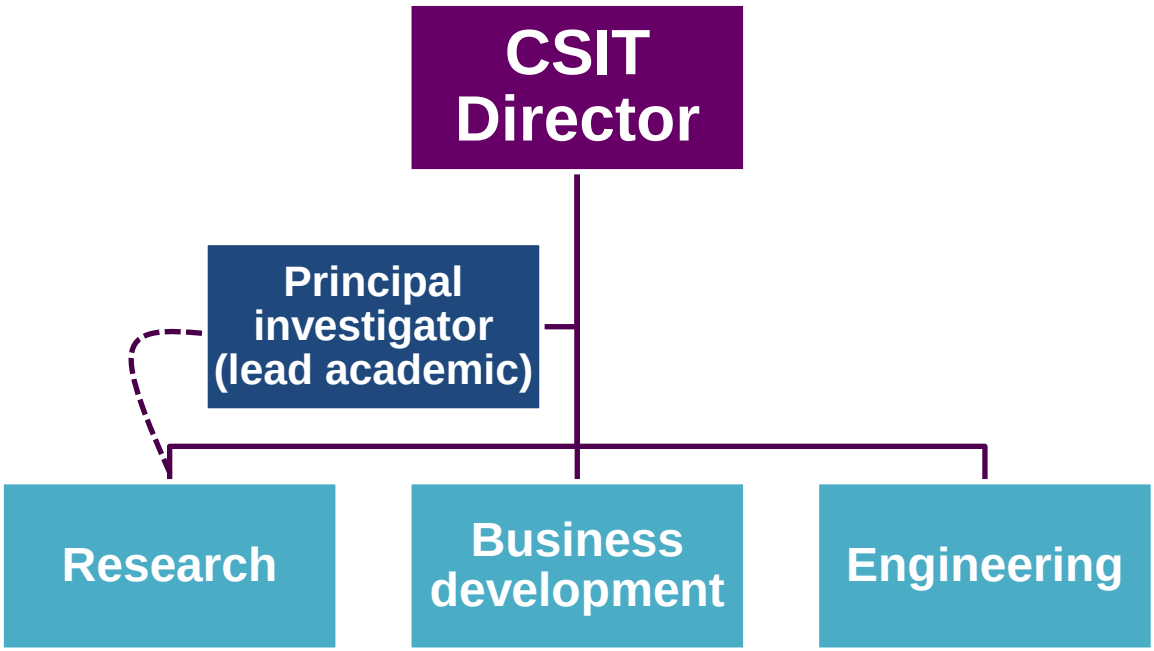
3.22 There are clear commonalities across each of the comparators in terms of the delivery models. All have a dedicated physical hub or centre as the focal point for their activity, and have strong links with universities. In the case of CSIT, this sits within a wider science park. In contrast, the Bayes Centre will occupy space within the University of Edinburgh campus.

3.23 A notable feature of several comparators is the clear distinction between operational teams, and thus activity. For example, the OGTC has functions that cover Innovation Networks, External Relationships, and the Technology Accelerator, as well as teams for each of its technology solution centres.

3.24 CENSIS has a small team of around 19 FTEs, with a small administrative team supporting two teams: engineering and business development. The business development team members are often trained engineers, and add value to CENSIS's activity, helping to shape projects, develop bids, etc. Similarly, CSIT has around 90 staff working in dedicated teams across Cyber Security research, business development and engineering – the latter dealing with innovation and deployment of technology, working directly with industry to achieve this.

3.25 The leadership at many of the centres is commercially focused. In both CSIT and CENSIS in particular, this is a deliberate approach to ensure that the strategic direction of the centres remains commercially focused; it also ensures that the academic staff are able to focus on research. In the case of CSIT, the centre's director is supported by a lead academic investigator to oversee the research, and act as conduit between this and the commercial areas of the centre.

Figure 3.1: Broad structure of CSIT's delivery team



3.26 Adopting a similar approach within *JustTech* will bring benefits to the project. It would allow the academic researchers within the centre to continue Dundee's world-leading research in Forensic Science, without having to divert resources to operational delivery and management of the Project. It allows for clear separation of two related but very different functions, namely research and innovation, as discussed above. Also, it enables the centre to have oversight of the innovation pathway from

research through to market-ready testing. This is discussed below with regard to Technology Readiness Levels.

3.27 With regard to governance, two separate models are being deployed effectively across the comparators under consideration:

- A separate legal entity, led by industry, with its own board of directors, e.g. the OGTC, and the Catapult Centres; and
- A distinct unit or centre within a university, with a degree of autonomy or agility through delegated authority to its own board and director, but ultimately reporting to university boards and corporate leadership teams, and operating within university processes, e.g. for procurement, financial reporting, etc.

3.28 Though the former offers flexibility in terms of the speed of decision-making and responsiveness to market demands/challenges, it is possible that adopting such an approach would diminish the reputation and prestige that Dundee has won, even if the same staff are involved. Though establishment as an entity within the university structure may limit the Project's flexibility to respond to opportunities and challenges, existing staff would be easily transferred to the new structure, and the 'branding' of the university would continue to benefit the new centre. There would also be access to existing university funding streams and resources, e.g. administrative support, estates, HR, etc. Consultees considered that this was the better option for *JustTech*. Additionally, the former option would bring complexity to the existing funding for *JustTech*, e.g. the ability to use/access the Leverhulme Trust grant as match funding.

Clustering

3.29 Across the comparators under consideration, there are some very good examples of clustering and collaboration. In terms of clustering, the presence of a physical centre is an important element of clustering activity.

3.30 A physical centre in the shape of a building or campus provides a focal point for research and innovation activity, but also raises the profile of each of the centres. It also enables the co-location of academia and business through the provision of incubation space, business units and shared research and enterprise facilities. This helps to create a physical and cultural environment that fosters partnerships, and leads to collaborations. The opportunities presented as a result can be considered a key 'attractor' to businesses locating on or near the site. Nevertheless, a new facility does not guarantee this, and just as important is the activity and profile of the Centre itself.

3.31 Clustering activity at CSIT has been driven by its status as an ESPRC-funded Innovation and Knowledge Centre (IKC). Through this designation, CSIT has access to funding to support entrepreneurial activity between researchers and business, and drive commercialisation of technology. This has been underpinned by CSIT's location at the Northern Ireland Science Park. This has allowed appropriate space for collaboration within CSIT itself in the form of incubation and laboratory space, as well as space to establish spin-outs for SMEs, attract inward investment, and develop an ecosystem around the CSIT building itself. Further, the approach taken by CSIT's teams – with a separation of functions across research, engineering and commercial/business development activity – has allowed the development of a unique form of the triple-helix ecosystem. However, this has developed over a relatively long period of time. CSIT consider that the cluster has taken seven years to establish, but there is now a strong Cyber Security cluster that has developed around CSIT.

3.32 As noted above, the OGTC's approach to clustering takes a slightly different form, in that it is fostering clusters around solution centres, as well as its central Innovation Hub. Though the OGTC has a physical presence – which will be bolstered by the development of centres of excellence – this clustering and collaborative activity can be considered more conceptual. Nevertheless, OGTC offers incubation space and access to shared facilities. The OGTC's TechX centre and Innovation Hub are central to this offer. Access to such facilities is critical to better integrating organisations within centres. It is arguable, however, that the OGTC's efforts in terms of clustering have been greatly helped by the existing concentration of Oil and Gas businesses and operations in Aberdeen and Aberdeenshire. Nevertheless, the approach used by the OGTC is innovative in itself.

Collaboration

3.33 There is a common thread to collaboration across all comparators under consideration: to address industrial or societal challenges through a collaborative approach to research and innovation. Centres either directly partner with industry where they are established in academic settings, or they facilitate academic industry partnerships to enable applied research and project development to drive innovation. All have a clear focus on a number of challenges, rather than a broad brush approach to sectors or technologies. This is a key point of learning for *JustTech* – targeting activity to realise maximum benefit from activity.

3.34 Funding programmes are a key component of activity to drive collaboration. This is central to the operation of Catapult Centres, but also across Innovation Centres and other comparators. For example, CENSIS has so far disseminated £1.2 million of funding to collaborative projects, which has generated £17 million of project activity to the end of Q2 2017/18. CSIT make use of funding to support Knowledge Transfer Partnerships.

3.35 This activity is also supported by an outreach programme, consisting of a series of innovation events and workshops that are driven by the needs and priorities of the industry. CENSIS offers a similar outreach programme, designed to create opportunities to bring together key strategic supply chain actors, SMEs and researchers. This ranges from a programme of small, focused workshops dealing with specific technological problems, to its large annual conference.

3.36 An additional strand of activity that supports collaboration is the use of membership schemes through which companies commit to inform research and take developed technology to market. Both CSIT and the OGTC operate membership schemes, with varying levels of membership fees depending on business size, and level of involvement. In return, members are able to tap into extensive research expertise, facilities, business support services, etc., as well as influence the direction of research and innovation within the centres. OGTC's approach to membership also allows member companies to offset their fees and pay in kind by providing expertise, equipment or assets during each financial year.

Commercialisation

3.37 There are two aspects to consider in terms of commercialisation. First is the commercialisation of services, and specifically consultancy. This is something that both UT Sydney and the University of Lausanne do with regard to providing professional expertise to industry and judiciary partners and clients. CENSIS also offer a consultancy service for Innovation Centre partners and industry organisations who require bespoke solutions to technical problems. They also broker broader access to academic partners and skills, recognising that not every project needs access to the latest academic research.

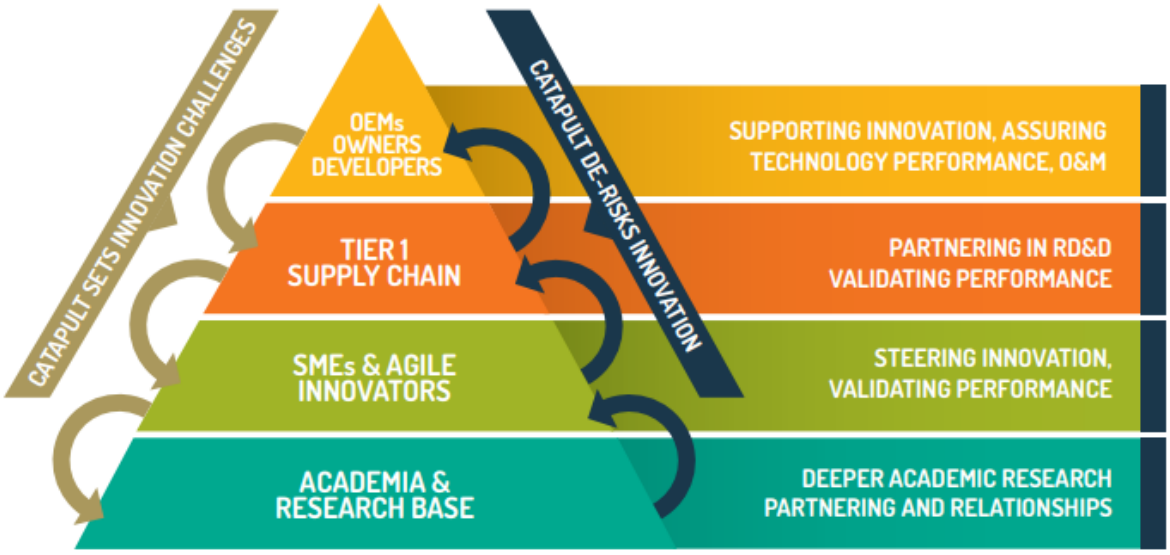
3.38 Dundee is also already providing expertise on a consultancy basis. However, as noted above, formalising this approach is something that Dundee could benefit from. This would especially benefit

efforts to tap into new markets. By exploiting existing relationships and using these to foster new contacts and partnerships, Dundee would be able to cross-sell services to break into emerging markets, e.g. markets where there is now an increasing reliance on Forensic evidence, in contrast to the past where there may not have been.

3.39 The second consideration is actively translating research into commercial products and services. The nature of collaboration across the centres under consideration means that the research undertaken is applied, and ultimately commercially focused. It is targeted at specific industry, technological or societal problems, and driven by industry need. It can be considered challenge- or demand-led innovation – research driven by commercial end goals/users, rather than research being the driver. Industry partnerships established around centres help to keep the focus on commercialisation of research, and ensure continued collaboration. Also, the membership approach evident in some centres ensures that direction of research is influenced by member organisations.

3.40 The purpose of Catapult Centres is to overcome market failures, and demonstrate technical feasibility and commercial viability of devices, components and technology. Figure 3.2 sets out the ORE Catapult's approach to addressing innovation challenges, de-risking innovation, and bringing projects, products and services closer to markets. A good example of this is that the ORE Catapult considers itself the first step in the innovation and commercialisation chain that feeds market testing of wave and tidal energy devices at EMEC in Orkney.

Figure 3.2: ORE's innovation challenge flow chain



3.41 The commercialisation activity undertaken at CSIT in Belfast is extensive. Its approach to commercialisation and supporting start-ups and spin-outs is overtly commercial – industrial and entrepreneurial experts support the translation of research and IP from academia to commercial status, rather than the researchers themselves. CSIT also works to attract foreign direct investment in Cyber Security companies, and seeks out venture capital investment. Further, its CSIT Labs facility offers hot-housing and incubation facilities to help develop spin-out and spin-in companies. There are a growing number of spin-outs and spin-ins, including Titan IC Systems, and Seven Technologies Ltd. CSIT also delivers two innovation accelerator programmes: *HutZero*, which is targeted at pre- and early-stage start-ups; and *Cyber 101*, which provides advice and mentoring to more mature Cybersecurity SMEs. The ecosystem that has developed around CSIT at the Northern Ireland Science Park is strong evidence of the commercial value of its operation.

3.42 As an industry-led centre, the OGTC's overt focus is on commercialisation of technology for deployment in the North Sea oil field. As a result, in its first year of operation, the OGTC has co-invested £37 million in industry-led projects. It has also invested a further £3 million in SMEs and start-ups to help bring innovative technology to market, in order to exploit the economic potential of North Sea oil.

3.43 A key focus of Catapult and Innovation Centres is the progression of projects through Technology Readiness Levels (TRLs). Catapults are focused on TRLs 3-6, taking experimental proof of concepts through validation to demonstration of technology in a relevant environment, with a view to progressing technology to TRL 7, prototype demonstration in an operational environment. Innovation Centres fulfil the same function, drawing on existing research to inform development and progression of technology, processes, etc. through TRLs.

Figure 3.3: Technology Readiness Levels in the European Commission[17]

Technology Readiness Level	Description
TRL 1	basic principles observed
TRL 2	technology concept formulated
TRL 3	experimental proof of concept
TRL 4	technology validated in laboratory
TRL 5	technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL 6	technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL 7	system prototype demonstration in operational environment
TRL 8	system complete and qualified
TRL 9	actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

3.44 However, consultees consider that Catapult Centres may have difficulty in converting concepts from TRLs 1 and 2. Given Dundee's expertise in Forensic Science research, there is an opportunity for it to focus on this range of TRLs from TRL 1 to TRL 7 through the *JustTech* Centre. This would allow it to manage the conversion of research concepts to pre-commercial ideas and market testing ready. It will also be able to manage the translation of pre-existing approaches, and their validation for use within forensic science, e.g. at TRL 5+.

Funding and resourcing

3.45 All comparator centres have a mix of funding sources with which they deliver their activity. These involve some or all of: core public funding (including for capital expenditure), competitively won R&D and innovation grants from Government and EU funding programmes (excluding UT Sydney for the latter), industry co-funding for projects, consultancy fees and membership subscriptions.

3.46 Both UT Sydney and Lausanne operate with core university funding, supported by research grant funding. UT Sydney has benefitted from the Australian Research Council's linkage grant scheme, whilst Lausanne has participated in FP7 and Horizon 2020 projects amongst others. UT Sydney also

[17] For example, see: https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf

received AUS$3 million in grant for laboratory facilities. Both also offer consultancy services, which generate a revenue stream.

3.47 The Catapult Centres receive £10 million per year from Innovate UK to deliver their programme of activity. Their long-term target is to operate according to the following funding model:

- One third core public funding to deliver infrastructure, technology, expertise and skills development work
- One third industry-funded R&D contracts
- One third collaborative R&D projects funded through competitive funding programmes

3.48 The ORE Catapult has already seen some success in terms of external funding. For example, it is currently participating in the Horizon2020-funded programme LIFES50+. It has also signed a Collaboration Agreement with Spain's TECNALIA.[18]

3.49 The funding model at CENSIS is similar to that for the Catapult Centres, albeit at a smaller scale. It received £10 million plus £2 million capital funding from SFC for its initial operating period, with co-funding from SE and HIE. In addition, it has secured grant funding through Innovate UK and EU funding streams. Through collaborative project delivery, it has co-funding from industry, as well as income generation from its consultancy offer.

3.50 CSIT has benefitted from a comprehensive range of public funding sources. Both Invest NI and the Northern Ireland Executive have supported it with capital and revenue funding. It receives core funding from the ESPRC as an Innovation and Knowledge Centre, which so far has totalled £44 million over Phase 1 and 2 of its operation. CSIT's status as an Academic centre of Excellence in Cyber-Security Research (ACE-CSR) has also seen it secure funding for PhD studentships, as well as wider support through the National Cyber-Security Centre. It has also secured £53 million in competitive funding through Innovate UK, ESPRC, Invest NI and European funding programmes. In addition, its membership scheme is an additional source of revenue funding, and it has also benefitted from central QUB funding. In many senses, this is a mature form of the 'trefoil' model pursued by Catapult Centres.

3.51 The OGTC's £180 million funding is a substantial amount secured through the Aberdeen City Deal. It will be matched over the lifetime of the project with £174.1 million of match funding (in both cash and in-kind contributions) from industry, academic and other partners. It should be noted that whilst the OGTC does not currently anticipate being commercially viable at the end of its project life cycle, it plans to ensure that the network of centres of excellence currently under development will be.

3.52 However, a key feature of current grant funding regimes is that they are highly competitive and typically in project cycles of 3 years or less. This presents difficulties for smaller research units, and ultimately makes it riskier to recruit new permanent research staff. With larger research awards, it is increasingly risky to take the lead in proposals which require a large upfront investment in time with increasingly smaller likelihood of success.

3.53 Similarly, funding cycles for existing Catapult and Innovation Centres, as well as some others, mean that centres are continually having to search for new funding streams to maintain activity and staff levels. To an extent this undermines the sustainability of some centres. Whilst city deal monies are delivered over a longer time period of ten years, they are still time bound in their duration.

[18] https://ore.catapult.org.uk/press-releases/ore-catapult-and-tecnalia-to-collaborate-on-offshore-renewable-energy-research-and-development/

3.54 There are substantial changes under way in the UK funding landscape. The consolidation of the UK's research councils and Innovate UK under UK Research and Innovation (UKRI) will undoubtedly bring some changes to funding arrangements. The UK Government's Industrial Strategy Challenge Fund provides funding and support to UK businesses and researchers. It identifies a number of key challenges to be addressed, and though Forensic Science isn't directly addressed by existing challenge themes, there is scope to influence future calls and challenges. Though there will be a learning curve in terms of understanding research areas and funding requirements, the changes will undoubtedly bring with it a range of new research opportunities, whether in terms of research areas or collaborations. However, some consultees noted that new funding streams for innovation may possibly fund programmes of activity rather than projects, and so limit the potential to secure funding, and make the application process even more competitive.

3.55 More widely, Brexit will possibly mean loss of access to European funding sources such as Horizon 2020. It is anticipated that there will be a shift in focus to opportunities with Official Development assistance (ODA)-eligible counties as a result. Though the UK Government has committed to "establishing a far-reaching science and innovation pact with the EU, facilitating the exchange of ideas and researchers", this nevertheless poses a significant threat to future funding revenue streams for research and innovation beyond the 2014-2020 programme period. It is unclear what access UK organisations will have to the EC's future research framework programme. Additionally, the UK Government has committed in principle to matching its Horizon 2020 contribution. However, UK research and innovation participants in Horizon 2020 are effective in securing a greater share of funding in return; as a result, there is likely to be a substantial funding gap.

3.56 It is clear that there are increasing challenges to accessing public funds, whether core or competitive grant funding. There is also a perception that with research and innovation centres increasingly pursuing a 'trefoil' funding model, there may not be sufficient funding available to support all innovation centres. Further, with more government units and agencies becoming autonomous or being transferred out of the control of government, many will adopt the 'trefoil' model – and pursue funding aggressively to replace block grants, or similar.

3.57 Nevertheless, there is strong agreement that a mix of public, private and competitive funding should be sought. There is also strong support for maintaining a degree of core funding from the public sector, as this ensures a strategic steer. Without this, there is a danger that centres are continually chasing grant funding, which is ultimately unsustainable, or simply providing services to meet short-term industry demands rather than addressing key technological or societal challenges.

Summary

3.58 Based on the analysis and discussion above, there are a number of key points on which to base the development of the business model. These are discussed in the subsequent chapter.

4 Business modelling for the *JustTech* project

Introduction

4.1 This chapter draws on the evidence presented in Chapter 3 and presents a business model for the *JustTech* project. It considers the components and resourcing requirements for an effective delivery model based on what *JustTech* is aiming to achieve and the learning developed through the study. It presents high level information on the likely set-up and operating costs with associated indicative funding and discusses other potential revenue streams over the 10-year project timeline.

The *JustTech* Offer

4.2 The *JustTech* project comprises three distinct activity streams, namely:

- The development of new forensic techniques and approaches, as well as support technologies and tools, through research activity.
- The translation and commercialisation of resulting IP through industry-oriented innovation and the development of a geographically-focused innovation cluster using the University's existing, extensive knowledge exchange network.
- This activity will be underpinned by a state-of-the-art physical centre for research and innovation in Forensic Science which will act as a focal point for the Forensic Science cluster's activity as well as providing incubation and start up space for SMEs and facilities for University staff and students.

4.3 As mentioned earlier, evidence suggests that the Dundee *JustTech* offer is unique in that there is neither provision of a similar centre elsewhere in the UK for Forensic Science nor does any other centre or institute currently occupy the same research space as the University of Dundee.

4.4 To effectively deliver this unique offer and its associated activities requires a fit for purpose delivery model. In scoping out a delivery model we have drawn upon evidence from other Catapult and Innovation Centres and Clusters, as discussed earlier in Chapter 3, which has informed the shape and scope of the model for the *JustTech* project. Key points critical for ensuring an effective delivery model are as follows:

- The Centre's staffing should be defined according to distinct teams/functions and their planned activity. As a minimum, this should be across research and business development, so that the expertise within the Centre is deployed where it is most effective.
- To ensure that *JustTech* remains focused on applied research, commercialisation and innovation to address technological, industrial and societal challenges, the Centre should be led by a commercially focused director.
- There is a need to ensure that the research is challenge or demand led and applied; this will ultimately drive innovation. Evidence from other Centres and clusters shows that funding programmes are a key component of activity to drive collaboration. Thus the provision of an Innovation Fund for collaborative projects to attract industry involvement is considered critical for the project.

- The Project should be set up as a team (virtual centre) in the first instance, rather than waiting for construction/completion of a physical building. This will allow the Centre to build momentum and gain traction from day one.
- The delivery model needs a physical base that reflects the purpose and forward-looking ethos of *JustTech's* aspirations and ambition.

4.5 The three distinct activity streams to be incorporated into the delivery model are depicted in Figure 4.1. These are Research, the *JustTech* Centre itself and Innovation and Cluster Development.

Figure 4.1: Activity streams

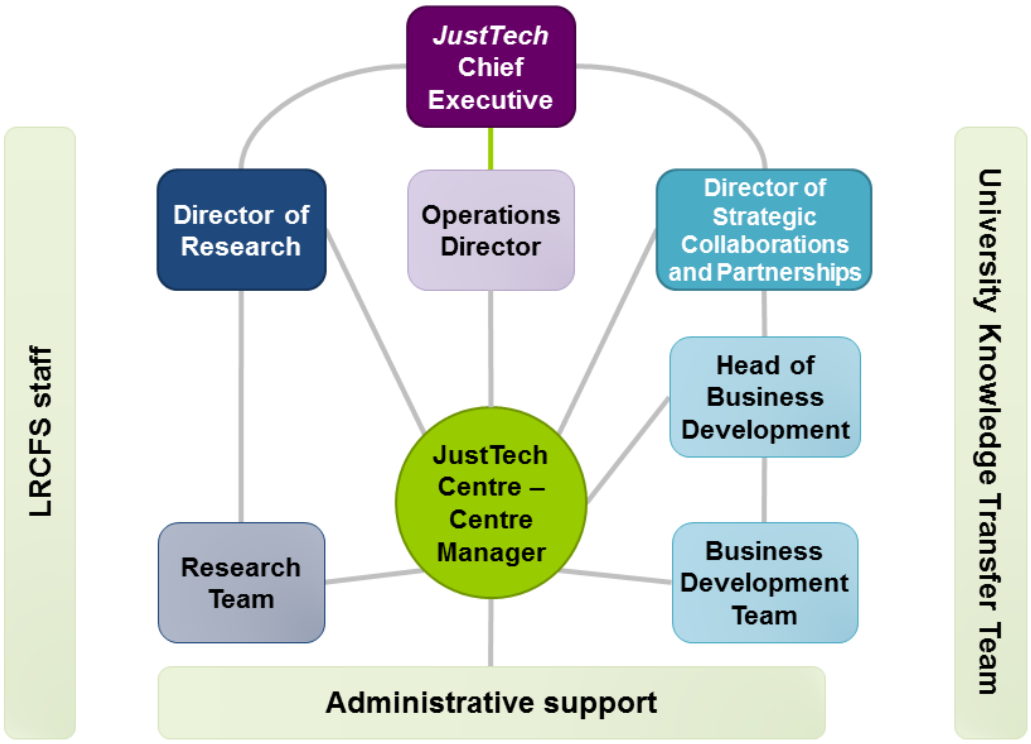
Activity stream 1: Research	Activity stream 2: *JustTech* Centre	Activity stream 3: Innovation and cluster development
• Development of disruptive technologies in breakthrough areas • Identify applications elsewhere which can benefit from FS tech/processes • Develop more rigorous techniques and tools to make existing techniques more robust • Bring together academia and industry to conduct collaborative research	• New build physical centre to be established at the heart of the campus • Host *JustTech* staff and activities • Provide a physical base for industrial engagement activities • Provide a base for wider entrepreneurial activity • Facility for university staff and students, to attract students and provide necessary pipeline of talent	• Engagement with the SME base • Building a tech cluster (initially around LRCFS) • Focus on commercialising research and technologies, and developing spin-outs • Collaborative working with SMEs and start-ups • Provision of incubation facilities • Building on collaborative research delivered through the Research Team

4.6 The proposed delivery model discussed below reflects these work streams and the functions and resources required to deliver them.

Towards a preferred delivery model

4.7 The proposal is for a single, streamlined delivery model for the project as a whole, which encompasses the elements discussed above. It is illustrated in Figure 4.2 below. The following commentary deals principally with the operational configuration of the project and thus the revenue aspects of project set-up and delivery. The capital build programme, i.e. the *JustTech* centre is discussed later at Section 4.43. This model draws on an extensive range of UK-wide and international best-practice to set out a compelling justification for full resourcing of the *JustTech* project.

Figure 4.2: Proposed delivery model



Structure

4.8 The delivery model structure comprises an overall Chief Executive of *JustTech.* Each of the three activity streams is led by a Director-level staff member. The model is based on the findings of the research showing that separate processes and activities require specific skill sets and so staff teams with particular expertise i.e. academics or industry engagement experts.

4.9 Each of the three Directors manages a team of staff:

- Director of Research: research assistants and technicians
- Director of Operations: centre manager and project administration staff
- Director of Strategic Collaborations and Partnerships: Head of Business development and executives

4.10 It may be useful to consider that one of the Directors as a named Principal Investigator for the project, which is likely to be an academic who can deal directly with the hierarchy of the university when it is required.

4.11 It is anticipated that the Director of Operations post will be for a fixed term i.e. for the duration of the design, build and fit out and launch of the *JustTech* Centre. Thereafter, the *JustTech* Chief Executive will manage the Centre Manager and administration staff.

Roles and skills

Roles

4.12 The role of the Chief Executive and three Directors is twofold; one is to be part of the Project's Leadership Team and the second is related to the activity stream for which they are responsible.

4.13 The role of the Chief Executive is to provide leadership and deliver the vision for *JustTech*. They will have ultimate responsibility for the financial sustainability of the project and will have overall responsibility for managing the Project's assets and resources.

4.14 The Director of Strategic Collaboration and Partnerships (leading on Innovation and Cluster Development activity) will guide and drive the activity of the business development team. Namely, to prospect for and secure commercialisation opportunities for (research and) innovation outputs as well as work on project delivery. The team will also liaise with industry and identify its research requirements, essentially the issues that *JustTech* can develop solutions for.

4.15 The role of the Director of Research is to define the research programme and manage the research teams and their outputs. Securing consultancy and research contracts is also part of his/her remit.

4.16 The role of the Operations Director (either a secondee from University estates/facilities management or an external appointee on fixed term contract) would primarily focus on the build of the new Centre and include the procurement and management of contractors and consultants; budgeting and cost control; oversee the project management of the build and its subsequent fit out. Administration staff would also report into this Director.

Skills

4.17 In terms of person specification, to realise the ambitions of *JustTech*, the Chief Executive should have a commercially-focused background with knowledge and experience of working with industry and in a commercialisation/innovation environment. They will ideally have an existing network and will certainly have a proven track record in developing and working in cross-sectoral partnerships.

4.18 In a similar vein, the Director of Strategic Collaborations and Partnerships position, although likely to be a Forensic Science academic with existing knowledge of the sector and its key stakeholders and players, requires an individual with experience of outward facing partnership working and proactive industry engagement and networking activity.

4.19 The Director of Strategic Collaborations and Partnerships would be supported by an experienced Head of Business Development and business development executives, which may have a combination of commercial, science and technical skills.

4.20 The Director of Research post may filled by the Lead Forensic Science academic at the University of Dundee.

Costs and revenue model

4.21 At this stage, it is possible to provide high level 10-year budgets (incorporating funding and set-up and operating costs) for the Research and Innovation and Cluster Development activity streams. These are provided in the next section. We have based our calculations within the broad envelope of illustrative funding as outlined in the project's Strategic Outline Case. This is shown in Table 4.1 below.

Table 4.1: Proposed Project Funding

Phase	Timing	Total Project Cost	UoD Contribution	TCD Contribution
JustTech project including strategic appointments	2017-27	£27,400,000	£14,400,000	£13,000,000
Innovation cluster development	2017-22	£15,000,000	-	£15,000,000
JustTech Centre	2019-21	£20,000,000	£5,000,000	£15,000,000
Total		**£62,400**,000	**£19,400**,000	**£43,000**,000

4.22 Funding received from the TCD will allow the securing of additional resource for the project. It should also be noted that a £10 million funding contribution from the Leverhulme Foundation (included in the UoD contribution) will help to support scientific research activities including the provision of an Innovation 'Fund'. This will not operate as an outward-facing, open competition to support R&D activities in SMEs, in contrast to funds operated by similar clusters and centres. Rather, it will help to support collaborative research with the University of Dundee's commercial partners. In essence, it is resource dedicated to supporting research and innovation activity through LRCFS and *JustTech* staffing resource and in partnership with industry. This does not preclude a grant-giving mechanism as part of research and innovation activity, however.

4.23 It should be noted that Leverhulme research monies will support all research activity through the LRCFS including that undertaken with commercial partners, and this could be undertaken or overseen by *JustTech*.

Research and Innovation Cluster Development

4.24 Table 4.2 presents a 10-year indicative revenue and expenditure budget for the *JustTech* project (excluding the capital expenditure on a new build Centre). It shows the position without the generation of any additional income. This is discussed later in the chapter.

Table 4.2: 10-year indicative budget

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Total
£000s	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	202/265	2026/27	2027/28	
Income											
UoD JustTech	1440	1440	1440	1440	1440	1440	1440	1440	1440	1440	14400
TCD JustTech	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	13000
TCD (ICD)	3000	3000	3000	3000	3000	0	0	0	0	0	15000
Sub-total I	5,740	5,740	5,740	5,740	5,740	2,740	2,740	2,740	2,740	2,740	**42,400**
Expenditure											
Staff											
Salaries: Directors	375	375	375	375	375	375	375	375	375	375	3750
Salaries: Research staff	180	180	180	180	180	180	180	180	180	180	1800
Salaries: BD	137.5	137.5	137.5	137.5	137.5	137.5	137.5	137.5	137.5	137.5	1375
Salaries: Administration	96.25	96.25	146.25	146.25	146.25	146.25	146.25	146.25	146.25	146.25	1362.5
UoD overhead contribution	200	200	200	100	0	0	0	0	0	0	700
JustTech Centre operating costs	0	0	0	250	500	500	500	500	500	500	3250
Innovation fund	0	2,500	2,500	2,500	2,500	2,000	2,000	2,000	2,000	2,000	20,000
Marketing	50	50	50	50	50	50	50	50	50	50	500
Recruitment	60	0	0	0	0	0	0	0	0	0	60
BD/KE budget	30	30	30	30	30	30	30	30	30	30	300
Research materials	50	50	50	50	50	50	50	50	50	50	500
Innovation/cluster dev	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	10,000
Total expenditure	2178.75	4618.75	4668.75	4818.75	4968.75	4468.75	4468.75	4468.75	4468.75	4468.75	**43,597.50**
Surplus/deficit	3,561	1,121	1,071	921	771	-1,729	-1,729	-1,729	-1,729	-1,729	**(1,197.50)**

Cost assumptions

4.25 The financial projections above are based on the following assumptions:

- A staff complement of 17 FTE staff which represents the minimum number required to staff the proposed teams and deliver the range and volume of activity required to achieve project objectives. For the purposes of modelling, the Chief Executive/Director roles are set out as full-time posts, but it is recognised that in reality these may be delivered on a part-time or proportionate FTE basis. It comprises the following:

Table 4.3: Proposed staffing

Staff	FTE
Project Director/Chief Executive	1
Activity stream Director	3
Head of Business Development	1
Business Development Executive	2
Research Fellow/Assistants	4
Lab technicians	2
Marketing Manager	1
Centre Manager	1
Administrative assistants	2

- The post of Centre Manager is introduced at the end of Year Two to provide input to the preparation for the opening and operation of the new centre.
- All salary costs include national insurance and pension contributions.
- Prior to the opening of the new centre we have assumed a contribution to the University to cover the cost of staff accommodation, use of facilities and overheads.
- Operating costs of the new centre overlap in Year 4 with the contribution to the University for six months hosting costs.
- We have assumed the establishment of an Innovation 'Fund' of £20 million over the 10-year period. As noted above, this is not to fund open-competition activity amongst SMEs; rather it is for the delivery of a wide range of collaborative research and development activity with University of Dundee commercial partners, with support through the Leverhulme research award.
- Resources of £10 million have been allocated to developing commercialisation activity and cluster development and are equally distributed over the period. The types of activity could include:
    - The provision of commercialisation consultancy services;
    - An outreach programme, consisting of innovation events, seminars and workshops that are driven by the needs and priorities of the sector;
    - Small, focused workshops dealing with specific scientific or commercial challenges.

In summary

4.26 Of a total expenditure budget of almost £43.6 million, 19% is accounted for by salaries and the bulk, some 60% by an Innovation Fund for collaborative research and activities to support innovation

and cluster development. Just over £4 million (10%) is allocated to operating costs and the remainder to support operational activity and material costs and the like.

4.27 There is a small funding gap if *JustTech* were only to operate within the £42.4 million budget suggested and presented in the forecasts in the table above.

Scenario planning

4.28 In this section we consider three funding scenarios if the available funding package secured via the Tay Cities Deal (TCD) is less than anticipated. We have presented the resultant project expenditure and resourcing for funding levels of 70%, 50% and 30% of the original total TCD 'Ask'. The table below presents a summary of these compared to the Preferred Option discussed above; detailed 10-year revenue and costs projections can be found in **Appendix 4**.

Table 4.4: Options Appraisal

Item	Preferred Option	Scenario 1	Scenario 2	Scenario 3
	£000s			
Total project income	£42,400	£29,680	£21,200	£12,720
Salaries	£8,287.5	£6,600	£6,125	£4,775
Number of FTEs	17	12	12	9
Other costs, of which:	£35,310	£22,570	£15,075	£8,825
Innovation fund	£20,000	£7,500	£5,000	£3,000
Innovation/cluster development	£10,000	£10,000	£5,000	£1,000

Alternative scenario 1

4.29 With a reduction of 30% in the funding package whilst the shape of the resultant delivery model remains the same, the resourcing of the model would necessarily change as follows:

- No change in the Chief Executive and Director level capacity, i.e. Chief Executive plus Directors;
- A reduction in headcount of 2 FTEs in the research team;
- Loss of one Business Development executive; and
- Loss of Centre Manager (with these duties taken up initially by the temporary/fixed term Operations Director, and subsequently the Chief Executive), and one Administrative Assistant.

4.30 In addition, funding for the proposed Innovation Fund is reduced by some 60% from £20 million in total to £7.5 million. There are also reductions in the annual budgets for business development/knowledge exchange activity and research materials reflecting the reduction in activity as a result of reduced headcount of three delivery (and two back office) staff.

4.31 The reduction of some £14 million in income (from less TCD funding) would require other funding and revenue streams to be identified and secured in order to fund staff posts and to be able to deliver the same volume of activity as proposed under the preferred option.

Alternative scenario 2

4.32 With a reduction of 50% in the funding package the resourcing of the delivery model would require to be <u>further</u> reduced (from Scenario 1 above) as follows:

- Removal of the post of Operations Director with the Chief Executive taking over responsibility for the design and planning of the *JustTech* Centre; and
- The headcount is 12 FTEs as the post of Centre Manager is re-instated to manage the build and subsequent operational phase of the *JustTech* Centre.

4.33 In addition, the budget for the proposed collaborative Innovation Fund is further reduced to £5 million and innovation and cluster development activity funding is necessarily halved to £5 million. As well as impacting the volume of activity which can be delivered by the project this will also likely result in a longer time lag to realising any potential commercialisation benefits.

4.34 The reduction of some £21 million in income from the Preferred Option represents a sizeable funding gap. A significant amount of additional time would be required from Director resource in an attempt to source, bid for and secure other funding including the time needed to build relationships with potential funders. This will detract from the Chief Executive and Directors' main roles in developing the project and the wider Forensics cluster. Similarly, identifying additional income generating streams would be critical for the funding of additional staff posts and to allow for the delivery of the same volume of activity as proposed under the Preferred Option.

Alternative scenario 3

4.35 With a reduction of 70% in the funding package both the shape and resourcing of the delivery model would require to be significantly re-scoped as follows:

- This level of funding would not allow for the critically important post of Director of Strategic Collaborations and Partnerships. The Chief Executive and Research Director only would remain;
- A Director team supported by a Head of Business Development and one Executive, and a research team of three staff; and
- An administrative team consisting of a Marketing Manager and Centre Manager only.

4.36 The lack of a Director of Strategic Collaboration and Partnerships has implications not only for the level of cluster development and collaborative activity that could be potentially generated but does not support the overall vision for the *JustTech* project. With a team of only 9 FTEs and a vastly reduced Innovation Fund (£3 million) and budget for innovation and cluster development activity (£1 million), it begs the question of whether the *JustTech* project is still a viable proposition.

4.37 This also applies to the proposal to build the *JustTech* Centre. It aims to host SMEs and start-up businesses as well as deliver a wide range of partnership and innovation focussed events, projects and activities. The latter is very much dependent on the ability of the project to establish and build external relationships with industry, law enforcement agencies and the judiciary and the wider academic and research community. This requires an individual (and supporting team) who can promote and build the profile of the Centre to support this objective.

Other revenue sources

4.38 The evidence gathered from other Innovation and Catapult Centres and clusters suggests, however that there are a number of significant potential sources of income aside from core public sector and/or grant funding to be exploited.

4.39 These include rental and service income which should derive from the Centre's proposed incubator/co-location space. We estimate that this could amount to a minimum of £1.1 million from Year 4 onwards based on standard occupancy rates and rental levels.

4.40 The potential income stream from a membership system if introduced could yield for example a minimum of some £3 million over Years 6-10. This figure is a conservative estimate based on an assumption of c.10-14 new members joining per year at subscription rate levels enjoyed at other centres.

4.41 There is significant potential for revenue to be generated from consultancy for industry (research contracts) and competitive R&D contract awards. The University has existing revenue streams in these markets which would transfer into the Centre. However, there is the opportunity to formalise and better target these types of contracts under the *JustTech* brand and ramp up activity in this area.

4.42 There may also be the opportunity to earn commission income resulting from spin-out activity where IP is partly owned by *JustTech*/University of Dundee. Exploring and quantifying the potential of developing this income stream would be part of the Innovation and Cluster Development team's remit in fully developing the Centre's service offer.

4.43 The new emerging funding landscape, as discussed earlier in Chapter 3, may present opportunities for *JustTech* to bid to manage and deliver specific funding programmes. Equally, the Centre may be well positioned to work with partners like Scottish Enterprise to assist them in delivering their business growth agenda through the Centre by managing and delivering innovation support to SMEs.

4.44 The resulting revenue from a variety of sources will fund additional core staff required for the running of the Centre and delivering research and other services as it develops and increases its activity levels thus attracting more tenants, users and collaborators. Importantly, it will provide the funding to conduct industry focussed research employing more researchers and project delivery staff.

4.45 Quantifying the potential income from these sources should be part of the detailed business and financial modelling which follows this study.

The *JustTech* Centre

4.46 The capital investment of £20 million earmarked for the *JustTech* Project relates to the construction of a state of the art, new build facility on the University of Dundee campus. Whilst we recognise that the capital build programme may have synergies with other TCD projects and the Centre may be co-located or housed as part of another new facility, we have attempted to present an outline plan of what shape and scale the *JustTech* Centre might have,

4.47 At the time of writing there is neither an agreed site on campus nor outline design for the *JustTech* Centre. We have therefore been required to make a number of assumptions with respect to:

- The proportion of the total budget which will be allocated to build and fit-out versus equipment;
- The probable cost of the design and build itself; and
- How the resultant space afforded might best be configured to reflect the intended activities to be undertaken in the Centre.

4.48 The details will be fine-tuned as the proposal develops but at this stage, the outline budget and funding required to build and equip the Centre is c. £20 million. We have assumed that a budget of £3 million will be required to purchase equipment (this figure is a very broad estimate and requires to be

worked out in detail at a later stage based on the full service and research offer). The remaining £17 million will be available for the design and build of the Centre.

4.49 Based on proxy indicators and experience, it is estimated that it will cost approximately £3,500 per square metre to build the Centre which would result in a total space of around 5,000 square metres. This is mid-sized in comparison to other centres.

4.50 Given the aspirations for the Centre as both a research and innovation hub and cluster we can anticipate that the Centre is likely to require the following spatial areas:

- Academic/research space – that provides innovation active academic lab space to support applied research discoveries.
- Innovation space – which allows industry and other partners and stakeholders to develop, test and evaluate new processes and product ideas and prototypes. This would include e.g. commercial labs, staff office accommodation, meeting rooms, event space and supporting facilities like break out areas and a café.
- Co-location space – which provides incubation space and can accommodate businesses working in related fields.

4.51 We propose that this space could potentially be divided as shown at Table 4.5 below. This is based on a number of Centres which we have worked with in the past which have had similar requirements in terms of lab space versus other functional areas.

Table 4.5: Division of centre space

Space	m^2	Usage
Research space	750	Predominantly lab space
Innovation space	1,250	Lab space. Includes reception and shared areas
Co-location space	3,000	Capacity for 15-20 tenants

4.52 However, the Project's detailed service offering will inform the exact design requirements of the new Centre and its accompanying configuration of space. The preparation of an outline plan should be undertaken at the next stage.

Project roll-out

4.53 As stated, to gain momentum and impact, the Centre should be set up as a team (virtual centre) in the first instance before the physical Centre is established. The following high-level project plan shows the stages and timings of the roll-out of the delivery model for *JustTech*. It comprises three stages made up of a number of actions, some of which will run concurrently.

- **Stage 1:** Focus on establishing the core *JustTech* project team. Broadly, this will involve recruiting key Chief Executive/Director level staff, setting up operational aspects such as office accommodation and (access to) laboratory space, marketing communication and brand awareness raising activities, and the commencing of early activity to engage with external partners, stakeholders and industry. It will also include early planning activity associated with the physical centre build e.g. site selection, design and architectural plans, planning approval, costing, and work planning also happens at this stage.

- **Stage 2:** Recruiting the wider research and business development teams and the accelerating of partner engagement and collaborative activity with industry. Developing the innovation and cluster activities may also require the temporary sourcing and/or upgrading of existing University facilities for hosting SMEs and providing incubation space at this stage. Existing research contracts would be transferred across to the project and new research seeking opportunities sought out at this stage. Work on planning the physical build continues at this stage with procurement and the appointment of a contractor and commencement of the build.
- **Stage 3:** Continued research activity and a focus on launching cluster development. The Centre will be nearing completion and fit out at which point staff will locate in to it. There will be a soft then a formal launch.

4.54 The roll-out of the *JustTech* Project in its entirety will, we estimate, take some 36-42 months. A high level project plan for the above three stages is presented in Table 4.4 below.

Table 4.6: JustTech project plan

	Yr 1 2018				Yr 2 2019				Yr 3 2020				Yr 4 2021	
	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun
Stage 1														
Director recruitment														
Director team in place		X												
Early outreach activity														
Securing staff accommodation														
Idenitying lab space														
Marketing/profile raising activity														
Space brief														
Engage full consultant team														
Outline design and costs														
Planning approval and procurement process														
Appointment of contractor														
Stage 2														
Transfer/recruitment of other staff														
Engagement and collaboration activities														
Sourcing temporary space to host SMEs														
Research activity continues/commences														
Centre build														
Stage 3														
Focus on cluster development activity														
Centre handover to University of Dundee														
Fit-out and equipment installed														
JustTech launch and open														X

4.55 An efficient and timely set-up of the main components and building blocks of the Project prior to the opening of the Centre will be critical to how quickly the Centre can establish itself in the Forensic Science ecosystem as a centre of excellence. A solid foundation must be laid in the first three years and progress made to establish the *JustTech* research and innovation brand and profile, and its associated high quality, world class research and commercialisation activities.

5 Conclusions

Introduction

5.1 This chapter sets out the conclusions from the comparator study, providing a basis for the next phase in developing the project proposal. Key priorities for the success of the project are also highlighted. The steps required to drive the development of the Business Case for the *JustTech* Project are presented in Appendix 5.

Dundee's *JustTech* proposal

5.2 There is a growing market for Forensic Science and it is increasingly diverse in terms of its applications although at its heart is the detection and prevention of crime. Globally it is projected that the sector will grow by $8 billion to $18-20 billion by 2019 demonstrating both the scale and the speed with which it is expanding.

5.3 The University of Dundee is recognised as an international leader in Forensic Science and works collaboratively with institutions and organisations around the world. It has one of the largest Forensic Science research groups in the UK and is amongst the largest in Europe. Its reputation has been cemented by the establishment of the Leverhulme Research Centre for Forensic Science (LRCFS) at the University in 2016. The focus of the LRCFS and, more widely, Forensic Science at the University of Dundee is on the development of disruptive technologies that can radically improve the discipline and address where the market has and is continuing to fail.

5.4 The *JustTech* proposal is looking to build on the existing strength in Forensic Science at the University of Dundee in order to deliver sustainable economic growth in the Tay Cities region, and exploit the growing market for Forensic Science.

5.5 The project is also responding to wider issues in Forensic Science. There is a quickly developing crisis, as certain tools and techniques that crime prevention and detection has relied upon are increasingly lacking the credibility and robustness to be admissible in court. This has very serious implications for the criminal justice system in the UK and of course, internationally.

5.6 Coupled with this, the nature of crime is changing with an increase in a wide range of crimes with a digital element and so there is an urgent need to develop tools and techniques that can respond to the rapid increase in digital evidence. An important issue here is that because of the pace of change of technology generally, so our responses must continually be reviewed and developed to keep pace.

5.7 Within this context, the University of Dundee, with its strong existing expertise is, through *JustTech,* ideally placed to respond to a number of opportunities around the need for new research, tools and techniques within Forensic Science.

5.8 The University of Abertay has significant expertise in cyber security with proposals to develop a cyber security cluster in the city which would complement *JustTech*. The presence of both *cyberQuarter* and *JustTech* would achieve significant added value for Dundee, for both projects and for the wider Tay Cities Deal Region. The presence of the Leverhulme Research Centre for Forensic Science is also an important anchor and attractor for Forensic Science in Dundee.

5.9 Whilst *JustTech* must be designed specifically for Forensic Science, and build on what is already in Dundee, there is a lot that can be learned by examining similar centres for Forensic Science, and for wider research and innovation. These have been used to form and shape the recommendations for a delivery model for the *JustTech* Project (and Centre) and identify the key considerations and decisions that need to be taken.

5.10 Critical to the success of *JustTech* will be that it is built on the academic and research expertise at the University but that it is designed to address market failure and is, and is seen to be, industry focused and industry facing. *JustTech* should create a virtual and real space to bring industry together with academic research, encourage collaboration between enterprises as well as with academic researchers. There are some very good examples of this type of collaborative working, for example CSIT is an exemplar of best practice, having a very strong and clearly articulated commercial focus. A description of CSIT is provided at Appendix 3.

5.11 Successful centres build on their core expertise, in this case Forensic Science. They then draw on expertise from other disciplines to support that core function, for example Business Development and Financial Management, as well as complementary research as appropriate. This ensures that there is an effective, integrated approach to research and innovation that is supported and sustainable, addressing identified market failure and industry need. To ensure that *JustTech* remains focused on applied research and innovation, the Centre should be led by a commercially focused Director.

5.12 It is clear from elsewhere that *JustTech* must work with the market to identify technical and scientific challenges, in this case, driven by the changing requirements of Forensics Science in the prevention and detection of crime and the criminal justice system. This must then be the focus of activity and it should target a small number of very clearly-defined areas where it can have the most impact. This granularity will be important so that *JustTech* is clearly positioned and recognised for its particular specialisms. A more broad brush approach will not be as effective.

5.13 Built around *JustTech,* there must be a comprehensive package of support that enterprises can access, including clear links to external agencies and support providers where this is not provided directly through *JustTech.*

5.14 Collaboration is difficult to achieve, particularly where potential partners may feel they are in competition with each other. Brokering collaborative projects will be an important function of *JustTech* and will require dedicated resource and activity. An Innovation Fund for collaborative projects will be an important tool in encouraging collaborative working and joint research and innovation projects.

5.15 Learning from elsewhere clearly shows that establishing a core team in the first instance is critical and should not wait until the physical building is in place and fully functioning. There is a lot that can and must be achieved in advance of the building being complete and this team will be central to ensuring that.

Key priorities for *JustTech*

Key components for the delivery model

5.16 In scoping out a delivery and model we have drawn upon evidence from other Catapult and Innovation Centres and Clusters which has informed the shape and scope of the model for the *JustTech* project. Key components of the proposed delivery model include:

- Clearly defined teams and functions which reflect the planned activity and work streams of research and business development, so that the expertise within the Centre is deployed where it is most effective.
- A commercially focused Lead Director.
- The provision of an Innovation Fund for collaborative projects which will attract industry involvement.
- A Project roll out prior to the construction/completion of a physical building.

Priorities for supporting delivery

5.17 The *JustTech* proposal sets out the prime opportunity to be seized in disrupting the forensic science market, and essentially creating a new market for innovative new and translated techniques. Dundee is in an ideal position to take advantage of this opportunity. The value proposition set out through *JustTech* is strong.

5.18 However, in order to realise this, *JustTech* must be adequately resourced and supported by the University of Dundee and its strategic partners, and through the Tay Cities Deal. The scenarios set out in the preceding chapter demonstrate that in order to deliver the scale of ambition that *JustTech* sets out, significant investment is needed to ensure that critical mass of size and activity is achieved. It is also required to ensure that the necessary functions to deliver the desired activity can be put in place.

5.19 As demonstrated by the indicative budgets in each scenario, in order to fill an anticipated funding gap in later years of delivery, Dundee and partners must work to secure additional funding outwith the Tay Cities Deal. As noted previously, though not explicitly identified in the current programme for the UK Industrial Strategy Challenge Fund, Dundee has an opportunity to influence the direction of future funding calls by establishing itself as an innovation centre of excellence. In a rapidly changing funding environment, it has the also opportunity to do this across a range of current and potential funding streams.

5.20 A mix of public, private and competitive funding should be sought on an ongoing basis. Maintaining a degree of core funding from the public sector ensures a clear strategic steer, and also allows for greater responsiveness to new market opportunity in future, as well as need identified in societal challenges within Scotland, and more widely.

Appendices

Appendix 1: Study objectives and methods

Aims and objectives

The aim of the study was to further develop the thinking and evidence needed to build the business case for the University of Dundee's *JustTech* proposal for a significant investment in a forensic science industry cluster. Specific objectives were to:

- Develop a business model for the *JustTech* Forensic Catapult Centre and Innovation Cluster Development activity based on examples of international best practice.
- Assess the potential impact if possible, of the *JustTech* Forensic Catapult Centre and Innovation Cluster Development based on the business model.

Methods and report structure

The method comprised comprehensive desk research alongside consultations with key stakeholders covering:

- **Scene setting:** For the first stage of the study we undertook scene setting consultations with Susan McMullan, Michael Marra, Professor Dame Sue Black and Professor Niamh Nic Daeid to gain further insight into the development of the SOC and wider proposal. Scene setting consultations were coupled with detailed review of the *JustTech* SOC and other relevant project documents and materials.
- **Comparator research:** The comparator research started with a longlisting of international innovation centre/Forensic Science comparators. For each comparator high level research was conducted on the innovation offer of the institution. The comparators were chosen on the basis of steering group recommendations, research conducted by the ekosgen team, and the level of innovation and commercialisation activity. ekosgen, working with the steering group developed a set of criteria against which we assessed each comparator in order to prepare a shortlist of eight comparators for more detailed research.
- **Stakeholder consultations:** Consultations were carried out with ten stakeholders including members of the steering group, strategic stakeholders and representatives of the shortlisted comparators. See Appendix 6 for a full list of consultees.
- **Business modelling:** From the information gathered during the desk review and consultations, ekosgen considered potential business models for the *JustTech* project.

Appendix 2: Initial review and shortlisting of comparators

Introduction

This paper sets out the research to date on the review of comparators to inform the development of the *JustTech* project at the University of Dundee. It presents the long list of potential comparators, and sets out the method we used to identify them. It then applies a set of criteria against which the ekosgen team has assessed each example in the long list to arrive at a proposed short list of candidate comparators to explore in more detail. The long list comprises eighteen potential comparators. By applying the criteria, we have identified a proposed shortlist of eight comparators that the analysis indicates will be of most value to inform *JustTech*.

Long list

We identified the long list of potential comparators n the following ways:

- Desk research of potential comparators undertaken by the ekosgen team
- Recommendations from the project steering group members
- Existence of applied research and commercially-focused activity
- International reputation of institutions' and research centres' activity in forensics.

We have undertaken high-level research on each example in the long list in order to assess its fit and value to the development of *JustTech*. Descriptions of each comparator in the long list of comparators are set out in Table 1 below.

Table 1: Longlist of comparators

Comparator	Description of cluster/centre	Objectives	Research focus	Collaborative activity	Impact
UT Sydney	• Centre for Forensic Science based at University of Technology Sydney involving both	• Focus on application of research – offering tools that can applied in the real world – often work with law	• Examples of research: ○ Development of novel methods for the detection of hidden fingerprints, in	• Research has involved industry, law enforcement and academic partners • The University of Dundee is a partner of UT Sydney	• The centre aims to build tools that can be used in the real world • Examples include:

Comparator	Description of cluster/centre	Objectives	Research focus	Collaborative activity	Impact
	academic and industry partners • Centre has state of the art forensic and imaging laboratories	enforcement, insurance companies and industry • Research is industry- and outcome-driven; and through practical innovation, the Centre contributes to the UTS vision of becoming a world-leading university of technology.	collaboration with law enforcement organisations and partner academic institutions ○ Projects with National Institute of Forensic Science-led around building illicit drugs forensic capacity in Australia and explosives analysis ○ Novel research into forensic intelligence in collaboration with the Australian Federal Police and a number of police forces in Australia and overseas, and the University of Lausanne		○ Development of novel cyanoacrylates and FTIR imaging for fingerprint detection ○ Development of Forensic Science for use in illicit drug trade
University of Lausanne	• Well established research and teaching in forensic science • The first university to offer Forensic Science training • Offers undergraduate and postgraduate Forensic Science degrees • A member of the European Network of Forensic Science Institutes	• Aims to contribute to development of Forensic Science through research, teaching and collaborative activities	• Recent research includes studies on imitation and counterfeit medicines and altered fingerprint detection • The university also offers expert services to national and international law enforcement in a number of areas: ○ Narcotics ○ Fires and explosion ○ Documents, writings, signatures ○ Identification of people ○ Image analysis and photogrammetry ○ Micro-traces	• Contributes to training of judicial bodies e.g. magistrates and police • Participates in pilot projects and collaborations with local and international judicial bodies	• 60% of Swiss research papers on Forensic Science come from the University of Lausanne • Offers the only Francophone comprehensive training in Forensic Science

Comparator	Description of cluster/centre	Objectives	Research focus	Collaborative activity	Impact
			○ Interpretation		
King's College London	• Offers Forensic Science MSc/MRes courses which are fully accredited by The Chartered Society of Forensic Science • Longest running Forensic Science Masters programme in England	• Aims to deliver research that, through collaboration with industry and law enforcement, can be applied in the real world • Through education the university aims to give graduates the skills to work in the forensic science profession	• Forensic Science research groups work in collaboration with Metropolitan police, the European Forensic Genetics Network of Excellence and industry • Forensic Science research is organised around three groups: ○ Explosives and environmental forensic group ○ Trace DNA and body fluid detection group ○ Forensic Genetics group	• Forensic Science Programme has strategic partnership with Metropolitan Police Forensic Services Directorate and research partners with LGC Forensics forming the Met/LGC/KCL managed forensic service provision • Links with over 25 forensic laboratories and institutions worldwide provide research placement opportunities for students' projects. • Academics take part in Forensic Science networks such as British Academy of Forensic Science • Masters programme developed and delivered with input from practitioners	• Structure of DNA originally discovered at KCL, university continues to strive for real world impact in its research. Examples include: ○ Work with Metropolitan police on threat mitigation around explosives ○ Work with Metropolitan police, with Home Office funding, to devise an automated detection system using human specific biomarkers.
Co van Ledden Hulsebosch Center – Amsterdam Centre for forensic science and medicine	• Interdisciplinary centre of expertise for Forensic Scientific and Medical research in Amsterdam. Brings together researchers from the University of Amsterdam, Academic Medical Centre and the Netherlands Forensic Institute • Runs a Multidisciplinary Masters programme in collaboration with	• Aims to develop into the Netherlands' leading Forensic Science research institute. • Seeks to contribute to specially-themed collaborations between researchers and those working in the field, supervise ongoing projects and define new projects and initiatives.	• Matrix based research – themes matched to researchers within different institutions • Six key themes are: ○ Objective Forensic methods ○ Innovation in Forensic medical research ○ Biological Forensics ○ Digital Forensics	• Collaborative in nature as bringing together researchers from different institutions • Established an international network with partners in the USA and Belgium • Works on research in collaboration with industry/law enforcement	• Developing research institute to draw on expertise from across institutions, law enforcement and industry. Seeking to build national and international collaboration.

Comparator	Description of cluster/centre	Objectives	Research focus	Collaborative activity	Impact
	University of Amsterdam – available to students from a variety of scientific backgrounds	• Relevant scientific insights and research methods from the academic world will be made available for the purpose of Forensic research in general and crime scene research in particular.	○ Micro-Forensics, microscopy and imaging ○ Innovative crime scene techniques		
NIST US Government agency – National Institute of Standards and Technology	• Within the field of Forensic Science NIST conducts research, provides reference standards and data for Forensic labs to validate their methods and ensure accuracy, works with others on policy including accreditation requirements for Forensic Science providers and administers the Organisation of Scientific Area Committees (OSAC) for Forensic Science to facilitate the development of standards and guidelines	• More broadly aim of NIST is to carry out research that can improve US competitiveness – aiming to boost industry and quality of life	• Key research areas are: ○ Ballistics ○ Digital and multimedia evidence ○ DNA and biological evidence ○ Drugs and toxicology ○ Pattern and impression evidence ○ Trace evidence and chemistry • From 2013 to 2017 NIST also participated in National Commission on Forensic Science, which looked to enhance the practice and improve the reliability of Forensic Science.	• Works with government agencies, academic institutions, and the private sector for OSAC and the development of reference and accreditation standards	• Aiming to boost Forensic Science industry through collaboration with different bodes to develop research, reference standards and accreditation requirements
Cranfield University	• Postgraduate and research based university, specialises in science, engineering, technology and management • Forensic modular Masters programme has the largest number of students on a Forensic MSc course in UK –	• Aims to provide excellence in research, facilities and education	• Has following research groups: ○ Digital Forensics ○ Forensic Anthropology ○ Materials Science and Radiation ○ Musculoskeletal and Medicolegal Research ○ Archaeological and Forensic Analysis	• Links with industry due to companies based at Cranfield University technology park • Teaching includes external lecturers from industry	• Offering unique facilities within the UK • Provides expert services for archaeological and forensic communities • Particular expertise within ballistics, explosives, materials science, engineering failures and Forensic computing

Comparator	Description of cluster/centre	Objectives	Research focus	Collaborative activity	Impact
	includes modules around ballistics and forensic archaeology and anthropology • Offers GCHQ accredited digital forensics course, professional development courses and PhDs • New laboratory facility is unique in the UK, features Forensic contamination and audit control				
University of Strathclyde, Centre for Forensic Science	• UK's first Forensic Science postgraduate degree established at Strathclyde 50 years ago • A purpose-built laboratory, offering students the opportunity to analyse a wide range of evidence types. This includes a microscopy suite, DNA profiling laboratory, analytical chemistry laboratory, blood pattern analysis room, and a suite for setting up mock crime scenes • Member of European Network of Forensic Science Institutes	• Development of research that can be applied in the field, excellence in teaching and facilities	• Research related to the field, sometimes carried out in collaboration with operational Forensic Science laboratories. Academics also act as expert witnesses • Examples of research include work with practitioners and academics to develop an account of the use of Forensic Science in Scottish policing • Exploring how Forensic Science can be used effectively in criminal investigations	• In 2016 appointed Angela Gallop as its first professor of practice and strategic director for forensic science. Through her industry experience looking to strengthen links between Strathclyde and operational Forensic Science. • Forensic Science MSc students undertake 3 month placements, often with international laboratory or law enforcement partners • The course also includes a series of lecturers from practitioners within the Forensic Science field • Academics take part in networks including the Scottish Institute for Police Research, JUSTICE Scotland, Accreditation Service Forensic Science	• Academics provide important research and work as expert witnesses. The university has also worked to strengthen links between academics and practitioners.

Comparator	Description of cluster/centre	Objectives	Research focus	Collaborative activity	Impact
				Technical Advisory Committee and the Forensic Science Society	
University of Leicester, Alec Jefferys Forensic Science Unit	• Multidisciplinary research and teaching centre coordinated jointly by the College of Science and Engineering and the College of Social Sciences.	• Aims to bridge the gap between academic research and Forensic practice by supporting forensic research and teaching across the University and making research and innovation available to key stakeholders within the Criminal Justice System.	• Recent areas of innovation include: ○ Developing novel DNA recovery methods for use in cases of sexual violence in low-resource environments (Department of Criminology/Genetics) ○ Classification of stab injuries (Department of Engineering) ○ Novel methods of fingerprint enhancement (Department of Chemistry) ○ Defining emerging crime types such as car key burglary (Department of Criminology)	• Work with partner institutions and law enforcement agencies • Work within forensic science networks and with industry e.g. Ongoing collaborations with industry partners such as Consolite Forensics and Key Forensic • Provide expert witness testimony to court • Aim to make research available to the wider field	• Alec Jefferys discovered genetic finger printing at the university in 1984 • The unit aims to continue this legacy by providing further research that is applicable in the field, working within Forensic Science networks and collaborating with industry and law enforcement
University of Portsmouth, Forensic innovation centre	• Formed in partnership with Hampshire constabulary and allows students and academics work alongside police Forensic scientists	• As the first operational police facility on a university campus the centre aims to take a leading role in Forensic Science research, practice and police work	• Research areas include: digital crime, cybercrime, DNA, finger mark development • The centre is home to a cutting edge fingerprint development research hub • Digital Forensic group – Hampshire constabulary digital forensic group relocated to Portsmouth campus which has allowed	• As shown, there is extensive collaborative work with Hampshire constabulary through the centre	• Aims to develop research for use in the field, for example in the field of developing DNA recovery methods research from Portsmouth has changed operation practices to swab glove marks found at crime science for DNA rather than recovering for prospective matching , which leads to a significant

Comparator	Description of cluster/centre	Objectives	Research focus	Collaborative activity	Impact
			for sharing resources and examination of real crime evidence		increase in positive outcomes • First operational police Forensic research facility based on a university campus so the centre has had an important role in building links between academia and law enforcements
Offshore Renewable Energy Catapult	• Flagship offshore renewable energy technology and innovation research centre, offices in Glasgow, Leven and Blyth	• Through focus on six knowledge areas the Catapult is looking to accelerate the design, deployment and commercialisation of offshore renewable energy technology innovation. • This is done through a number of functions including conducting research to develop and test new theory, translating this research into tools to address industry needs and knowledge gaps and contributing to policy creation and information sharing.	• Research organised around six knowledge areas that they believe must be focused on in order to reduce costs of offshore renewable energy: ○ Blades ○ Drive trains ○ Electrical infrastructure ○ Operations & maintenance ○ Wave & tidal ○ Foundations & substructures	• The Catapult works with industry and academic partners to collaborate on research projects. It also offers its testing facilities and other services to academic and industry partners. • Industry partners include Scottish Power and EDF whilst academic partners include the University of Edinburgh and University of Strathclyde.	• Works to promote collaboration and commercialisation within offshore renewable energy • In 2016/17 the Catapult supported 257 industry collaborations and 137 academic collaborations. For every £1 of core grant invested £3 of additional research was leveraged which drove £21 of activity.
Digital Catapult	• One of ten Innovate UK funded Catapult centres, focused on driving economic growth through innovative research collaborations between industry and academia • It has five bases in London, Brighton,	• Aims to unlock digital growth through offering test centre facilities and connecting companies with academic researchers to fuel the development and application of innovative digital tools	• Research is organised around four technology drivers: ○ Data driven – new ways to work with personal data ○ Connected – the internet of things	• The Catapult works collaboratively with industry and academia and looks to drive partnerships • It also plays an important role in offering testing facilities and providing access to in house and	• To date, the Catapult has: ○ Worked with 25 corporate businesses ○ Worked with over 2000 SMEs and tech startups ○ Won collaborative R&D projects with 11 UK universities

Comparator	Description of cluster/centre	Objectives	Research focus	Collaborative activity	Impact
	Northern Ireland, North East and Tees Valley and Yorkshire		○ Intelligent – Artificial intelligence, particularly machine learning ○ Immersive – augmented, virtual and mixed realities	academic research/expertise	○ Collaborated with 14 international universities ○ Built three successful regional centres ○ Joined 16 European wide R&D consortia ○ Hosted over 30 international delegations
Cell and Gene Therapy Catapult	• Focused on collaboration to drive commercialisation of technology and industry adoption of research expertise and IP • Facilities include a laboratory in London and manufacturing centre in Stevenage (which is currently being built)	• Aiming to improve collaboration and commercialisation within the sector	• Services to researchers and companies are focused in the following areas: ○ Industrialisation ○ Manufacturing ○ Regulatory ○ Health economics and market access ○ Non-clinical safety ○ Clinical operations	• Existing partnerships with universities including Aberdeen, Newcastle, Edinburgh and Loughborough and with industry include GlaxoSmithKline	• Since the establishment of the Catapult in 2012, over £1.3 billion has been invested in UK companies, the number of jobs in the industry has more than doubled to over 1,000 and there has been a 180% growth in UK clinical trials.
The Data Lab	• One of eight innovation centres in key sectors across Scotland, funded by SFC with support from HIE and SE • Data Lab has hubs in Aberdeen, Edinburgh and Glasgow • Its work within informatics and computer science comes under three main headings: ○ Collaborative innovation – main way by which data lab	• Hubs work with industry, public sector and universities to promote research in informatics and computer science	• Its work is focused within informatics and computer science and research is carried out through collaborative innovation projects. • Projects typically feature one or more industrial or public sector partners, ore or more university researchers, professional project management staff and computing staff. To receive funding must have clear commercialisation outcome.	• The main objective of the Data Lab is to promote research and collaboration • Collaborative innovation projects are a particularly important part of promoting collaboration between industry, public sector and universities and commercialisation of research	• Helps to promote collaboration and commercialisation – examples include the development of tools to use customer satisfactions ratings to predict future revenue and improving fleet reliability through data insight

Comparator	Description of cluster/centre	Objectives	Research focus	Collaborative activity	Impact
	looks to transfer research into industry. ○ Skills and talent – aiming to grow skills supply through Data Lab MSc, co-funding of industrial doctorates and delivery of CPD and online learning to support local industry. • Community building – this includes an annual data science festival, monthly data science and technology meetups and sandpit and workshop events.				
Oil & Gas Technology Centre	• Established in Aberdeen in 2016 as part of the Aberdeen City Region Deal • Works to support research and collaboration to maximise economic growth from North Sea Oil	• The fundamental aim of the centre is to support economic growth from North Sea Oil • To do this it funds and supports collaborative research projects between industry, academia and government as well as giving wider support to innovative start-ups and SMEs	• Focused on the Oil and Gas industry, key areas of focus are: ○ Asset integrity ○ Well construction ○ Small pools ○ Decommissioning ○ Digital transformation	• Looks to act as a hub that can bring together actors from across industry, academia and government • This is done through a number of different models, including solution centres based at the centre focused on the five key research themes; centres of excellence based around universities; an incubation support centre; and an innovation hub.	• In its first year the centre invested £15 million in industry led projects • A further £3 million was invested in SMEs and start-ups. • 80 companies have joined as members of the solution centres and 72 projects and 10 field trials have been started • There were 200 applications to the incubation centre – 125 from SMEs and 75 from start-ups
Bayes Centre, University of Edinburgh	• Part of the University of Edinburgh	• Looking to drive the development and application of new	• Research will be focused around the following areas:	• Will look to drive collaborative activity	• The centre is not yet operational

Comparator	Description of cluster/centre	Objectives	Research focus	Collaborative activity	Impact
	• Focused on driving data-based innovation • Will be based in new-build at heart of the university of campus from 2018	technologies to fuel economic growth and attract talent • This will be done through academic and industry collaboration around key areas of challenge	○ Computational principles ○ Methods ○ Systems for extracting knowledge from data	between industry and academia • It will host university academics, spin-out companies, start-ups and industry partners	
Technology and Innovation Centre, University of Strathclyde	• Opened in 2015, the Technology & Innovation Centre is a building on the University of Strathclyde campus dedicated to building industry collaboration	• Aims to build collaboration between universities and industries and the commercialisation of research	• Focus on sectors such as Energy, Health, Manufacturing and Future Cities. In doing so the Centre is looking to tackle key industrial challenges. • The Technology and Innovation Centre offers laboratory facilities for industry to work with academic researchers	• Main objective is to promote collaboration • Projects can include: ○ a one off piece of contract research ○ long lasting collaborative research ○ participation in a consortium with other businesses with common interests	• Promoting collaboration and commercialisation. Companies already working with the Technology & Innovation Centre include Scottish and Southern Energy, the Weir Group and Scottish-Power.
Centre for Secure Information Technologies, Queens University Belfast	• Established in 2008 as centre for cybersecurity, hosted in Institute of Electronics, Communications and Information Technology • One of seven UK Innovation and Knowledge Centres	• Aim is to focus on real world research through collaboration with industry and promotion of commercialisation and support for SMEs/start-ups • Specifically designed as off campus - based at Northern Ireland Science Park alongside major computing players including IBM	• The focus of the centre's research is on Cyber Security	• CSIT takes an 'entrepreneurial approach' featuring collaboration between academics, researchers, engineers, industry and government • Multinational partners include Altera, BAE Systems, Cisco, Infosys, IBM, Intel/McAfee, Roke and Thales • The centre offers hot housing and incubation facilities • CSIT has prominent examples of spin outs and spin ins • Commercialisation activities include: ○ IP licensing	• CSIT has built up a significant reputation as a key player within Cyber Security • It has developed commercialisation and collaborative activities with major computing companies and government bodies

Comparator	Description of cluster/centre	Objectives	Research focus	Collaborative activity	Impact
				○ spin-outs ○ facilitation and support for spin-in companies ○ joint R&D with industry ○ creation of Knowledge Transfer Partnership (KTP) schemes ○ Innovation Vouchers ○ seminars ○ conferences ○ publications etc.	
Biopeople: Denmark's Life Science Cluster, University of Copenhagen	• A Life Science cluster, which part of the Danish infrastructure for innovation - established and co-funded by the Ministry of Higher Education and Science	• Promotes collaboration between companies and public research as part of an aim to lead a paradigm shift in the health care sector	• Biopeople is focused on Life Sciences and the health care sector in particular • Current projects and platforms include participation in the EU Boost4Health partnership of SME support groups, which is looking to set up transnational support in North West Europe for SMEs to bring innovations to European markets, and participation in a Biomarkers commercialisation project	• Aim of the centre is to promote collaboration between companies and public research	• The development of projects that can help to support businesses with collaboration and commercialisation. Examples include the development of a series of tools to support biomarker commercialisation
CENSIS	• One of eight SFC funded innovation centres, it is the Innovation Centre for Sensor and Imaging Systems. • Based in Glasgow at the Inovo building	• Looking to develop academic and industry collaboration in order to drive the Scottish economy • Particularly important as sensor and imaging systems is a globally growing sector	• Focus is on sensor and imaging systems research, applications include: ○ Sea/subsea areas ○ Rural areas ○ Industrial usage ○ Urban/city areas	• Offers testing facilities and expertise to promote collaborative research around sensor and imaging systems (SIS) • Aims to assist businesses in developing ideas through provision of in house researchers and	• From 2013 to 2017 CENSIS has been involved in 81 projects • In 2017, CENSIS had a GVA of £100 million and a current project portfolio of £14.3 million.

Comparator	Description of cluster/centre	Objectives	Research focus	Collaborative activity	Impact
				providing connections with academics • Offering an Internet of Things Centre to help businesses, mainly SMEs, overcome challenges in product development around the Internet of Things	
SynbiCITE, Imperial College London	• SynbiCITE is the Innovation and Knowledge Centre for Synthetic Biology	• Aims to accelerate and promote the commercial exploitation of synthetic biology research and engineering biology applications. • Does this through collaboration between academia, industry and government organisations	• SynbiCITE focuses on promoting collaboration and commercialisation of synthetic biology • Focus on new biological molecules and living organisms to create new drugs, industrial materials and energy sources	• SynbiCITE promotes innovation by providing academic and industry partners with resources to transfer research and ideas into commercial products. These resources include: • Education and training programmes for entrepreneurs looking to start synthetic biology companies • Funding opportunities • Laboratory facilities with staff scientists available to provide assistance • The London DNA foundry – at the core of SynbiCITE's facilities hub, provides a suite of state-of-the-art robotic equipment, training and workshops provided on all equipment at foundry	• Providing facilities and research to boost collaboration and commercialisation within the sector • Already a growing sector in terms of investment and start-ups and SynbiCITE has been key in supporting this, particularly with funding and incubation facilities
Medicines Discovery Catapult	• National facility based in Cheshire for collaborative research to develop new approaches to the	• Aims to support innovation in medicine discovery science in order to benefit patients	• Work with partners to find new diagnostics, biomarkers and drugs • Services include:	• Much of the work of the Catapult is to promote collaboration and as shown it works with	• Driving collaboration and research within a fragmented field in order to tackle the challenge of

Comparator	Description of cluster/centre	Objectives	Research focus	Collaborative activity	Impact
	discovery and proof of medicines, diagnostics and biomarkers	• Aims to do so by developing discovery techniques through bringing together a fragmented sector including industry , academia, charities, technologists, services, finance companies, SMEs and start-ups • Looking to address the challenge of the need to develop medicines more quickly and cheaply	○ Apply industrial decision making and project management to speed up drug, diagnostic and biomarker projects and enable them to be more readily adopted by industry and investors ○ Apply and test new scientific models of disease and new ways of measuring complex biology ○ Make fragmented data systems work together and harness valuable data to drive better decisions ○ Access the best UK discovery minds to give agile advice to our partners' projects and concepts ○ Broker access to patient samples and patient data to test and prove new biomarkers, diagnostics and software ○ Help patient charities and academics move their good science more quickly into great targeted products	partners from various fields to help improve medicine discovery	expensive and lengthy medicine discovery process
Fraunhofer Group for Life Sciences	• Fraunhofer society is a German group of research institutes. The	• The group aims to provide services and research to clients across the various	• Business areas include: ○ Medical Translational Research and	• Fraunhofer works in collaboration with industry and government clients	• Fraunhofer services and projects help to develop research in the area of life

Comparator	Description of cluster/centre	Objectives	Research focus	Collaborative activity	Impact
	society is based on a model of 70% of income coming from industry or government contracts and 30% from federal and state grants • Life Sciences group comprises six institutes and one research institution: the Fraunhofer institutes for Biomedical Engineering IBMT, Interfacial Engineering and Biotechnology IGB, Molecular Biology and Applied Ecology IME, Toxicology and Experimental Medicine ITEM, Process Engineering and Packaging IVV, and Cell Therapy and Immunology IZI, and the Fraunhofer Research Institution for Marine Biotechnology and Cell Technology EMB.	areas of life sciences covered within the institutes	Biomedical Technology: The Challenge of Innovative Diagnostics and Personalized Therapy ○ Regenerative Medicine: The Challenge of Qualified Biobanking and Controlled Self-Healing ○ Healthy Foods: The Challenge of High Consumer Acceptance and Disease Prevention ○ The New Potential of Biotechnology: The Challenge to Learn from Nature for Industrial Exploitation ○ Process, Chemical, and Herbicide Safety: The Challenge of Environmental and Consumer Protection	• The Life Sciences group also works on collaborative projects including work with Ribolution start up on a biomarkers project	sciences. In the Ribolution project, collaboration with Fraunhofer has also contributed to the success of a new life sciences start up.

Shortlisting

We have drawn on all 22 comparators outlined above in the report, using the information presented in Table 1. This contextualises the findings presented in the report, and demonstrates the breadth of activity in forensics, and also helps demonstrates relevant best practice in Catapult centre-type development. It is out with the scope of the work and unnecessary to undertake detailed research analysis of all 22. However, he research will be most effective if it is focused on the comparators from which we can learn the most, and the mix of comparator examples that will maximise the learning. ekosgen has reviewed the long list and applied a set of shortlisting criteria, in agreement with the client team, to arrive at the eight comparators that have been researched in more depth and

provide the detailed comparator study. The criteria are set out below and the rating provided for each indicates the relevance and potential of learning for the *JustTech* proposal.

Criteria for shortlisting

- **Forensics clustering**

    a) A dedicated physical hub/centre

    b) Reputation for research, either in forensic science or in relevant specialism

    c) Evidence of impact of taking research outputs to market

    d) Explicit economic development objective

- **Catapult centre development**

    a) A centralised, physical centre of Catapult activity (if applicable, alongside innovation cluster)

    b) Evidence of business-led collaboration working with academia and public sector

    c) Evidence of impact – exploiting market opportunities, focus on demand-led innovation

    d) Opportunity to gather detailed information on set up and implementation

Table 2 sets out the scoring against the criteria above. The highest scoring, and selected comparators are indicted in bold.

Table 2: Scoring against criteria

Comparator	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Score (/12)
Forensics clustering					
UT Sydney	**3**	**2**	**2**	**2**	**9**
University of Lausanne	**2**	**3**	**3**	**3**	**11**
King's College London	1	2	3	2	8
Amsterdam Centre for forensic science and medicine	3	2	2	1	8

Comparator	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Score (/12)
NIST	0	2	2	2	6
Cranfield University	1	2	2	2	7
University of Strathclyde	2	2	2	2	8
University of Leicester	2	2	2	2	8
University of Portsmouth	2	2	2	2	8
Catapult/innovation centre development					
Offshore Renewable Energy Catapult	**2**	**3**	**3**	**3**	**11**
Digital Catapult	**3**	**2**	**3**	**2**	**10**
Cell and Gene Therapy Catapult	2	2	3	2	9
The Data Lab	2	3	2	2	9
Oil & Gas Technology Centre	**3**	**3**	**2**	**3**	**11**
Bayes Centre	**3**	**3**	**2**	**2**	**10**
Technology and Innovation Centre, University of Strathclyde	3	2	2	2	9
Centre for Secure Information Technologies, Queens University Belfast	**3**	**2**	**3**	**2**	**10**
Biopeople: Denmark's Life Science Cluster	2	2	1	1	6
CENSIS	**3**	**3**	**2**	**3**	**11**
SynbiCITE, Imperial College London	1	3	2	2	8
Medicines Discovery Catapult	2	2	2	2	8
Fraunhofer Group for Life Sciences	2	1	3	1	7

We have focused on these comparators as they offer the best learning for the University of Dundee and the *JustTech* project in terms of the criteria outlined above. We have structured the comparator study drawing on the criteria and key areas of learning as headings.

Table 3 sets out the comparators for more detailed consideration, and the rationale for these choices.

Table 3: Shortlist of comparators

Comparator	Rationale
UT Sydney	UT Sydney has leading expertise in forensic science. It takes a triple-helix approach to research, and its focus on applied research with real-world uses is core to the centre's purpose. Its links with law enforcement agencies and commercial enterprises can offer lessons for cluster development around the centre.
University of Lausanne	Lausanne is arguably one of the leading European forensic science research institutes. Its wide range of activity offers insight into how Dundee can maximise the impact of its research expertise, and work collaboratively to take its output to market. Its existing links with Dundee (As well as UT Sydney) also offer additional channels of learning.
Offshore Renewable Energy Catapult	The ORE Catapult represents a good example of a Catapult-type centre designed to accelerate the development of renewable energy technology. In particular, the *JustTech* Project can potentially learn from the scale of collaborations, and the return on investment that these are realising, as well as how its test facilities are shared with industry, and also how services are provided to commercial organisations.
Centre for Secure Information Technologies, Queens University Belfast	CSIT has a strong commercial and industry focus, with an explicit commercial lead for enterprise and innovation, alongside academic leadership. Its presence at Northern Ireland Science Park aims to provide industry-relevant experience. It is also focused on a dedicated building on which to centre the cluster and its activity. There are some notable spin-outs and spin-ins present in the cluster.
Oil and Gas Technology Centre	The Oil and Gas Technology Centre is an important example of an innovation centre established through City Deal funding. Due to its being part of a City Deal it is a particularly relevant example and important learning can be derived from how the centre has delivered its activity through an innovation hub, working with universities and to support SMEs and collaborative projects.
Bayes Centre at University of Edinburgh	The Bayes Centre is a key example of a university based, City Deal funded innovation hub. In its work to develop data-driven innovation within and beyond the University of Edinburgh, it offers important learning on business models for university based, City Deal funded innovation centres. The opening of a new building in 2018 will also offer key insight into the importance of the built environment for innovation centres.
CENSIS	CENSIS is a key innovation centre that is working to drive innovation within the related fields of sensors and detectors. The work of CENSIS to provide resource and expertise to allow companies to develop and innovate will offer important learning on delivery models for how best to assist industry.
Digital Catapult	The Digital Catapult is another relevant example of a Catapult centre, working with industry and research to bridge gaps and foster innovation. Its focus across four centres on specific regional development, tapping into existing strengths, offers particularly relevant learning for how *JustTech* can contribute to the Tay Cities region.

Appendix 3: Comparator research case studies

Bayes Centre, University of Edinburgh

Overview
The Bayes Centre is part of the University of Edinburgh. It is a hub that will look to drive forward data-based innovation within and beyond the university. From 2018 it will be housed in a new purpose built building at the heart of the university campus with links directly to the Informatics Forum. The Centre will host occupants from the university alongside its start-up, spin-out and industrial collaborators. The building will have four to six floors and an occupancy of 600 to 660 people. It is receiving funding through the Edinburgh City Deal and is part of a wider focus in Edinburgh on driving digital innovation and forming the centre as a key data hub. This has included projects such as the Data Lab SFC funded innovation centre.
Objectives
The focus of the Bayes Centre is on forming a data-driven ecosystem that develops and applies new technology, fuelling economic growth and attracting talent. Its delivery will be focused on interdisciplinary and academic/industry collaborations that can develop solutions to key challenges. *"The core mission for the Bayes Centre is to excel in technology which powers the interaction of people, data and systems, and to create significant positive impact from talent and ideas."* Within this core mission there are five themes: • **Talent** – attract and sustain a talent pool • **Entrepreneurship** – increase opportunities for entrepreneurs across sectors through targeted supports, attracting investment and encouraging partnership and collaboration • **Research** – Form the city region as a key area for data science research by connecting the talent pool with the research base and promoting interdisciplinary research • **Datasets** – Provide expertise and tools to show the value of data assets, put privacy, security and trust at the heart of data driven innovation • **Adoption** – Accelerate the adoption of data driven innovation in industry through new partnership with local and global companies and agencies
Overview of research expertise
Research expertise comes from the School of Informatics at the University of Edinburgh. The centre will focus on research around computational principles, methods, and systems for extracting knowledge from data. This will then be applied as tools for applying data science to practical problems.
Collaborative activity
The Bayes Centre will look to drive forward collaborations between industry and academia, hosting university academics, spin-out companies, start-ups and industry partners. Existing partnerships include key players in the industry such as Intel and Huawei.
Commercialisation activity
The centre is looking to drive entrepreneurship and encourage commercialisation and application of research. It will do this through bringing together academic and industry partners, including university start-ups and spin out companies.
Delivery Model
The centre will be based on the University of Edinburgh campus and will host academics, industry partners and start-up and spin out companies.
Funding/Resourcing
The centre has received funding through the Edinburgh City Deal. In terms of resourcing, it is estimated that the centre will be able to host between 600 and 660 people.

Sources

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CENSIS

Overview

CENSIS is one of eight Innovation Centres initially funded by the Scottish Funding Council with support from Scottish Enterprise and Highlands and Islands Enterprise. It is based in Glasgow and is the Innovation Centre for Sensor and Imaging Systems.

Objectives

The focus of CENSIS is on developing innovation in sensor and imaging systems and promoting collaborations between industry and academia. In doing so CENSIS looks to drive the Scottish economy. This is particularly important in the growing market of sensor and imaging systems – globally the market is worth over £600 billion. There are currently over 170 SIS companies in Scotland, which employ over 16,000 people and contribute over £2.6 billion annually to the Scottish economy.

Overview of research expertise

CENSIS offers facilities and expertise to promote collaborative research around sensor and imaging systems (SIS). There are many different utilisations for SIS products, These include:

- Sea/subsea
  - Oil & Gas
  - Marine science
  - Offshore renewables
  - Aquaculture
- Rural
  - Management and protection of wilderness and forest areas
  - Precision agriculture
  - Tourism
- Industrial
  - Manufacturing
  - Power stations
  - Transmission lines
  - Solar energy
  - Onshore wind farms
- Urban/City
  - Smart city management
  - Smart buildings
  - V2x
  - Residential
  - Air quality Urban drainage
  - Transportation

CENSIS also offers support for industry based projects as part of the Sensor and Imaging Systems MSc delivered by the University of Edinburgh and the University of Glasgow and the Sensor and Imaging Systems EngD offered by Universities of Edinburgh, Glasgow, Heriot-Watt and Strathclyde. CENSIS also supports a small number of PhD studentships via the EPSRC CDT in Integrative Sensing and Measurement, where businesses can take the lead in arranging projects with an academic partner.

Collaborative activity

The Centre aims to assist business development by bringing together academic experts and its in house experts to work with technology companies to develop new, and improve existing, sensor and imaging systems. The role of CENSIS is to allow companies to overcome barriers to technological development. It does this through offering a safe environment with the necessary facilities and expertise to explore and develop the limits of technological capabilities and from this achieve transformational growth. In this sense it offers companies a bridge to move technology into the commercial realm. This is done through bringing together in house and academic researchers, offering funding and assembling projects that can leverage further funding. This work includes:

- Sourcing expertise and resources according to what companies need
- Co-funding feasibility studies and helping to leverage additional funds for larger projects
- Assisting companies by positioning them within the supply chain and emerging technologies landscape
- Offering standard Ts&Cs and IP arrangements to make it easier to work with academic partners
- Offering an Internet of Things Centre to help businesses, mainly SMEs, overcome challenges in product development around the Internet of Things

Through these services, CENSIS has had great success in improving the Technology Readiness Level of its projects. The majority of projects start at TRL level 3 (analytical and experimental critical function) and finish at TRL level 6 (system/subsystem model of prototype demonstration in a relevant environment).

CENSIS also works with non-technology companies to help them develop their companies through the use of sensors and imaging systems, a key focus has been on the Oil and Gas industry due to the opportunities within the subsea and offshore sectors.

A key success has been the formation of the LoRA Internet of Things network in partnership with Stream Technologies, Semtech Inc. and Boston Networks. This is a wireless Internet of Things network covering 12 km of Glasgow. The aim of the network is to provide a low cost Internet of Things network which can make the city more connected and enable the development and use of devices such as building and indoor environmental monitors, pollution sensors, tags for tracking valuable assets and social care devices designed to support independent living.

In total, from 2013 to 2017 CENSIS has been involved in 81 projects across five sectors.

Commercialisation activity

CENSIS' activity is focused on assisting companies in commercialising technologies. An important part of this is offering expertise and facilities, both in house and with academic partners, to businesses that can help them overcome the risks and barriers involved in technological development. Key examples include a project between Biogex and the University of Strathclyde to develop a bio-imaging platform that can perform accurate, live, intracellular analysis of cells in 3D, and a project between Amethyst Research and the University of Dundee to develop new uses for infra-red spectroscopy and infra-red cameras to identify biological and chemical deposits.

In 2017, CENSIS had a GVA of £100 million and a current project portfolio of £14.3 million.

Delivery Model

CENSIS is based at the Inovo building in Glasgow. The centre also houses the Internet of Things Centre. Industry and academics who are interested in taking part in projects are invited to contact the centre, whilst the Internet of Things centre is available to companies who join as members. The centre also has several university partners: University of Glasgow, University of Aberdeen, University Dundee, University of Edinburgh, Glasgow Caledonian University, Heriot-Watt University, UHI, Robert Gordon University, University of St Andrews, University of Stirling, University of Strathclyde and UWS.

Funding/Resourcing
CENSIS is one of eight Innovation Centres supported by the Scottish Government through funding from SFC and support from Scottish Enterprise and HIE. In terms of projects, CENSIS will fund or co-fund with a third party collaborative R&D projects and will solely fund projects researching industry trends. Industry is expected to fund projects requiring consultancy on specific needs. In terms of staff resource, as mentioned CENSIS makes use of both in house and academic partner researchers. At CENSIS there is a total staff of 22, with seven working specifically within business development, one CEO, one academic lead, one chairman, six technical staff, two project management staff, one finance staff member, one contracts staff member and two administration staff.

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Centre for Secure Information Technologies, Queen's University Belfast

Overview

The Centre for Secure Information Technologies at Queen's University Belfast was established in 2008 as one of seven Innovation and Knowledge Centres (IKCs) within the UK, funded through the Engineering and Physical Sciences Research Council (EPSRC). It is hosted within the Institute of Electronics, Communication and Information Technology (ECIT). ECIT opened in 2004 as an off campus department, located in the Northern Ireland Science Park (now Catalyst inc), which is part of the waterfront Titanic Quarter regeneration project in Belfast. The institute was located within the Science Park in order to better promote links and collaboration with industry and encourage a more "real world" approach, aligned with economic development. CSIT is co-located with other academics and researchers and within the wider Park neighbours include a number of major players within the computing industry such as IBM and Microsoft. The Centre offers Cyber Security teaching through specific Masters and PhD programmes and also undertakes academic research across 5 research groups. As well as its co-location, work with industry is promoted through incubation facilities for start-ups, including through the CSIT Labs programme, the CSIT membership programme, the centre's status as an Innovation and Knowledge Centre and Knowledge Transfer Partnerships.

Objectives

CSIT aims to be 'a global innovation hub for cyber security' through driving innovation and capacity building within the Cyber Security sector. In doing this it aims to support industry, promote academic and industry collaboration and to become the "go-to" place for innovative and collaborative research. It also aims to address the challenge of Cyber Security skills provision through the delivery of Masters and PhD courses.

Overview of research expertise

CSIT is the largest UK academic centre undertaking Cyber Security research. There is emphasis within the centre on real-world research and collaboration with industry. This has shaped the direction of research. The four main research themes for the Centre are:

- Information security – This refers to research aimed at improving ways to detect cyber threats and defence mechanisms. CSIT research around network security and video surveillance systems has been commercialised by industry partners and content processing technologies research has led to the establishment of a number of start-ups.
    - Specialities include:
    - Network Security
    - Cloud Computing Security
    - SCADA & Smart Grid Security
    - Malware Analysis
    - Physical Unclonable Functions (PUF)
    - Side Channel Attacks and countermeasures
    - Legal and Ethical Aspects of Security

- Physical security – This research focuses on technologies such as CCTV, which track people and events. An important aim is to enable CCTV to notify security alerts in real time so that perpetrators are more likely to be caught.
    - Specialities include:
    - Person Tracking in 3D
    - Event Recognition, Search and Retrieval
    - Event Management Platform

- Convergence of physical and cyber security – This research focuses on the coming together of traditional and information security technologies. For example, video surveillance technology making use of digital and intelligent surveillance technology.
    - Specialities include:
    - Converged threat detection and handling
    - Overlaid ad-hoc networking
    - Access control

- Wireless enabled security systems – This research aims to develop solutions to problems that arise from the use of wireless front-end technology.
    - Specialities include:
    - Frequency Selective Surface Filters for sub–terahertz space applications
    - Use of liquid crystal for steerable antennas
    - Stealth absorbers and frequency selective windows
    - Novel broadband antenna design
    - Far Field, Near Field and Reverberation Chamber Antenna Measurement
    - 60 GHz Gbit communications system design

Research groups within the Centre are:

- Data Security systems
    - Research within this group includes:
    - Quantum safe cryptography – the design of physically secure and quantum-safe hardware and software
    - Cryptographic hardware and software architectures
    - Physical Unclonable Functions for M2M and IoT authentication
    - Side channel analysis
    - Hardware Trojan detection

- Networked Systems Security
    - Research within this group includes:
    - Network security
    - Virtual Networks
    - Cloud computing security
    - Mobile & IoT security
    - Critical Infrastructure Security
    - Malware/Botnet defence

- Security Analytics and Event management
    - Research within this group includes:
    - Deep learning neural networks
    - Graph mining
    - Event reasoning
    - Multimedia content analysis

- RISE: UK's Research Institute in Hardware Security & Embedded Systems
    - Research within this group includes:
    - £5 million UK Global centre for research and innovation in hardware security
    - Engagement with UK industry and stakeholders
    - Top place for hardware security research
    - Research is translated into commercial projects
    - Network of international collaborations & project partnerships

A fifth research group – The Leverhulme Interdisciplinary Network on Cybersecurity and Society (LINCS) – supports interdisciplinary research between the social sciences, computer sciences and electronic engineering. Seven interdisciplinary doctoral scholarships were offered by LINCS in 2017. LINCS scholarships are jointly funded between the Leverhulme Doctoral Scholarships Scheme and QUB. Research in this area has particularly focused on issues such as ethics within algorithms and machine learning, use of social media and attribution of criminal responsibility in an age of robots and new machines.

Recent research projects completed at CSIT reflect the importance of collaboration with industry. For example, the centre has taken part in a number of European Framework FP7 programmes that have sought to build collaboration. These include the PRECYSE project, which has involved a consortium of university, local municipalities and businesses, such as Thales and Skytek, to develop technologies and tools that can improve the security of ICT systems that support Critical Infrastructures. To date these have been applied at the traffic control centre in Valencia and Linz Storm electricity distributor in Austria.

Liopa is another example of an industry focused project. It is a spin-out from CSIT that has commercialised biometric authentication and speaker verification technologies developed over a number of years. The spin-out was supported through winning the Technology Strategy Board "Preventing fraud in m-Commerce" Small Business Research Initiative (SBRI) competition. The application allows user to speak a random sequence of letters, digits or words into a smartphone camera, a server then uses the biometric characteristics of the person to verify against a database. It is of particular interest as other security verification systems are often off putting to customers as they are time consuming, resulting in customers not completing sales.

More academic based projects, funded by the EPSRC, include Providing Autonomous Capabilities for Evolving SCADA (PACES). This project received £620,000 funding and looked to develop the Multi-Agent System architecture integrated with advanced event reasoning that will allow for the ability to detect, diagnose and respond in real-time. The result of the project will be a cyber sensor able to respond to threats in real-time.

A new ESPRC and National Cyber Security Centre £5 million funded hardware security institute has also recently been launched at CSIT. The Research Institute in Secure Hardware and Embedded Systems (RISE) is looking to tackle global Cyber Security threats through four initial component projects and involves researchers from Queen's University, the University of Cambridge, University of Bristol and University of Birmingham.

CSIT has been recognised as one of the 14 Academic Centres of Excellence in Cyber Security Research in the UK by the National Cyber Security Centre at GCHQ since 2012.

Collaborative activity

Clustering and collaboration is very important for CSIT. As noted above, CSIT is involved in a number of research projects that involve collaboration and links with industry. The Centre is one of seven Innovation and Knowledge Centres (IKCs) within the UK, funded through the EPSRC. IKCs are focused on key emerging technologies, with funding used to support entrepreneurial research between university researchers and businesses with the aim to progress research as well as grow businesses. IKCs are led by an expert entrepreneurial team, which advances the research agenda and drives commercialisation of technology for wealth generation.

Collaboration activities primarily include the opportunity for companies to become members and associate members of CSIT. Membership offers a number of opportunities including PhD and Masters placements, involvement in undergraduate projects, access to the wider membership network to encourage further innovation and collaboration, linking with CSIT projects, opportunities to contribute to undergraduate courses, discounted places on CSIT masters and CPD courses, advisory board seats and opportunities to influence research plans. Current partners include global companies such as IBM, BAE systems and McAfee.

Collaborative opportunities also include Knowledge Transfer Partnerships (KTPs). These are partnerships between academic groups and businesses, where one or more graduate is employed to help transfer skills and expertise between partners. Up to £60,000 of support is available at a cost of £20,000. CSIT's KTPs are part of a wider KTP initiative and £13 million funding from the Northern Ireland Executive. One example of a KTP at CSIT is with Intelligent Environments, a digital financial solutions firm. The partnership offers benefits for both as CSIT's research will allow Intelligent Environments to develop more innovative and secure digital financial solutions while CSIT will gain more insight into industry and the digital financial sector in particular.

Another important example of CSIT's clustering and collaboration is CSIT Labs. This is a programme open to start-ups, academia and government organisations. Those who are successful receive 9 months of support in Business Plan Development, are provided mentoring through an iterative innovation model and given 3 man months of engineering support. CSIT Labs also offers incubation space at CSIT. Mentoring and business plan development support is provided by associates from industry partners. A particular benefit of the programme is access to CSIT's wider ecosystem. Alumni of the programme include Cyber Lytic, a real-time risk and security intelligence company, which has particularly benefited from CSIT's partnership with IBM as this has helped the company to accelerate the integration of their software with the IBM QRadar system.

Commercialisation activity

As has already been noted, commercialisation and industry links are very important for the Centre. Commercialisation activities include:

- IP licensing
- spin-outs
- facilitation and support for spin-in companies
- joint R&D with industry
- creation of Knowledge Transfer Partnership (KTP) schemes
- Innovation Vouchers
- seminars
- conferences
- publications etc.

Relationships with industry are primarily through the membership scheme mentioned above and multinational partners include Altera, BAE Systems, Cisco, Infosys, IBM, Intel/McAfee, Roke and Thales. Membership allows industry partners to access placements, professional development courses and shape research plans, and in return gives CSIT students vital industry experience.

Through CSIT Labs, CSIT also offers hot-housing and incubation facilities to help develop spin-out and spin-in companies. In total CSIT has produced 8 spin outs. Seven technologies Ltd is an example of a spin-in, it is an engineering company specialising in rugged SCADA type applications for monitoring real time data. All designs are optimised for operation in inhospitable environments.

Titan IC Systems is a spin-out and it is a key innovator within the regular expression for content processing area. Applications include Intrusion Detection Systems, Intrusion Prevention Systems, Data Loss Prevention, Next Generation Firewalls, Smart Network Interface Cards (SmartNIC), Network Adaptors and PCIe Accelerator cards. Other spin outs include Ditaca, which provides services to transform industrial control systems. There are a growing number of spin outs from the CSIT Labs programme with 5 alumni from the first 2016 cohort and another 6 taking part in the 2017 cohort. Another example of a spin-out is the Liopa project mentioned in the research section.

CSIT also delivers two innovation accelerator programmes. HutZero, which is delivered with Cyber London, is aimed at helping early stage ideas form into potential businesses. It includes a free one week boot camp and 3 months of mentoring. Cyber 101 is aimed at more mature cyber SMEs and gives access to advice and mentoring both in person and online. There is also an intensive single day workshop. The programme is advertised to the private and public sector along with the investment community through a demo day and it is targeted at senior stakeholders. The programme is delivered in partnership with UK Digital Catapult and UDC intends to start delivering boot-camps nationally with contented tailored to local cyber clusters.

CSIT has been very influential in the development of the Belfast cyber cluster which now hosts 38 companies and has produced over 1200 jobs.

Delivery Model

CSIT is delivered through a centre located off-campus at QUB's Institute of Electronics, Communications and Information Technology (ECIT), which is based at the Northern Ireland Science Park/Catalyst inc. As described, through the centre it offers teaching, research (including collaborations with industry) and lab/incubation facilities to spin-outs, spin-ins and SMEs.

Funding/Resourcing

As noted above, the centre is one of seven Innovation and Knowledge Centres (IKCs) within the UK, funded through the EPSRC. It also leverages additional support from Invest Northern Ireland. Initial funding from EPSRC amounted to £30 million. In 2015 phase 2 core funding of £14 million was secured. In addition to this £15 million in competitive tendering was leveraged between 2009 and 2015 and it is expected that from 2015-2020 phase 2 core funding will leverage an additional £38 million. Major funders are: EPSRC, InnovateUK, InvestNI, Industry (both for services and membership fees: £30,000 annually for full member, £5,000 for associate), EU FP7 and UK's National Cyber Security Centre (NCSC).

In total there are 90 staff based at the centre – one director, 16 academics, 16 engineers, 5 business development staff, 15 Post-Doctoral Research Associates, 29 PhD students and 9 IT/clerical staff. This includes four key management staff – Director, Head of Business Development, Head of Strategic Partnerships and Engagement and Operations Manager.

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Digital Catapult

Overview

The Digital Catapult is one of ten Catapult centres in the UK. Catapult Centres were first established by Innovate UK in 2011 following a 2010 report for the Department for Business, Innovation and Skills which recommended the establishment of a number of technology and innovation Centres. They are not-for profit, independent technology and innovation centres that aim to drive research and innovation through collaborations between industry, research and academia. Through driving innovation the Catapult centres look to make a significant contribution to economic growth. The Digital Catapult was established in 2014 and has five bases – in London, Brighton, Northern Ireland, North East and Tees Valley and Yorkshire. It intends to work with companies to accelerate growth through the application of digital tools.

Objectives

The Digital Catapult aims to unlock digital growth in the UK economy by working with companies to assist them in applying digital innovation tools. In this sense it helps to bridge the gap between research and innovation by finding the right cutting edge tools that can address challenges, increase productivity and accelerate market development. It does this by connecting enterprises with researchers and providing experimental and testing facilities.

Overview of research expertise

The Digital Catapult is focused on developing digital research that can then be applied as technological tools. It works across the following four technology drivers:

- **Data driven** – this focuses on the development of new ways to work personal data that will allow for greater control and trust and includes applications of blockchain and smart contracts, cybersecurity particularly for emergent threats
- **Connected** – the Internet of Things and networking technologies that enable it e.g. Low-Powered Wide-Area networks and 5G
- **Intelligent** – Artificial intelligence, particularly machine learning
- **Immersive** – augmented, virtual and mixed realities and related new forms of human interface

Collaborative activity

The Digital Catapult is focused on the use of digital technologies to grow and develop the economy. To do this it works with industry and academia, mostly through the following core interventions:

- Building, coordinating and increasing access to large scale tests beds
- Driving engagement between small companies and large companies
- UK, EU or International Collaborative Research & Development projects
- Accelerating the growth of markets by supporting ecosystems and helping exports
- Development of standards
- Building prototypes, testing feasibility of technologies
- Helping large companies become more efficient through the introduction of digital innovation
- Providing access to facilities, skills and space

In terms of its collaborative activity, the Digital Catapult offers coffee mornings to meet potential collaborators; holds various events to promote its work; is building networks within personal data, trust and the Internet of things; holds open calls to invite companies to take part in projects; and also invites start-ups and small to medium sized businesses to submit their product to be part of its showcase programme which highlights the latest digital innovations.

Some examples of collaborative projects undertaken at the Catapult include the Catapult's current work to map 5G in the UK. The Digital Catapult is leading on an Innovate UK funded project to provide evidence on the current state of the UK 5G ecosystem, this will be key in developing the 5G ecosystem which will be vital for the development of future digital applications. The Digital Catapult is also currently working with early stage investor Seedcamp on the Augmentor Programme which is seeking to help early stage businesses with the development of immersive technology.

Commercialisation activity
As detailed above, the Catapult's is a not-for-profit organisation but its core objectives are to assist in economic growth through the development of digital technologies. It does this through offering facilities and expertise and participating in research projects that can help to drive growth.
Delivery Model
The Catapult is delivered through its Headquarters in London and four centres in Brighton, Northern Ireland, North East and Tees Valley and Yorkshire. Each of these centres has a specific focus: • **Brighton** – This centre focuses on project to encourage innovation and growth in retail and creative industries through the utilisation of digital tools. It is led by Coast to Capital LEP in collaboration with core delivery partners, Wired Sussex and the University of Brighton. • **Northern Ireland** – This centre focuses on helping organisations work more productively through the utilisation of innovative digital technologies. It is anchored within the local digital ecosystem, including CSIT. • **North East & Tees Valley** – Based in Sunderland, offers incubation space for start-ups and SMEs developing new data-driven products and services. The centre offers an expert team of industry experts and academics. • **Yorkshire** – the Digital Catapult works to grow the region's digital economy through developing the Yorkshire digital community and convening projects to support collaboration, innovation, supporting SMEs and working academics on R&D projects.
Funding/Resourcing
Catapult Centres receive approximately £10 million core funding per year for five years from Innovate UK. In the long term centres aim to be funded through: one-third core public funding for long-term investment in infrastructure, expertise and skills development; one third business-funded R&D contracts (won competitively); and one third collaborative applied R&D project (funded jointly by the public and private sectors, also won competitively). In terms of staff, the Digital Catapult has 10 directors and nine technology experts. It also has eight non-executive directors including representatives from academia and industry.

Sources

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University of Lausanne

Overview

The University of Lausanne has a prestigious reputation for Forensic Science research and training. It offers the only comprehensive Francophone teaching of Forensic Science and was the first university to open a School of Forensic Science and offer Forensic Science degrees. The School of Forensic Science is a member of the European Network of Forensic Science Institutes and offers undergraduate, postgraduate and doctorate degrees as well as online short courses. Demonstrating its strength in the area, 60% of Swiss research papers on Forensic Science come from the University of Lausanne. As well as academic research, the university takes part in collaborative projects and offers consultancy services.

The University of Lausanne is also a key partner, along with the University of Geneva, in the University Centre for Forensic Medicine (CURML). The centre has two university hospital sites – one in Lausanne and one in Geneva. The centre provides expertise and assistance to the judicial and police authorities, cantonal administrations, national and international sports federations, the world anti-doping agency, the International Olympic Committee and international public/private institutions. Through an academic wing it also takes part in research and offers training.

Objectives

The focus of the School of Forensic Science is on the development of Forensic Science through effective teaching, research and collaboration across academia, law enforcement and industry. The primary aim of CURML is the provision of Forensic Science services that allow for the effective use of forensic evidence in court cases. CURML supplements these services with research and teaching that aim to embed the skills and tools necessary to develop effective forensic evidence.

Overview of research expertise

Recent research within the School of Forensic Science includes:

- Studies on the detection of altered fingerprints
- A study on the use of colour as a forensic tool for detecting counterfeit medicines
- Studies exploring data and likelihood ratios

Some of the main areas of research for CURML are:

- Sudden cardiac death
- Forensic imagery
- Post mortem clinical chemistry
- Post mortem forensic imaging
- Clinical forensic imaging
- Forensic anthropology
- Analytical and forensic toxicology – study of new markers, impact of drugs and medicines on behaviours and the relationship between road accidents and drug and medicine use
- The use of DNA in a medico-legal context

These research areas are spread across the CURML units:

- French Unit for Forensic Medicine (URMF)
- Forensic Imaging and Anthropology Unit (UIAF)
- Toxicology and Forensic Chemistry Unit (UTCF)
- Forensic Genetics Unit (UGF)
- Unit of Medicine and Traffic Psychology (UMPT)
- Swiss Laboratory for Doping Analysis (LAD)
- Unit of Violence Medicine (UMV)
- Forensic Psychiatry (PL)
- Medical Law, Ethics and Humanitarian Medicine (DMMH)
- Working Group: Reception and Communication (GTAC)

Collaborative activity
The School of Forensic Science contributes to training of judicial bodies e.g. magistrates and police and participates in pilot projects and collaborations with local and international judicial bodies. Collaboration is often through the European Network of Forensic Science Institutes (ENFSI), for example the school participated in an ENFSI project to evaluate new DNA multiplex kits. The University of Lausanne also works in collaboration with the Leverhulme Research Centre for Forensic Science at the University of Dundee. As detailed below, the school also offers services to law enforcement. CURML is in and of itself a collaborative project as it is based on a partnership between University of Lausanne and University of Geneva. Much of the centre's work is also based around offering expertise and assistance to law enforcement agencies and industry.
Commercialisation activity
The School of Forensic Science is commercially active through offering expert services on a consultancy basis to national and international law enforcement in a number of areas, including: • Narcotics • Fires and explosion • Documents, writings, signatures • Identification of people • Image analysis and photogrammetry • Micro-traces In particular academics based at the School of Forensic Science can assess the reliability of evidence and whether or not it would stand up in court. As detailed in the overview, much of the CURML's work is based around offering expert services to law enforcement and other organisations, both. These services are provided nationally and internationally and CURML has worked on a number of high profile cases including the Sierre coach crash. The units specified above demonstrate CURML's areas of work and particular areas of expertise for which it provides services include legal medicine, medical law and doping analysis.
Delivery Model
The School of Forensic Science is located on the University of Lausanne campus, and is located within the Faculty of Law, Forensic Science and Public Administration. It has built on collaboration with law enforcement and industry through its ENFSI membership. CURML is delivered through two university hospital sites – one in Lausanne and one in Geneva. It was formed through a partnership between University of Lausanne and University of Geneva. It is comprised of the nine units mentioned above. Teaching and research is delivered via the two universities and some of its main work is through provision of expert services to the organisations mentioned above.
Funding/Resourcing
The school is part of the University of Lausanne, its research is funded through various grants and it also develops its own revenue through consultancy work. The school has 16 academic staff, just under 50 graduate assistants and just under 50 administrative and technical staff. CURML was formed and funded through the merger between the University of Lausanne and University of Geneva. Its provision of services and expertise also creates commercial revenue and it has 160 staff across its two sites.

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Oil and Gas Technology Centre

Overview

The Oil & Gas Technology Centre was established in October 2016 with £180 million funding as part of the Aberdeen City Region Deal. The Deal is supported by the Scottish Government, UK Government, Aberdeen City Council, Aberdeenshire Council and Opportunity North East. The centre is industry-led and knowledge focused, it receives support from the UK and Scottish governments to fund innovation projects between industry, academia and government that help to maximise economic development within North Sea Oil.

Objectives

The focus of the Oil & Gas Technology Centre is on developing innovation and technology that can help to maximise economic development from the UK North Sea Oil continental shelf, more locally the centre aims to anchor the Oil and Gas supply chain in the North East and help the region become a global technology hub.

Overview of research expertise

The centre is focused on innovative research within and outside Oil and Gas that can help to drive economic growth and development in the sector. As is covered in more detail in the delivery models section, key areas of focus within its solution centres are:

- **Asset integrity** – developing technology to manage issues around ageing assets
- **Well construction** – developing and utilising innovative technologies to support reducing well construction costs on the UK Continental Shelf by 50%.
- **Small pools** – developing technology to lower costs of exploiting small oil pools
- **Decommissioning** – developing research and technology to address challenge of decommissioning costs
- **Digital transformation** – working with other sectors to develop ideas for use of technology in the centre

More generally the centre welcomes innovative ideas and research that can help fully exploit the economic potential of North Sea oil and offers facilities and expertise to drive this forward. Centres of excellence are one example of this, where universities and industry will provide staff to offer expertise.

Collaborative activity

The Centre aims to be a hub that can bring together industry, independent researchers and academia. The centres of excellence and innovation hub offer industry and academia the opportunity to come together to drive innovation and new technologies that can further develop the economic potential of North Sea oil. In particular the first Centres of Excellence are being established with the University of Aberdeen and Robert Gordon University. The solution centres are working to develop solutions and technologies to key challenges facing the industry. In the first year 80 companies have joined as members of the solution centres and 72 projects and 10 field trials have been started. There were also 400 technologies screened and 183 new technology ideas generated during the centre's first year. The TechX centre is key for supporting innovation through services and funding for start-ups and SMEs. In the first year, there were 200 TechX applications, 125 from SMEs and 75 from start-ups. In total in its first year the centre had over 5,000 visits from government, industry, schools and the community.

Commercialisation activity

The focus of the centre is on commercial technology development that can be deployed within industry in order to fully exploit the economic potential of North Sea oil. This includes supporting the development of research and technology from industry and academia in order that it can reach the market. In its first year the centre co-invested £37 million in industry led projects, with £22 million coming from industry and £15 million from the centre. The centre has also worked to boost industry and commercialisation through £3 million funding invested in SMEs and start-ups.

Delivery Model

The centre works through four different models:

- **Solution centres** based within the Oil and Gas Technology centre. These are based around five key themes, identified in collaboration with the Oil and Gas Technology Leadership Board and Oil and Gas authority:
    - **Asset integrity** – works to develop and the utilise technologies to help manage issues around ageing assets, particularly given the high costs of technologies and facilities and the need to maximise economic growth. In particular the centre aims to assist industry in reducing asset integrity costs by 30-50%, which requires the use of innovative technologies;
    - **Well construction** – developing and utilising innovative technologies to support reducing well construction costs on the UK Continental Shelf by 50%. Reducing drilling costs is key to reversing decline in exploration and development and unlocking further oil reserves.

    - **Small pools** – seeks to develop innovative technologies to lower development lifecycle costs of small pools in order that they can be exploited economically
    - **Decommissioning** – developing research and technology to reduce the challenge of decommissioning costs that the industry is currently facing. This is being done through work with academics and accelerating technologies to market.
    - **Digital transformation** – working with partners from other sector to learn how digital technology can improve, transform and disrupt the industry and from this develop transformative data solutions.
- **Centres of excellence**: stimulating innovation - Centres of Excellence will be established around new technology R&D capability that either already exists in or is being developed within local universities or industry. They will be physical centres with the facilities to drive transformative technological research in the North East. The first centre will focus on Field Life Extension and Decommissioning with the two local universities, Aberdeen University and Robert Gordon University, at its core. They will be integrated with partner anchor companies from the Oil and Gas industry who will be invited to contribute and participate with funding, equipment or staff.
- **TechX: Accelerating Innovation** – based at the Oil and Gas Technology Centre, TechX offers expertise and support both as a technology accelerator and incubator for start-ups and SMEs. Facilities include funding, business mentors, co-working space, business partners, prototyping, test facilities, field trials and showcase events to assist in commercialisation of new technologies. Applications are open to ventures – companies looking to fill technology gaps (this strand is in partnership with Deep Science Ventures), pioneers – start-ups with potentially game-changing technologies and market entry – SMEs looking to fast-track validation and entry to Oil and Gas market (aimed at those inside and outside industry).
- **Innovation Hub** – based at the Oil and Gas Technology Centre, the offers state of the art facilities to drive innovation and new technologies that can fully exploit the economic potential of North Sea Oil. It helps to bring industry, academia and technology providers (from within and outside the sector) together to develop solutions to challenges. The hub also delivers a programme of innovation events and workshops, which is driven by the priorities of industry and used to engage with young people in schools, colleges and universities.

Funding/Resourcing

The centre is funded through the Aberdeen City Region Deal, which is supported by the Scottish Government, UK Government, Aberdeen City Council, Aberdeenshire Council and Opportunity North East. From the City Region Deal £180 million funding was made available and in its first year the centre invested £15 million in projects with industry and a further £3 million in supporting start-ups and the development of SMEs. In the long term an additional £174.1 million is to be generated in matched funding from industry, universities or others as part of the Centre's long-term funding, which can be both cash and in-kind.

The centre has a leadership team of 10 managers/directors, covering the following posts: CEO, Innovation Network Director, Finance and Commercial Director, External Relationship Director, Technology Accelerator Director, Asset Integrity Solution Centre Manager, Well Construction Solution Centre Manager, Small Pools Solution Centre Manager, Digital Transformation Centre Manager and Decommissioning Solution Centre Manager. The centre also has a board with a chairman, vice chairman and representatives from industry and academia. The organisations represented are:

- Bibby offshore
- Scottish Enterprise
- Opportunity North East
- The Oil & Gas Technology Centre
- The Oil & Gas Authority
- Oil & Gas UK
- Robert Gordon University
- University of Aberdeen
- Scottish Government
- MER UK Supply Chain

Sources

- https://theogtc.com/

Offshore Renewable Energy Catapult Centre

Overview

The Offshore Renewable Energy (ORE) Catapult is one of ten Catapult centres in the UK. Catapult Centres were first established by Innovate UK in 2011 following a 2010 report for the Department for Business, Innovation and Skills which recommended the establishment of a number of technology and innovation Centres. They are not-for profit, independent technology and innovation centres that aim to drive research and innovation through collaborations between industry, research and academia. Through driving innovation the Catapult centres look to make a significant contribution to economic growth. The ORE Catapult has four bases – in Glasgow, Blyth, Levenmouth and Hull. It intends to build on the already existing strength of UK research innovation within offshore renewable energy.

Objectives

One of the ORE Catapult's key roles is providing the facilities and expertise necessary to test wind and marine turbine components prior to expensive commercial deployment. The ORE Catapult has £250 million worth world-leading test and demonstration facilities, which it uses to drive innovation and economic growth. Other roles have included the development of sector-defining programmes and projects that can provide research which will help to further develop the sector. The Catapult is also key in developing relationships with individuals and organisations across the supply chain. In doing this the Catapult aims to drive research and innovation and, as a result, the economic development and growth of the sector.

Overview of research expertise

The centre is focused on innovative research within offshore renewable energy. Key strands of ORE's research are:

- Testing and validation of new technologies
- Operational performance
- Disruptive innovation

Within each of these programmes there are sub-programmes of activity in the following areas: Rotors, Powertrains, Electrical Infrastructures, Foundations/Structures and Wind & Ocean Conditions (incl. Resource Assessment).

Research is industry led and therefore the ORE's research strategy is influenced by consultations with key stakeholders. Outputs from consultations with industry are then combined with research community engagement (particularly academics) and from this the three key research programmes are formed.

The ORE also has a wind blade research hub based at the University of Bristol and is seeking a UK-based university to partner in the delivery of an Electrical Infrastructures Research Hub. The Research Hubs are looking to build a collaborative offering based on academic and industry skills so that resources can better respond to the needs of industry.

Collaborative activity

The main objective of the ORE Catapult is to broker relationships and foster collaboration across all areas of the sector. Its activity includes three primary functions:

Operations and performance – working with owner/operators and original equipment manufacturers to improve existing windfarms and develop capabilities and opportunity
Testing and validation – use of assets and expertise to support technological development and demonstration, improving existing technology and developing new technologies
Research and innovation –working with academia and SMEs to support the development and commercialisation of technologies

The key roles of the ORE Catapult are to set innovation challenges and de-risk innovation. It does this by:

- Leading sector-defining research programmes
- Offering test and demonstration assets that are capable of testing larger and faster trains and blades than the largest commercially available turbine
- Developing strategic relationships with Original Equipment Manufacturers (OEM) who are developing the fastest turbine blades through the offer of testing facilities
- Through its innovation support the Catapult has also developed relationships with the Tier 1 suppliers who support the OEMs and less established companies and SMEs.
- The Catapult has supported less established companies by exposing their technologies to more established companies and OEMs.
- Delivering the Innovation Challenge Programme, which is run as follows. Firstly, the needs of industry are shared with innovators who can then apply to take part in developing a technological response. Those who are successful are then assisted in developing and commercialising the technology, this

can include funding and bringing in partners for collaborative R&D projects if this is needed to solve the challenge. Where projects are successful the Catapult will introduce innovators to end users in order to bridge the final gap towards commercialisation.

- The Catapult has also worked to link innovative companies with academia and to signpost academic partners to the R&D priorities of industry. The current links with academia will be built on through the new and future research hubs.

With the Catapult's in house facilities and expertise it has partnered with UK companies to help the access R&D funding that can support their technology development. The Catapult's new academic research hubs have helped develop further insight into the core technical areas of research required by all companies.

As an indication of the ORE's activity, in 2016/17 the ORE Catapult took part in 137 academic collaborations, 257 industry collaborations, 94 active R&D projects and 35 international projects. It supported 134 SMEs and 51 companies.

Since its establishment, the ORE Catapult has taken part in 263 academic collaborations, 574 industry collaborations, 41 international projects and supported 338 SMEs and 119 companies.

Commercialisation activity

As detailed above, the Catapult's is a not-for-profit organisation but its core objectives are to assist the offshore renewable energy sector in economic development and growth. It does this through offering facilities and expertise that allow for the development of new technologies. More broadly it also assists the development of the sector through brokering relationships that can then help to generate innovative technologies and developments.

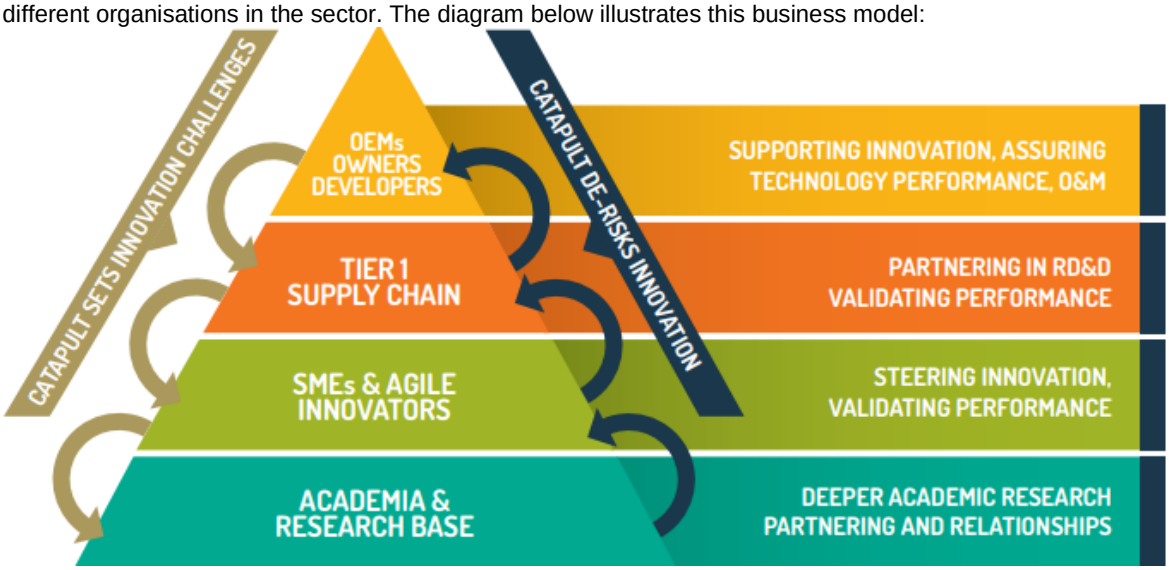
As is detailed further below, the aim of Catapult centres is to achieve a one-third, one-third, one-third model whereby funding comes from one-third core public funding; one third business-funded R&D contracts; and one third collaborative applied R&D projects. The ORE has developed business-funded R&D contracts through its customers in industry and academia. Over 2016/17 there was a 77% uplift in competitive R&D revenue and for every £1 of core grant invested the ORE Catapult has leveraged £3 of additional research funding driving £21 of activity. Since its establishment, activity from the ORE Catapult has delivered a £324 million boost to the UK economy.

Delivery Model

As detailed under collaborative activity, the ORE Catapult has three delivery functions:

- Operations and performance – working with owner/operators and original equipment manufacturers to improve existing windfarms and develop capabilities and opportunity
- Testing and validation – use of assets and expertise to support technological development and demonstration, improving existing technology and developing new technologies
- Research and innovation –working with academia and SMEs to support the development and commercialisation of technologies

Its business model is also based around the formation of relationships and different activities with relation to different organisations in the sector. The diagram below illustrates this business model:



In terms of actual sites and areas of delivery, the ORE Catapult has four bases – in Glasgow (a central office in the Inovo building), Blyth (National Renewable Energy Centre), Levenmouth (Fife Renewables Innovation Centre) and Hull (Operation and Management Centre of Excellence at University of Hull, a collaboration between the university and the Catapult). As mentioned, it has also recently opened aa wind blade research hub in partnership with the University of Bristol. Aside from these bases, through a Regional Engagement Strategy, the Catapult has sought to engage with regions with growing supply chain strength outside of its bases and has made key contributions of over £2.5 million to projects based across the UK.
Funding/Resourcing
Catapult Centres receive approximately £10 million core funding per year for five years from Innovate UK. In the long term centres aim to be funded through: one-third core public funding for long-term investment in infrastructure, expertise and skills development; one third business-funded R&D contracts (won competitively); and one third collaborative applied R&D projects (funded jointly by the public and private sectors, also won competitively). As has been detailed above, in 2016/17 there was a 77% uplift in competitive R&D revenue and for every £1 of core grant invested the ORE Catapult has leveraged £3 of additional research funding. As mentioned above, since its establishment, ORE Catapult activity has delivered a £324 million boost to the UK economy. In terms of resourcing, the ORE Catapult has a team of over 140 people. The Executive management team comprises: chief executive, finance director, marketing & communications director, general counsel/company secretary, operational performance director, test & validation director and research & disruptive innovation director. There is also a board of directors, including non-executive directors from industry and academia.

Sources

- https://ore.Catapult.org.uk/
- https://ore.Catapult.org.uk/our-impact/our-impact-report/
- https://ore.Catapult.org.uk/app/uploads/2018/01/IMPACT-Story-So-Far-JPEG-FINAL-460x300.png
- http://www.bristol.ac.uk/news/2017/june/turbine-blades.html

University of Technology Sydney

Overview

UT Sydney has a strong reputation for Forensic Science internationally and hosts a Centre for Forensic Science with academic members from the university as well as industry partners. The centre acts as a hub for research that is focused on developing solutions and tools for real world usage as researchers work in collaboration with industry and law enforcement. The centre also offers state of the art facilities, $3 million has been spent on forensic and analytical equipment and instruments. UTS offers Forensic Science courses at undergraduate, postgraduate and doctorate levels.

Objectives

The centre aims to be a site for collaborative innovation that can provide practical solutions to issues around intelligence, law enforcement and justice .In this sense research is industry and outcome driven as it aims to provide forensic tools for application in the real world. This is encouraged through collaborative working, with industry (including centre members), law enforcements and other universities.

Overview of research expertise

The focus of research is on collaboration and innovation that can be used to develop practical tools for the extension of forensic capability and to provide solutions to current challenges.

Particular areas of expertise include:

- Fingerprints
- Questioned documents
- Trace evidence (fibres, paint, glass, miscellaneous, etc)
- Fire investigation and analysis
- Illicit drugs
- Toxicology
- DNA profiling
- Forensic anatomy
- Statistics and data handling
- Interpretation

Examples of research include:

- Development of novel methods for the detection of hidden fingerprints, in collaboration with law enforcement organisations and partner academic institutions
- Projects with National Institute of Forensic Science around building illicit drugs forensic capacity in Australia
- Novel research into forensic intelligence in collaboration with the Australian Federal Police and a number of police forces in Australia and overseas, and the University of Lausanne
- A study reviewing different approaches to gun shot analytics
- Research analysing the physical and online illicit drug markets

Collaborative activity

The centre is built around collaboration with industry and law enforcement and its focus is on developing real-world tools for use by law enforcement agencies and Forensic Science practitioners. In this sense collaboration is at the heart of the centre's research. Industry and law enforcement research partners include The National Institute of Forensic Science, Australian Federal Police, NSW Police Force, NSW Forensic and Analytic Science Service, National Measurement Institute, Agilent technologies, XTEK.

A number of collaborative projects have already been described above. Other examples include:

- Collaboration with the Australian Federal Police, NSW Police Force and two other Australian tertiary institutions as part of the National Institute of Forensic Science's innovation pilot project on explosives analysis
- Collaborative research projects with the Australian Federal police, other universities and industry on nuclear forensics
- A collaborative project with Australian Federal Police, NSW Forensic and Analytical Science Services, UN Office of Drugs and Crime and the University of Lausanne to investigate how forensic data can be used to prevent crime.

UTS also works to promote collaborations through the Key Technology Partnership Program, which links UTS with other institutions globally. Since 2013 a KTP based around Forensic Science research has been in place with the University of Dundee.

In collaboration with the UTS Surgical and Anatomical Sciences Facility, the centre has also partnered with 14 partners and collaborators - University of Wollongong, University of Sydney, ANU, University of Canberra, University of New England, AFP, ANSTO, Victoria Police, NSW Police, NSW Health Pathology, Victorian Institute of Forensic Medicine, Western Sydney University, and Central Queensland University – to open AFTER: The Australian Facility for Taphonomic Experimental Research, which is a unique body donation facility dedicated to the study of human decomposition and forensic science.
Commercialisation activity
UTS has looked to commercialise through offering consultancy services to industry and law enforcement. These services include: • Criminalistics/trace evidence • Explosives residues • Fire investigation and analysis • Illicit drugs/toxicology • Questioned documents • Marks and fingerprints As well as offering such services, the centre also accesses lucrative Linkage grants for research undertaken in collaboration with industry and law enforcement.
Delivery Model
The centre is located in the science building on the UTS Broadway campus. It is directed by Professor Claude Roux and members include academics from a variety of backgrounds. They are joined by industry and law enforcement partners. Through its strong reputation for applied and collaborative research the centre has built up extensive linkages with industry, law enforcement and other universities and regularly collaborates with partners on research projects.
Funding/Resourcing
The centre is part of and located at UTS. Outside of university funding the centre accesses research grants, in particular Linkage grants from the Australian Research Council have been important as they specifically fund collaborative projects. For the AFTER facility, funding has been provided by the Australian Research Council alongside support from partner organisations. The centre also creates its own revenue through the provision of consultancy services. In terms of staff, as mentioned above, centre membership is based around academic staff. In total there are 15 core members from UTS academic staff, six associate members from UTS academic staff and seven honorary members – three from other universities (two from University of Canberra and one from University of Lausanne) and four from Australian federal police.

Sources

- https://www.uts.edu.au/research-and-teaching/our-research/centre-forensic-science
- https://www.uts.edu.au/research-and-teaching/our-research/centre-forensic-science/news/uts-forensic-facility-launch
- https://www.uts.edu.au/research-and-teaching/our-research/centre-forensic-science/news/ten-years-forensic-science-uts-and
- https://www.uts.edu.au/about/faculty-science/after-facility/about-us

Appendix 4: Alternative scenarios – costings

Preferred option

Preferred option **£000s**	Yr 1 2018/19	Yr 2 2019/20	Yr 3 2020/21	Yr 4 2021/22	Yr 5 2022/23	Yr 6 2023/24	Yr 7 2024/25	Yr 8 202/265	Yr 9 2026/27	Yr 10 2027/28	Total
Income											
UoD JustTech	1440	1440	1440	1440	1440	1440	1440	1440	1440	1440	14400
TCD JustTech	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	13000
TCD (ICD)	3000	3000	3000	3000	3000	0	0	0	0	0	15000
Sub-total I	5,740	5,740	5,740	5,740	5,740	2,740	2,740	2,740	2,740	2,740	**42,400**
Expenditure											
Staff											
Salaries: Directors	375	375	375	375	375	375	375	375	375	375	3750
Salaries: Research staff	180	180	180	180	180	180	180	180	180	180	1800
Salaries: BD	137.5	137.5	137.5	137.5	137.5	137.5	137.5	137.5	137.5	137.5	1375
Salaries: Administration	96.25	96.25	146.25	146.25	146.25	146.25	146.25	146.25	146.25	146.25	1362.5
UoD overhead contribution	200	200	200	100	0	0	0	0	0	0	700
JustTech Centre operating costs	0	0	0	250	500	500	500	500	500	500	3250
Innovation fund	0	2,500	2,500	2,500	2,500	2,000	2,000	2,000	2,000	2,000	20,000
Marketing	50	50	50	50	50	50	50	50	50	50	500
Recruitment	60	0	0	0	0	0	0	0	0	0	60
BD/KE budget	30	30	30	30	30	30	30	30	30	30	300
Research materials	50	50	50	50	50	50	50	50	50	50	500
Innovation/cluster dev	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	10,000
Total expenditure	2178.75	4618.75	4668.75	4818.75	4968.75	4468.75	4468.75	4468.75	4468.75	4468.75	**43,597.50**
Surplus/deficit	3,561	1,121	1,071	921	771	-1,729	-1,729	-1,729	-1,729	-1,729	**(1,197.50)**

Staff	FTE
Project Director	1
Activity stream Director	3
Head of Business Development	1
Business Development Executive	2
Research Fellow/Assistants	4
Lab technicians	2
Marketing Manager	1
Centre Manager	1
Administrative assistants	2
Total	**17**

Alternative scenario 1

Scenario 1: 70% funding **£000s**	Yr 1 2018/19	Yr 2 2019/20	Yr 3 2020/21	Yr 4 2021/22	Yr 5 2022/23	Yr 6 2023/24	Yr 7 2024/25	Yr 8 202/265	Yr 9 2026/27	Yr 10 2027/28	Total
Income											
UoD JustTech	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	10080
TCD JustTech	910	910	910	910	910	910	910	910	910	910	9100
TCD (ICD)	2100	2100	2100	2100	2100	0	0	0	0	0	10500
Sub-total I	4,018	4,018	4,018	4,018	4,018	1,918	1,918	1,918	1,918	1,918	**29,680**
Staff											
Salaries: Directors	375	375	375	375	375	375	375	375	375	375	3,750
Salaries: Research staff	122.5	122.5	122.5	122.5	122.5	122.5	122.5	122.5	122.5	122.5	1,225
Salaries: BD	100	100	100	100	100	100	100	100	100	100	1,000
Salaries: Administration	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	625
UoD overhead contribution	200	200	200	100	0	0	0	0	0	0	700
JustTech Centre operating costs	0	0	0	250	500	500	500	500	500	500	3,250
Innovation fund	500	500	500	500	500	1,000	1,000	1,000	1,000	1,000	7,500
Marketing	50	50	50	50	50	50	50	50	50	50	500
Recruitment	60	0	0	0	0	0	0	0	0	0	60
BD/KE budget	21	21	21	21	21	21	21	21	21	21	210
Research materials	35	35	35	35	35	35	35	35	35	35	350
Innovation/cluster dev	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	10,000
Total expenditure	2526	2466	2466	2616	2766	3266	3266	3266	3266	3266	**29,170.00**
Surplus/deficit	-2,526	-2,466	-2,466	-2,616	-2,766	-3,266	-3,266	-3,266	-3,266	-3,266	**510.00**

Staff	FTE
Project Director	1
Activity stream Director	3
Head of Business Development	1
Business Development Executive	1
Research Fellow/Assistants	3
Lab technicians	1
Marketing Manager	1
Centre Manager	0
Administrative assistants	1
Total	**12**

Alternative scenario 2

Scenario 2: 50% funding	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Total
£000s	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	202/265	2026/27	2027/28	
Income											
UoD JustTech	720	720	720	720	720	720	720	720	720	720	7200
TCD JustTech	650	650	650	650	650	650	650	650	650	650	6500
TCD (ICD)	1500	1500	1500	1500	1500	0	0	0	0	0	7500
Sub-total I	2,870	2,870	2,870	2,870	2,870	1,370	1,370	1,370	1,370	1,370	**21,200**
Staff											
Salaries: Directors	287.5	287.5	287.5	287.5	287.5	287.5	287.5	287.5	287.5	287.5	2,875
Salaries: Research staff	122.5	122.5	122.5	122.5	122.5	122.5	122.5	122.5	122.5	122.5	1,225
Salaries: BD	100	100	100	100	100	100	100	100	100	100	1,000
Salaries: Administration	62.5	62.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5	112.5	1,025
UoD overhead contribution	200	200	200	100	0	0	0	0	0	0	700
JustTech Centre operating costs	0	0	0	250	500	500	500	500	500	500	3,250
Innovation fund	500	500	500	500	500	500	500	500	500	500	5,000
Marketing	50	50	50	50	50	50	50	50	50	50	500
Recruitment	45	0	0	0	0	0	0	0	0	0	45
BD/KE budget	21	21	21	21	21	21	21	21	21	21	210
Research materials	35	35	35	35	35	35	35	35	35	35	350
Innovation/cluster dev	500	500	500	500	500	500	500	500	500	500	5,000
Total expenditure	1923.5	1878.5	1928.5	2078.5	2228.5	2228.5	2228.5	2228.5	2228.5	2228.5	**21,180.00**
Surplus/deficit	2,703	2,688	2,638	2,638	2,638	1,038	1,038	1,038	1,038	1,038	**20.00**

Staff	FTE
Project Director	1
Activity stream Director	2
Head of Business Development	1
Business Development Executive	1
Research Fellow/Assistants	3
Lab technicians	1
Marketing Manager	1
Centre Manager	1
Administrative assistants	1
Total	**12**

Alternative scenario 3

Scenario 3: 30% funding **£000s**	Yr 1 2018/19	Yr 2 2019/20	Yr 3 2020/21	Yr 4 2021/22	Yr 5 2022/23	Yr 6 2023/24	Yr 7 2024/25	Yr 8 202/265	Yr 9 2026/27	Yr 10 2027/28	Total
Income											
UoD JustTech	432	432	432	432	432	432	432	432	432	432	4320
TCD JustTech	390	390	390	390	390	390	390	390	390	390	3900
TCD (ICD)	900	900	900	900	900	0	0	0	0	0	4500
Sub-total I	1,722	1,722	1,722	1,722	1,722	822	822	822	822	822	**12,720**
Staff											
Salaries: Directors	200	200	200	200	200	200	200	200	200	200	2,000
Salaries: Research staff	90	90	90	90	90	90	90	90	90	90	900
Salaries: BD	100	100	100	100	100	100	100	100	100	100	1,000
Salaries: Administration	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5	875
UoD overhead contribution	100	100	100	100	0	0	0	0	0	0	400
JustTech Centre operating costs	0	0	0	250	500	500	500	500	500	500	3,250
Innovation fund	300	300	300	300	300	300	300	300	300	300	3,000
Marketing	50	50	50	50	50	50	50	50	50	50	500
Recruitment	30	0	0	0	0	0	0	0	0	0	30
BD/KE budget	25	25	35	35	35	35	35	35	35	35	330
Research materials	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	315
Innovation/cluster dev	100	100	100	100	100	100	100	100	100	100	1,000
Total expenditure	1114	1084	1094	1344	1494	1494	1494	1494	1494	1494	**13,600.00**
Surplus/deficit	1,589	1,604	1,544	1,294	1,144	-457	-457	-457	-457	-457	**(880.00)**

Staff	**FTE**
Project Director	1
Activity stream Director	1
Head of Business Development	1
Business Development Executive	1
Research Fellow/Assistants	2
Lab technicians	1
Marketing Manager	1
Centre Manager	1
Administrative assistants	0
Total	**9**

Appendix 5: Developing the *JustTech* business case

Next steps

Based on the findings of the research, there are a number of recommendations and points to consider for the development of the business case and the project more generally. Underpinning the recommendations are the need for the proposal to more clearly articulate the offer and demonstrate the economic development potential along with the importance of addressing the current market failure and the opportunities it presents.

Recommendation 1: The proposal should focus on the innovation, collaboration, clustering and economic growth proposition, rather than the University of Dundee's capability in Forensic Science. It must put forward a strong articulation of what the Centre is seeking to do and make it clear that it is not simply an extension of what the University is already doing. The activities must add value and be additional to the University's current offer.

Recommendation 2: The business case must identify the role of *JustTech* in achieving such objectives as retaining and attracting talent and enterprise, creating high-value jobs and activities, and the direct and indirect economic and social benefits that it could deliver for Dundee and the Tay Cities Region, for example helping to address the productivity gap. It should also point to its contribution to boosting Dundee's reputation on the world stage as a centre for digital innovation.

Recommendation 3: Accurately forecasting the impacts of the *JustTech* project as part of the business case will require a much more detailed financial model to be prepared. This should contain information, for example about the type of activities undertaken, the number of businesses engaged with the Centre, the value of R&D research funding, the number and value of commercialisation projects and the scale of the wider cluster of companies, all of which will allow for a robust assessment of economic, social and scientific impact.

Recommendation 4: Forensic Science is a complex area and there can often be misunderstandings of what it actually is and its applications. It is critical that the business case provides detail on the specific activities that will comprise *JustTech,* the market failure it will address and how it will do that. It could be just as important here to express what it will not do, as well as what it will. An effective approach may be to carry out a structured options appraisal for the mix of activities and the focus, to demonstrate the rationale for the specifics of the proposal.

Recommendation 5: Flowing from Recommendation 4 (what it will do), the business case should set out detailed costings building on what it has been possible to provide in this report and at this stage of its development. The costs will be based on what *JustTech* will comprise physically i.e. the size of the building or buildings, and the facilities and equipment. The approach must be rooted in the principal that form must follow function. The building and facilities must, as far as possible, be future proofed to respond to changes in, for example, technology. There are some very good examples of buildings that have been designed to be flexible and easily adapted to changing need.

Recommendation 6: The business case should include an outline funding strategy that takes account of the range of current and emerging funding sources and reflects the significant changes occurring in the UK and EU funding landscape. It should identify the revenue streams and the levels of revenue that could be generated, and how they are likely to grow over time. The outline strategy will be informed by discussions with strategic partners, potential 'customers' as well as industry and industry representatives.

Recommendation 7: There should be a clear articulation of the roles of each partner and the distribution of responsibilities for specific areas at each stage of the development, implementation and on-going delivery of *JustTech*. This will help to ensure ownership by partners and provide clarity on where the various responsibilities lie. It will form the basis of the governance structure of *JustTech.* Alongside this will be details on the 'asks' of the different public agencies with a role to play, for example Scottish Enterprise, the Scottish Funding Council and SCDI.

Recommendation 8: It would be useful to develop a logic model for the project. It would give an at-a-glance picture of the aims and objectives of *JustTech*, the inputs and activities required and how these will lead to the outputs, outcomes and impacts. The impacts should demonstrate the impacts for Dundee, the University and for the criminal justice system. A logic model would also be a useful tool for developing a monitoring and evaluation framework to review and drive progress.

Recommendation 9: Business cases always include a risk assessment and early consideration of the risks and how they will be managed will be helpful in shaping the proposal. Some risks will be tangible, for example, financial risks and the long term sustainability of *JustTech*. Others will be less tangible and will include impact on the reputation and status of the University of Dundee and its Forensics Science offer *if JustTech* does not meet expectations.

Appendix 6: Consultees

Consultee	Role	Organisation
Professor Dame Sue Black	Director of CAHID and LRCFS	University of Dundee
Luca Corradi	Director, Innovation Network	The Oil and Gas Technology Centre
Godfrey Gaston	CSIT Director	Queen's University Belfast
John Innes	Vice President Business Innovation	Leonardo
Andrew Jamieson	Chief Executive	Offshore Renewable Energy Catapult
Michael Marra	Research Strategist, LRCFS	University of Dundee
Susan McMullan	Project Manager – Strategy & Sectors	Scottish Enterprise
Professor Niamh Nic Daeid	Director, LRCFS	University of Dundee
Ian Reid	CEO	CENSIS
Olivier Ribaux	Director, School of Forensic Science	University of Lausanne
Claude Roux	Director, Centre for Forensic Science	UT Sydney
Stephen Sheal	Director of External Relationships	The Oil and Gas Technology Centre
Chris Van der Kuyl	Chairman	4J Studios
Siân Williams	Business Development Manager	CENSIS