

Appendix 1: Bayes Centre Project Summary

Overview

The vision of the City Deal regional partners is for Edinburgh to become the Data Capital of Europe. To realise the vision, the University of Edinburgh [UoE] is proposing a combined capital [£45 million] and revenue [£70 million] investment totalling £115 million in its underlying data science innovation capabilities, and by developing a new centre of Data Science excellence in the heart of Edinburgh which will be known as the “Bayes Centre”. This business case is specifically seeking £32.5 million towards the £45.0 million capital investment in the Bayes Centre.

The Bayes Centre will provide the physical capacity to address capability gaps in five key areas which translate **innovation at scale** from a concept into tangible activity that can produce economic impact - talent, research, adoption, data and entrepreneurship [TRADE]. UoE capabilities are exemplified by the principal actors who will be housed in the Bayes Centre including; the School of Informatics, Design Informatics, International Centre for Mathematical Sciences (ICMS), The Data Lab [TDL], Alan Turing Institute [ATI] and Edinburgh Parallel Computing Centre [EPCC]. Through the Bayes Centre, these DDI priorities will be pursued with organisations in three emerging sectors of strength in the City Region economy – Digital Technology, Space & Satellites, and Robotics and Autonomous Systems.

From September 2018, a 9,000 square metre facility will provide the regional focal point for the development and deployment of Data-Driven Innovation (DDI). The Bayes Centre will do this by establishing the core data science innovation capability within the wide portfolio of DDI projects and will become a globally recognised destination in which innovative companies come together with world-leading applied researchers, talented students, existing data science institutes and dedicated adoption resource supporting outreach activities, to ‘breathe the same air’ and realise commercial value from their data science and artificial intelligence (AI) collaborative innovations.

Within an inclusive growth context, over the next fifteen years, the university expects to:

- engage over 40,000 learners; of which over 3,000 will hold a University degree;
- secure an additional £59 million of public and private sector research funding;
- work on adoption strategies with ~300 companies and support ~1,000 CPD learners;
- nurture approximately 250 spin in/out companies, and create employment opportunities for around 400 graduates in micro and SME businesses.
- Delivery will be overseen by a dedicated team and governed by a Bayes Steering Group that will report to the overall DDI Programme Board. Overall the Project, its envisioned growth and associated risk profile, is affordable and capable of being self-sustaining over the longer term if the capital costs are substantively met by capital grant. Both the capital investment and Programme activities proposed can be accommodated within current University business procurement and estates management processes.

In economic terms UoE expects, as illustrated in Table 1 below, over the fifteen years of the DDI Programme, to deliver a forecast net present value (NPV) of gross value added (GVA) of £251 million¹ with a UK Cost Benefit ratio is likely to be around 1 to 5.6.

Table 1: UoE Bayes Centre GVA benefits

Benefit Ratio for Bayes Centre based on Govt funding contribution: 1:5.6				
	City Region	Rest of Scotland	Rest of UK	UK, as a Whole
GVA (£ million)	73	32	146	251

For the benefit of the reader and to provide some background context, the following points should be noted:

- The preparation of this business case has been led by the University of Edinburgh (UoE) on behalf of City Deal consortium partners, and it has been prepared in accordance with the HM Treasury 5 Cases model.
- In terms of University structure, the University of Edinburgh has three Colleges;
 1. Arts, Humanities and Social Sciences
 2. Medicine and Veterinary Medicine
 3. Science and Engineering

At the next level down are Schools and there are twenty Schools within the three Colleges. This business case sits within the College of Science and Engineering and whilst it principally refers to the Schools within this College, it also reaches across to Schools within other Colleges. References are made to Schools throughout the document.

- Throughout this document references are also made to the National Robotarium, which is a collaborative initiative between Heriot Watt University (HWU) and UoE. For the purposes of this business case UoE present the business case for its facilities. The business case for the facilities at HWU is described separately in the National Robotarium Business Case. This business case should therefore be read in conjunction with the business case for the National Robotarium.
- The document references “innovation at scale”. HBR² analysis defines this as “the ability to create repeatable and sustainable organic growth from new products, services and business models that build on the core business”. It is incredibly difficult to achieve with just 6% of companies that HBR analysed being able to do this. UoE is uniquely placed; large volumes of talent with deep expertise coupled with data access and supporting infrastructure as well as established links to a diverse range of high quality external partners and customers, when combined with investment in a collocated inter disciplinary capability gives the University a huge opportunity to create **innovation at scale**.

¹ All benefit streams are captured over a fifteen year period except talent effects which, given the pervasive impact of DDI upon future productivity account for uplifts in graduate lifetime GVA (discounted back to present day values).

² <https://hbr.org/2012/11/innovating-innovation-at-scale>

- Detail has been provided in this business case where it is materially relevant and known, some of which is being worked through and consequently still to be determined. The Bayes Centre opened in summer 2018 and has a steering group in place. Most of the tenants are signed up but there is a degree of fluidity as a consequence of negotiation. There is a good degree of understanding of how all the tenants will work together to optimise the benefits but some of the specifics of how this happens commercially are still to be agreed.

Aligned and material opportunity realised through UoE vision

Opportunity

We are now entering an era when the generation, collection, analysis and monetisation of huge volumes of data underpins the Digital Economy. The value of data comes from its use in real time, or aggregation over long periods, to understand and predict behaviour. Whilst data has become ubiquitous, the challenges for all organisations are to use this data effectively to shape, develop and deliver innovative digital products and services to consumers and citizens. This is what we call Data-Driven Innovation (DDI) and is the focus of this outline business case.

As evidenced in various Scottish and UK Government policy documents, and in publications by the OECD and global consultancies, Data-Driven Innovation has become a key pillar of 21st century growth with potential to significantly enhance; productivity, resource efficiency, economic competitiveness and social wellbeing. The Edinburgh and South East Scotland Science and Innovation Audit (SIA) identified that:

1. The region is already a **powerhouse** in Data-Driven innovation with a fast growing cluster;
2. Regional growth is at a **tipping point** and requires further investment to meet demand; and,
3. There are a number of industry sectors that are key to the local economy and which align to national areas of focus and opportunity, providing an opportunity for **inclusive growth**.

Vision

The University of Edinburgh's **vision** is to be a world leader in Data Science. It will do this by playing to its strengths in education and research and boosting its commercial activity. Furthermore, it will enable these activities to maximum effect by creating the Bayes Centre as a hub for informatics and data-driven innovation activity within the region. The Bayes Centre will drive **innovation at scale**, by physically integrating over 600 students, university, industry and public-sector researchers in a single location to establish and grow the region's critical mass of interdisciplinary researchers with expertise in Digital Technology (Digitech), Robotics, Space & Satellite (S&S), artificial intelligence, statistics and modelling, informatics, computer science, data governance, ethics and economics.

Current Position – good, but further investment needed

The city region has a long history of data excellence and leadership, including the largest computing school in Europe – the UoE School of Informatics, the UK's principal super-computing facility - the Edinburgh Parallel Computing Centre (EPCC) and the largest concentration of internationally significant and world-leading informatics research, in the UK.

Moreover, in the last four years, the local DDI capability has grown significantly as multiple new initiatives within the data science, robotics and computer systems areas have been secured. The city region hosts Scotland-wide initiatives like the Data Lab, the Farr Institute, the Centre of Excellence for

Cyber Security Research, and Administrative Data Research Centre, as well as hosting four doctoral training programmes in Data, Robotics, Systems and Analysis. It hosts the UK's most successful computing start-up community around a university and has joined an elite group of key UK universities in data science.

In addition, in conjunction with Scottish Enterprise, the Bayes Innovation Programme (BIP) is delivering activities targeted at:

- Adoption: attracting and embedding R&D focused corporates; and,
- Entrepreneurship: forming and nurturing companies with high-growth potential.

Engagement support will create and sustain new corporate R&D partnerships, and attract corporate venture capital to help boost entrepreneurship. Entrepreneurship support will inspire and nurture a new generation of entrepreneurs to form companies, and refresh the investor readiness programme that takes them to scale. UoE has an existing strength in entrepreneurship and commercialisation but this will be further amplified by BIP and the City Deal.

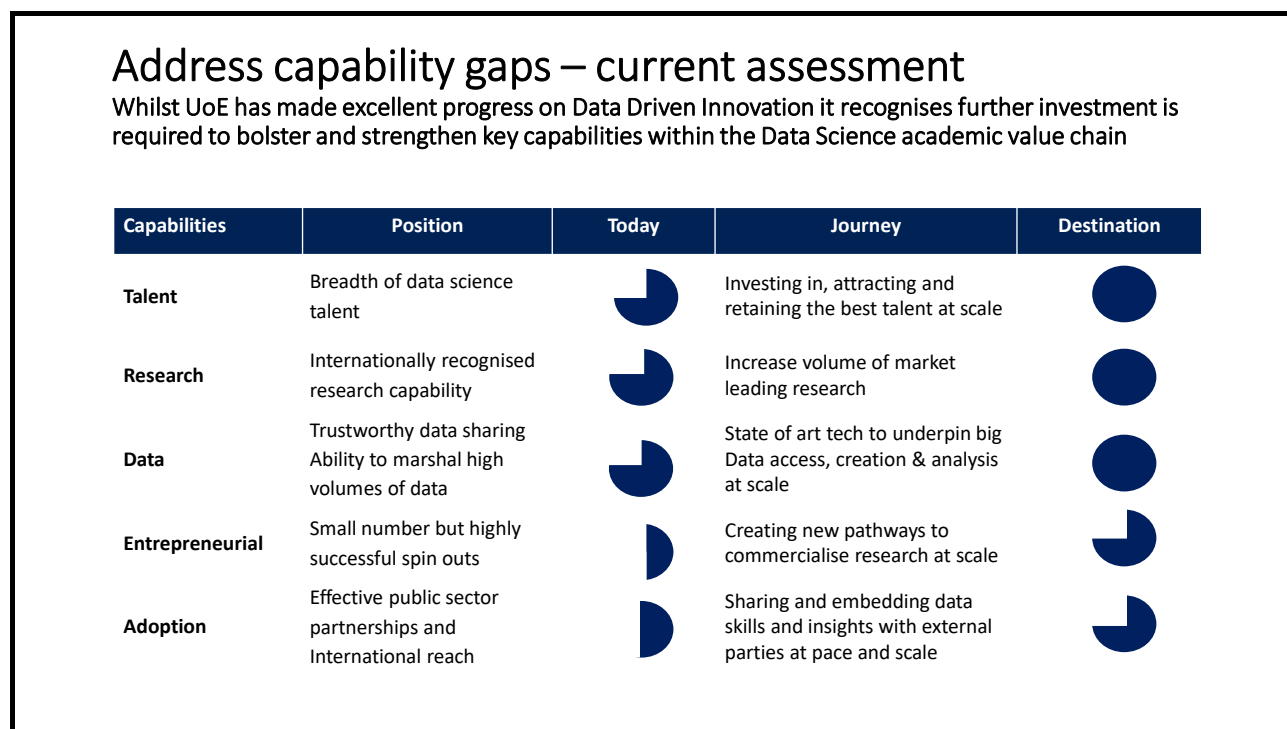
Underpinning UoE's success and reputation are **well-established TRADE³ strengths**, although these require further development and organised focus. Additionally, many of the UoE schools are geographically dispersed across Edinburgh, inhibiting the opportunity to collaborate and innovate, and potentially resulting in sub-optimal outcomes. Colocation will not only counter this but will become a catalyst for innovation.

Figure 1 below represents a current view of UoE capabilities and demonstrates, and reinforces the SIAs finding that there are well established capabilities in the University, however, it also identifies where gaps exist and what is required to improve the position.

UoE has an excellent platform and opportunity from which to grow and consolidate for the future but investment is needed to robustly respond to the DDI opportunity. The SIA highlighted the data opportunity but also recognised that growth was at a tipping point and, without substantive investment, there is significant risk that the region and Scotland is unable to maintain its global position resulting in a detrimental impact on both the University and the local economy.

³ TRADE; Talent, Research, Adoption, Data and Entrepreneurship

Figure 1: Capability assessment



How UoE will achieve its vision

Given the SIA findings that UoE is aligned nationally and has a local strength in DDI, this business case proposes an overall investment of **£115 million** to develop world-class data science capabilities and a hub for Data Science in the region. Given the complexity of this business case, which combines a both capital and operational investment, achieving the vision is best articulated as three distinct components, all of which are intrinsically linked and, importantly, interdependent:

1. **Address capability gaps:** Enhance and develop capabilities in five key areas identified in the Edinburgh and South East Scotland Science and Innovation Audit (SIA) - talent, research, adoption, data and entrepreneurship [TRADE - **£70 million** UoE and partner revenue investment]
2. **Organise activities effectively:** create an effective operating model to successfully organise, optimise and execute all these activities [in point 1] underpinned by the creation of strong governance with clear accountabilities and delivery plans,
3. **Strategic asset development:** Construction and fit-out of the Bayes Centre facility, providing physical space and facilities for the relevant UoE schools and external partners to collaborate, innovate and deliver on said activities [**£45 million** capital investment, of which Government is asked to fund £32.5 million]

The following sections describes each of the above in more detail.

Investing in and addressing core capabilities and gaps: TRADE

Through the SIA it was recognised that UoE is strong across a range of capabilities. However, in order to grow and prepare for the future it needed to improve. Investments for Bayes, totalling £70 million, will be made across the TRADE capabilities to enhance and develop its position. These investments will be managed and overseen through the Bayes Steering Group (BSG, described later).

Figure 2 shows the UoE Schools and external partners that will play a role in core data science activities within Bayes, where their main TRADE focus is presently and how much will be invested in each capability. It also shows how the £70 million is broken down at TRADE level as well as giving a view of where UoE versus external partners are concentrated in TRADE activities.

Figure 2: “Who does what?”

Address capability gaps – who and what
 UoE and partners are investing £69.8m¹ to bolster and strengthen its TRADE capabilities, leveraging and recognising the collective and current relative strengths

	Bayes Centre – Occupants	Talent	Research	Adoption	Data ²	Entrepreneurship
	DDI Investment £m	£2.5m	£m	UoE £7.0m + Ext £12.8m	UoE £5.2m + Ext £8.5m	UoE £12.9m + Ext £15.5m
UoE	EPCC	✓		✓	✓	
	School of Informatics: Design Informatics	✓	✓	✓		
	School of Informatics: Informatics Ventures [BIP]			✓		✓
	School of Informatics: Robotics	✓	✓	✓		
	Maths: Maxwell Institute	✓	✓			
	Maths: ICMS	✓	✓			
External	Alan Turing Institute		✓	✓		
	The Data Lab	✓		✓	✓	✓
	External Industry			✓	✓	✓
	Total	6	5	7	3	3

✓ Key Activity Note: 1. includes £5.3m for Programme costs 2. Data investment is an allocation of WCDI revenue, held in its business case

The detail of this investment in TRADE activity is outlined below.

Talent: A vibrant and innovative talent pipeline is essential if UoE is to grow high-quality employment in the City Region and meet its inclusive growth ambitions. UoE is investing £2.5 million in more lecturers and content development, to expand its data related course content and teaching delivery capacity. Over a ten-year period, the Bayes Centre will provide over 40,000 people with the skills needed to commercialise data-driven innovations through a mix of:

- On-campus 10-point MSc level module/course targeting students within the University;
- A MOOC targeting corporate employees, alumni and students situated in local colleges;
- Talks delivered by entrepreneurs and promoted to those in the Edinburgh City Region; and,
- Continued Professional Development activities – offering industry and public sector staff opportunities to benefit from focused courses that educate them on data-driven technology innovations and associated business models.

The Bayes Centre resources will also undertake public outreach activities at both the Primary and Secondary School level as well as local colleges in the Edinburgh City Region, aiming to attract a minimum of 10,000 students to these events over the ten-year period.

Working in collaboration with initiatives like the Digital Xtra Fund⁴, UoE will co-fund activities that support the delivery of extra-curricular computing and digital activities to young people, aged 16 and under, within the Edinburgh City Region. One particular aim on the inclusion agenda is to improve participation of young women and underrepresented groups in digital, dispel negative perceptions

⁴ <http://www.digitalxtrafund.scot/>

about computing science, and promote digital as an attractive career path. Content developed through these initiatives would be made available to other groups across Scotland.

Research: Scotland lags the UK as a whole in business research and development investment. Private sector research is viewed as a weakness within the Scottish economy where R&D spend per head was £400 in 2015, versus £486 for the UK. Since the opening of the Informatics Forum in 2008, UoE has seen many new research and innovation activities form across multiple institutes. The Bayes Centre aims to advance this further in two ways: by co-location of an even broader range of academic units with intersecting interests; and by inviting strategic industry partners to co-locate within the enriched research and innovation ecosystem. This will address the currently fragmented physical inhibitor to innovation.

The organisations hosted in the Bayes Centre will also work closely with groups in other innovation hubs in healthcare and medicine, arts, social sciences and humanities as well as business and law. Through new forms of research collaboration, the aim is to **accelerate innovation** and advance future research agendas.

Adoption: UoE is investing £7 million which is expected to attract a further £12.8 million external funding to build business development teams that will target the sectoral initiatives being delivered via the Bayes Centre – digital technology, robotics and autonomous systems and space & satellites. Historically, the UK has not been as successful at commercialisation as it has been at early-stage research. Overseas competitors are investing more in research and development; the UK invests a total of 1.7% of GDP and the OECD average is 2.4%. UK public funding is also relatively concentrated on early-stage research as opposed to commercialisation. (Source: Industry Strategy Green Paper January 2017). Bayes business development teams will actively engage with industry partners and will also help to scout for opportunities to interact and work with Scotland’s burgeoning start-up and scale-up company network. The primary focus for this team, however, is to build industry relationships with corporates. This team would be supported by a Chief Data Technologist who will help shape the technical components and engage relevant groups within the University as well as technical partners externally. This role would interface between various groups in Informatics, EPCC, Information Services and The Data Lab. An administrator and community/events manager would be required to support contract execution and deliver events within the Bayes Centre.

Budget would also be required for running industry days, marketing, travel and seed-funding small collider-style events. A key focus is on marketing the Edinburgh City Region to a global audience and encouraging new inward investment opportunities.

Datasets: Gaining convenient access to “real” data is a recurring challenge. The Open Research Data Task Force has recognised that a number of technical, cultural and behavioural issues need attention to make data sharing more accessible. To enable greater levels of innovation in the local economy, the SIA highlighted the need for “real” data to inform talent development and research, and for access to this data to be made more straightforward. The organisations and facilities hosted in the Bayes Centre, together with the World Class Data Infrastructure (WCDI), will increase the City Region’s ability to manage, access and utilise a vast pool of diverse data assets, and the associated value that it generates by:

- Developing the skills needed to securely store and manipulate data;
- Agreements to share data with public and private sector data owners;
- Improving the utility of data assets to enable their wider use to drive higher levels of research, adoption and entrepreneurship activity; and

- Promoting the data assets available to attract investment and talent.

Entrepreneurship: UoE is investing £12.9 million directly into salaries and mentoring activity to support start-up growth and is expecting to attract a further £15.5 million equity type funding from external funders. A strong pipeline is required to attract corporate capital and other forms of inward investment. Many of the corporate partners involved in research and innovation are also interested in engaging with early-stage high-growth ventures that may be acquisition targets or who offer increased competitive advantage. Access to quality deal flow is frequently cited as the main challenge from an investor’s perspective.

A core objective of the Entrepreneurship activity is to help build the next generation of ‘data entrepreneurs’ and data-driven companies of scale. The focus will be on building a sustainable pipeline of high-growth start-up and spin-out data-driven innovation companies operating from the broader ecosystem the Bayes Centre will support, that leverage new enabling data science technologies, helping the Edinburgh City Region to maintain and strengthen its entrepreneurial ecosystem. This will help increase future deal flow leading to increased investment in new high-growth companies as well as creating high-value jobs in the region. All of this activity sits squarely within UoE’s inclusive growth ambitions.

Building the Engage Invest Exploit investor readiness programme by Informatics Ventures has latterly focused on connecting scale-up companies with investors (mainly angel and VC). Further emphasis will be placed on identifying customer development opportunities with larger corporates and developing relationships with corporate venture groups. Since 2008, through the EIE investor readiness programme, Informatics Ventures has engaged with around 300 early-stage high-growth ventures. UoE will continue to grow this pipeline by opening up EIE to companies’ outwith Scotland and further refining the number of sectors that companies can apply from, sectors such as Internet of Things, energy, climate and cleantech, digital health, and robotics and autonomous systems. UoE has strong, long-standing relationships with several local, national and international investor groups that recognise the value of EIE as a source of deal flow.

Table 2 below outlines UoE main objectives for TRADE in Bayes and how it will measure success. It provides an initial draft, outlining what might or might not form some of the “benefit measures” that either Government might want the University to capture as part of any future funding agreement.

The selection of investment returns is, however, deliberate as the Universities will capture initial investment levels (in the form of grants, direct expenditure by third parties etc.) and at minimum can ask partners about the returns they have secured.

Table 2: DDI Programme investment objectives and KPI’s

Theme	Investment Objective(s)	KPIs
Talent	Develop a world-flow of talent in data driven entrepreneurship and the application of DDI in the digitech, S&S and robotics sectors	<ul style="list-style-type: none"> • 3,234 - Total numbers trained and retained in the UK
Research	Develop, in conjunction with industry, a world-leading research capability in data science.	<ul style="list-style-type: none"> • £59 million – Total funding

Theme	Investment Objective(s)	KPIs
Adoption	Undertaken a range of industry engagements focused on building collaborative partnerships to enable new research and innovation activity.	<ul style="list-style-type: none"> • 312 – Collaborative adoption assignments
Data	Support initiatives such as IoT and City Data Exchanges to encourage and enable the creation of new forms of data asset.	<ul style="list-style-type: none"> • ~180 – New data sets utilised
Entrepreneurship	Generate a pipeline of new high-growth start-ups and scale-ups, and support equity investment	<ul style="list-style-type: none"> • 253 – number of start-ups

Organising activities effectively

Understanding how UoE can effectively capitalise on the data opportunity is best explained by setting out who the **key players** are, how they will work without falling over each other, through a new **operating model** and which market opportunities they will focus on. Further, by instituting rigorous, but agile governance, it is intended to ensure well-orchestrated management, aligned to the overall City Deal governance, thus harnessing the collective opportunity outlined in this business case.

In order to understand this, the following sections describes who the key resources are and what they do and then articulates the operating model that will enable these resources to effectively deliver TRADE to meet market demand.

Key Players [per Figure 2]

Critically, the Edinburgh region already has a number of centres of excellence in data science which has underpinned its reputation and brand to date. The central vision of this business case is to achieve and maintain world class data driven innovation. It will do this by bringing together the main groups and institutes that have been responsible for enabling many of the region’s recent successes. These organisations, and their key defining characteristics, are outlined below.

1. The **School of Informatics** is Europe’s largest centre for informatics and computing science research with over 250 academic and research staff and 1400 students from 70+ countries. Informatics is ranked 1st in the UK for research power, given the combination of quantity and quality and, in the most recent national research assessment, authored over 50% of all AI publications submitted to by all UK universities. Informatics currently hosts over 300 MSc students and around 360 PhD students, including three Centres for Doctoral Training in Robotics, Data, and Systems. The School of Informatics is physically connected to the Bayes Centre, enabling ready interaction between industry, students and researchers.

Informatics is a world-leading research institution in Data Science and AI with unparalleled breadth, diversity that is at the forefront of new advances in the field. It will enable Bayes to deliver its research and talent agenda, ensuring data-driven innovation capitalises on high-quality computing research and a world-class talent pipeline, which feeds into the national and regional skills base and aligning with UoE inclusive growth agenda.

2. **Informatics Ventures**, part of the School of Informatics’ Commercialisation and Industrial Engagement programme has enabled £360 million in early-stage capital. Its Engage Invest Exploit

conference attracts over 200 investors each year and features 60 early-stage companies. Over the last decade, Informatics has helped create 67 new technology start-ups including a 'Unicorn' company with over £1 billion valuation, contributing to the University's track record in producing more start-up and spin-out companies than any other UK university. Informatics Ventures is currently located within dedicated offices at Wilkie House that is located 100 yards from the site of the Bayes Centre, physically separating commercialisation support activities from technology innovation activities.

This knowledge transfer and commercialisation capability provides linkage to industry, investment, and the local tech community, which enables us to accelerate innovation by leveraging existing and building new partnerships across all sectors.

3. **Design Informatics** is a collaboration between the School of Informatics and the Edinburgh College of Art that focuses on designing with data. It combines the power of massive connectivity and information processes with design thinking to generate, develop, and test new physical objects, capabilities and human-centric processes. Design Informatics designs tangible products and intangible services to transform the ways we work, live at home, care for each other, and play. Exploring design from, with, and by data: the central concern is the design of flows of data which sustain and enhance human values. Relevant technologies range from the internet of things, through blockchains, to robotics, speech recognition, data visualisation, interaction design, and social computing. Design Informatics is currently located approximately one mile from the Bayes Centre.

Design Informatics provides a unique perspective on how to develop transformative products and services, applying creative problem-driven thinking to data-driven technologies. This enables us to discover entirely new value propositions based on imaginative concepts of how people, data, and systems might interact in the future and to evaluate their viability by working closely with users in all stages of design.

4. The **Edinburgh Parallel Computing Centre (EPCC)** is an international centre of excellence in all aspects of high-performance and data-intensive computing, accelerating the effective exploitation of novel computing throughout industry, academia and commerce for over 25 years. This is achieved through a range of activities spanning advanced expert-led teaching and training programmes, service provision, industrial affiliation, research, and contract work. EPCC houses an exceptional range of supercomputers, with 90 staff committed to the solution of real-world problems using world-class systems, data storage and support services for industry and researchers. EPCC is located at King's Buildings – some 2 miles from the Bayes Centre site.

EPCC provides state of the art computing and data storage infrastructure that is needed to develop the new technologies that underpin data-driven innovation, and the capability to deploy highly skilled R&D-focused data scientists, architects, and engineers to support innovation projects.

5. **Robotarium East** is part of the Edinburgh Centre of Robotics (ECR), a collaboration among four Schools of the University of Edinburgh and Heriot-Watt University, which comprises several integrated and interconnected components, available to researchers inside and outside ECR.

These include spaces for humans and robots to work together, humanoids, and unmanned vehicles, underpinned by rapid prototyping and micro-assembly facilities, and state of the art computing accelerators with programmable hardware. Robotics researchers are currently located

in the School of Informatics, and co-location into the Bayes Centre will increase available physical space.

Jointly with HWU, the Robotarium is part of the strongest Robotics research group in the UK, and takes a data-centric approach to developing robots and other autonomous systems (RAS). Their unique expertise and equipment will accelerate innovation by allowing us to test new RAS technologies and combine them with other data-driven innovations into new products and services.

6. The **International Centre for Mathematical Sciences (ICMS)**, one of the two national centres for mathematical research, develops and organises international workshops and conferences in all areas of mathematics. The **Maxwell Institute for Mathematical Sciences** brings together research activities in the mathematical sciences at Edinburgh and Heriot-Watt Universities.

The two institutions bring expertise to Bayes that opens up new opportunities for utilising statistics, computational mathematics, operations research, and other applied mathematics disciplines for data science and AI, with concrete benefits for innovation in financial, engineering, and environmental applications. As with The Data Lab, ICMS is located at South College Street currently.

Extending core Informatics capability with deep mathematics expertise will enable new research collaborations, and create new opportunities to use maths in data-driven innovation (providing a conduit, in particular, to statistics expertise), while also providing access to UK-wide excellence.

7. The **Alan Turing Institute (ATI)**, an external partner whose Edinburgh node will be hosted in the Bayes Centre, is the national institute for data science, headquartered at the British Library in London. ATI is a joint venture between eleven universities and the UK Engineering and Physical Sciences Research Council. Its mission is to make great leaps in data science research in order to change the world for the better, investigating the hardest questions in data science and working with key industrial partners to drive innovation in the area. ATI has also recently become the UK's national centre for AI, which extends its mission to leverage the opportunities for the UK economy that arise from the growth of AI research and innovation.

The ATI allows us to leverage data science and AI expertise across the UK, facilitating new collaborations across academia, industry, and government, and shaping future strategy and policy at a UK level. It acts as a multiplier for both fundamental and translational research by providing access to partners, data, and funding.

8. **The Data Lab**, an external partner, is Scotland's Data Innovation Centre funded by the Scottish Funding Council. It enables industry, public sector and world-class university researchers to innovate and develop new data science capabilities in a collaborative environment. Its core mission is to generate significant economic, social and scientific value from big data. With a Scotland-wide presence, and close proximity to leading industry and university institutions, it focuses on building relationships locally and delivering a range of activities that span across three key areas – collaborative innovation, skills & training, and community building.

The Data Lab enables industry and government in Scotland to create value from data, matching innovation needs with the expertise, skills, and partnerships needed to exploit new data-driven technologies. It focuses on knowledge transfer and skill/capability development, complementing the Informatics knowledge exchange activities with an industry-driven focus.

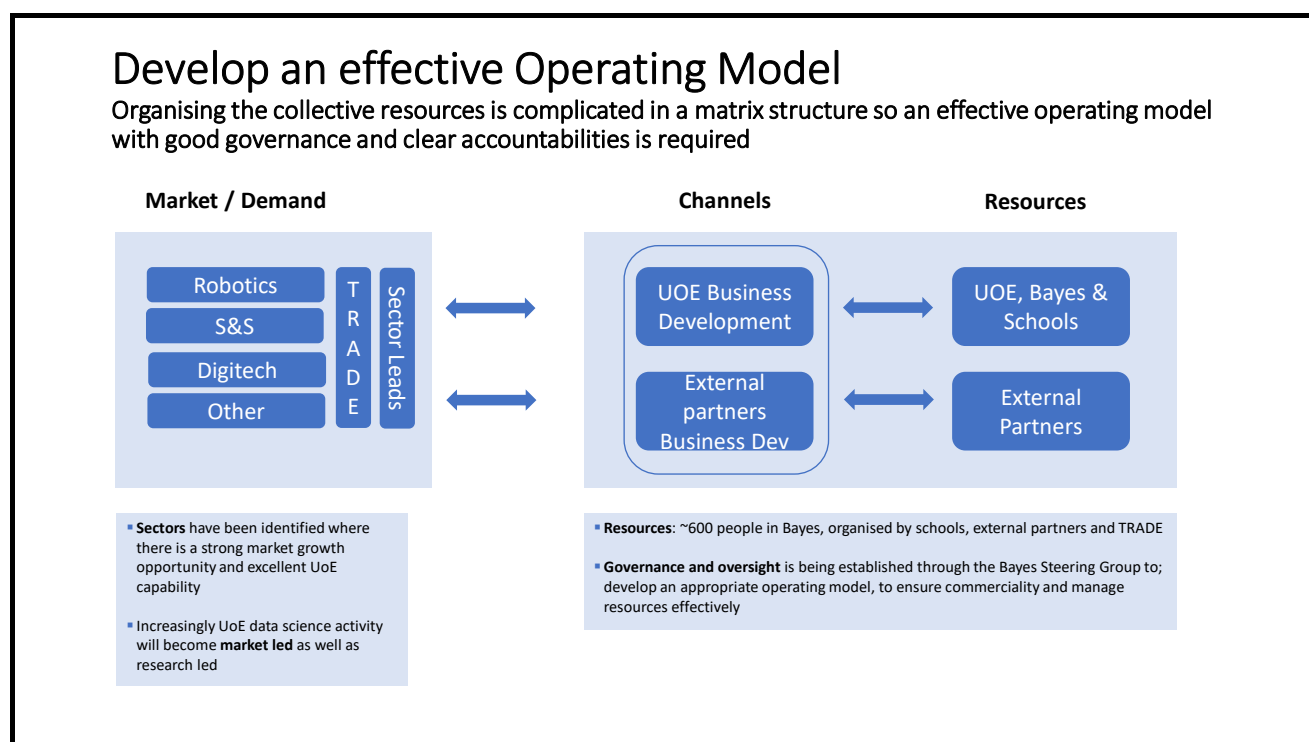
Operating Model

The above list of resources at an individual level is very impressive, recognised nationally and internationally. The challenge is being able to further leverage this to drive innovation so that the collective is significantly greater than the individual parts. The objective, as a starting point, is to co-locate all of the above but a strategy will only ever be as good as its delivery mechanism. Given the complicated nature of the cross-matrix organisation structures described above which will, going forward, have a specific data-driven innovation remit and thus will need to collaborate and organise to be effective, a defined operating model is being instituted to facilitate strategy delivery. Figure 3 below depicts the high-level view of the operating model. This depicts the basic organisation of resources and how Bayes will face of into its chosen sectors. Importantly, in the first instance, sectors leads are being hired to amplify the City Deal within those sectors, pump prime the pipeline from those sectors and develop sector specific plans.

In parallel the institutes located within the Bayes Centre will communicate and collaborate through various management fora (e.g. Bayes Centre Innovation Group). Events (e.g. brown bag sessions, seminars, webinars and town halls) will also be convened to foster collaborations across and between client organisations within the Bayes Centre. In addition a membership model is currently in development to facilitate wider collaboration with organisations that wish to interact with, but are not physically located in, the Bayes Centre.

Building on the above various joint programmes will be put in place – with resident and non-resident organisations to ensure substantive on-going collaborative working and project development. A collaboration lead role has been established for this purpose. The collaboration lead appointee will be in place by December 2018.

Figure 3 Bayes operating model



The Bayes Centre will undertake a range of activities that are different and additional:

1. It will physically co-locate, and enable new and innovative multi-disciplinary (and data) interactions between, a range of data-centric institutes and departments that previously existed within narrow disciplines;
2. It will foster new collaborations between academia and industry in order to better connect world-class research with the global marketplace (i.e. as addressed under the ADOPTION theme activities); and,
3. Through activities such as the Wayra Accelerator, it will bring industry together with entrepreneurs in order to increase the flow of fast-growth companies within the region (i.e. as addressed through the ENTREPRENEURSHIP theme).

A key aspect of the DDI Programme is outreach outwith the City of Edinburgh. The University already has a sophisticated outreach capability that attracts thousands of foreign students, and millions of pounds of international research funding, every year. The DDI Programme will build upon this in order to provide outreach capabilities in support of ADOPTION and ENTREPRENEURSHIP activities.

Outreach activities will be undertaken across the city region (e.g. via local councils), across Scotland (e.g. in conjunction with The Data Lab), across the UK (e.g. via existing and new partnerships with relevant government Departments (and supporting policy initiatives), academic institutions and personal networks) and internationally (e.g. via UoE, SDI and UK Government trade missions). These activities will be defined and co-ordinated through sectoral leads, four of which are in-post currently. In this role sector leads will identify, create and establish sector focus, outreach priorities and an associated engagement plan.

It should be noted that the UoE brand is extremely strong, and business readily engage with UoE. As a result it has not been difficult to attract a pipeline of activity as described below. Historically this type of engagement has tended to be reactive. With target sectors identified and sector leads secured, the DDI Programme has and will continue to actively engage target organisations in a more pro-active manner.

As a result, the response from industry to the opportunities within Bayes is strong. The current pipeline has over 200 opportunities. This traction has been achieved by industry interaction from the Bayes Business Development team (funded by the Bayes innovation Programme - Project A) and the School of Informatics Business Development team (funded by the School and national research bodies). Current pipeline projects include companies who wish to engage directly with the academics within the School of Informatics and, what makes the offering unique, companies who wish to engage with multiple Bayes partners in a single project.

2018 has seen significant pipeline conversions including laboratory programmes with values of over £1 million, together with other projects being undertaken with a range of global organisations. Examples of cross-Bayes projects include a joint research project involving a US satellite system company, ICED (international Centre for Earth Data), EPCC, School of Geosciences and the School of Informatics and a programme framework agreement that has recently been secured with a global telecoms equipment company.

Similarly the Bayes “Accelerator” programme is an example of an exciting recent DDI initiative. Funded by the University of Edinburgh, Bayes Innovation Programme - Project A) and WAYRA (part of Telefonica) the accelerator focuses upon AI and Blockchain technologies. The first cohort of companies (10 places) was significantly oversubscribed – over 140 applications were received from throughout

the UK and Europe. The combination of the market reach of Telefonica, its experience of accelerator management, and the attraction of Bayes and the School of informatics has produced a very strong initial cohort of 6 Scottish based companies, 3 from England and 1 from Switzerland.

The pipeline is being further enhanced by specific campaigns. These include trade missions, working with Scottish Development International and using external business development organisations such as Intralink which is funded through the Bayes Innovation programme - Project A. As a result a strong project pipeline with Japanese companies is emerging.

Further evidence of this of this new approach to outreach is reflected in the scale of some of the collaboration opportunities which would not have happened pre-City Deal (including the Global open banking centre of excellence bid to Strength in Places Fund (>£20 million)).

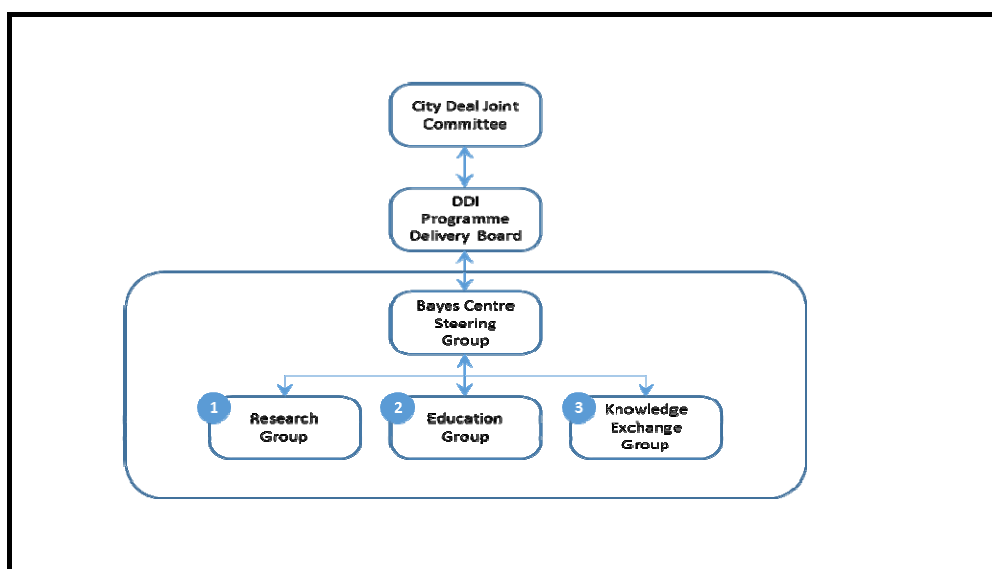
These activities build upon existing successful outreach activities including the Engage, Invest, Exploit (EIE) technology investment conference that attracts annually over 50 organisations seeking investment and 700 delegates.

The Bayes Centre will also interact with other similar initiatives (e.g. ATI) as a strategic collaborator in areas where UoE has a distinctive data capability that complements those of its partners. Traditionally, this will have occurred predominantly in a research context. As indicated by all the above, the Bayes Centre allows new and stronger quality collaborations to occur at scale across the different TRADE themes, for example through:

1. Talent (e.g. global professional services company graduate apprenticeship programme);
2. Adoption (e.g. major commercial organisation seeking to innovate later-life care provision);
3. Data collaborations encompassing, for example, provision of child health care; and,
4. Entrepreneurial support programmes that are delivered in conjunction with key industry partners (e.g. WAYRA accelerator).

Sitting below the operating model will be robust governance (see Figure 4) to ensure alignment with the overall City Deal programme as well as giving clarity to roles and remits for Bayes Centre occupants. Note that Knowledge Exchange deals with Adoption and Entrepreneurship.

Figure 4: Bayes governance structure



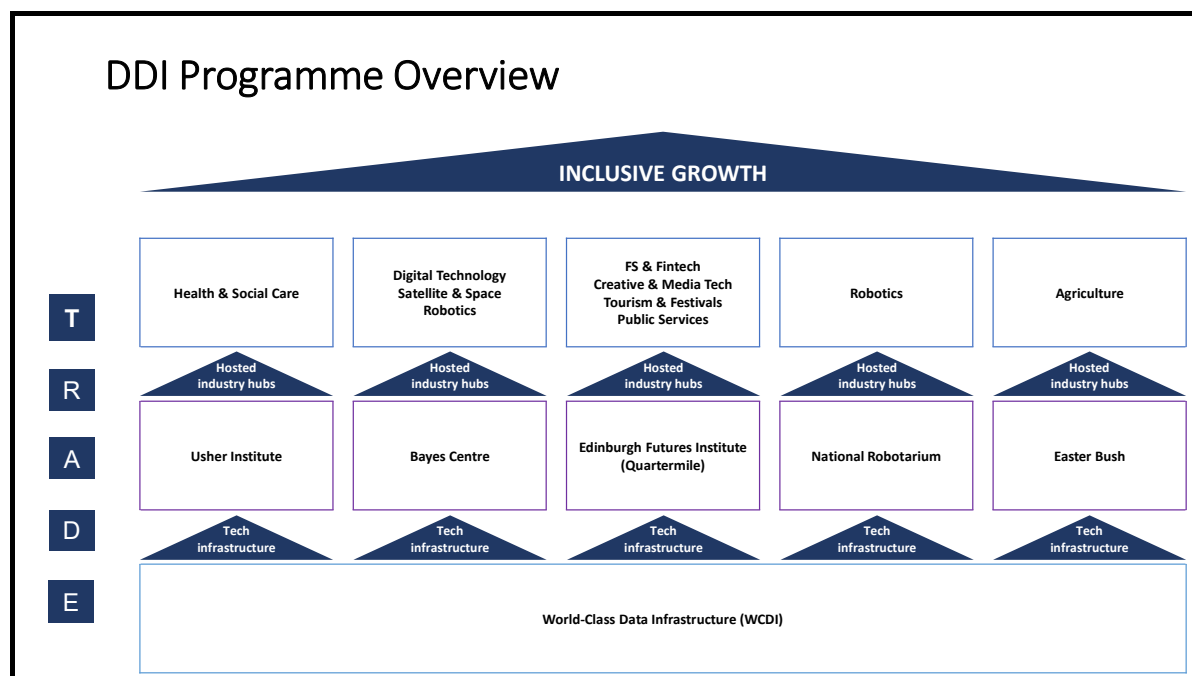
Investing in sectoral activities: Digitech, Space & Satellites and Robotics and Autonomous Systems

Having identified the main actors, described how they will operate and be governed and consequently organised through channels to the market, the final element is to understand UoE chosen sectoral participation.

The overarching intent of the UoE DDI vision is to drive innovation by harnessing the collective expertise of the various actors already outlined and then packaging this for industry in a practical and commercial format. Typically, industry and external consultants do not have the depth of talent and expertise of universities. Conversely universities often struggle to commercialise their expertise. The challenge being addressed by UoE is to improve its capabilities right along the academic value chain i.e. TRADE, thus being able to innovate successfully and becoming an attractive source of innovation for industry partners and investment.

The SIA identified local assets and capabilities that could be exploited to create a competitive advantage. Through this analysis ten target sectors (see Figure 5) were selected in order to align with regional priorities. Edinburgh is recognised as one of the UK's fastest growing and most productive cities. New areas where the UoE could engage further include financial services, technology & software, creative industries, life sciences and tourism (all of which are key sectors of local strength). As one example of realising these opportunities, engagement has started within Financial Services organisations, both large corporate as well smaller Fintech companies. The initial response has been positive with multiple areas to collaborate in terms of talent supply and technology issues such as portfolio optimisation in asset management, helping with lending credit models to looking at people performance data from both a tech and organisational leadership perspective.

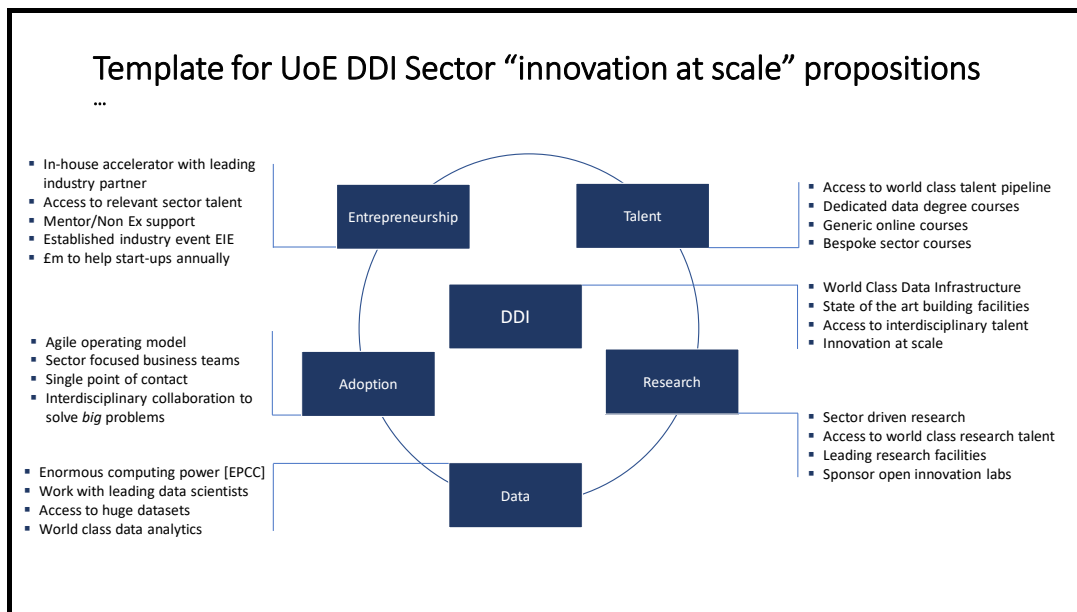
Figure 5: DDI overall programme



Similarly by focussing on space and satellite, digital technology (e.g. - blockchain, AI, Software engineering and Data science) and robotics, the Bayes Centre will build on existing talent, research, data (software) and adoption strengths in these sectors. Given the UoE expertise in informatics and geoscience and an already established presence in these markets combined with the opportunity, these sectors are a good strategic fit for future proofing success.

In addition, to develop a proposition approach, and recognising TRADE capabilities, a generic DDI proposition template is being developed, which is outlined below in Figure 6. At a DDI level the TRADE proposition could be summarised as; access to expertise (T) and world class research (R), huge computing power and datasets (D), sector specific engagement teams in place to navigate the world of academia (A) and mechanisms and funding in place to commercialise ideas (E). This generic TRADE framework will be adopted and tailored to individual sectors.

Figure 6: DDI Proposition Template



The innovations arising from the Bayes Centre will be data science-led, the applications of which will be found in existing markets and/or new markets enabled by technological disruption. Examples of technological innovation areas that will be explored through the Bayes Centre include:

- Digital Technology: the Blockchain Technology Lab is focused on developing distributed ledger technologies including smart contracts and cryptography across multiple cross sector applications;
- Artificial Intelligence: Machine learning, expert systems and natural language systems;
- Space & Satellite: Real-time big data management and analysis; and,
- Robotics: Autonomous systems with applications for vehicles on earth and in space.

In addition, support for the manufacturing sector is also a key focus. Discussions on opportunities afforded by data-led, automated, advanced manufacturing are currently underway with local councils. Global organisations are seconding staff to the University to develop factory automation approaches, and the University has recently established a professorship specialising in factory automation and layouts.

Given the above **clusters of new activity** are already emerging. For example:

- In the BONSEYES consortium machine learning and computer systems experts are working with companies to create a platform for the open development of distributed AI systems emerging as a key growth driver in cyber physical systems;
- The Blockchain Technologies Lab, a collaboration between leading cryptocurrency company IOHK and the School of Informatics, is pioneering technologies such as multi-party

computation, which allows several organisations to perform a joint computation without sharing their data with each other;

- As part of the Prosperity Partnerships programme, experts at the University's supercomputing centre, EPCC, are leading a project with Rolls-Royce to develop a detailed simulation of a gas-turbine engine in operation. The research aims to lead to the virtual certification of gas turbine engines and will be used to develop the next generation of engineering simulation and modelling techniques;
- The Edinburgh Huawei Research Lab is developing the next generation of AI and computer science technologies using expertise from Informatics researchers in areas such as natural language processing, machine learning, computer networks, computer architecture, and cybersecurity addressing a host of important technical challenges of importance to the digital technology sector; and,
- A cluster of activity is emerging in Scotland around space and satellite applications that includes downstream data analysis, satellite devices and satellite launch capabilities.

Sector Leads

As described above each sector will have a sector lead role, the role of which is to provide a sector specific focus which will align the market and commercial opportunity with the delivery capability. Sector leads are the key mechanism for driving engagement in emerging segments of opportunity that lie beyond the organisations with whom the university currently engages. The sector leads roles have been created to:

- Amplify the City Region Deal within the sector;
- Pump-prime the opportunity pipeline with sector and data related projects; and,
- Develop sector specific activity plans.

These roles are being recruited from the sectors where the individuals already have deep sector knowledge and will utilise their wide networks to drive engagement beyond those organisations with whom the University would typically engage. We will continue to recruit sector leads in additional sectors that we consider to be rich areas of opportunity.

Sector leads will work with The Data Lab to leverage data science skills across Scotland. More broadly, sector leads will engage with ATI - and institutions such as the Universities of Newcastle and Leeds, ONS, NHS, the Police Service and GCHQ - in order to diffuse our domain knowledge across the UK.

Sector leads will also engage with UK trade missions in order to export AI and data science expertise, and encourage inward investments by international organisations.

Bayes Sectors

The three sectors are described below as follows:

1. **Digitech**, is a new revolution that will be driven by cyber-physical systems and includes areas such as: Driverless Cars, The Internet of Things, Robotic Services, Smart Cities, Wearable Internet, Ubiquitous Computing, and Blockchains. Estimates of market sizes and growth rates are formidable. For instance: computer vision is predicted to reach \$49 billion by 2022, with a CAGR of 33%; AI-based analytics to reach \$70 billion by 2020, with a CAGR of 36%; natural language

processing to reach \$13.3 billion by 2022 (CAGR 18.4%) and IoT to be worth £81 billion to the UK Economy by 2020.

The University has strengths that underpin a string of enabling technologies with pervasive reach, fuelling the fourth industrial revolution. These technologies can be organised into a three-level stack, where new Interaction is supported by new Data, which is supported in turn by new Systems:

- **Interaction:** Robo-Advisors, Cognitive Computing, Design Informatics, Personal & Care-Bots, Manufacturing Robotics, Computer Vision, Natural Language Processing;
- **Data:** Predictive Analytics, Machine Learning, Social CRM, Database Systems & Analytics, NoSQL, AI-Based Analytics; and,
- **Systems:** Microprocessor, graphics processors & peripherals, Internet of Things, Sensors, Semiconductors, High Performance Computing.

Talent: the UoE will develop an under-graduate/MSc level course on data-driven entrepreneurship; an online course in data-driven entrepreneurship; a Public engagement programme that includes a data-driven entrepreneurship series; Schools and outreach programmes aimed at students, Universities (recruiting from local talent base), Companies (hiring). In addition a series of events, co-funded projects and various engagements through existing channels will be held to improve adoption. Finally a new start-up accelerator programme and Mentoring & Providing Financial Support for entrepreneurs, investors, Universities and companies will aim to boost deal flow for the region.

Adoption: significant investments from companies such as Huawei, IOHK and Intel have been announced with many other partner organisations in the pipeline discussing strategic partnerships around Bayes. Bayes aims to promote the Edinburgh City Region's innovation and tech cluster to all partners to help strengthen the case for investing locally. The current UoE pipeline of existing and new industry projects is healthy and growing with over 50 notable opportunities with companies of all sizes. As part of Adoption, the plan is to establish an industry engagement group under the Bayes Steering Group that will operate within the Bayes Centre, working in collaboration with existing business development groups to increase the capacity for converting this pipeline into actual projects. They will engage with industry partners and also help to scout for new opportunities to spin-out or start-up new ventures that can be directed into the company formation activities. The primary focus for this team is to build industry relationships with corporates.

Entrepreneurship: In addition to the above, one of the major challenges the University of Edinburgh is currently facing is a decreasing pipeline of new start-up and spin-out companies. In order to capitalise on significant growth markets that are enabled by the technologies developed within the Bayes Centre, it is intended to establish a new start-up accelerator that focuses on creating new companies from the significant talent pool within the Edinburgh region.

2. **Space & Satellites:** London Economics and the OECD reports together show that Scotland has the potential to generate £3.2 billion of revenue from Space Data business by 2030. Central to delivering on this opportunity is the University of Edinburgh and its nexus of high-growth space data companies that deliver Earth Observation (EO) Services. **Of major concern is the skills shortages in EO Science**, which is the principal challenge reported by space companies in

Scotland, and new talent and talent retention could inhibit the capacity of the region to realise the DDI opportunity. Interest in relocating to a strong Space Data Analytics hub in Edinburgh has recently been expressed by S&S industry incumbents and complements the current ramp-up activities happening for the start of the Higgs Centre for Innovation (UoE partnership). The focus of the Higgs Centre is on Space and Big Data – these themes having been chosen after market analysis showed a need for public-sector support to remove barriers to entry into these markets for start-ups and SMEs.

The primary focus, aligned to UoE capability, is on downstream services which are data-oriented rather than the upstream activity of putting satellites in space and industry interest has already been evidenced, recognising the insights that the University could bring. Partners are willing to provide access to their platforms for training and research, but are unable to provide direct funding until the ability to train large cohorts simultaneously is proven. They are very excited at the prospect of a highly scalable delivery capability that could train hundreds of space related experts whilst maintaining group working ethos.

Although not wholly dependent, the market for climate services represents the biggest growth application area for satellite data, and it is presently unproven. There is evidence of a nascent global market for demand-driven climate services for both climate change mitigation and adaptation needs. Satellite data is an essential technology to harness this opportunity and strengthen the UK's capacity to respond and to improve resilience to climate change.

To address the opportunity UoE will build on its existing capabilities. Specifically to ignite the **(Talent)** programme in Year 1 it will take advantage of existing courses and design a series of course modules, for the 'Data Science' Masters students in each of the climate 'EO' services; forests, agriculture, infrastructure and atmosphere and employ 2 new staff to deliver it . By Year 4 it will develop more innovative learning and evolve this into a hybrid online/group work-based model that allows us to deliver the course with cohorts of up to 100 from year 6 onwards. UoE will develop a new master's-level programme of modules drawing together Earth Observation and data analytics. An investment in **(Data)** computing power and budget will increase capacity to receive and handle very large data volumes for both students and business. A more computationally efficient approach will increase capacity to run more sophisticated modelling scenarios to support a range of market driven applications including, for example, climate-informed decision-making for government and industry.

The key beneficiaries will be the students enrolled on the courses, the government and regulatory authorities and the SME application providers.

3. **Robotics:** McKinsey has estimated that by 2025, advanced Robotic and Autonomous Systems (RAS) could have a worldwide economic impact of \$1.7 trillion to \$4.5 trillion annually. The potential and importance of RAS to the UK economy and its future growth is fully recognised in Government and through the UK RAS 2020 Strategy.

One of the strengths in the area of robotics lies in the synergies between HWU and UoE robotics research and skills training that have been strengthened over that last 5 years, and the collaboration has been formalised in the Edinburgh Centre for Robotics. The HWU team brings to the collaboration industrial connections and industry-informed problems, as well as the engineering and manufacturing expertise and technical staff, and this is complemented by the

strong algorithmic and artificial intelligence expertise and experience at UoE. The Edinburgh ecosystem has the potential to become the UK's lead player in this revolution across the prioritised healthcare, hazardous environment and manufacturing sectors through the research and innovation activities of the Edinburgh Centre for Robotics⁵ already producing 100 innovation-ready PhD students.

In the first three years Bayes will establish the core physical infrastructure and run first challenges. Expansion in the training (Talent) provision that currently exists will commence using the facilities once ready. A spiral development approach is envisaged on a 3-year timeframe establishing and then expanding each of the 5 strands from embryonic activity to world-class centre. Initial challenges will be in infrastructure inspection, repair and maintenance for subsea, nuclear and civil sectors and healthcare for assisted living. It is intended to work closely (Adoption) with Scottish Enterprise in particular but Scottish Development International and Scotland Europa also link their activities into the National ROBOTARIUM so as to leverage from their considerable networks in Scotland and internationally. Similar links to UKTI and FCO Science Innovation Network will also be leveraged to fuel growth through international sponsorship and further possible inward investment in future years.

The key beneficiary groups include; new generations of graduates and postgraduates, scientifically trained and also 'innovation ready', with access and support (Entrepreneurship) to start businesses from their research, start-ups creating the next generation of RAS businesses within and across sectors that will play a leading role in the next wave of disruption affecting everything that moves, spin-in business seeking technical support for their business endeavours, SMEs at various scales seeking a technological edge, knowledgeable about their marketplace and prepared/able to invest in order to scale and have international competitive advantages, technical staff in local high-tech business, through training in technical subjects and innovation, local economy through inward investment of large international businesses co-locating facilities and people for access to talent, ideas and markets and schools across the central belt and potentially Scotland-wide through robotics outreach programmes.

Investing in infrastructure: Bayes Centre Construction

The third and final component of the investment is a £45 million investment for the construction of the Bayes Centre. Formally approved in 2015 to ensure regional competitiveness in DDI, the Bayes Centre opened in September 2018. The 9,000 square metre facility provides additional space required to grow DDI capacity, by hosting 600 staff and associated facilities, which will be deployed to support acceleration of DDI in the region. Located next to the existing School of Informatics, this will create a world-class DDI powerhouse capable of attracting data services companies to the City Region. It will anchor a full facility approaching 2000 people across the integrated centres as shown in Figure 7 overleaf.

⁵ Edinburgh Centre for Robotics: <http://www.edinburgh-robotics.org/>

Figure 7: The Bayes Centre



The Bayes Centre has been designed to facilitate delivery of the TRADE activities. The major commercial components of the Bayes proposition relate to building construction and fit-out, and equipment procurement.

The total project cost of the Bayes Institute is £45 million and the gross floor area, across five floors, within the new facility is 9,000m². The design ethos for the building is to create an open plan building which encourages collaboration. The occupants of the building are PhD students, academic, support staff and external partners. City Deal activities will be distributed throughout the building and they will also have the benefit of sharing the communal collaboration spaces, meeting spaces and break out facilities incorporated into the development.

The overall identity of the Bayes Centre will be lively, high quality (to reflect its status and outward-facing approach), exciting, connected, innovative, open, flexible and adaptable. Internally, there may be a need to support separate identities for specific occupiers within their fitting-out arrangements.

Organisational Structure of the Bayes Centre

The Bayes Centre will be managed and run by the Bayes Steering Group (BSG). Much of the activity in the Centre will build on the strengths of Informatics as the key data science centre of research excellence. Whilst the School of Informatics activity will be prevalent in the Bayes Centre, it will be strongly interdisciplinary with a focus on translational research and education. Much of its activity will be outward-facing, working across a range of application domains and engaging directly with industry, government, and the third sector.

Inside the building: the BSG will establish a focal point for data intensive technologies of all kinds; entrepreneurial and innovation activities surrounding this; and data intensive technology for education. This will include:

- The data-intensive component of the **Edinburgh Parallel Computing Centre** (the UK's major academic supercomputing centre), connecting to off-site data and high performance computing and data facilities;
- The **Informatics** technology transfer operation, embedding an innovation culture in Bayes, providing business development support across the University;
- International Centre for Mathematical Sciences (ICMS), bringing core mathematics and computation expertise into the Centre;
- Design groups from ECA and Informatics (extending the **Design Informatics** initiative);
- Sensor and robotics researchers, including the **Edinburgh Centre for Robotics**; bringing in related researchers in School of Engineering and connecting to the Sensors Innovation Centre;
- **The Data Lab** acting as a lynchpin for community building, training, and data-driven innovation projects activities across Scotland;
- Connecting and facilitating Data Science and AI across the UK, the **Alan Turing Institute** will help align the relevant stakeholders across the UK;
- Incubation space, company engagement space and company engagement activities; and,
- External partner organisations, students, and academic researchers hosted as part of the broader data science activity across the University (see below).

Across the University: the Bayes Centre will act as a hub supporting data technologies, data-intensive research and data analytics in education. Examples of high impact areas within Schools are:

- Physics: through joint interest in EPCC and data-intensive and high-performance computing;
- Engineering: through joint research in sensors and robotic systems;
- Mathematics: on the statistical aspects of data at scale;
- Biology: in collaboration with its DNA synthesis research, and Bioinformatics more generally;
- Geosciences: connecting to the prospective NERC environmental big data centre and **Higgs**;
- Edinburgh College of Art: through the joint Design Informatics initiative;
- Social Sciences: through the Institute for the Study of Science, Technology and Innovation;
- Molecular, Genetic and Population Health Sciences: through joint work on Data Safe Havens (a **secure** place used to store particular research **data**, for access exclusively by approved colleagues) and analytics;
- Clinical Sciences: image analysis via the Centre for in vivo Imaging Sciences and, through this, engaging with the Scottish SINAPSE imaging network; and,
- Education: through joint work on learning analytics, educational media, and data-driven educational technology.

Beyond the University: the Bayes Centre will form alliances with like-minded organisations to develop a shared agenda nationally and internationally. This will be driven through strategic themes and Grand Technologies including:

- Healthcare (building on Farr and the Digital Healthcare IC);
- Medicine (building on research at Molecular, Genetic and Population Health Sciences and regenerative medicine);
- Synthetic and systems biology (building on DNA synthesis and synthetic biology);
- Finance and economy (exploiting links to London and the CDEC Catapult);
- Design (building on Design Informatics and the Edinburgh Centre for Robotics);
- Data Science (e.g. working with The Higgs Centre for Innovation);

- Education (adding an analytics and social computation element to MOOCs and other media); and,
- Government and public sector (via open data and administrative data efforts).

By consolidating activities, creating a hub for innovation at scale and collaboration, the Bayes Centre will convene, in one location for the first time, world-leading applied researchers with talented students and industry supported by existing data science expertise.

As part of the overall £45 million investment, £5 million is sought to equip robotics Living Labs. A significant component of the robotics activity in the Bayes Centre will focus on the development of Living Labs that bring together world class cutting-edge research with industry buy-in for de-risking disruptive technologies in various domains. These activities will complement the activities undertaken by the Robotarium, and is documented in the National Robotarium business case for investment.

The Bayes facility will house field robots designed to work in extreme and hazardous environments, including construction of mock-ups, plus associated supporting systems for:

- the offshore and built environment infrastructure asset inspection sector (Total Argos Challenge mock-up with ANYmal quadruped robot for sensor deployment); and,
- fuselage co-assembly and manipulation mock-up (multi-arm manipulators on omni-directional mobile base) for the airline assembly and maintenance sector
hospital / operating theatre mock-up (realistic OT setup, motion trackers -- kinect, cameras) along with reconfigurable hospital and smart home settings.

Bayes Centre Target Outcomes – the “so what”

Through the investment in capability, the effective organisation of resources to face the market and housing all of them in a single centre the UoE expects to make a substantial impact.

By taking the above approach, UoE will fuel inclusive growth by demonstrably improving innovation and incrementally growing its capabilities which will transform the City Region DDI ecosystem over the next 15 years delivering:

- **Talent:** using the teaching resources within the UoE School of Informatics, train and engage with over 40,000 people across data-driven entrepreneurship, digital technology, space and satellite data driven innovation and robotics;
- **Research:** Bayes research facilities will host world-leading applied researchers, and convene projects with talented students and industry worth £59 million;
- **Adoption:** staff from the various organisations within the Bayes Centre will undertake around 300 new company engagements, including early stage and scale-up companies, to increase their level of data adoption;
- **Data:** through EPCC, The Data Lab and Alan Turing Institute, Bayes will support private, public and third sector organisations to utilise the WCDI platform to enable the creation and utilisation of new forms of data asset; and,
- **Entrepreneurship:** using the expertise of organisations such as Informatics Ventures and Edinburgh Innovations, refresh the fast-growth company pipeline through the establishment of 250 new high-growth start-ups utilising a new, targeted, Pre-Incorporation Accelerator Programme, and support equity investment through an investor-readiness programme: Engage Invest Exploit.

Overall Summary

The Bayes Centre, and the diverse range of groups and activities that it will host, is an ambitious and complex undertaking. It will provide a huge boost to innovation at scale in the region and beyond, leveraging world-class capabilities within its resource organisations and appropriate sectoral targeting, driving inclusive growth. Robust governance and financial arrangements have been outlined and will be developed further in the cases below, along with the strategic, commercial and economic considerations.