The University of Edinburgh: Response to the Scottish Tech Ecosystem Review
Executive Summary

The University of Edinburgh, and the Edinburgh & South East Scotland City Region Deal partners have written their responses to the Scottish Tech Ecosystem review (STE Review) side by side. As a City Region Deal partner, the University of Edinburgh underwrites the CRD Partners' response. With a few exceptions, we have sought to not duplicate observations, comments, and proposals across the two documents.

The University of Edinburgh welcomes the STE Review. The Review is well articulated and action-oriented, and we are in broad agreement with its observations and recommendations. We find the study very timely. The analysis that our current Technology Ecosystem is not yet self-sufficient is accurate, and we agree that it is of critical importance to increase both the rate of Scottish tech start-up creation and the speed of their growth.

The three domains of interventions (education, infrastructure, and funding) of the Review are appropriate, and we welcome the focus on education as the most important of the three. If implemented holistically, as suggested, the proposed recommendations will be highly impactful and push our Tech Ecosystem over the "tipping point".

The Structure of this Response

In this Executive Summary, we discuss the role of Scottish Universities and the University of Edinburgh in the Scottish Tech Ecosystem on a generic level, and have collated our key messages from the latter chapters of our response.

In first three chapters, we have collated our feedback for the three main areas of the Review - Education, Infrastructure, and Funding.

In the fourth chapter, we propose an additional focus on two domains (People and Innovation), to future-proof our Tech Ecosystem.

Finally, we have collated our comments for each of the recommendations in chapter five.

Across our response, we have added local and international case studies for inspiration and benchmarking purposes.

Tech Ecosystem & Scottish Universities

For a small nation, Scotland has a uniquely strong higher education cluster. Scottish Universities are an excellent asset as a source of world-class research, IP, and talent across many of the key relevant disciplines. We recognise the prominent role of universities in our Tech Ecosystem and accept our responsibility in increasing their entrepreneurial drive.

The University of Edinburgh recognises the challenges in driving innovation¹. Process of securing large-scale innovation investment can take up to 3 years and is highly complex and challenging. Consequently, Scotland is not universally considered a global destination for innovation.²

We propose that universities join forces and develop a strategic, nation-wide model to address this challenge, in collaboration between the Scottish Government, the Scottish Funding Council, and the private sector, based on the recommendations of the STE Review, and aligned with the most relevant proposals of the Muscatelli Report (2019). Leadership and prioritisation are necessary to target resources on domains with most expertise and investment potential.

Technologies evolve exponentially and the Tech Ecosystem of tomorrow will be different from the one of today. We propose to pay special attention on future-proofing our Tech Ecosystem: what kind of entrepreneurs do we

² InnovationCities 2019: Edinburgh on a downward trend from 64th in 2010 and 68th in 2015 to 98th in 2019
educate and support, what are the problems they will focus on, and which key enabling technologies are needed to solve them. Together with private and public sector partners and communities of innovators, Scottish Universities can play an essential role in this future-proofing. We have addressed this in more detail in Chapter 4: Future-proofing the Scottish Tech Ecosystem.

The role of the University of Edinburgh

The University of Edinburgh has been one of the main contributors to the evolution of the thriving start-up scene of the capital city. Regional and national success are connected - the future of the Edinburgh tech start-up scene depends on the availability of talent from all corners of the nation, and from abroad. Therefore, we aspire to be one of the leading contributors to the Scottish Tech Ecosystem, building connections and launching entrepreneurship programmes and platforms, available across Scotland and beyond, as well as attracting significant investment into the Scottish tech innovation sector.

The University coordinates the Data-Driven Innovation initiative (DDI) of the Edinburgh & South East Scotland City region Deal. As the largest innovation grant ever won by a University in the UK, DDI can be an exceptional resource to our Tech Ecosystem. The five DDI Innovation Hubs (Bayes Centre, Edinburgh Futures Institute, Usher Institute, Roslin Institute, and National Robotarium with Heriot-Watt University) are externally facing innovation centres. Supported by the massive-scale data storage and processing capacity of the world-class Edinburgh International Data Facility and external network of partners, they form an excellent platform for incubating and scaling high-growth tech ventures, and connecting them to an extremely strong talent pipeline.

Early results of the DDI Programme are impressive. After the first two years, over 1100 jobs have been created through construction and innovation activities. The industry has invested £61.7 to DDI projects (+100% over target), and 42 new data-driven companies have been launched (+85% over target).

The UoE has an ongoing collaboration with the world-class innovation drivers of Edinburgh (incubators, accelerators, and venture funders) and has already started the process to deepen the partnership with Codebase, to realise the STE review recommendations, especially the Tech Scaler, in collaboration.

The UoE is also well placed to support the International Tech Market Square through existing activities, such as the Engage Invest Exploit (EIE) programme, when those are scaled up and funded on the national level. With support from Scottish Enterprise, the UoE has made a continued significant investment in supporting such activities for the benefit of the regional ecosystem. Scaling this up to a national scale, in collaboration with HE and innovation partners across the region will require substantial and continued investment from the public and private sectors, but is essentially to attracting the levels of inward start-up investment require to make a step change.

Governance Model, Monitoring and Evaluation

The success of our tech ecosystem will depend on fostering trust across the wide range of organisations. On the strategic level, in delivering “innovation”, Scottish Government interventions are provided through the Scottish Funding Council, Scottish Enterprise & Scottish Investment Bank, Skills Development Scotland, Highlands and Islands Enterprise, and South of Scotland Enterprise.

Ecosystem support measures must encourage collaboration, rather than competition. Following the STE Review, there might be a need for a holistic analysis of the roles currently played by the Agencies above, how they could work in a more integrated way to support the ecosystem, and which are the critical gaps to be addressed by the Government.

The STE Review is relatively light on metrics and numbers, with recommendation 3 “Tech-scaler North Star Metrix” being the most important concrete proposal, regarding evaluation. The University of Edinburgh
considers that the impact of investments allocated to the development of the tech ecosystem is likely to be rather complex and nuanced, extending beyond the (perceived) market value of start-ups.

To be able to evaluate the return on investment to the Scottish economy, we recommend developing a detailed assessment framework capable of capturing the economic, societal and sustainability results of the interventions.

The Edinburgh & South East Programme partners have developed a joint-up benefits realisation approach to measure how the Deal is performing against the agreed delivery plans and objectives, and what economic, social and other impacts are generated as a result within the Region, Scotland and elsewhere in the UK, based on an overarching Theory of Change mapping out the relationships between Deal programme inputs, activities, outputs, outcomes and impacts. DDI, for example, has five impact areas of Talent, Research, Adoption, Data, Entrepreneurship, and Inclusion which form a joint-up benefits realisation approach, spanning the whole programme period of 15 years.

A similar approach could work well for evaluating the impact of our Tech Ecosystem. The University of Edinburgh would welcome the opportunity to contribute to the development of a Theory of Change for the Ecosystem, as proposed in the response by the Edinburgh City Region Deal partners.

Acknowledgements:
Lead author (UoE): Jarmo Eskelinen
Lead authors (Edinburgh & South East Scotland City Region Deal): Ritchie Somerville, Mark Graham
Contributors: Jim Ashe, Mark Graham, Professor Jane Hillston, John Lonsdale, Professor Michael Rovatsos, Professor Judy Robertson, Tracey Slaven, Professor Melissa Terras
Key Messages in a Nutshell

1. Education
   - **School level:**
     - The main challenge of CS education is a shortage of specialist computing teachers. The UoE has proposed ways to tackle the issue in its report with SDS in 2019.\(^3\)
   - **University level:**
     - *Graduates with start-up skills:* These skills should be provided across disciplines
     - *Computing Science Graduates:* Joint effort between stakeholders is required
     - *University Spin-outs:* Collaboration of universities, the public sector and the private sector is necessary to develop Deeptech start-ups
     - *Tech Skills:* Data & digital skills are important also for non-tech professionals
     - *Peer learning:* Founders learn from each other – endorse and support bottom-up initiatives.
   - **Early-stage Leadership:**
     - *Role of Universities:* Universities attract top talent to Scotland and are key partners in international collaboration
     - *Role of Colleges:* Further Education Colleges should be recognised as an alternative pathway towards skills acquisition and pathways progression

2. Infrastructure
   - **Tech-scaler network:**
     - Universities can provide platforms for multidisciplinary collaboration to launch Tech-scalers.
     - *UoE aims to join forces with Codebase to deliver Edinburgh*
   - **International marketplace**
     - The Engage Invest Exploit (EIE) Programme can be a foundational element in the International Market Square.

3. Funding
   - The UoE proposes additional grants and other mechanisms to support student entrepreneurship.

4. Future-proofing the Scottish Tech Ecosystem
   - **People - the founders of tomorrow:**
     - *Empowerment:* empowered bottom-up communities can transform the tech ecosystem
     - *Inclusivity and diversity:* A small nation cannot waste talent. Our tech ecosystem must be inclusive, diverse, and connected, nationally, and internationally.
     - *Purpose:* The next generation of founders and talent come from diverse backgrounds and are driving a shift towards purpose.
   - **Innovation – the solutions of tomorrow**
     - *Case of Sectors:* Industry clusters supported by research can deliver lasting value
     - *Key Enabling Technologies:* Developing radical innovations requires multi-disciplinary collaboration across organisational silos.
     - *Growing Deeptech start-ups:* New, multi-stakeholder funding models and collaboration between the entrepreneurs, universities, the government, and corporations are needed.

5. The University of Edinburgh responses to the 34 recommendations
   - In a small nation like Scotland it is critical for all the stakeholders to join forces
   - The University of Edinburgh agrees with the need to aim for international best practice across all aspects of the Tech Ecosystem. The strongest Scottish Universities are globally networked, making them capable of supporting the internationalisation agenda – by attracting top talent, and by connecting to globally leading research and innovation.

---

Table of Contents

Executive Summary ................................................................................................................................. 2

1. Education .................................................................................................................................... 7
   1.1 School Level ............................................................................................................................. 7
   1.2 University Level........................................................................................................................ 8
      1.2.1. Graduates Equipped with Start-up skills ............................................................... 8
      1.2.2 Computing Science graduates ................................................................................... 8
      1.2.3. University Spin-outs .................................................................................................. 9
      1.2.4. Tech Skills .................................................................................................................. 9
      1.2.5. Peer Learning .............................................................................................................. 10
   1.3 Early-stage Leadership ............................................................................................................ 10
      1.3.1. Role of Universities ..................................................................................................... 10
      1.3.2 Role of Colleges .......................................................................................................... 11

2. Infrastructure ............................................................................................................................ 11

3. Funding ..................................................................................................................................... 12

4. Future-proofing the Scottish Tech Ecosystem .......................................................................... 13
   4.1. People – the Founders of Tomorrow ...................................................................................... 13
      4.1.1 Empowerment .............................................................................................................. 13
      4.1.2. Inclusivity and Diversity ............................................................................................ 14
      4.1.2. Purpose ....................................................................................................................... 14
   4.2 Innovation – the Solutions of Tomorrow ................................................................................ 15
      4.2.2 Case of Sectors .............................................................................................................. 15
      4.2.3. Developing Key Enabling Technologies ....................................................................... 15
      4.2.4. Growing Deeptech Start-ups ..................................................................................... 16

5. University of Edinburgh: Responses to the 34 Recommendations........................................... 16
1. Education

Talent is at the centre of all thriving tech ecosystems. The University of Edinburgh agrees that our future professionals should be equipped with a basic grounding in understanding digital disruption, regardless of their discipline. Data literacy and information literacy are necessary stepping stones leading to computer science.

The Education Funnel is the most strategic of the elements, but also the one that will require the longest delivery time to have a meaningful, sustained impact. The education funnel needs the support of other mechanisms to ensure the near-term availability of talent. Potential means are reskilling, upskilling and lifelong learning activities to upgrade our existing workforce; platforms to support geographically distributed companies; international partnerships; and proactive immigration programmes for professionals.

1.1 School Level

> See also the University of Edinburgh responses for recommendations 5 - 8 in Chapter 7

We welcome the recommendation of treating Computing Science like Maths and Physics in secondary education. Prioritisation of CS will improve the diversity, aptitude and number of students subsequently taking CS degrees, and raise the awareness and standing of the discipline in students of other subjects, and the public.

The Centre for Research in Digital Education in the University of Edinburgh has analysed the status of Scottish CS education thoroughly in the report for Skills Development Scotland in 2019. We are critical of the qualitative analysis of the CS teaching in the Review (calling it “boring”). The quality of Scottish CS teachers is high: they are well-qualified specialists with more thorough CS education at HE than in most countries. There are many materials available to support teachers in planning exciting and engaging classes.

The main challenge of Scottish CS education is quantitative, not qualitative: there is a shortage of specialist computing teachers. The University of Edinburgh is committed to addressing this bottleneck of teacher numbers in partnership with SDS, SICSA, GTCS and SG.

We recommend that primary school teachers (and other non-specialist teachers) should have access to additional support and education. Schools should be encouraged to offer a more comprehensive set of NPA qualifications including Computer Games, Data Science or Cyber Security. Teaching professionals and learners should also be given an opportunity to express their views on what is needed.

We agree with the observation that the teaching profession needs to be made more attractive to Computing Science (and related disciplines) graduates. A rapid-access path into teaching for Computing Science graduates is an excellent recommendation which we also made in our report in 2019.

**Best Practice case study**

With the speed of change in the digital era, business leaders can also be critical partners in helping students develop job-ready skills. A model of this is P-TECH (Pathways in Technology Early College High School), which launched in New York City in 2011 as a partnership of IBM, the City University of New York, and the New York City Department of Education.

During the six-year program, students earn a high-school diploma and an associate’s degree while gaining work experience with industry partners. The model has since expanded to include 220 schools and 600 industry partners in 24 countries.

In response to the COVID-19 crisis, IBM announced the launch of Open P-TECH to expand the reach of the program further, enabling students aged 16 and older to register individually for classes in topics such as cybersecurity, artificial intelligence, and cloud computing.

Activities in the School level should go beyond supporting CS education. The schools outreach initiatives of Universities, inclusive career advice in schools, and public engagement including parents and guardians are

---

important to increase the awareness about different opportunities for learners from early age through the school years.

1.2 University Level

> See also the University of Edinburgh responses for recommendations 9 – 14 in Chapter 7

The University of Edinburgh is in broad agreement with the proposed three main domains of outputs:

- graduates who are interested in founding or joining a start-up and equipped with the start-up skills
- the number of Computing Science graduates
- the rate and viability of spin-outs from our universities

However, we recommend widening the focus beyond Computer Science and Business students. Universities can support the growth of future founders in different vertical disciplines by embedding tech and data skills across the whole curriculum.

1.2.1. Graduates Equipped with Start-up skills

The number of computing science graduates equipped with tech start-up skills is the most important output at the university stage in the STE Review.

While the University of Edinburgh agrees with this ambition, we propose a broader scope. The lack of diversity in the tech ecosystem limits the scope of start-ups since people tend to focus on challenges that concern them (bias against women in medical research is an example of this).

Computing, data, and start-up skills should be provided to students across all disciplines in our universities, to support the growth of a multidisciplinary and diverse cohort of future founders. We already see the benefits of diverse backgrounds in our "tech for good" start-ups - Amy Williams of GoodLoop is a psychology graduate, and Christian Arno of Pawprint has a degree in languages, for example.

Of course, diversity and inclusivity are wider societal topics, and critical for the sustainability of the Tech Ecosystem. We discuss the need to build a more diverse and inclusive tech ecosystem in more detail in Chapter 4.1.2. - Inclusivity and Diversity.

1.2.2 Computing Science graduates

The University of Edinburgh agrees with the aspiration to increase the number of CS graduates. We have already witnessed the positive cycle of innovation in our city, driven by the availability of talent. The School of Informatics of the UoE is one of the largest in Europe, and the ongoing availability of CS graduates to the vibrant start-up scene of Edinburgh has been one of the key drivers in making the city region a powerhouse in Data-Driven Innovation. However, this growth is at a tipping point. Without targeted investment on a national level, the growth will stall.5

The University of Edinburgh is ready to join forces with the Scottish Government, Scottish Funding Council, other Higher Education institutes and the industry to build an aligned talent pipeline to support the national innovation strategy (also proposed in the Muscatelli report6).

---

5 Edinburgh & South East Scotland City Region Science and Innovation Audit Report - Enabling a World-Leading Regional Digital Economy through Data Driven Innovation, 2017

6 Professor Sir Anton Muscatelli - Driving Innovation in Scotland – A National Mission, Recommendation 8, October 2019
A higher number of CS graduates is part of the solution, but we also need those already in work to be able to power the digital transformation of existing organisations.

After the first two years of the DDI programme, over 90,000 data-driven programmes and courses have been taken across the UoE. The lessons will be used to develop our guiding principle of inclusive growth further.

The goal of the DDI Skills Gateway is to ensure that the entire population can benefit from the opportunities of the new economy, including people whose roles are changing and who may now face redundancy, or people returning to the workforce after a break.

The eight-year Programme covers teaching and skills at all stages, from early years to adult learning. It includes people of all backgrounds and social groups, people with disabilities and other challenges, and people with all levels of previous education.

In the spirit of the City Region Deal's partnership approach, the DDI skills gateway includes new and upgraded programmes in colleges and universities, work-based learning projects, pre-apprenticeship and apprenticeship pipeline elements, and sector-specific projects.

1.2.3. University Spin-outs

We agree with the aspiration to increase the numbers of University spin-outs across Scotland. We propose an additional focus to support multi-disciplinarity, to widen the scope of University tech spin-outs.

Recently, low-code and no-code development platforms have made it possible for people with limited coding skills to develop simple applications for prototyping and testing, in search for a product-market fit. It is likely that over time, low-code leads to an increasing ratio of designers and product managers in tech start-ups.7 Future founders can indeed come from diverse backgrounds.

However, at the other end of the complexity spectrum, solving our biggest challenges, especially climate change, requires new Key Enabling Technologies (KETs) which do not exist yet. Companies founded on a scientific discovery or meaningful engineering innovation and which also seek to make the world a better place are called “Deeptech” (term introduced by Swati Chaturvedi, CEO of PropelX, in 2014).

According to the European Investment Bank8, companies working in KETs currently have difficulties to bridge the gap after seed funding because the current venture capital system is insufficient for funding frontier science. Collaboration of universities, the public sector and the private sector is necessary to unlock the full potential of the ecosystem to create Deeptech start-ups capable of producing radical innovations.

We discuss the needs of Deeptech spin-outs in more detail in Chapter 4.2.3. Major Challenges & Key Enabling Technologies.

1.2.4. Tech Skills

As recognised by the Edinburgh Region Science & Technology Audit9, Accenture10, and other research, data-led disruption will be at the heart of future growth in the Digital Economy and can enable transformational change across the broader economy. Consequently, tech & digital skills and awareness are necessary for professionals (not just entrepreneurs) across most domains, for three main reasons:

- Digital disruption will have a profound impact on most sectors and disciplines, changing the way they operate. Our workforce needs to be able to adapt to the changes.
- Tech start-ups need finance, marketing, and other legal services, with professionals who understand the tech scene.

---

7 Abdo Riani, Forbes, 2020
8 Soren Gigler, Brendan McDonagh, European Investment Bank: Financing the Deeptech Revolution - How investors assess risks in Key Enabling Technologies (KETs), 2018
9 Edinburgh & South East Scotland City Region Science and Innovation Audit Report - Enabling a World-Leading Regional Digital Economy through Data Driven Innovation, 2017
• Our policymakers and regulators must be tech-savvy, to stay up to speed with the fast-evolving technological development.

In Edinburgh, the City Region Deal Partners have recognised and invested in parallel Skills and Data Driven Innovation Programmes, to link skills pathways from school to colleges and universities and beyond, and to enhance the ability to stimulate invention, innovation, and entrepreneurship.

1.2.5. Peer Learning

We encourage developing and integrating new ways of learning and teaching as standard elements in our Universities and emphasise the importance of bottom-up initiatives to drive entrepreneurship. Platforms and programmes for peer learning and support are excellent ways to encourage founders and speed up team building. Entrepreneurship communities, challenge-based learning, start-up competitions, hands-on partnerships between companies and aspiring student entrepreneurs, teaching secondments by business people, and student placements in start-ups are some of the ways to develop ongoing collaboration.

Best practise case study: Ecole 42

Ecole42 is an excellent example of the power of peer learning. It is an innovative engineering and programming college that offers rigorous, industry-leading education in a professional environment. Originally founded in Paris in 2013, Ecole 42 has also a campus in the Silicon Valley, with the model adapted to 16 other locations across the world, for example to HIVE Helsinki and the Netherlands.

The school does not have any professors and is open 24/7. The training is inspired by new modern ways to teach which include peer-to-peer pedagogy and project-based learning. Student selection happens in an intense coding camp. Program is designed to prepare students for the workplace using an instructional design that means students learn skills for the digital world and for the technology industry. Students learn technical skills as well as interpersonal skills, time management, and project management.

1.3 Early-stage Leadership

> See also the University of Edinburgh responses for recommendations 15 - 19 in Chapter 7

1.3.1. Role of Universities

We recognise the need to strengthen the early-stage start-up leadership skills across our tech ecosystem, building on best global practices.

Scotland’s Universities are by default international and offer a significant resource for this aspiration, with their capability to attract top talent to Scotland. Their experience in developing connections and partnerships can strengthen brand awareness, provide links to best institutions, and support research & innovation collaboration around the world. Universities build long-term relationships and can support the efforts of benefiting from Scottish diaspora through their international alumni networks.

Edinburgh case study: DDI Ambassadors Network

The DDI Ambassadors Network is an example of utilising international networks and the Scottish diaspora to promote the DDI vision of 'data for good'. DDI ambassadors are highly influential domain experts passionate about ethical and inclusive innovation. The network will offer a valued source of expert advice and insights for our activities and strategic aims and bring opportunities from Scotland's burgeoning tech-innovation Ecosystem to organisations around the world.

The DDI Ambassadors Network is a crucial component of the wider DDI knowledge-sharing strategy. We aim to stimulate global debate on crucial issues such as ethics in data innovation.

---

11 https://www.42.us.org/
12 https://www.hive.fi/en/
1.3.2 Role of Colleges

Scottish Colleges have been mentioned in the Review only briefly. As noted in Scotland & South East Scotland City Region Deal partners' response, they provide a well-working alternative pathway towards skills acquisition and pathways progression. Adding "Big Data" modules to a range of curriculum areas is currently being explored as part of the DDI Skills Gateway programme.

2. Infrastructure

> See also the University of Edinburgh responses for recommendations 1 - 4 and 19 - 23 in Chapter 7

The University of Edinburgh is in full agreement with the proposal to create a national network of Tech-scalers, "one-stop shops" for start-ups to access services currently offered separately by incubators, accelerators and other organisations. These Tech-scalers should benefit from the economies of scale by sharing processes and incentivisation mechanisms but have their foundations in local strengths. The Muscatelli report (2019) also proposes to develop city-based place-making strategies for major city regions in collaboration between city authorities, the universities and colleges, Scottish Enterprise and other Enterprise Agencies. 13 Tech-scalers should be aligned and complementary to the existing activities of the Scottish Innovation Centres.

The strong Scottish Universities have a significant presence in their home cities. They can provide platforms for multidisciplinary collaboration and partnerships in Tech-scalers and the International Market Square.

**Edinburgh case study: Data-Driven Innovation Hubs**

The DDI Initiative, delivered in collaboration by the University of Edinburgh and Heriot-Watt, can support the Tech Scaler Funnel with the network of Innovation Hubs:

- Existing capacity of innovation hubs in Bayes Centre, BioQuarter, Easter Bush, Argyle House, Murchison House
- Additional capacity of DDI innovation hubs between 2020 and 2025 - Edinburgh Futures Institute, National Robotarium, Usher Institute (BioQuarter)
- Data resources available via the Edinburgh International Data Facility
- Well-established incubator and accelerator facilities (such as Codebase) and collaboration models between the higher education institutions and the private sector, driving the growth of start-ups

**Creative Informatics** is an example of breaking boundaries. It brings together informatics, creative industries and festivals, joining forces with Codebase to support entrepreneurship. Designed for creatives, the **Creative Bridge** model has already been adapted to provide entrepreneurial skills for the farming industry, for example.

The University of Edinburgh is the leading University in Scotland, located in a capital city with a fast-evolving start-up scene. We aspire to be a pivotal contributor to the Scottish Tech Ecosystem on the national level because the future of the Edinburgh tech scene depends on the availability of talent – it will thrive when the nation thrives. The City Region Deal partners are also strengthening their collaboration under the Regional Growth Framework to be able to support Scotland-wide initiatives.

Building on the success of the Data-Driven Innovation initiative, the UoE has already started to join forces with the key stakeholders of the Edinburgh tech ecosystem (especially Codebase) to develop the Edinburgh Tech-scaler as a joint initiative. The first activities will launch in 2021, with an entrepreneurship programme jointly delivered by Edinburgh Innovations and the five DDI Innovation Hubs, supporting the regional recovery.

**Edinburgh case study: Bayes Innovation Plan**

The Bayes Centre is the first DDI Hub of the UoE, opened in 2018. The Bayes Innovation Plan, funded until December 2020 by the Scottish Enterprise, has substantially exceeded its targets, **67 high-growth companies supported and £129 million investment secured** in companies and support activities. We intend to accelerate the momentum with the BIP 2.0 strategy, designed as a Tech Investment Platform for Scotland.

---

13 Professor Sir Anton Muscatelli - Driving Innovation in Scotland – A National Mission, Recommendation 20, October 2019
As part of the BIP 2.0, the Engage Invest Exploit (EIE) Programme has the potential to be a foundational element of the future growth of the International Market Square.

Together with our partners, we are in a prime position to play a leading role in the strategic design and implementation of several review recommendations:
1. Driving a Tech Innovation and Investment Platform for Scotland that is inclusive and diverse
2. Driving Scotland’s economic recovery post Covid-19
3. Driving Scotland’s digital transformation across industry and economic sectors
4. Driving Scotland’s internationalization agenda by extending our global reach, showcasing the best of Scotland’s Tech Innovation and Talent and attracting international talent to Scotland
5. Driving Data Driven Innovation and attracting global Investment for the benefit of society
6. Driving Scotland’s education agenda by feeding the Data Driven Innovation pipeline with talent from schools to Universities and on to Lifelong Learning.

3. Funding

> See also the University of Edinburgh responses for recommendations 29 - 34 in Chapter 7

We are in general agreement with the recommendations regarding the funding of start-ups – following a thorough gap analysis, further availability of capital would assist the Tech Ecosystem. We see a demand for funding right along the 'valley of death' including at seed/series A stage.

There are challenges along several initial stages of the funnel:
- discoverability of prospects is an issue, driven by the fact that investors are time-strapped
- availability of capital can also be a challenge in the earlier pre-seed stages (securing the first cheque)
- in scale-up stage (Series A and beyond), local investors start to run out of capital or become fatigued

We support the proposal to set up a Series A fund as a joint initiative between the government/SE, Scottish VCs or syndicates and, potentially, external VCs. Additional funding could provide a mechanism to allow early-stage investors to exit, so their funding can be recycled, and attract private sector capital and expertise with a more patient outlook.

We also support the proposals to increase the diversity and inclusivity of the Scottish Tech Ecosystem, and the proposal to develop an investment vehicle to support female founders.

We strongly endorse developing grants and other mechanisms to directly or indirectly support the development of student entrepreneurship. Such initiatives help students to reach out to the local tech ecosystem and solve some of the typical early challenges of start-ups.

**Best practice case study: Student entrepreneurship Prize**

In France, the Ministry of National Education, Higher Education and Research has created the Prize PEPITE-Tremplin for Student Entrepreneurship in 2014. In 2016, nearly 600 start-ups or start-up projects took part. Universities have systems to support students to participate in the competition. For example, Université Paris runs PSL-Pépite service which is dedicated to all students and young PSL alumni that are looking to work on a project to create a company. It aims to give students the skills, services, and support that they need to realise their project. The PSL-Lab coworking space of the University provides young entrepreneurs with opportunities for exchange and project collaboration with other students from different PSL institutions. Students have access to resources and tools which will benefit their project.

Bottom-up, diverse communities of young people with an entrepreneurial mindset can be transformative to the Tech Ecosystem, as shown later in the Finnish case study of Slush and AaltoES.

---

14 https://www.pepite-france.fr/
4. Future-proofing the Scottish Tech Ecosystem

We recognise the prominent role of universities in the tech ecosystem and the need to increase entrepreneurial drive at universities. Our universities are an exceptional asset to the Scottish Tech Ecosystem. For a small nation, Scotland has a uniquely strong higher education cluster, with three universities in Top 200 in global rankings (the University of Edinburgh in Top 30) and two others close to the top. Our universities are a source of unparalleled research, IP, and talent.

The tech world evolves at exponential speeds, and the tech ecosystem of tomorrow will be different from the one of today. The Review focuses on the quantitative aspects – the size and breadth of the tech ecosystem, and its speed of growth. In our response, we also emphasise the qualitative aspects of our Ecosystem to future-proof our Tech Ecosystem: what kind of entrepreneurs do we educate and support, and what kinds of problems and solutions they will address. The “Entrepreneurship Redefined” white paper by Slush addresses this change, highlighting three main domains of change: diverse and inclusive culture, purpose-driven narrative and seeking for revolutionary innovations (based on rich data from the Slush participant databases the Dealroom platform).17

Building on the foundation of excellence of Scottish Universities, we propose an additional role for them: Universities as crucial partners in future-proofing the Scottish Tech Ecosystem. We approach this through two main areas: People – Founders of tomorrow, and Innovation – Solutions of tomorrow.

4.1. People – the Founders of Tomorrow

4.1.1 Empowerment

As the STE Review recognises, best tech ecosystems encourage and enable peer support and networking. They also have flat structures, encouraging informal networking between participants from diverse backgrounds and at different points on their careers. Such mechanisms of empowerment and peer learning can be genuinely transformative (see the Slush case study below).

Best Practice Case Study: Slush

Slush is an excellent example of empowerment. In two decades since 2008, Slush has grown from an event of 300 attendees to an international network hosting massive start-up events in Helsinki, China and elsewhere. The secret of Slush is its unique production model: it is a student-led, not-for-profit movement, with a mission to help founders to change the world. Slush is in a state of conscious renewal, rotating the production team and placing young students in positions of responsibility.

The main organiser of Slush, the Aalto University Entrepreneurship Society (AaltoES), has been in a vital role in the flourishing of the Finnish Technology Ecosystem, at large. Multidisciplinary networking, learning from other students with entrepreneurial experience, and meeting external mentors have been the key drivers of AaltoES. Systemic entrepreneurial education and training supports peer-to-peer activities, which are causally related to entrepreneurship outcomes.18

Ensuring an unbroken entrepreneurial pipeline which covers all stages of education from undergraduates to PhDs pays as new companies and investments because young entrepreneurs to stay close to their home base. According to research data from Sweden19, most graduates launch their start-ups in the same region as the university.

There are several lessons to learn from those tech ecosystems which focus on empowerment:

- Empowered young people are a source of continuous renewal and innovation capacity.
- Entrepreneurship education and training should be delivered side-by-side with peer-to-peer networks and activities for students - start-up courses, garages, meet-ups, and pre-incubators.

---

• Data and digital disruption have an impact in all sectors so that future founders can come from any domain. Data, digital and entrepreneurship studies should be available across all disciplines, and multidisciplinary, challenge-based collaboration built in the educational programmes.
• Incentivisation and funding mechanisms for student start-ups are critical

**Edinburgh Case Study: SACHA – Students as Change Agents**

“Never underestimate the power of a small group of committed people to change the world. It is the only thing that ever has.”

Students as Change Agents is a challenge-based learning and innovation programme which brings together student teams to tackle real-world problems. It is open to students from all subjects, at all degree levels. Teams work with experts from the public, private and third sectors in a ‘living lab’ environment to tackle some of the most pressing challenges facing society, our environment and economy.

Students benefit from the opportunity to apply their learning to impact positively on others, working with their peers from a mix of subjects as well as building up networks with external organisations.

For partners, SACHA offers a unique opportunity to experience the exceptionally motivated and talented students at the University and benefit from the innovative approaches of the student teams.

In the first two years, student teams have addressed for challenges such as Ending violence against children; Gender financial equality; Circular economy; and Healthy ageing in communities.

4.1.2. Inclusivity and Diversity

A small nation like Scotland cannot waste talent. Brilliant minds need to get a chance, regardless of their background. Currently, people in the tech sector represent a limited subset of our population across several factors - beyond gender, also ethnicity, education, and income level. We need a more inclusive tech ecosystem, attracting talent across demographics and locations.

Inclusivity and diversity are also a competitive asset – according to research, diverse teams perform better leading to long term outperformance\(^{20}\). Diverse teams are also better at developing solutions which reflect the diversity of the society, which is critical in domains such as health, care, or education.

The pandemic has also provided us with an additional opportunity to build distributed teams which can increase diversity. We have all had a crash-course in remote working. The new breed of companies can work remotely from the get-go, employing people from all corners of Scotland (and beyond).

4.1.2. Purpose

According to the State of European Tech 2019\(^{21}\), the European start-up scene is moving toward purpose-driven companies. Investments into purpose-driven companies more than doubled year-over-year from 2018 to 2019. It seems that the next generation of founders and talent is driving a shift towards purpose-driven business models.

Social responsibility which was once viewed as a tangential activity to core business, is now being weaved into the mission of many companies. This phenomenon is also connected to diversity - women are more likely to work in domains such as biotech, education and foodtech.\(^{22}\)

More mature companies are also aware of the growing importance of sustainability. In 2015, HBR Analytic Services surveyed executives regarding their view on “purpose”\(^{23}\). 81% believed that purpose-driven firms deliver higher-quality products and services and 80% stated that having a shared sense of purpose correlates with higher customer loyalty.


\(^{21}\) Atomico, Slush, Orrick: State of European Tech, [https://2019.stateofeuropeantech.com/chapter/key-findings/](https://2019.stateofeuropeantech.com/chapter/key-findings/)

\(^{22}\) Tommi Bergström, Mikko Mäntylä / Slush: Entrepreneurship Redefined, 2020, [https://www.slush.org/entrepreneurship-redefined/](https://www.slush.org/entrepreneurship-redefined/)

4.2 Innovation – the Solutions of Tomorrow

4.2.2 Case of Sectors

The Scottish Technology review is "sector agnostic", which is justified. According to the Edinburgh & South East Scotland Science & Technology Audit, as well as broader research, digital and data-led disruption will be at the heart of future growth in the Digital Economy. It will enable transformational change across the economy, in almost any sector.

While we welcome that the process of growing successful start-ups is mostly similar regardless of the industry sector, and "execution is everything", we believe there is merit in combining a horizontal, ecosystem-wide approach with a vertical sector strategy. The specialisation is a tried & tested way to reach the critical mass in a small market like Scotland.

In recommendation 22 it is proposed that instead of trying to pick a set of future winning areas, the Scottish Government would provide funding for industry-domain networks, based on the notion that the tech industry develops more quickly than Government can move. We support this proposal, but with an additional angle of having universities as active partners in the clusters. The current business environment in Edinburgh has already proven the benefits of such joined-up clusters: for example, the recently announced Global Open Finance Centre of Excellence in FinTech\textsuperscript{24}, and the collaboration of agritech companies in Easter Bush campus.

<table>
<thead>
<tr>
<th>Edinburgh Case study: Innovation themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>The 2016 Science and Innovation Audit of the Edinburgh &amp; South East Scotland identified Data-driven Innovation as an essential strength for the region. Following the launch of the Data-driven Innovation initiative in 2018 and large-scale interdisciplinary innovation initiatives such as the Global Open Finance of Excellence, the University of Edinburgh has been developing the strategic approach to deliver innovation at-scale with a strong focus on entrepreneurship. The following innovation themes have been selected:</td>
</tr>
<tr>
<td>- Agriculture &amp; Food Security</td>
</tr>
<tr>
<td>- Digital Manufacturing &amp; Automation</td>
</tr>
<tr>
<td>- Financial Services</td>
</tr>
<tr>
<td>- Health &amp; Social Care</td>
</tr>
<tr>
<td>- One Health</td>
</tr>
<tr>
<td>- Smart Places</td>
</tr>
</tbody>
</table>

An industry-driven approach for sector support works in domains where companies develop iterative innovations based on existing technologies or develop markets together. However, the situation is different when developing radical innovations based on Key Enabling Technologies. We will discuss this in the next chapter.

4.2.3. Developing Key Enabling Technologies

We have mentioned before (Chapter 1.2.3 University Spin-outs) that solving our biggest challenges, such as climate change, requires KETs which do not exist yet.

The role of the Government, in the most successful economies and in the periods of highest growth, has gone beyond creating the right infrastructure and setting the rules (Mazzucato, 2011). It has been a leading agent in achieving the type of innovative breakthroughs that allow companies and economies to grow, by proactively creating a strategy around a new high-growth area before the business community understands the potential. Government has been funding the most uncertain phase of the research that the private sector is too risk-averse to engage with; seeking and commissioning further developments; and overseeing the commercialisation of 'general-purpose technologies'.\textsuperscript{25}

There is a 10-year journey from taking a company from a start-up to a unicorn. But equally, there is a 10-year journey from taking fundamental science to something that is suitable for a start-up. Deeper collaboration

\textsuperscript{24} Global Open Finance Centre of Excellence: https://ddi.ac.uk/case-studies/gofcoe/

\textsuperscript{25} Mazzucato, Mariana (2011). The Entrepreneurial State. London: Demos
between universities, the public sector and the private sector is necessary to unlock the potential of the ecosystem to produce the start-ups capable of producing radical innovations based on key enabling technologies.

4.2.4. Growing Deeptech Start-ups

Universities are the place where the groundwork for solving the problems of humankind happens. Deeptech start-ups which tackle big global challenges must be grown through collaboration, bringing together start-ups, the academia, the government, and larger corporations. Today, innovation efforts remain too fragmented between the stakeholders. WEF\textsuperscript{26} and Nesta\textsuperscript{27} have emphasised the importance of such collaboration. Done right, it will unlock the potential in our young innovators and companies and allow corporations to take part in the benefits.

Companies working in key enabling technologies currently have difficulties to bridge after grants and seed funding because the current venture capital system is insufficient for funding frontier science.

According to the European Investment Bank\textsuperscript{28}, the main challenges are high capital commitments needed quite early on, technology risks, long lead times to profitability, and challenges to assess the risks until quite late on the start-up’s journey. The VC model is not compatible with ideas that do not materialize within the next few years.

Despite the challenges, European investment into Deeptech has increased nearly threefold over the last five years. When successful, Deeptech start-ups are defensible and thus attractive investments. They produce solutions that are hard for competitors to replicate and often protected by intellectual property.\textsuperscript{29}

This amplifies the importance of alternative funding paths and routes for growth for Deeptech start-ups. Currently these remain insufficient. New, multi-stakeholder funding models and collaboration between the entrepreneurs, universities, the government, and corporations are needed, to realise the opportunity to benefit from revolutionary, meaningful technologies.

5. University of Edinburgh: Responses to the 34 Recommendations

The STE Review shows deep understanding of the components and processes of a prosperous technology ecosystem. In a small nation like Scotland it is critical for all the stakeholders to join forces to build an efficient, optimised ecosystem model, supported by an agile governance model based on incentives.

The University of Edinburgh agrees with the strategic principles behind the recommendations. We support aiming for international best practice across all aspects of the Tech Ecosystem – global competition is the only one which matters.

Scottish Universities are by default international and globally networked, making them capable of supporting the internationalisation agenda, by attracting top talent, and by connecting to cutting-edge global research and innovation.

**Area: TECH-SCALER NATIONAL BACKBONE**

**Recommendation 1: Creation of a Tech-Scaler National Backbone**


The University of Edinburgh is in full agreement with the proposal to create a national network of Tech Scalers. Scotland's current support network for start-ups is too fragmented for such a small nation and inefficient, with too high overheads. We are in favour of the proposal to develop "one-stop shops" for start-ups to access services currently offered separately by incubators, accelerators and other organisations. We are also in favour to ensure geographical coverage by establishing the Tech-scalers across Scotland, and by making the tech-scaler services available online.

In Edinburgh, the UoE is already developing the tech ecosystem based on a cluster approach, based on the success of the Data-Driven Innovation programme. Our goal is to join forces with Codebase and other key stakeholders of the Edinburgh tech ecosystem to deliver the Tech-scaler in close collaboration between industry and university sectors.

As the first step, and as a response to the Covid-19 crisis, Edinburgh Innovations and the six DDI Innovation Hubs are developing a joint entrepreneurship support programme to launching in 2021, consisting of a joint scale-up environment, venture builder services, entrepreneurial skills support, and systemic industry & investor engagement.

When building up the network of tech-scalers, it is essential to take a critical look at the current structures providing these services, seeking for efficiencies, cutting overheads, and overlapping functions, focusing on best practices to ensure the Tech-scaler backbone delivers maximum impact.

Ideally, the Programme would stay clear of being property driven. Existing incubation providers typically must recoup costs through space rental, with much effort devoted to landlord functions rather than the ecosystem development. It is possible to break this dependency by funding the activity differently.

As stated earlier in paragraph 1.2 of this response, the pandemic has been a crash-course in remote working. Consequently, the pandemic has challenged the property-driven incubator business model. The impact on our ways of working is likely to be permanent. Companies can work remotely from the get-go, seeking for talent anywhere in Scotland, UK, and the world. The role of the home base will still matter, but not to the same extent as before. The availability of tech-scaler services online will be arguably at least as important as location-based services.

Rec.2. Structure of Scottish Government contract model for the provision of services

The UoE welcomes a timescale of a minimum of five years for the Ecosystem Programme. However, in agreement with other Edinburgh & South East Scotland City Region Deal Partners, we would recommend a timescale of 7-10 years.

In developing the Edinburgh & South East Scotland CRD, it became clear that to look to effect a meaningful change of this type in a period less than a decade, leaves the consolidation of the change vulnerable. It provides insufficient time for the change to become "normal," or for the CRD Programme to respond meaningfully to external pressures, such as that experienced due to COVID-19.

Rec. 3. The Tech-Scaler North Star Metric should be aligned to value created, using the Current and Past Tenant Value (CPTV) metric

We do understand the motivation behind this recommendation. Driven by the speed of the digital world, the start-up scene has been focused on the growth-driven model, where success is rare to come by, but astronomical when it happens.

However, the University of Edinburgh argues against the proposal to use valuation as the only metric. First, from our portfolio management experience in Edinburgh Innovations, client valuation is a lengthy and complicated business and can be very subjective.

Second, the growth-obsessed model has recently come under criticism in Europe, due to overly speculative unicorn valuations and excesses of the tech scene, such as the collapse of WeWork. The research team of Slush predicts that path to profitability, rather than growth, will increasingly become the basis for late-stage funding. The driver behind this thinking is the emerging trend to more purpose-driven and sustainable businesses.

Therefore, instead of valuation alone, we propose to apply a more expansive basket of measures in terms of investment received, TRL progress, the number of clients, jobs created, turnover, profit, et cetera, more in line with the current university and economic development measures, and with the emerging, profit-focused European start-up model described above.

Rec. 4. Tech-Scaler Grant Funding Should be Integrated into the Tech-Scaler Network

The streamlined model does appear justified and logical. A more thorough analysis of the impact on current grants and funding would be necessary.

---

Area: FOUNDATIONAL TALENT PIPELINE

Recommendations 5 – 8: Foundational Talent Pipeline: School Level

Rec.5. Treat Computing Science like Maths or Physics and follow through on the consequences of that decision

The University of Edinburgh welcomes the recommendation, which will improve the diversity, aptitude and number of students subsequently taking Computing Science degrees and raise the awareness and standing of the discipline amongst the students of other disciplines, and the public.

We would welcome the opportunity to work with the Scottish Government and other partners on the development of this pedagogy. The UoE is developing the Data Education in Schools programme in partnership with schools across the city region, as part of the DDI Skills Gateway. The programme will pilot a range of approaches to develop data literacy skills, and studies ways to develop more STEM-focused schools.

We do have comments on several of the sub-proposals, as listed below.

Rec. 5 (2): The teaching profession needs to attract more Computing Science (and related disciplines) graduates into teaching

We agree with this aspiration and have collaborated with Skills Development Scotland in 2019 on a review which proposes ways to address the shortage of teachers.32

Rec. 5 (3): The need to align salary levels accordingly

The SDS review mentioned above covers the salary question in detail. While the UoE supports the aspiration, there has been a teacher pay settlement very recently, and it is unlikely there will not be another one soon.

Rec. 5 (5): A rapid-access path into teaching for Computing Science graduates

We support this proposal which is also one of the recommendations in the SDS report.

Rec. 5 (6): Existing Professional Graduate Diploma in Education (PGDE) entry routes into Computing Science teaching should be significantly strengthened as regards Computing Science skills

This proposal reflects an insufficient understanding of these degrees and the constraints on recruitments to them. CS teachers do receive either shorter ITE degrees or more complete CS qualifications (PGDE applicants). Lengthening the duration of ITE degrees would put off applicants and substituting the CS qualifications with a CodeClan course would make our computing teachers less qualified in CS content than currently. Neither would be advisable.

Rec. 5 (7): The curriculum should be revised to include far more programming and project work

The University of Edinburgh is firmly against narrowing the Computer Science education. The current curriculum at BGE has been revised in 2016 and designed deliberately to be broader than just programming, as documented in Scottish teacher handbooks.33

Rec. 5 (8) Curriculum designers should work closely with the university sector to ensure that the school and university curricula join-up effectively

The UoE supports this, reminding that joint curriculum development when developing CS education is already a standard practice between Universities and schools.

Rec. 5 (9): Teachers should be given dedicated training time each year to stay current

We agree that teachers would benefit from additional time for continued professional learning, but we are afraid it would be challenging to achieve in an equitable way.

Rec 5 (10): An annual Computing Science Teaching Conference

---


We are very supportive to the proposal and recommend expanding the focus to cover also data literacy, information literacy, and design-driven subjects.

**Rec. 6. Establish an industry partnership with schools to give Computing Science pupils summer work experience.**

The University of Edinburgh endorses this proposal.

**Rec. 7. School-stage extra-curricular programming clubs should be strategically supported**

The University of Edinburgh strongly recommends ensuring inclusion by educating everyone through existing school infrastructure. For successful teaching in the secondary schools, we must have suitably qualified teachers with access to the continuing professional development, to ensure their knowledge and skills stay up to date in a rapidly changing field. Coding clubs can be useful extra-curricular activities to foster enthusiasm, but they are no substitute for rigorous teaching. Extra-curricular activities are by their nature patchy, they are not available for everyone, and they are often run by volunteers who lack teaching experience. Funding for such clubs should not be at the expense of adequate support for teachers.

**Rec. 8. Overcoming gender-stereotyping in early years**

The UoE wholeheartedly supports the aspiration to tackle gender stereotyping. While we agree that role models are part of the complex set of influences on girls’ career choices, a public information campaign alone is not sufficient. We recommend joining forces with initiatives and organisations with a track record of success. Besides dressCode, we propose checking out WISE, who launched a successful My Skills My Life programme in 2019 and are recruiting 30,000 ambassadors to run it across the country.34

Inclusivity must also extend beyond gender. As mentioned earlier, people in tech currently represent an extremely limited subset of population across several factors - beyond gender, also ethnicity, education, and income level. The Scottish tech Ecosystem must embrace inclusivity and diversity to avoid bias and ensure talented people do get the opportunities they deserve. Teacher education about inclusion within the classroom could be beneficial to address this.

**Recommendations 9 - 14: Foundational Talent Pipeline: University Level**

**Rec. 9. Adjust university incentivisation and funding to improve tech-entrepreneurial focus**

The University of Edinburgh supports the proposed widening of the course funding model beyond teaching, as well as the ambition to share initiative across institutions. The UoE has already acted on several proposed attributes.

The proposal to add a KPI to increase the entrepreneurial skills amongst computer science students is worth exploring. However, we are already witnessing the diversification of the tech scene, with founders from diverse backgrounds. We encourage widening the scope to also include digital, computing and data literacy, as well as entrepreneurship, amongst students of most disciplines.

Multi-disciplinarity is especially relevant since the next generation of founders is driving a shift towards more purpose-driven companies. Solving our most significant societal challenges requires skillsets from many domains of science, not just computing and business.

An annual competition for students would be an excellent way to incentivise the development of new start-up ideas. The scope should be multidisciplinary, and involve innovators across any domain, collaborating with Computing Science, Business and Design students.

The Student Enterprise team of Edinburgh Innovations is actively promoting engagement of all students in enterprise-related activity, with incubation spaces available for student teams, and ongoing university-wide discussions about the curriculum applied to both tech and non-tech subjects.

**Rec. 10. Increase university funding to create more local software engineers**

The proposal to adjust the funding mechanisms to make local software engineering students financially more lucrative to Universities is worth exploring further.

---

34 My Skills My Life: https://www.wisecampaign.org.uk/
35 See: https://www.ncwit.org/resources/ncwit-engagement-practices-framework
The number of places available for Scottish students is causally related to the number of funded places available. The funding model in Scotland protects the level of provision available at the price group level. Therefore, there is no competition between Scottish applicants and those from the rest of the UK – though it remains an institutional decision on the spread of places across subject areas included within the price group.

The identification of the need for additional places to support the Scottish CS sector is something which might usefully inform the SFC review of Coherent Provision & Sustainability, which is currently underway. Also, the change of fee status for new EU students post-Brexit is likely to disruptive and consequently the allocation of funded places for 2021 and beyond should reflect the need to support the supply of STEM graduates.

The Review recognises the fact that many international students tend to return to their home countries. Until this year, they usually had to, if they were not from the EU. The recent introduction of the post-study visa is a welcome policy to incentivise graduates to build their career in the UK. It would be good to study different ways to incentivise international graduates to stay in Scotland.

Incentives will not work if the demand for courses does not provide enough local CS students (vs. international students). It would be necessary to study how many local CS students Universities are currently turning down. Stimulating early-stage interest (as per schools Programme) may get better results.

Rec. 11. Adjust university incentivisation to improve spin-out scale and quality

In general, the UoE welcomes the aspiration to incentivise the Universities to deliver more spin-outs. In the UoE, we already provide support for founders, work extensively with industry experts to develop companies, and take extensive legal advice on articles and other legal agreements.

In our experience, no deals have foundered on the bases of equity allocations, since the University stake dilutes throughout the series of investment rounds, to small percentages. However, we know the practices vary between universities, and that equity stakes have caused challenges in some cases. We are ready reconsider our position if further evidence is produced.

Mutually beneficial incentivisation models are worth studying, based on best practices. Besides equity stakes, licencing models and exit points could be added in agreements with founders, to avoid disincentives. Higher or longer licencing fees could work especially for spin-outs with a strong tech focus.

We do recognise there is more to be done in supporting the founders' development as entrepreneurs and connecting them to networks of peers and mentors.

Universities should be incentivised to focus also on the potential impact of their spin-outs, with KPIs aligned with national and global priorities, such as Scottish Government net zero targets and Sustainable Development goals of the UN. In Edinburgh, the 2030 strategy of the University is already connected to the SDGs.

Rec. 12. Relax other KPIs in the overall university KPI portfolio to accommodate the new KPIs

There is a Scottish Funding Council review currently underway will strongly influence the refinement of the Outcome Agreement framework, intended to articulate the strategic alignment of objectives between the SFC and individual institutions. We would hope and expect that the review work will support the articulation of focused strategic KPIs for the sector.

We concur that an ever-expanding set of metrics does not contribute to strategic focus. Relaxing KPIs tends to be discussed far more often than realised. If KPIs are changed, they should be aligned with the national and international measurement systems of Universities.

Rec. 13. National, pan-university Tranzfuser-style summer-school

The UoE supports the proposed summer school model, providing a gateway to Tech-Scalers. However, any publicly funded initiative should be procured through an open and fair competitive bidding process.

Rec. 14. Increase the number of start-up internships available to students

The University of Edinburgh supports both the recommendation, and the proposed two incentive mechanisms.

Recommendations 15 - 18: Foundational Talent Pipeline: Funnel-wideners

<table>
<thead>
<tr>
<th>Rec. 15. Codeclan should be treated as a strategic ecosystem asset</th>
</tr>
</thead>
<tbody>
<tr>
<td>The University of Edinburgh supports the recommendation. The proposed ambition level sounds challenging but possible, of the proposed new, medium-term funding mechanisms can be implemented. The opportunity to mitigate the impact of the pandemic by retraining activities is exciting. The alternative funding mechanisms are worth studying after the initial grant-funded period.</td>
</tr>
<tr>
<td>The proposal to study Codeclan's approach to renew our Colleges is interesting but would require further analysis.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>If the tech visa is possible to implement, the University of Edinburgh does support it. It could be also combined with the two-year post-graduation visa to create a “red carpet” for accomplished international students, in selected high-demand sectors.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rec. 17. Attraction of executive-level talent to Scotland</th>
</tr>
</thead>
<tbody>
<tr>
<td>This recommendation refers to the difficulty in attracting experienced international executives to a sparse pre-tipping point ecosystem. In the initial stages of strengthening our ecosystem, it makes sense to focus activity on non-sparse areas such as Edinburgh, which is progressing well towards tipping point (though we understand this would be against national &quot;levelling up&quot; approaches).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rec. 18. Reduction in inter-city rail travel costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Because of the size of the main cities and their short geographical distance, the central belt area functionally operates as a twin city, which makes the proposal relevant. However, while the price of the annual ticket is on the high side, it is not outrageously more expensive than tickets for similar routes in Europe. Changes to the pricing and routes should be studied in the context of the whole regional transport system. Better to spend the money on improving speed of rail and connecting rail, and other public transport within cities.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Area: INTERNATIONAL MARKET SQUARE</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Rec. 19. Provide support for our major tech conferences, to internationalise them</th>
</tr>
</thead>
<tbody>
<tr>
<td>The University of Edinburgh supports this recommendation. The Engage Invest Exploit (EIE) Programme has the potential to be a foundational element of the future growth of the Ecosystem in Scotland, providing a broader economic development function. EIE shares the ambition of the Turing fest to develop an international tech industry event in Scotland (inspired by Finland's Slush).</td>
</tr>
</tbody>
</table>

We are ready to work with other events and networks of investors and start-ups to develop the perfect “product-market fit” for EIE, to ensure it becomes the best platform possible for matching start-ups with investors. We recognise the need to develop the event to highlight also companies which have progressed beyond the first funding rounds, in order to the cater for the needs of investors from outside Scotland who search for more mature companies ready for later funding rounds. Besides Scottish companies, we are ready attract such companies from elsewhere to participate in EIE, and develop ways to incentivise them to relocate to Scotland. |

To succeed, our events need to be driven by an engaged community. As described earlier in the "Best Practice Case Study: Slush" (Chapter 4.1), Slush is an example of a bottom-up initiative. Despite its scale, it is still a student-led, not-for-profit movement. The main driver behind Slush is a student organisation, the Aalto University Entrepreneurship Society which has also been in a key role in the growth of the Finnish Technology Ecosystem, at large. |

In the (post)pandemic world, the events must renew themselves. After we have been remote working for a year next March, remote access and online content repositories for events will be here to stay. That opens completely new ways to build networks, substance, and participation. Slush, for example, has launched a new, subscription-based Node of Slush B2B network.37 |

<table>
<thead>
<tr>
<th>Rec. 20. Establish International Investor Conference, not limited to Scottish Start-ups</th>
</tr>
</thead>
</table>

---

37 Node of Slush: https://node.slash.org
The University of Edinburgh supports this recommendation. EIE has achieved good results at a local level and should scale well to become a national event. Currently, EIE is underwritten by the University of Edinburgh but would ideally be supported by SE or SG. See also our comments to the previous recommendation 19, above.

Re. 21. Provide support for the Scottish tech meet-up network

The UoE supports the recommendation. We also propose opening tech meet-ups to student participants. That exposes interested students to entrepreneurs and their experiences, in addition to the technical skills discussed, and connects entrepreneurs to talented students who might be their future employees. Since students are often available for part-time work, this can be a more manageable approach to grow than having to commit to a full-time employee in the initial stages of a company.

Rec. 22. Support and strategy for specific economic sectors

The University of Edinburgh largely agrees with the proposed approach to empower the industry to self-organise around sectors, as well as the risk of trying to pick winners "top-down", especially in innovating markets.

However, as we are written earlier, the situation is different for revolutionary innovations and Key Enabling Technologies (such as quantum computing, nanotechnologies, space exploration, et cetera). Historically, the role of the Government in the most successful economies has been a leading agent in achieving the type of innovative breakthroughs, by proactively creating a strategy around a new high-growth area before the potential is widely understood.38

For tackling significant challenges such as climate, we need public-private collaboration between companies, universities, and governments. We are in favour of developing a holistic Sector/Domain strategy for Scotland, as mentioned in Rec. 22.

Rec. 23. Establish a strategy to exploit Scotland's Diaspora.

The UoE agrees that Scotland's diaspora provides a considerable untapped potential (especially University alumni).

A revised approach to reach out to alumni and additional funding for implementation would be necessary. As an example, the Data-Driven Innovation Initiative is launching a DDI Ambassadors' Network, consisting of prominent UoE alumni thought leaders and business executives in data-driven industries organisations around the world.

Area: INTERGRATED ECOSYSTEM GRANT FUNDING

Rec. 24. Establish Funding Coverage in Four Ecosystem Areas

In general, the University of Edinburgh welcomes additional funding in the proposed areas. We would be cautious of repurposing existing funding currently going to skills, innovation, and start-ups, as there would be little gain if any.

However, we do welcome the reallocation of existing funding if the funds are released from fixed costs and overheads of existing, overlapping funding mechanisms. We endorse structural changes which streamline decision making and reporting processes, increase productivity and efficiency, and maximise the resources for skill development, innovation, and start-ups.

We are also supportive of the proposed approach to avoid assessment measures that are overly localised.

As we have discussed in chapter 4.2.3 Deeptech, companies working in key enabling technologies have difficulties to bridge the gap after seed funding39. New, integrated grant funding mechanisms and collaboration models between universities, government and private sector should be developed to address this challenge.

Rec. 25. Foundational Talent Fund

The University of Edinburgh supports the creation of this fund.

Rec. 26. Tech-Scaler Start-up Fund

---

38 Mazzucato, Mariana (2011). The Entrepreneurial State. London: Demos
39 Soren Gigler, Brendan McDonagh, European Investment Bank: Financing the Deeptech Revolution - How investors assess risks in Key Enabling Technologies (KETs), 2018
https://www.eib.org/attachments/pj/study_on_financing_the_deep_tech_revolution_en.pdf
In principle, we support the fund. Some individual components require more research to see whether they would work as proposed:

- PMF Grant sounds quite a bit like the existing "I Cure" programme. As such, it might take much effort to administer, because of the amount of conditionality.
- Investment Seekers' Grant sounds good if it covers commercial champions/executive's designated time and expenses. The measure of evidence of seeking outside of Scotland is not particularly relevant if investors are available in Scotland.
- Student Internship Grant is an excellent idea.

**Rec. 27. Ecosystem-Builders Fund**

The University of Edinburgh supports this recommendation, and the two proposed categories.

**Rec. 28. International Market square Fund**

The University of Edinburgh supports this recommendation.

**Area: INVESTMENT FUNDING**

**Rec. 29. Scottish VCs should partner with the Scottish Government on various joint initiatives**

Further availability of capital would assist the Tech Ecosystem. We see demand for funding right along the 'valley of death' including at seed/series A stage as identified in the Review. However, the availability of capital is also a challenge in the following phases:

- Earlier pre-seed stages, where it can be difficult to secure the first cheque (often done by angels, but the mechanisms of finding angels are relatively informal). This is a problem for founders who are younger or from less affluent backgrounds. Besides, an experienced private investor can also make a significant difference at this early stage.
- Scale-up stage (Series A and beyond), where local investors start to run out of capital or become fatigued, preventing our companies raising enough capital to provide them with the runway they need to scale up meaningfully.

Discoverability of prospects is an issue. In our experience this is compounded by the fact that most investors are time-strapped and hence want pre-qualified / validated prospects. For example, they prefer completed DD / market research, or meaningful commercial traction by the start-up.

**Rec. 30. Explore the possibility of establishing a Series A fund in a partnership between the Scottish Government, Scottish VCs and External Investors**

The UoE recommends that the Scottish Government explores setting up a Series A fund, as a joint initiative between the government/SE, Scottish VCs or syndicates and, potentially, external VCs. The Government and the VCs would contribute the funds, and the Government would leverage the knowledge of VCs to manage the fund or provide expertise and capacity in due-diligence at Series A level.

In our experience, additional funding at this level (and beyond) would be of benefit to the Ecosystem, particularly if it:

- provided a mechanism to potentially allow early-stage investors (i.e. angels) to exit, so their funding can be recycled. Currently, early-stage investors are extended further into the funding cycle.
- attracted private sector capital and expertise but with a patient outlook, to help provide the space, runway, and ambition to meaningfully scale-up business activity

Reliance on external VC's would need to be carefully considered, given the traditional VC model is not necessarily always aligned with patient capital and is also driven by fees, preferential share rights, et cetera.

The concept of government money being 'softer' than private-sector money is a theme that regularly comes up, but in our experience, it rarely creates a 'dependency culture.' Private-sector capital and expertise are critical, adding urgency, expertise, and access to networks. It can work well alongside government support.

**Rec. 31. Introduce an investment vehicle specifically supporting female founders**

The UoE supports this proposal. This finding resonates with our experience: a funding vehicle (ideally pre-seed / seed) that helps to promote, and fund early-stage female-founded businesses would be very welcome.
We welcome additional initiatives to strengthen this partial solution, and support measures which increase gender diversity (and diversity more broadly) amongst founders, management teams and boards of directors.

**Rec. 32. Introduce an education/mentoring scheme for start-ups in funding models, venture capital, pitching**

We are generally supportive of the idea. More education, if supported by those in the market (VC's or start-ups who have been successful in raising) is always helpful.

However, there is quite a lot of high-level resource out there already on these topics (although admittedly quality varies). The question is often about signposting to the right advice, helping companies interpret it for their circumstances and then broader problems around getting in front of the right investors at the right time.

A further challenge is, how much capacity will local investors have to regularly deliver such training or bespoke sessions, beyond engagement they already do as part of their activities in our Ecosystem.

Investors often have small numbers of staff across several activities (deal flow, transactions, portfolio management, raising capital from their LP's / investors).

Understanding the investor perspective/language/funding models is helpful but not a substitute for demonstrating the fundamentals to the investors (team, problem/solution, product-market fit, market research, business model/strategy, early commercial validation).

There is also work to be done in understanding what kind of start-up the founder has and how this informs strategy (playbooks, et cetera, have their place here). Many businesses are not in market sectors or do not have high-growth business models that naturally lend themselves to 50-fold returns for investors, but they can still provide meaningful returns.

**Rec. 33. Grant support for Scottish start-ups to support external raising expenses**

Supporting costs in this area would be helpful, although in our experience the cost of travel tends to be incidental (especially for companies looking to raise more substantial rounds from London based investors) versus the cost and drains on founders / exec time.

**Rec. 34. Maintain and publicise a live database of all angels and all start-ups in Scotland. In due course extend concept into a specialised crowdfunding platform for angels and Scottish start-ups**

A database of seed-stage start-ups is an exciting idea, but not without challenges. It would need to be carefully curated and may be of limited value if it would be just an unvalidated list, since angels prefer curated opportunities. Issues around IP disclosure, privacy, confidentiality require consideration.

The concept of linking pre-seed companies to angels (particularly those with relevant market expertise in that sector), could be of value. In our experience, many syndicates tend to be more interested in later seed rounds (£500k+) due to their underlying fee structure/economics. However, a platform that supported sharing of opportunities between individual syndicates, angels and wealth managers representing their clients, and helped individual angels invest early in areas of personal interest would be valuable, developed in conjunction with Linc Scotland and Angel syndicates.

A Scottish-start up crowdfunding platform is a promising concept, especially for early-stage companies, particularly those with consumer, retail, or ESG / impact focus.

The governance of crowdfunding mechanisms should avoid the challenges of having too many disengaged small investors, which has been raised as a concern of Scottish companies elsewhere in the Review. Crowdfunding could be a mechanism of co-investment to leverage up private sector expertise.

For high-growth tech businesses, crowdfunding would be less likely to provide additional value in terms of network or expertise, except by introducing a meaningful minimum investment to try and keep cap tables more straightforward.

An alternative could be to launch a crowdfunded investment fund focussed on Scottish tech companies.

**Governance / Operating Model**

The University of Edinburgh agrees that the biggest challenge to the delivery such a large-scale endeavour is to secure the up-front buy-in of all participants.

The UoE supports the observation in the response by the Edinburg & South East Scotland CRD partners, that success will depend on fostering trust across the wide range of organisations, and the ability to structure the measures in ways that encourage collaboration, rather than competition.
City Region and Growth Deals offer a model which works well. A core set of principles guides all activity, with projects selected thematically or geographically.

In collaboration with other Edinburgh City Region Deal partners, the University of Edinburgh would welcome the opportunity to contribute to the development of a Theory of Change for the Ecosystem. In the Data-Driven Innovation Programme, the target impact areas of Talent, Research, Adoption, Data and Entrepreneurship and Inclusion formed the foundation of a joint-up benefits realisation approach.