Mid-term evaluation of the Computational Foundry

Final Report

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SQW

Contents

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1. Introduction

The Computational Foundry

1.1 The Computational Foundry is a core component of Swansea University's new Bay Campus, an ambitious project to create a world-leading research, innovation and educational complex for the Swansea Bay City Region. The Foundry provides modern and state-of-the-art facilities, for the computational science community, comprising the staff of the University's Computer Science and Mathematics departments as its *core* personnel. The Foundry project aims to establish Swansea as a beacon and centre of excellence for computational science research.

1.2 The concept for the Foundry was first developed in early 2015, with a business plan to support an application for European Regional Development Fund (ERDF) monies commencing in March 2015. ERDF support for the operation was subsequently granted in March 2016: £15m in capital funding (to be spent by March 2019) and £2.1m in revenue funding (to be spent by March 2021).

1.3 The ERDF capital funding is related to the construction of a Foundry building, with revenue funding to support the appointment of academic and other staff to enhance the university's capacity and excellence in computational science. The ERDF funding was matched by an initial £8.8m funding from Swansea University, with a further £1.5m subsequently provided by the university to cover increased costs of construction. In addition, Swansea University contributed £5.2m capital funding to cover the cost of construction of teaching space within the Foundry building, which is not eligible for ERDF funding.

1.4 Construction of the Foundry building commenced in January 2017, and the building opened in September 2018 in advance of the 2018/19 academic year. During the construction period, 'beta' labs were set up at the University's Singleton Campus, as an interim measure to accommodate new staff and research activity supported by the revenue funding, in advance of the opening of the dedicated Foundry building.

The evaluation

1.5 Consistent with expectations of ERDF funding, the University of Swansea is committed to undertaking a robust evaluation of the Foundry operation, encompassing both the capital and revenue elements. As such, SQW was commissioned by Swansea University in February 2017 to lead an inception evaluation, and a mid-term evaluation of the operation, with a final impact evaluation to be commissioned separately at a later date. The evaluation involved two stages: an inception evaluation in 2017, and a mid-term evaluation in 2019.

1.6 Completed in September 2017, the inception evaluation involved a review of the context for the project, and the development of a logic model to articulate the theory of change underpinning the Computational Foundry operation and frame the assessment of its progress and impacts. The inception evaluation also involved confirming the approach to the mid-term evaluation, and clarifying the data to be collected to enable evaluation of the progress, outputs, outcomes and impacts of the operation at the mid-term and subsequently final evaluation stage.

1.7 This report sets out the findings of the mid-term evaluation. The main focus of the mid-term evaluation was to **assess the progress made** against the aims and objectives of the project, as established in the ERDF Business Plan and logic model agreed at the inception evaluation stage. The mid-term evaluation was also required to **identify any early outcomes and impacts** generated by the project, for example, around changing the behaviours/perspectives of members of the computational science community within Swansea and more broadly. Based on this evidence, the mid-term evaluation also sought to **identify key lessons** to inform on-going delivery of the Foundry and any similar future schemes, both in terms of what has worked well and less well to date.

1.8 Consistent with the aims and objectives of the Foundry project, as part of the assessment of progress, outcomes, lessons, the mid-term evaluation included a particular emphasis on the development of the 'Foundry community', and how this can be enhanced going forward. This reflects that the Foundry project is fundamentally about developing the capacity and contribution of the computational science community in Swansea i.e. the project is more than simply the 'bricks and mortar' development of a new physical base for the Computer Science and Mathematics departments of the university. This is considered in more detail in the theory of change and logic model set out in section 2.

Evaluation approach

1.9 The mid-term evaluation adopted a mixed methods approach, triangulating evidence from a range of sources to provide an assessment of the performance of the Computational Foundry. The evaluation involved:

- **desk-review of project documents and data** including the quarterly ERDF monitoring returns covering project progress, and data on expenditure and output delivery
- **consultations with members of the core computational science community within Swansea**: this included consultations with members of the Computer Foundry leadership and management teams (x10); academics from the Computer Science department (x10); academics from the Maths department (x9); and delivery staff from the CHERISH-DE project based at the Computational Foundry (x2)
- **consultations with the wider computational science community**: this included consultations with academics from other departments at Swansea University that have engaged with the Foundry (x6), academics at other universities (x8), and stakeholders including 'Friends of the Foundry', businesses and local economic development stakeholders (x12)
- **analysis of supporting and contextual data regarding the research profile and performance of the university in computational science**: this included analysis of research income data secured by the Computer Science and Mathematics departments over 2010-2018, and data from the SciVal database on research citations (quality and scale) and collaborations (with industry and academia).

1.10 Four points are noted regarding the evidence and coverage of the mid-term evaluation:

- First, whilst the Foundry building is now in completed and in use, it is important to recognise that the overall project covered by the evaluation remains on-going, with the revenue funding from ERDF running to 2021, and it remains early days in the utilisation of the building
- Second, the evaluation involved over 55 consultations with individuals each with a different perspective on and relationship to the Foundry, providing a very varied and complex set of qualitative findings; the analysis has sought to account for the different levels of engagement and knowledge across consultees, and this is reflected in the report where appropriate
- Third, and linked to the point above, the consultations with academics based at the Foundry (x19[1]) covered disciplines and levels, but may not reflect the views of all staff based at the Foundry; the focus was on gathering qualitative perspectives, not statistical representation given the unique nature of individual roles e.g. nature of existing collaborations and relationships, scope for 'intra-Foundry' collaboration given research focus, time-spent at the University
- Fourth, at this mid-term evaluation stage, the analysis of research income and SciVal data does not seek to claim direct impact or attribution of the project to any changes or trends in the data witnessed. Rather, the purpose is to provide the context for the development of the computational science in Swansea over the longer-term, and provide a baseline that can be tracked over time to inform the final evaluation, at which point conclusions over the potential effects of the project on performance may be possible given that the effect of the project on research activity will have worked through more fully.

Report structure

1.11 The report is structured as follows:

- Section 2 provides an overview of the project context, including the logic model
- Section 3 considers evidence on the rationale and objectives of the project
- Section 4 provides an overview of project expenditure and activities delivered at the mid-term stage
- Section 5 presents evidence on project outputs at the mid-term stage
- Section 6 provides an assessment of project outcomes at the mid-term stage
- Section 7 highlights the perspectives gained on the process and project delivery
- Section 8 presents the conclusions and key lessons from the mid-term evaluation,

1.12 Two Annexes are provided: Annex A lists the study consultees and Annex B: Detailed SciVal and research income data

[1] Not including members of the management and leadership team that includes the Director, Heads of Departments, and Head of College of Science

2. Context and logic model

Context

2.1 The Swansea Bay City Region, and the wider West Wales and the Valleys area within which it is situated, has faced long-term economic challenges. Whilst impacting differently across the area, economic restructuring has led to significant productivity and enterprise deficits compared to the UK, and from a European perspective. Despite significant assets and advantages (including Swansea University), the economic and business base in the area has, over the long-term, failed to realise its potential.

2.2 In this context, issues identified in the 2014-2020 Operational ERDF Programme[2], through which the project was supported, related to research and innovation include:

- **Investment in R&D is much lower than the UK as a whole, and even further behind the best performing regions across the EU**, which reflects that there are fewer R&D intensive businesses and clusters
- **Relatively low levels of success in securing competitive research funding, and barriers to accessing competitive funding** including as a result of the capacity and capability of existing institutions (e.g. in facilities, equipment, excellence of research and researchers), and lack of previous success.
- **Significant barriers to the commercialisation of R&D**, particularly for SMEs

2.3 This challenging context is reflected in the headline economic data. As shown in Figure 2-1, productivity in Swansea, and the wider West Wales and the Valleys has consistently lagged behind Welsh and national comparators.

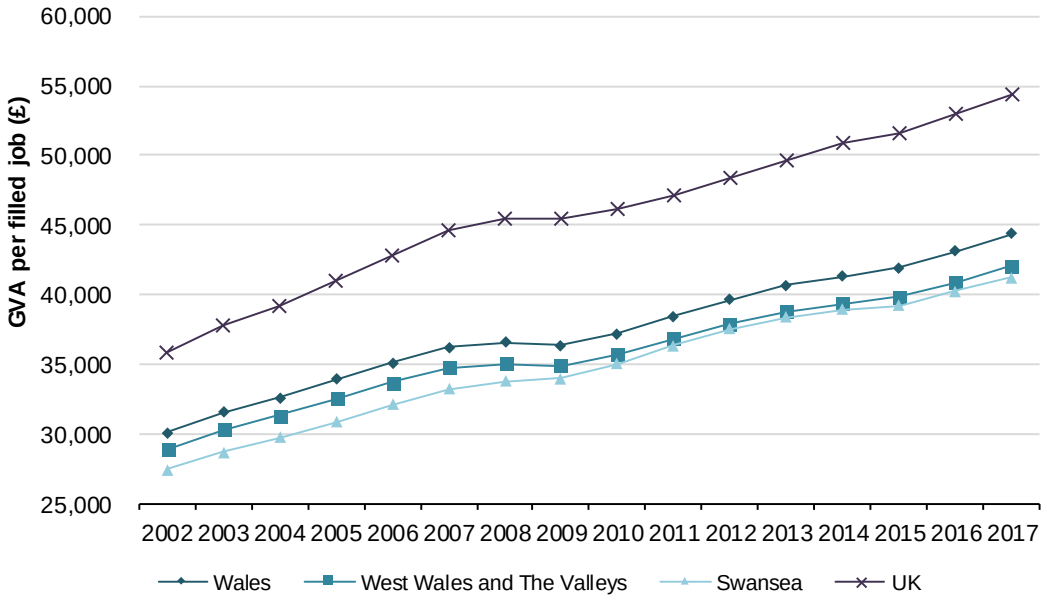
2.4 Within this context, the 2014-2020 Operational ERDF Programme identified 'Research and Innovation' as a Priority Axis for West Wales and the Valleys. The programme allocated approximately, €300m ERDF resource (increasing to €450m including match funding) to the Priority Axis, focused on the development of research, technological development and innovation.

2.5 The Objectives of the Priority Axis are to:

- increase the success of Welsh research institutions in attracting competitive and private research funding.
- increase the successful translation of research and innovation processes into new and improved commercial products, processes and services, in particular through improved technology transfer from HEIs.

[2] https://gweddill.gov.wales/docs/wefo/publications/190313-erdf-wwv-operational-prog-v3.3-en.pdf

Figure 2-1: GVA per filled job, 2002 – 2017 in Swansea and comparators



Source: ONS Regional and Sub Regional Productivity February 2019 release

... and the University

2.6 Within this context, over the past two decades, Swansea University has set an ambitious agenda to grow its contribution to the development of the local economy and realise its potential as a world-class research and teaching institution.

2.7 This was launched with a set of Strategic Direction policies in 2004, which provided the roadmap for long term development at the university, with a focus on improving research performance and academic strength within departments between 2004 and 2009. The second stage, from 2009 to 2012, consolidated this growth in key academic areas, while driving forward the development of the knowledge economy in South-West Wales through partnerships with businesses.

2.8 The third phase of the university's long-term development was set out in its 2012/17 Strategic Plan, which included a vision that by 2017 Swansea would be a research-intensive UK top-30 university, to deliver on its integrated mission, which focuses on: Excellence in research, Excellence in student experience, and Excellence in driving growth in the knowledge-led economy and enriching the knowledge-informed society. This involved commitment to a significant investment in estate and infrastructure, including the Bay Campus on the waterfront at SA1, on which the Foundry building is located.

2.9 The Foundry project was developed as part of the delivery against the 2012/17 Strategic Plan, and is now delivering against the successor Strategic Plan 2020. This identifies and highlights the university's aims based on three strategic themes[3]: Student experience, World-class research, and Economic growth and societal impact, summarised in Table 2-1.

[3] Source from https://www.swansea.ac.uk/media/strategic-plan-2020-english.pdf

Table 2-1: Overview of Strategic Plan 2020

Strategic Themes	Commitments
Student experience Enhance an already distinguished reputation for excellence in learning and teaching, and the consistent delivery of an inspirational student experience that prepares all our students for personal and professional success.	• Deliver inspirational teaching enhanced and informed by world-class research and professional practice • Increase the participation of students from under-represented groups & communities, & provide the quality of support to enable their success • Respect and value students as partners • Create a supportive & enriching learning environment for all students • Provide exciting opportunities for students to enhance their skills, global knowledge, and cultural agility • Support students to achieve the highest personal, academic, and employment outcomes
World-class research Continue to grow the quality, scale, and impact of its world-class research.	• Publish research of the highest quality • Attract scholars with global reputations and foster partnerships with leading organisations around the world • Provide a world-class research environment • Deliver global and local impact from our research
Economic growth and societal impact SU will further establish its position within the Swansea Bay City Region, as a University that has the quality, scale of teaching & research to facilitate the powerful strategic collaborations needed to drive economic growth & societal impact both locally & nationally.	• Contribute to driving economic growth, productivity, and prosperity in the region, Wales, and the UK • Create and enhance global and local partnerships that deliver benefits for our students, staff, and the wider economy, society, and community • Contribute to an international community of learning, scholarship, and research that benefits society • Deliver a range of cultural and arts activities and work to enrich the Welsh culture and language

Source: Strategic Plan 2020

Logic model and theory of change

2.10 Based on a review of project documents and engagement with project partners, the inception evaluation involved the development of a logic model for the Foundry project to inform the evaluation. This logic model articulates the context and rationale for the project, and its anticipated inputs, activities, outputs, outcomes and impacts. The logic model is set out in Figure 2-2.

2.11 Underpinning the logic model is a 'theory of change', that explains how and why the proposed activities set out in the logic model is expected to lead to deliver the resulting outputs, outcomes and impacts.

Theory of change for the Computational Foundry project

Swansea University has one of the best computational science research communities in the UK, and the best in Wales. However, the potential for growth in computational science, and the wider computational science disciplines, is being constrained by out-dated infrastructure, with limited dedicated research space, dispersed across the campus, limiting the scope for collaboration, and impacting on research quality. The computational science research community is around 40% smaller than its nearest

competitors, with no room to expand. In short, the community currently lacks a critical mass and concentration of collaborative research activity, and the means to achieve it.

The Computational Foundry operation will unlock the potential of the University's computational science researchers, enabling Swansea to be a beacon of, and major hub for, collaborative computational science research, generating benefits for the University, business base and local communities. With Wales under-represented in securing competitive research income from public and private sources, and with a reported shortage across Wales of the type of space the Foundry is set to offer, the operation will be an opportunity for the whole of Wales.

These positive impacts will be achieved through the development of a new state-of-the-art research environment, substantially larger than existing provision at the University. The Foundry will be designed to be conducive to increased research collaboration within and across disciplines and sectors, and be able to accommodate, attract and retain a critical mass of high quality additional researchers and support staff. Cyber security ('Securing Life'), health technologies ('Sustaining Life') and the increasing pervasiveness of digital in everyday life ('Enhancing Life') will be the three core research themes initially, but the Foundry will adopt a flexible approach, responding to industry needs and emerging research priorities across computational science.

Opportunities presented by the growing pervasiveness of the digital agenda across all economic sectors and increasing convergence of technology areas, will help to drive the success of the Foundry.

2.12 At this mid-term evaluation stage, there is a particular focus on the extent to which the inputs and activities have progressed as anticipated, and whether the anticipated outputs and potentially outcomes have been realised. The mid-term evaluation has also sought to consider the validity of the rationale and objectives of the project, as understood by partners and stakeholders, and whether this has changed in any way since the project launched in 2015.

2.13 The mid-term evaluation did not include a formal review of the changing research and innovation landscape in Wales. However, a number of points are noted in relation to the evolving context within which the project has been delivered – and will be delivered in the future – since the approval of the logic model at the inception evaluation stage.

2.14 First, there have been important policy and strategic developments within Wales. This includes the publication of the Economic Action Plan for Wales[4] where 'R&D, Automation and Digitalisation' is one of the five 'Calls to Action' that will inform Welsh Government business support activity and decision making. This focus on R&D reflects the important role that universities play in their local economies, including as the source of significant science and research assets both in terms of expertise and specialist equipment that local businesses can tap into. With 'place' very much on the agenda in terms of Welsh Government economic policy

[4] http://gov.wales/docs/det/publications/171213-economic-action-plan-en.pdf

in the context of the Economic Action Plan, universities are likely to be seen as critical partners in delivering on the intention to reduce spatial disparities.

2.15 Second and linked to this, in 2018, the Reid Review of Government funded Research and Innovation in Wales[5] set out recommendations for several major changes to the research and innovation landscape in Wales that are currently being progressed by the Welsh Government. This has implications for the level and source of research funding available to the Foundry, and the wider innovation support landscape.

2.16 Third, at a UK-level, the Government's Industrial Strategy agenda has progressed, including the identification of 'Ideas' as one of the five foundations of productivity. The associated funding such as the Industrial Strategy Challenge Fund and the Strength in Places Fund (and other UKRI sources) are becoming increasingly important sources of funding for research and innovation. This is particularly relevant given the uncertainty around the UK's anticipated departure from the European Union in late-2019, which has led to some on-going uncertainty over access to European funding streams (e.g. Horizon 2020). The Foundry is arguably particularly well placed to seek to play into this evolving policy and funding agenda, given the increasing pervasiveness of data science and the range of inter-related and converging underpinning technologies including human-machine interaction, artificial intelligence, big data, embedded systems, and robotics within funding calls, including the 'Artificial Intelligence and data' Grand Challenge in the Industrial Strategy.

2.17 The extent to which these developments in the policy and strategic landscape, and any wider changes in the delivery context, may have influenced the progress of the project, has been considered as part of the mid-term evaluation via consultation with project partners and stakeholders.

[5] Reid, G. (2018) *Review of Government Funded Research and Innovation in Wales*

Figure 2-2: Logic model for the Computational Foundry operation

Context

Market

- Convergence of technology areas, with computational science & digital technology underpinning much of this & increasingly pervasive across the economy

Policy

- Commitment to computational science & digital by the EU (Horizon 2020), UK (Industrial Strategy, Digital Strategy) & Wales (Taking Wales Forward)
- Supportive policy context including Innovation Wales, Science Strategy for Wales, Digital Wales & the Economic Prioritisation Framework
- Digital as a key emphasis of the Swansea Bay City Deal (Internet Coast) & Economic Regen. Strategy

Place

- Swansea University's reputation is improving (top 30 university), with growth in research income & students
- Ambitious growth plans of the university, including the £450m Bay Campus & other projects (IMPACT, ASTUTE2020, Beacon+, AgorIP, Supercomputing Wales, Next Stage Digital Economy Centre/CHERISH-DE)
- Currently no space anywhere in Wales of the type that would be available in the Foundry

Rationale

- The University performs well in terms of the quality of computer science/informatics research (REF: 11th)
- However, the community of computer science researchers is half the size of its nearest competitors, & research assets are dispersed across the Singleton campus & too limited to accommodate all research activity
- This set-up is not conducive to attracting & retaining the best talent or accessing the best research opportunities
- Scope for growth & greater collaboration is constrained by a lack of space & quality research infrastructure; the University risks losing out to other universities in an increasingly competitive research funding landscape
- Wales does not 'pull its weight' in the amount of research income secured
- Business involvement in R&D is particularly low in Wales compared to other parts of the UK
- Swansea is Wales's second largest city, but suffers from high levels of deprivation & low productivity
- The Foundry is an opportunity to develop a new, high quality research environment to meet these challenges

Aims and Objectives

Strategic aims

- The Foundry will be a 'beacon' & centre of excellence for computational science research
- Provide the infrastructure, support, & critical mass of people & research activity to enable the University to remain competitive in securing computational science research income

Operational objectives

- Provide improved environment for research & collaboration between computational science researchers
- Increase the number of academics, researchers and academic-related staff engaged in computational science at the University
- Increase the volume, value & share of research income secured by the University in computational science
- Increase collaboration between computational science research groups and between computational science & other disciplines at the University
- Increase collaboration with industry (including in key sectors of life sciences, low carbon, advanced engineering/materials, & ICT/digital) & other organisations (including Welsh universities)

Wider economic objectives

- Contribute to the development of Swansea as a hub for computational science & digital technology businesses
- Support the growth of the Swansea City Region economy

Inputs

- Funding from ERDF (£15m capital; £2.1m revenue)
- Funding from Swansea University (£8.85m capital; £5.1m revenue)
- Time inputs from Swansea University staff

Activities

- Provision of 'beta' labs, prior to the opening of the Foundry building
- Construction of the Foundry building
- Recruitment activity for a Foundry Director, new researchers, bid writers & other support roles
- Engagement activity with prospective collaborators (within Swansea University, industry & other organisations)
- Support for staff to increase/improve research income-raising activity

Outputs

- A new research facility (the Foundry building), including dedicated research lab space
- Increase in the number of computational science researchers (increasing from 22 to 53)
- Increase in the number of other computational science staff (support)
- Grant applications worth some £85m submitted

Outcomes

- Increase in research income for computational science research (from £6.4m for 5 years from 2008-13 to £21.25m for 7 years from 2016-23)
- More collaborative research initiatives undertaken between computational science research groups, & between computational science & other disciplines at the University
- Computational science researchers working with more organisations on research (including with Welsh universities & firms in key sectors, & across disciplines) & undertaking more research initiatives with them
- Increase in the number of organisations using the University's facilities for computational science research

Impacts

Direct

- Raised reputation of the University's computational science research
- Swansea University more attractive to prospective staff and students
- Enhanced collaborative and research culture within computational science research at the University
- Swansea University at the forefront of convergence between disciplines involving computational science

Indirect

- Larger concentration of computational science-related economic activity in the Swansea City Region
- Inward investment activity from technology firms
- Positive impacts for staff, students & graduates, businesses, & local communities
- Potential longer term impacts on society as a result of research undertaken

External factors

- *Brexit (EU funding, UK immigration policy, economic uncertainty)*
- *Changing technology*
- *Actions undertaken by competitors*
- *Changes to the research council set-up, with research councils to be rationalised*

Source: SQW

3. Assessment of rationale and objectives

3.1 This Section considers the first element of the logic model, reviewing the underpinning rationale and objectives of the project. It draws principally on the consultations with members of the core computational science community within Swansea including academics and the management and leadership team of the project, alongside wider stakeholders.

Summary

- The rationale for the Foundry was based on a need for a new, fit-for-purpose space that enhances research capacity and scale in computational science. New facilities were required to facilitate more effective research on a single-site, promote cross-subject working, and enable industry to engage more fully in collaborative projects.
- The evaluation indicates that the rationale for the project stated in the business case and logic model was sound and is supported by academics within the Foundry and wider stakeholders. Feedback collected mainly reflected the physical nature of the facilities which demonstrates the importance of the physical platform and environment for research, and its role in supporting and catalysing the wider economic objectives.
- The aims and objectives of the Foundry focus on raising the profile of computational science in Swansea, becoming a beacon of excellence, developing a Foundry community, raising the scale and capacity of research, and encouraging collaborations across departments, universities and industry.
- The overall strategic and operational purpose of the Foundry is recognised generally by consultees both within and outside the Foundry core community. It is recognised that the project is 'more than a building' and includes a longer-term vision to influence behaviours to enhance the quality of research and maximise impact, and re-position Swansea's offer in computational science.
- Within this general picture, the views on what the Foundry is looking to achieve specifically vary amongst consultees, reflecting both the breadth of objectives and consultees own individual context in which they operate. There is scope for greater clarity on the 'purpose and vision' of the Foundry moving forward, particularly as the physical platform is now in place.

Project rationale

The case made in 2015 …

3.2 The rationale for the Foundry, as stated in the Business Plan and characterised in the logic model developed in the Inception Evaluation, can be summarised as based on three core (inter-related) arguments:

- **Environment**: The set-up of the Singleton campus was not conducive to attracting and retaining the best talent or accessing the best research opportunities; and there was a lack of space and quality of research infrastructure (including the capabilities of the laboratories) which constrained the scope for growth and greater collaboration, and risked the University's chances of competing in the increasingly competitive research funding landscape.

- **Resource**: Research assets within the Computer Science department were dispersed across the Singleton Campus and the Department was over-reliant on accessing laboratory space outside Swansea

- **Scale:** The size of the Computer Science department was small in comparison to its competitors; the top 10 Computer Science departments (REF2014) were all at least 40% bigger than at Swansea. Business involvement in R&D is particularly low in Wales compared to other parts of the UK; and Wales secures the least amount of research income compared to other parts of the UK.

3.3 The argument for ERDF funding was therefore made on the basis of a genuine need for a new, fit-for-purpose physical space that promotes and enables collaboration, and for research activities that can contribute to the wider innovation landscape and community.

… and reflections at the mid-term evaluation stage

3.4 Academics based at the Foundry, and the project leadership and management, were asked to identify their perspectives on the case for the project some four years on from the original business plan. The purpose was to test the extent to which the evaluation evidence points to a valid rationale at the outset, and whether this evolved or changed in anyway subsequently.

3.5 The nature of the issues identified that justified the project were consistent generally with the rationale stated in the business case and logic model, suggesting that the original rationale was considered valid by consultees. The factors underpinning the rationale which consultees raised included the following:

- a recognition that the **facilities available at the Singleton campus were of an insufficient scale** to provide a platform to develop the critical mass of research activity and researchers required to develop fully and exploit the potential of the computational science excellence in Swansea i.e. the facilities were limiting the scope for generating further research income and growing the size of the departments

- linked to this, **the quality of the facilities,** which academics reported were not 'state of the art' limited the research undertaken; as one consultee noted "*the main gripe was the limit on facilities, it disjointed the department*".

- The physical location of the Singleton campus meant staff within Computer Science and Maths departments were spread across numerous buildings. Due to this, it was reported that inter-departmental linkages and relationships were difficult to develop, including a lack of 'social architecture' such as meeting spaces, meaning there were **'missed opportunities' from collaborations as staff worked in siloes**. For example, feedback from academics consulted included:

  "The two departments were inaccessible to each other despite the links between the research areas … we needed space that could drive collaboration in computational science and provide the basis for informal 'corridor conversations' that might lead somewhere".

  "academics were dispersed in lots of different locations and any interaction was on a very ad-hoc basis dependent completely on personal relationships".

- The **appearance of the existing facilities and the building was regarded by some consultees as "off-putting"** both for potential collaborators with industry/other academics, and for potential staff and students. For example, one consultee noted that *"when you have an open day selling the computer science course as high tech, the old appearance was undermining the effort".*

3.6 As indicated in the findings above, the feedback from consultees focused principally on the nature of the facilities as providing the justification for the project, with the situation pre-Foundry not regarded as conducive to supporting an improved quality of research, and able to match the growth aspirations for computational science in Swansea. This is consistent fully with the case made for the project in the original business plan. The focus on the physical facilities as the basis for the project does not mean that consultees did not recognise the wider vision of the project to re-position computational science in Swansea. Rather, whilst recognising that the project is more than a re-location and capital project alone, it demonstrates the importance of the physical platform and environment for research, and its role in supporting and catalysing this wider case.

3.7 One further point is noted regarding the rationale. As noted above, the Mathematics Department was not originally part of the project, with the issues related to facilities and capacity in the business case specifically focused on the Computer Science department. However, feedback from the Mathematics department was generally consistent with those from Computer Science department in relation to the quality and nature of the estates position prior to the Foundry project. Further, the rationale for the project was enhanced through the recognition of the need for increased collaboration between the departments to address the missed opportunities. The evaluation evidence suggests that the role of the Foundry project to facilitate increased inter-disciplinary activity is an important way in which the rationale for the project has evolved and strengthened since the initial business case.

Project aims and objectives

3.8 In logic chain thinking, aims and objectives need to flow logically and seamlessly from the rationale for the intervention. We note, from the discussion above, that the rationale for the Foundry was based principally on addressing a sub-optimal physical infrastructure for effective and high-quality research activity and collaboration. These intents should therefore be reflected and developed in its objectives.

3.9 As stated in the inception report, whilst the Business Plan and associated documents (such as the Monitoring and Evaluation Plan) set out a range of broad aims for the operation, and the types of outcomes that are expected to be generated, there was not an agreed single, comprehensive and up-to date statement of specific operation aims and objectives over and above the ERDF metrics. This was addressed through the development of the logic model (see Figure 2-2), including both strategic aims and operational objectives.

Understanding the aims and objectives in practice

3.10 Within this context, the understanding of the aims and objectives of the project were tested in consultations with project delivery and management teams, academics within the Foundry and the wider computational science community. Three key messages emerged.

3.11 First, the overarching strategic aims of the Foundry were generally well recognised by consultees, particularly by those that are involved directly in the project as academics and collaborators, consistent with the underpinning rationale. There was a consistent recognition that the project was a rounded intent to develop the computational science offer in Swansea in part – but importantly, not exclusively so, – through the new physical facility.

3.12 Although the individual views varied, themes that emerged from the consultations when consultees were asked what they saw as the objectives of the project, which align with the agreed objectives, included:

- to position Swansea as a beacon for computational science research across Wales, and on an international scale; as part of this some consultees highlighted particular research areas where there is scope for the project to drive Swansea's profile including artificial intelligence, cyber security and human-led research with an application to the real world as specific areas within Computational Science which will be targeted. For example, one consultee noted that "*[the Foundry] is there to change the world in terms of the understanding of digital futures. And doing so, make this place a very clear centre for excellence, and of excellence".*

- to grow the scale and capacity of computational science by increasing the number of researchers and research outputs across both departments

- to promote a change in culture and mindsets amongst the academic community in Swansea, raising the aspiration and ambition of the two departments, both in terms of securing research funding and enhanced levels of collaboration

- to provide an improved environment for research, collaboration, and teaching.

3.13 Second, however, and reflecting both the breadth of the objectives for the project and the specific contexts, the feedback from individual academics based at the Foundry highlighted how the project is anticipated to lead to different types of benefits in different contexts. Put simply, what academics perceived the Foundry project was seeking to achieve was influenced to some extent by what it meant for them individually in relation to their area of research and activity. For example, for some consultees, increasing collaboration with industry was recognised as an important objective, but this was not relevant for others. Similarly, the extent to which the project was seen to be about driving enhanced collaboration between Mathematics and Computer Science was varied. Notably, some consultees (particularly from the Mathematics department) also highlighted that the project was regarded as seeking to promote an increase focus on applied research, consistent with an imperative to generate social and economic impact. This may be expected given the breadth of disciplines covered by computational science and different roles and responsibilities of consultees, but it does suggest that the Foundry project can mean different things to different people.

3.14 Third, and linked to this, the consultations with the wider computational science community – both in Swansea and more widely – did identify some uncertainty from consultees over the role of the Foundry. This was from two (linked) perspectives:

- First, regarding the purpose and position in the research and innovation landscape of the Foundry, as distinct (potentially) from the individual academic departments that form its core. For example, is the Foundry an independent and distinct research

facility which has its own agenda and focus, and to what extent should it be seen as a Welsh asset, rather than a Swansea University one?

- Second, regarding the offer of the Foundry to the business base, and what this was, or should be, including in relation to work with the SME community across the Swansea Bay City Region and more broadly the balance between the Foundry as a fundamentally research-oriented initiative, or an innovation facility with support for business and technology transfer as a core component.

3.15 To some extent, this uncertainty reflects the level of knowledge amongst consultees of the Foundry, and the timing of the mid-term evaluation as the Foundry had only been opened for six months at the time of the research. This said, taken alongside the feedback from academics based at the Foundry, the evaluation does suggest that there may be scope for greater clarity on the 'purpose' and 'vision' of the Foundry moving forwards, particularly as the physical platform is now in place and is increasingly recognised across the computational science landscape.

4. Inputs and activities

4.1 This section sets out the planned and actual inputs for the Foundry project and considers activities both in terms of the process of delivering the capital component of the project, recruitment and publicity, and summarises the activities undertaken to address the Cross-Cutting Themes (CCT).

Summary

- Total project expenditure by the end of March 2019 was £27.8m, 85% of the overall planned expenditure of £32.7m (including non-eligible elements). Consultations indicate that it is expected expenditure will be met by project close.
- Given the scale of the project, the successful delivery of the building should be regarded as a significant achievement for the project delivery and management team, and the university more widely. Consultations suggest the building has been well received by the academic community, and is providing an effective environment for the computational science research.
- Recruitment activities within the Foundry are progressing with recruitment of researchers. There have been challenges faced in recruitment due to the highly competitive nature of the UK and international landscape. The position of the Foundry Director has been filled and the role of the Director as a 'motivator' for the Foundry community was regarded as particularly important.
- The numerous publicity and communications streams used by the Foundry team has been largely effective – engaging audiences both internal and external to the Foundry. The engagement with high-profile academics and businesses was regarded as important in building the profile of the Foundry. The publicity activities started during the construction phase and have continued following hand-over and the operational phase to date.
- Cross-Cutting Themes appear to have been embedded successfully into the activities and ethos of the Foundry.

Project inputs

Planned expenditure

4.2 The project was funded by ERDF and Swansea University. ERDF support of £15m in capital funding and £2.1m in revenue funding was committed to the operation, with capital funding expected to be spent by March 2019, and revenue funding by March 2021. The ERDF capital funding was related to the construction of the Foundry building (including approximately 7.5k sqm of space), and the revenue funding is focused on supporting the costs of the recruitment and appointment of academic staff costs, plus project management. This ERDF funding was matched by £3.7m of capital funding and £5.1m of revenue funding from Swansea University. In addition, Swansea University also contributed £5.2m capital funding to cover the cost of construction for teaching space to be included within the Foundry building, which is not eligible for ERDF funding, and a further £1.6m as the costs for construction increased following the project approval. This additional investment by the university ensured that the scale and quality of the proposed facility could be maintained in line with staff expectations and requirements. The financial profile of the project is summarised in Table 4-1.

Table 4-1: Planned expenditures by source and type

	ERDF (£m)	Match funding (£m)	Total (£m)
Capital – eligible	15	3.7	18.7
Revenue – eligible	2.1	5.1	7.2
Capital - non-eligible and additional	-	6.8	6.8
Total	**17.1**	**15.6**	**32.7**

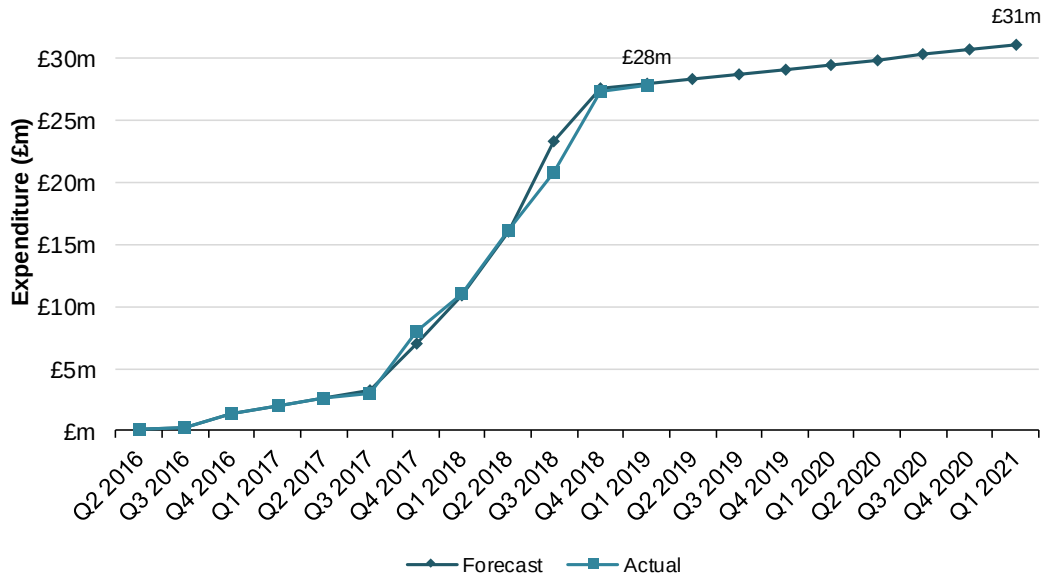
Source: EMC Grant Offer Letter

Actual expenditure

4.3 Total project expenditure at March 2019 stood at £27.8m (including elements that are non-ERDF eligible). Expenditure to date therefore accounts for around 85% of total planned expenditure to the end of the ERDF project in 2021. Figure 4-1 presents the cumulative forecast and actual expenditure over the project delivery period to this point. This indicates that the project has remained largely in line with anticipated expenditure to this mid-term evaluation point. Given the scale and complexity of the project, this is a positive message.

4.4 The £27.8m actual expenditure figure set out above excludes the £529k additional investment made by the university to cover the increased costs of construction (with £1m remaining to be spent). In practice, this means that the *total* expenditure to this point including this additional investment is £28.3m, 86% of total planned expenditure until 2021.

Figure 4-1: Forecast and actual expenditure data for the Computational Foundry, Q2 2016 – Q1 2019

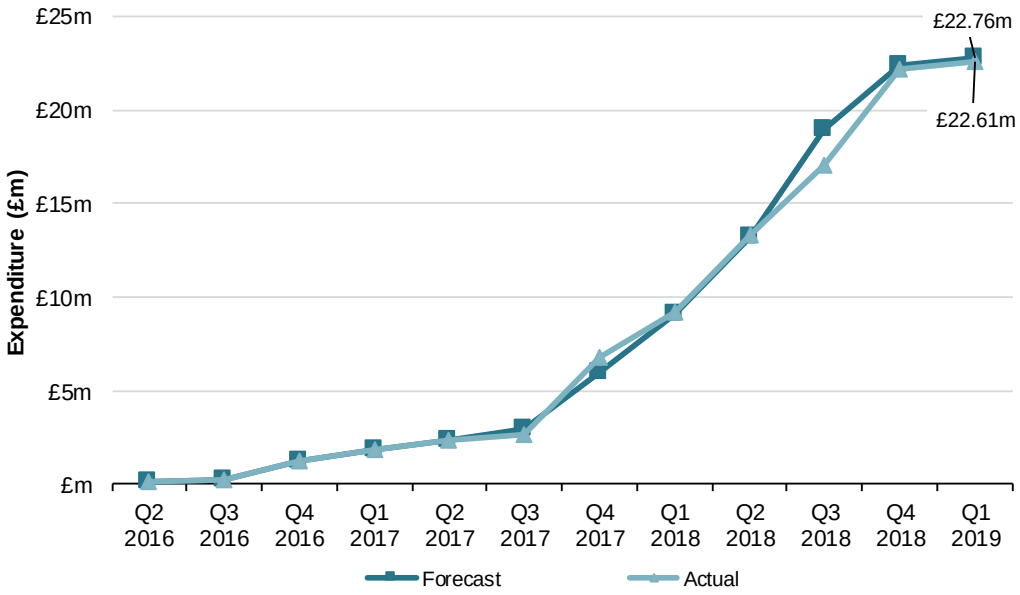


Source: SQW analysis from Foundry's expenditure data

4.5 The equivalent data for ERDF eligible expenditure only is set out in Figure 4-2. Actual expenditure at March 2019 stood at £22.6m, essentially in line (at 99%) of the planned eligible expenditure at this point, and actual expenditure has been broadly in line with anticipated expenditure throughout the delivery period. The evaluators understand that the majority of the outstanding eligible expenditure (£3.3m) is accounted for by revenue expenditure on

academic staff costs to 2021. Consultations with project partners indicate that it is expected that the project will meet its total expenditure claim by project closure.

Figure 4-2: Forecast and actual data on 'eligible' expenditure for the Computational Foundry, Q2 2016 – Q1 2019



Source: SQW analysis from Foundry's expenditure data

Cost breakdown

4.6 A breakdown of the Foundry's forecasted and actual expenditure (covering both eligible and ineligible spend) is given in Table 4-2. As expected, the construction of the building (estates) accounts for the largest proportion of forecasted spend (76.8% of £31.1m), followed by expenditure on staff (19.7%) e.g. recruitment of academic, project management and delivery staff, and the final 3.5% on project management and admin, e.g. marketing and promotion of the Foundry, evaluation development and monitoring by Professional services and further ICT hardware and software purchases to name a few examples.

4.7 When considering the actual expenditure until Q1 2019, expenditure on estates represents 85.7% (of £27.8m) which reflects underspend on staff and program management and admin categories. Expenditure on estates has broadly reached its target spend. Underspend on staff was reported to be owing to staff members leaving, and challenges in recruitment, however a reprofile will be made to ensure the project delivery team are able to undertake further activities for a longer time-period.

Table 4-2: Computational Foundry expenditure by category, June 2016-March 2019

Categories of expenditure	Proportion of planned total expenditure	Proportion of total actual expenditure
Estates	76.8%	85.7%
Staff	19.7%	12.3%
Program management & admin*	3.5%	2.0%
Total expenditure	**£31.1m****	**£27.8m**

Note *Program management & admin contains the following groups of expenditure: Admin, Flat rate, HR, ICT, Marketing & Promotion, Professional Services, and Travel and Transport

** The £31.1m does not include the extra £1.55m spent on the construction of the building by Swansea University

Source: SQW analysis from European Structural and Investment Funding Claim Form Submitted Report (March 2019)

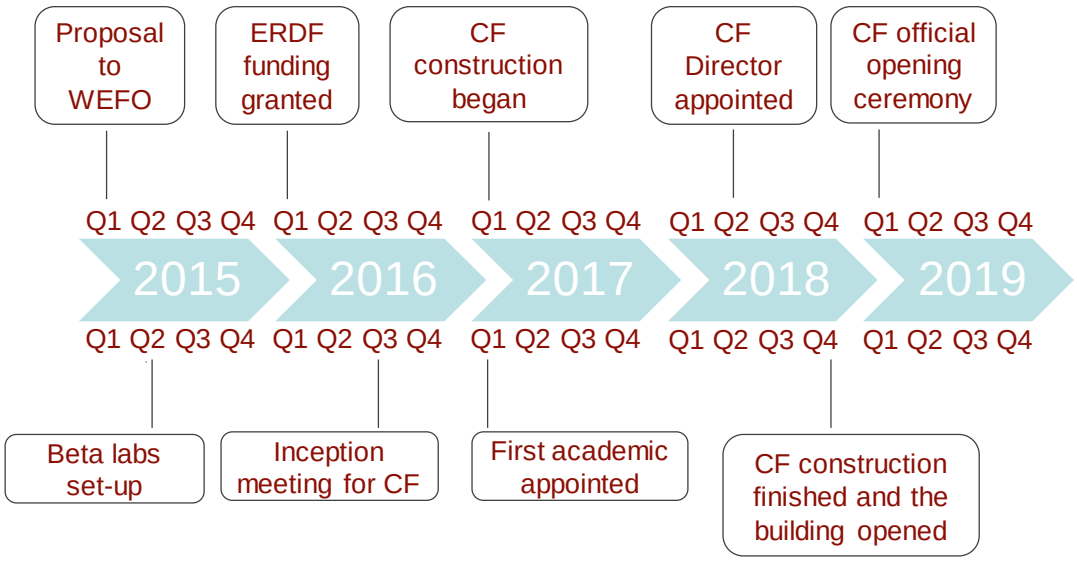
Project activities

Overview of project milestones

4.8 The Computational Foundry Operation is a large and multi-dimensional project, covering both the construction and fit-out of a major new facility for academic research, teaching, and collaboration, and the recruitment of new academic staff to build the capacity of two university departments. Complementing these elements delivery of a range of activities to develop the community within the building and amongst the academic and wider staff of the departments to deliver against the overall aims and vision of the Foundry; this included the appointment of a Foundry Director.

4.9 Figure 4-1 presents an overview of the key milestones in the delivery of the project from the initial submission of the proposal for ERDF funding to WEFO in Q1 2015, to the official opening ceremony in Q1 2019.

Figure 4-3: Timeline of key milestones for the Computational Foundry



Source: SQW manipulation from project documentation and consultation evidence

4.10 The key activities undertaken are considered in more detail in the paragraphs below, in terms of construction, recruitment and publicity and engagement.

Construction

4.11 Planning permission for the Foundry building was secured in June 2016. Willmott Dixon were appointed by the University to undertake the pre-construction works following a procurement exercise in May 2016, and subsequently appointed to deliver the full construction phase in 2017. The completion of the building was initially scheduled for April 2018, but due to an extended procurement process of subcontractor packages, negotiations with sub-contractors and a slight delay in completing the building, it was formally handed-over to the university in October 2018.

4.12 As expected with any capital development of this scale some challenges and issues were experienced throughout delivery these were detailed in the quarterly monitoring returns to

WEFO and are not rehearsed in detail in this evaluation report. However, consultations with the project management team indicate that notwithstanding the modest delay in the completion and hand-over of the building, overall the construction phase of the project was considered to have been delivered effectively, and largely as anticipated. This is a positive message.

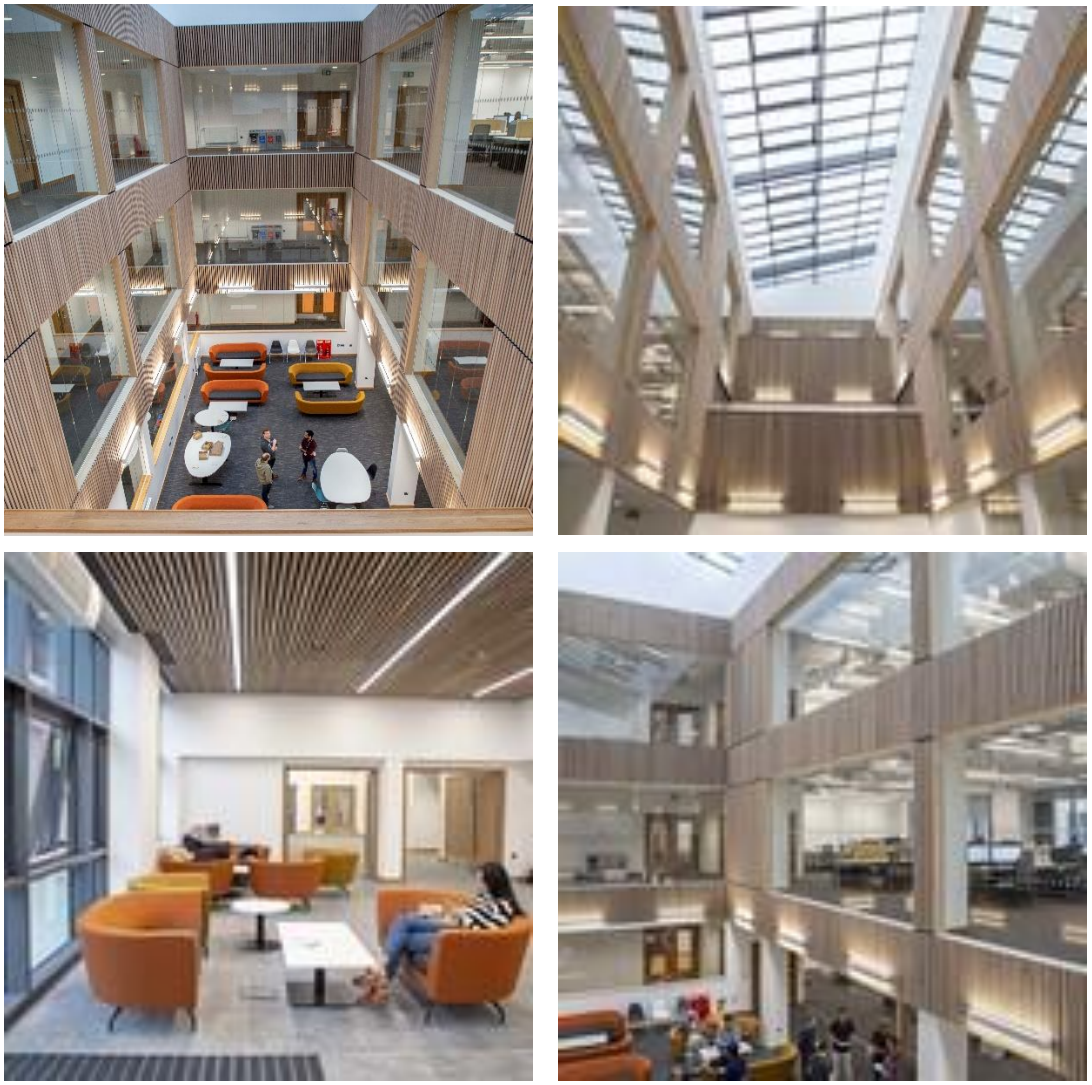
4.13 It is also important to note that during the construction period, 'beta' labs were set up at the University's Singleton Campus as an interim measure to accommodate new staff and research activity supported by the revenue strand of the operation. This enabled the research activity that the ERDF operation aims to achieve to commence prior to the completion of the building and mitigated the risk of delay in maximising the Foundry operation once the building is completed.

4.14 Now fully operational, it is expected that the Computational Foundry will host space for over 150 researchers within the computational science community. The Foundry building includes bespoke laboratories, including a 'Vision and Biometric Lab', 'Maker Lab', 'Techealth Lab', 'Theory Lab', '(Cyber) Security/Networking Lab', 'User Experience Lab' and 'Visualisation Suite' to support leading-edge research, and a mix of collaborative shared spaces, and teaching facilities.

4.15 As shown in Figure 4-4, the building has been designed to stimulate interaction and linkages between members of the computational science community and provide a high-quality working environment. Key components of this include:

- numerous meeting and social areas across all floors of the building
- specifically, one main area, the 'Research Crucible', has been designed to be a central hub, and provides space for staff from both academic departments, and professional and management services to interact, and a space for internal events and activities
- open plan offices for management staff, professional services and PhD students with the aim of promoting engagement between them
- internal walls surrounding the Research Crucible and some which form the corridors are glass, to enhance visibility of staff and allow light into places to improve the working environment in the building.
- the materials used in the construction of the building were from sustainable sources and an emphasis on including 'greenery' and bio-diverse landscape outside the building was made to improve the working environment for staff.

Figure 4-4: Examples of the working environment within the Foundry



Source: Computational Foundry

4.16 Consultations with the project management team for the evaluation indicate that considerable effort was put into engaging academic staff in both the design and on-going construction of the building to ensure that it met their expectations. This included site visits to the construction site as the construction progressed, and surveys/consultations to gather feedback on the fit-out and facilities required. This effort does seem to have been welcomed by the academic community with the academic consulted for the evaluation generally reporting they had an opportunity to influence the building and able to provide suggestions on what they needed in their respective offices or working environment. There was some feedback from academics from Mathematics that initially they did not feel as engaged (owing to the inclusion of the Mathematics department following the initial project approval), but this had been largely mitigated by the time of the building hand-over and operation. Communication with staff by the delivery and management teams continued post-construction to ensure staff were content in the new building.

4.17 Taken together, at this mid-term evaluation stage, given the scale of the project, the successful delivery of the building should be regarded as a significant achievement for the project delivery and management team, and the university more widely. Consultations suggest that

the building has been well received by the academic community, and is providing an effective environment for the computational science community. This is considered in more detail in Section 6.

Recruitment activity

4.18 Alongside the capital development of the building, core to the Foundry operation is recruitment of the Foundry Delivery team, the Foundry Director, and new researchers. The latter is an ERDF indicator, and progress against the agreed target is discussed in Section 5.

4.19 Considering these in turn:

- The **core Project Delivery Team**, alongside the Principal Investigator and Head of Maths and Computer Science departments includes a project manager, marketing and communications officer, finance officer, and cross-cutting themes officer. Project Delivery Team's posts were expected to be filled by August 2016 and following the quarterly progress claims reports, this was broadly on target with replacement of staff occurring in 2017 and 2018. The recruitment for the Team followed formal Swansea University's procedures with all post advertised internally first, and if not filled, advertised externally.

- The process for recruiting a **Foundry Director** began in 2016. Five shortlisted candidates were interviewed, and a preferred candidate was identified. However, owing to personal reasons, the preferred candidate chose not to take-up the position. The role of Director – including providing significant input to the staff recruitment, promoting collaborations and external engagement, and overall leadership and vision for the Foundry – was delivered collectively *pro tem* by senior members of the academic community (Professors Matt Jones Head of College of Science and Principal Investigator on the Computational Foundry; Biagio Lucini, Head of Mathematics; and Arnold Beckmann, Head of Computer Science). The recruitment process re-commenced in mid-2017, including support from an Executive Search Agency (funded by the university) that involved targeting key potential candidates in academic and industry. This process was successful and in mid-2018, Professor Alan Dix, was appointed as the Computational Foundry Director.

- **Recruitment of research staff** to deliver against the agreed ERDF target commenced in Q2 2017 with six appointments made for researchers in Human Computer Interaction, Cyber Security and Dependable Systems (Security and Safety). Subsequently, further positions have been filled progressively, involving a mix of permanent and fixed-term positions. The project aims to deliver an up-lift in the staffing capacity of the relevant computational science community, notably in the Computer Science department consistent with the overall aims and objectives of the project.

4.20 Consultations for the mid-term evaluation highlighted the challenges in the recruitment of academic staff – at all levels, but particularly at senior levels – given the highly competitive nature of the UK and international landscape, in both Computer Science and Mathematics. This was particularly noted to be a challenge over the 2016-19 period given the potential effects of the UK's exit from the EU, and the effects of this on the international recruitment (we

return to this issue in Section 7). There was a delay in recruiting the Foundry Director, however members of the Foundry's Leadership and Management team undertook to role and responsibilities of a Director to mitigate any loss of presence and ensure a smooth delivery and leadership of the project. Monitoring reports from the university report that this did not have a substantive or detrimental impact on the progress of the project, consistent with the consultations for the mid-term evaluation.

4.21 This said, it is noted that the consultations with both members of the core computational science community in Swansea, and wider stakeholders, did emphasise the importance of the recruitment of a high-profile Director for the Foundry to complement the existing leadership team. The role of the Director as a 'motivator' for the Foundry community, was regarded as particularly important, and as a 'symbol' of the ambition of the university in this space. We return to the role of key members of the Foundry community and its leadership in Section 7.

Publicity and engagement

4.22 Promotion of the Foundry to internal and external audiences is a key activity embedded into the working culture of the delivery team, supporting the focus on developing the 'community' aspect of the project. Broadly this has involved three main types of activity:

- **Website and social media:** The Computational Foundry has dedicated webpages on the University of Swansea website[6], and a social media presence with a Twitter feed (2.2k followers in July 2019), a dedicated YouTube channel, including containing promotional videos including 'Founding the Foundry' lectures and other material, and a LinkedIn profile that includes posts of relevant material and notifications regarding the Foundry. The website and social media is managed by a dedicated marketing and communications officer based at the Foundry.

- **Internal engagement:** The project has involved a broad mix of internal communication with staff based on the Foundry, and those visiting. This includes regular e-mails and newsletters regarding activities and events at the Foundry as a whole (as distinct from relevant departmental material), and the use of digital screens throughout the building to highlight news and activities of interest across the community e.g. research proposals and funding bids submitted, publications, and conference presentations. A range of promotional materials[7] have also been developed to help promote the Foundry both internally and with guests/visitors etc.

- **Events and conferences:** a programme of events have been delivered at the Foundry to date, both involving external speakers and attendees, and those focused principally on the core computational science community. Some examples include:

  - external speakers and attendees: the official opening of the Foundry in February 2019; lecturers and events by visiting academics and industry representatives (e.g. a lecture by Professor Sue Black of Durham University, and a discussion session with a representative of Facebook regarding online counterterrorism research; networking events for local businesses and

[6] See https://www.swansea.ac.uk/science/computationalfoundry/
[7] These include mugs, glasses, water bottles, bags, umbrellas, lanyards, ponchos, sticky labels, bunting and event folders for delegates attending conferences at the Foundry have been made available to staff and students.

industry in eaerly-2019; a cyber security conference in early-2019; hosting a 'Festival of Ideas' event in mid-2019; and

- internally, a regular series of 'My Research: Why it Matters' events which are held to enable staff in the two departments to provide a brief presentation of their research to the Foundry community, and encourage knowledge sharing and collaboration between departments

- prior to the opening of the Foundry building, workshops were also held with a group of leading technologists and academics in computational science known as 'Friends of the Foundry'[8]. These were undertaken at Swansea University to build momentum for Computational Science, further develop the reputation for Computational Science, at a global scale for the University and start building relationships with industry. Examples of such workshops include 'Coming Zombie Apocalypse of IoT' in 2017 by Scott Jensen (Google) and 'SIGCHI Across Borders Meeting' in 2018 with Susan Dray and David Siegel.

4.23 The feedback from consultations in the mid-term evaluation is that the range of marketing and communications effects has been largely effective, from both internal and external perspective. The engagement with high-profile academics and businesses (including internationally leading technology firms such as Facebook, Google, and Microsoft, amongst others) outside of Swansea was regarded as a key component in this, helping to 'put the Foundry on the map'.

Delivery against Cross-Cutting Themes

4.24 As part of the ERDF funding approval, the project was required to meet the requirements of the Cross-Cutting Themes (CCTs) of the operational programme in terms of:

- sustainable development
- equal opportunities and gender mainstreaming
- tackling poverty and social exclusion.

4.25 The evaluators understand that no formal targets/metrics were agreed for the project against the CCTs. However, the evaluation suggests that significant activity has been delivered against and aligned to the intent of the CCTs, with a summary of activity set out below.

CCT 1: Sustainable development

4.26 The following points are highlighted regarding sustainable development drawing on the monitoring returns and consultations with project partners:

[8] Friends of the Foundry refer to high-profile researchers around the world that have a connection to the Foundry (e.g. they have conducted workshops/seminars at the Foundry and principally know of the Foundry through Matt Jones) but are not involved in the delivery of the Foundry project.

- The Foundry has adhered to Swansea University's Sustainability Strategy[9] which highlights eight opportunities for sustainability[10] ranging from lowering carbon, ensuring wellbeing and health, having a biodiverse campus, having minimal waster to sustainable travel.

- The Foundry building, from inception, has been developed with sustainability in mind. The building aims to achieve a BREEAM[11] rating of excellent, and has been designed to ensure lower impact buildings which maximise carbon reduction and resource efficiency. The development has incorporated a significant element of renewable energy technology, in the form of PV installation, and an environmental management plan for the construction phase of the building was developed. Locally sourced and recycled materials have been used in the construction. The building itself complies with the Disability Discrimination Act[12] (1995) and Forest Stewardship Council (FSC)[13] accredited. All efforts were made to ensure that the employment generated benefitted local people.

- The Foundry has actively promoted participation in the University's SWELL scheme. SWELL is a sustainability and wellbeing scheme that rewards staff for taking positive steps such as using reusable coffee cups, using sustainable travel options, maximising recycling and resource conversation and making use of the open spaces (and green spaces) on campus to enhance wellbeing. A wetland garden and bird houses have also been included into the landscaping of the building.

- The Foundry ran twelve recycling events in the reporting period, including collecting books, paper, and electronic items that were sent for reuse. There has also been a continued participation by the Foundry staff in the University's SWELL initiative, that involves recording contributions to sustainable living.

- Working in collaboration with the University Sustainable Travel Officer, the Foundry provided free bus passes are to be provided to staff and students attending the Computational Foundry building site visits. A travel survey to inform travel patterns has been planned. Planned sustainable travel events will promote and facilitate car sharing, the use of public transport and cycling.

CCT 2: Equal opportunities and gender mainstreaming

4.27 The following points are highlighted regarding equal opportunities and gender mainstreaming drawing on the monitoring returns and consultations with project partners:

- With an aim to attract more female academics into computational science and promote gender mainstreaming at the Foundry, an application for the Athena SWAN[14]

[9] Updated Strategy located here: https://www.swansea.ac.uk/media/Sustainability-Strategy---updated-with-OandTs-2018-19-ENGLISH.pdf
[10] The eight opportunities are: Lower carbon, minimal waste, biodiverse campuses, sustainable travel, positive procurement, wellbeing and health, culture and community, and knowledge and skills.
[11] BREEAM is a sustainability assessment method for master planning projects, infrastructure and buildings.
[12] Information regarding DDA located here: http://www.unisonswanseauniversity.org.uk/disability-discrimination/
[13] Information regarding FSC located here: https://ic.fsc.org/en
[14] The Athena SWAN charter was established in 2005 to encourage and recognise commitment to advancing the careers of women in science, technology, engineering, maths and medicine (STEMM) employment in higher education and research. Information was sourced from: https://www.ecu.ac.uk/equality-charters/athena-swan/

bronze award, by the Foundry is underway, and due to be submitted in November 2019[15]. This was noted on a number of occasions by consultees as an important example of the commitment of the Foundry to this issue.

- The Foundry has hosted and supported events in a drive to enhance the culture of positive female roles. Events included a lunchtime seminar with Kate Gunn, CEO of CAASTRO (The ARC Centre of Excellence for All-sky Astrophysics), and an Ada Lovelace Welcome Breakfast in collaboration with Athena Swan departmental leads (November 2018) as an informal networking event to promote the ethos of Athena Swan amongst colleagues. An Ada Lovelace Lunch was also arranged for Foundry students, with a presentation on Equality, Inclusivity, and Diversity in the Computational Foundry. In addition, the Foundry hosted an International Women in Engineering Day event with a distinguished lecture with Professor Sue Black OBE[16].

- Other activities include undertaking surveys and focus groups with staff regarding equal opportunities, conducting targeted searches of researchers on women's websites and using gender decoding software so the terminology used on job adverts is gender friendly. At a more local level through the Technocamps project, the Foundry provides training, mentoring and business support (with an aim to break any barriers to technology engagement), whilst working to increase the uptake of computational science by female students and working with schools to foster a positive picture of computational science careers for girls.

CCT 3: Tackling poverty and social exclusion

4.28 The following points are highlighted regarding tackling poverty and social exclusion drawing on the monitoring returns and consultations with project partners:

- The appointed main contractors (Willmott Dixon) have delivered two main projects to support the local community.
  - a collaboration with Discovery (Swansea University's volunteer-led charity) to renovate parts of Danygraig School, a school located in one of the most deprived areas of Swansea. The contractor also worked with Western Bay Youth Justice & Early Intervention Service, and ran a 'Construction in the Classroom' enrichment programme for pupils at the Danygraig School.
  - working with local organisations to support marginal groups such as the long-term unemployed, by offering two job vacancies (a cleaner and gateman). The Foundry has also directly engaged with local school children by inviting them into the Foundry and placing a time capsule in the wall filled with messages from the children.

- With a further aim to reduce social exclusion and raise awareness of opportunities offered by the University, the Foundry is involving VIth Form students to get a taste

[15] The initial application for Athena Swan was planned to be submitted in November 2018. The submission was then delayed to November 2019 due to the Cross-Cutting Themes officer leaving and time needed to recruit a replacement.
[16] Professor Sue Black is an award-winning computer scientist, radical thinker and social entrepreneur. She is one of the top 50 women in 'tech' in Europe, has received an OBE and been appointed to the Government Advisory Board for shaping digital services.

of university life. The Foundry also sourced Welsh language resources and distributed them Welsh speakers and learners within the Foundry. It also encourages all staff members to learn Welsh and ensures all written/digital outputs produced are bilingual (both English and Welsh).

4.29 The evaluation did not involve undertaking primary research on the CCT or testing the outcomes/impact of the integration of the CCTs into the project; put another way, the assessment is of the *process* of integrating the CCTs, not the effects of this activity. This said, the consultation evidence suggests that the CCTs have been embedded substantively into the working culture of the Computational Foundry through delivery of the project to date, and the activities undertaken in the three CCTs are noteworthy, including incorporating sustainability elements into its construction, organising events to raise the profile of gender equality and engaging with the community (mainly school and higher education students) to improve the awareness of computational science in the local community.

5. Outputs

5.1 This section reviews the progress made by the Computational Foundry towards the ERDF indicators.

Summary

- The Foundry has delivered strongly against its agreed ERDF indicators and remains well on course to meet the agreed targets related to the revenue elements. This said, the variation in timescales for achieving the targets is somewhat unhelpful and a consistent approach going forwards or for similar interventions should be considered by the university.
- The two capital-related indicators have not formally been claimed yet but is expected to be following the BREEAM accreditation later this year.
- The number of enterprises cooperating with supported research institutions has delivered significantly against its target which is a positive message for the evaluation and should be regarded as an achievement given the remaining timescale for project delivery. However, the target was set too low and a revised target should have been provided.

ERDF target indicators

5.2 The ERDF grant for the project involved three formal targets, summarised in Table 5-1 below. It is important to note that reflecting the capital and revenue mix of the project, the target dates for the delivery of outputs vary, with capital-related targets expected to be delivered by (at the latest) June 2019, and revenue-related targets by (at the latest) end-2023. This varied timescale needs to be considered in an assessment of the progress of the project at this mid-term evaluation stage. It is also noted that the targets related to research income and enterprises cooperating with supported research institutions draw on activity from across the two departments that form the Foundry (i.e. Computer Science and Mathematics), they do *not* relate to the revenue staff appointed by the project only.

5.3 In this respect, the data depicts the 'gross' outputs of the project. They do not take into account what would have happened in any case without the Foundry project i.e. the level of additionality. Clearly, some of the research income would have been secured, and some cooperation with enterprises would have been achieved without the Foundry project.

Table 5-1: ERDF indicators for the Computational Foundry

Indicator	Explanation	Target	Target date
Number of improved research infrastructure facilities	The number of research infrastructure facilities which have been improved directly as a result of ERDF	1	April 2018
Number of researchers working in improved research infrastructure facilities	Existing working positions in research infrastructure facilities that (i) directly perform applied research activities and (ii) directly affected by the support provided by the project	53	June 2019
Amount of research funding secured	The amount of research funding secured by beneficiaries	£21.3m	end-2023

Indicator	Explanation	Target	Target date
Number of enterprises cooperating with supported research institutions	The scale of RD&I activity led by one or more ERDF funded research institutions	40	October 2020
Number of new researchers in supported entities	The increase in research capacity, measured by the gross number of new working positions (that did not exist before structural fund intervention) to directly perform applied R, D and I activities.	31	June 2019

Source: WEFO Business Plan Section 2: Further Delivery Criterion: Indicators and Outcomes

Progress at the mid-term evaluation stage

5.4 Output delivery and progress against the targets at March 2019 (the latest quarterly data available at time of writing) is set out in Table 5-2. The table covers the three revenue-related indicators only. The capital-related indicators have not been included as they have not yet been reported against; the definition for 'improved research infrastructure facilities' that underpins the performance is reliant on the provision of BREEAM accreditation of the building. This accreditation is assessed at different stages of the project, from the original design, through to construction and operation. The evaluators understand that the Computational Foundry was awarded the BREEAM accreditation in June 2019 and it is expected that the indicators will be claimed formally in a subsequent reporting period.

5.5 For the revenue-related indicators, progress at this mid-term evaluation stage is mixed. The project has delivered a notable over-performance on the '*Number of enterprises cooperating with supported research institutions*' target (at 254 by March 2019 compared to the target for October 2020 of 40). By contrast, progress against the '*Research funding secured*' and '*New researchers in supported entities*' is more in line with original expectations, with around two-thirds of the target met at this stage in both cases, although the time remaining for delivery varies. Further detail of progress and performance against the three indicators, including over time, is set out in the paragraphs below.

Table 5-2: ERDF indicators for the Computational Foundry (updated March 2019)

Indicator	Target	Target date	Data at March 2019	Performance at March 2019
Research funding secured	£21.3m	end-2023	£12.5m	59%
Enterprises cooperating with supported research institutions	40	Oct-20	254	635%
New researchers in supported entities	31	Jun-19	22	71%

Source: Computational Foundry monitoring workbook

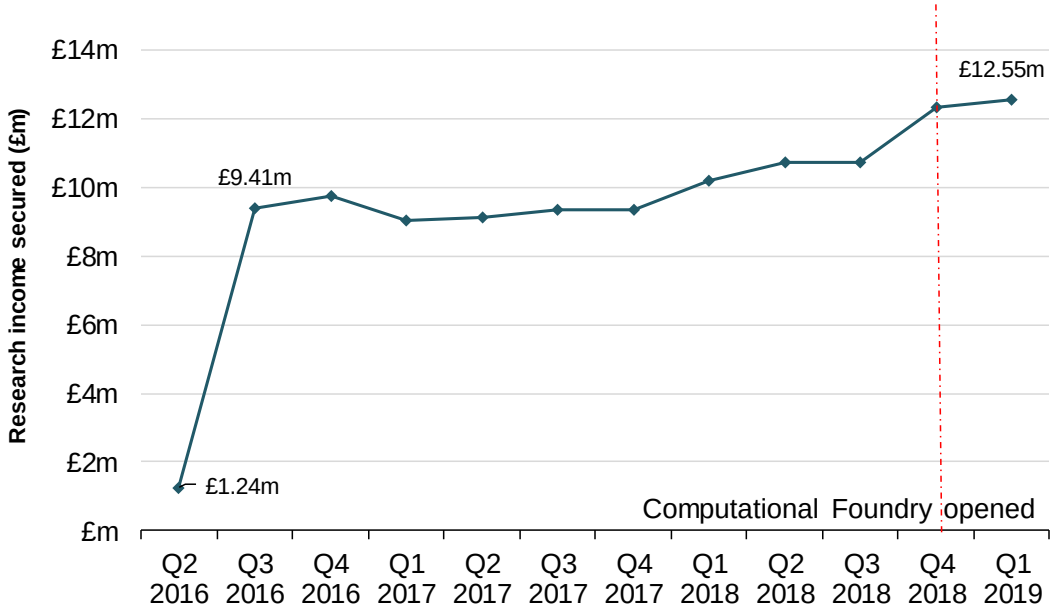
Research funding secured

5.6 The cumulative (by quarter) research funding secured is set out in Figure 5-1. The data indicates a generally consistent picture across the period to date, with a mean average of around £400k income secured each quarter, and a median of £200k. The exception was Q3 2016 when funding for the CHERISH-DE (Challenging Human Environments and Research Impact for a Sustainable and Healthy Digital Economy) from EPSRC was reported in the

monitoring data. It is worth noting that this one project accounted for over half (59%[17]) of the total research income reported to March 2019.

5.7 The experience to date does suggest that meeting the overall target of £21.5m by the end of 2023 is likely to be reliant on securing at least one further major award of similar scale to CHERISH-DE, to complement the larger number of more modest individual funding awards. Whilst this could be challenging potentially, we understand that the award of the EPSRC Centre for Doctoral Training (CDT) in Enhancing Human Interactions and Collaborations with Data and Intelligence Driven Systems (which is further discussed in Section 6) has not yet been included in data to March 2019. With a value of around £5m for the CDT, indicatively the project has therefore secured around £17.5m at this mid-term evaluation stage, over 80% of the target. This is very encouraging and suggests that the project is well on course to meet – and potentially exceed – the target by end-2023.

Figure 5-1: Cumulative research funding secured by the Computational Foundry, Q2 2016- Q1 2019

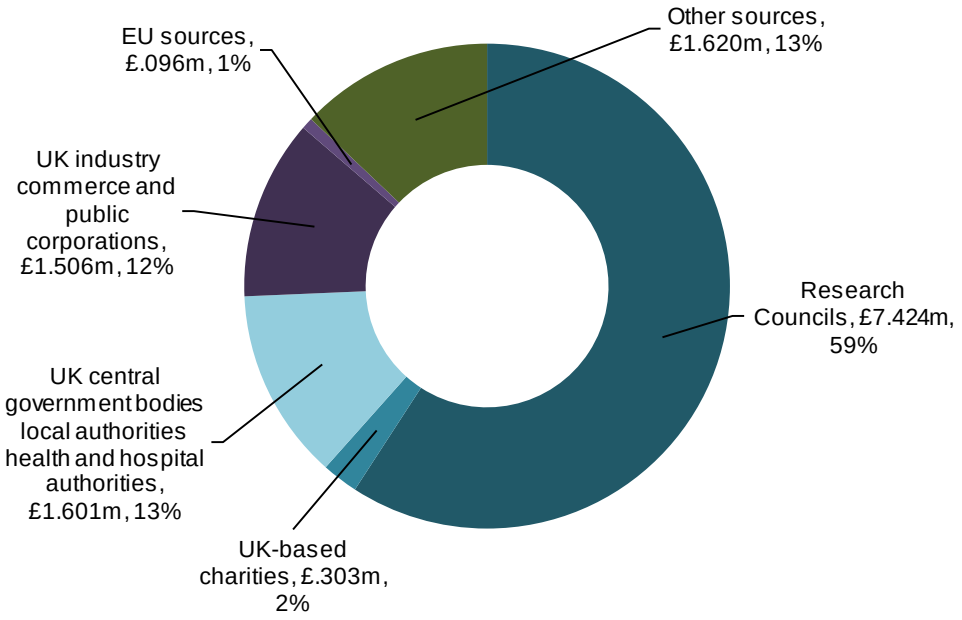


Source: SQW analysis from Computational Foundry monitoring workbook

5.8 No specific targets were set for the sources of research income to be secured. However, the university has reported this data as part of monitoring returns, with the position at March 2019 summarised in Figure 5-2. As may be expected, Research Councils accounted for the highest proportion of income, accounting for approximately 60% of the total. Other UK public sector agencies and industry also accounted for significant proportions, with research income of around £1.5m from each source respectively. It is notable that the level of research income secured from EU sources is very modest, at under £100k over the full period, which may relate to the uncertainty around Brexit impacting on participation in Horizon 2020 and other EU-funding programmes.

[17] The CHERISH-DE programme accounts for £7,418,593 research income secured

Figure 5-2: Total research funding secured, by source



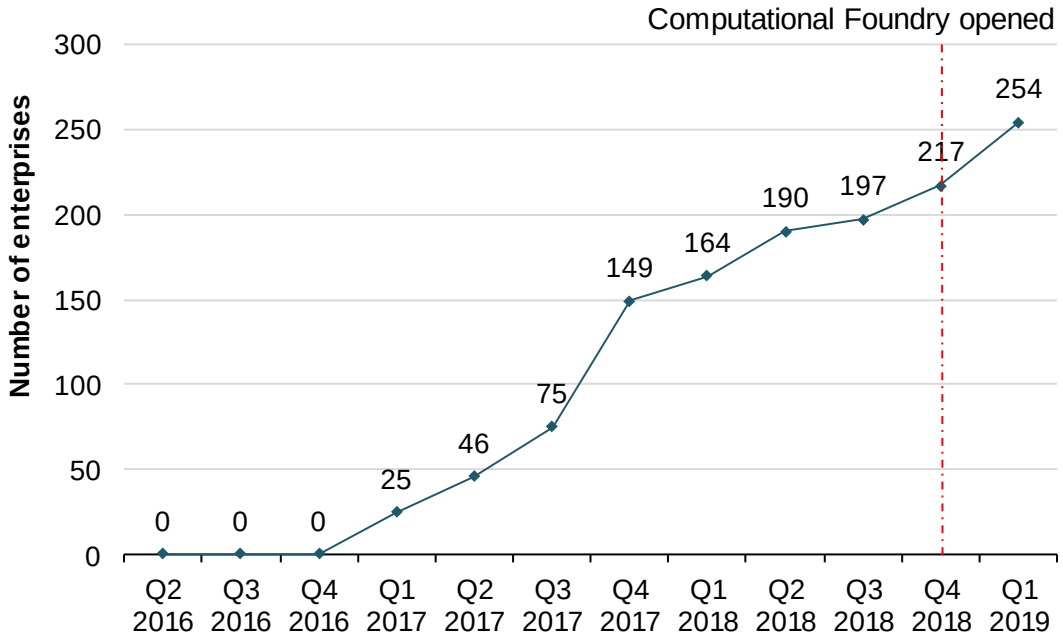
Source: SQW analysis from Computational Foundry monitoring workbook

Enterprises cooperating with supported research institutions

5.9 As shown in Figure 5-3, delivery of this output has been achieved steadily and consistently across the project delivery period to date. Notably, the agreed target for 40 '*Enterprises cooperating with supported research institutions*' for the project by October 2020 was met by mid-2017, very early in the project delivery period.

5.10 Importantly in this context, the evaluators understand that it was agreed between the University and WEFO that the definition of 'enterprises' for the '*Enterprises cooperating with supported research institutions*' indicator would include both commercial and non-commercial organisations. As a result, the indicator captures collaborative research projects with academics based at academic institutions, both in the UK and internationally, as well as industry and other non-academic partners.

Figure 5-3: Cumulative number of enterprises cooperating with supported research institutions, Q2 2016- Q1 2019



Source: SQW analysis from Computational Foundry monitoring workbook

5.11 To provide a more fine-grained insight into the nature of research activity covered by the indicator, the evaluators have analysed the information provided in the quarterly monitoring reports over the Q2 2016 to Q1 2019 period (that list the enterprises that the Computational Foundry operation cooperated with during each claim period) and coded institutions into four categories: University; Industry; Research Institute/RTO; and Other. This data should be regarded as indicative only: the number of organisations listed in the reports does not match exactly the output data, and in some cases the evaluators have had to make judgements over the most appropriate categorisation for the listed organisation. This said, the analysis does provide a useful indication on the nature of the organisations that have cooperated with the Foundry.

5.12 The data for the total number of entries, and unique organisations (i.e. removing duplication where an organisation cooperated on multiple projects as consistent with the output definition) by enterprise-type are set out in Table 5-3. Cooperation was most common with other universities; this does therefore explain in part the significant over-delivery against the project target noted above.

5.13 This said, the data also indicates the scale of cooperation by Foundry academics on research projects with the industrial base, with 55 businesses listed as cooperating with the Foundry over this period (covering 63 separate cooperations, with seven businesses cited on more than one project). Important in this scale of industrial engagement is the CDT for Enhancing Human Interactions and Collaborations with Data and Intelligence Driven Systems, which accounts for 25 of the organisations coded as 'industry' in the analysis.

Table 5-3: Enterprise-type of cooperations

	All entries		Unique organisations	
	Number	**Proportion**	**Number**	**Proportion**
University	102	47%	82	44%
Industry	63	29%	55	29%
Other	40	18%	38	20%
Research Institute/RTO	13	6%	12	6%

Source: SQW analysis of monitoring returns

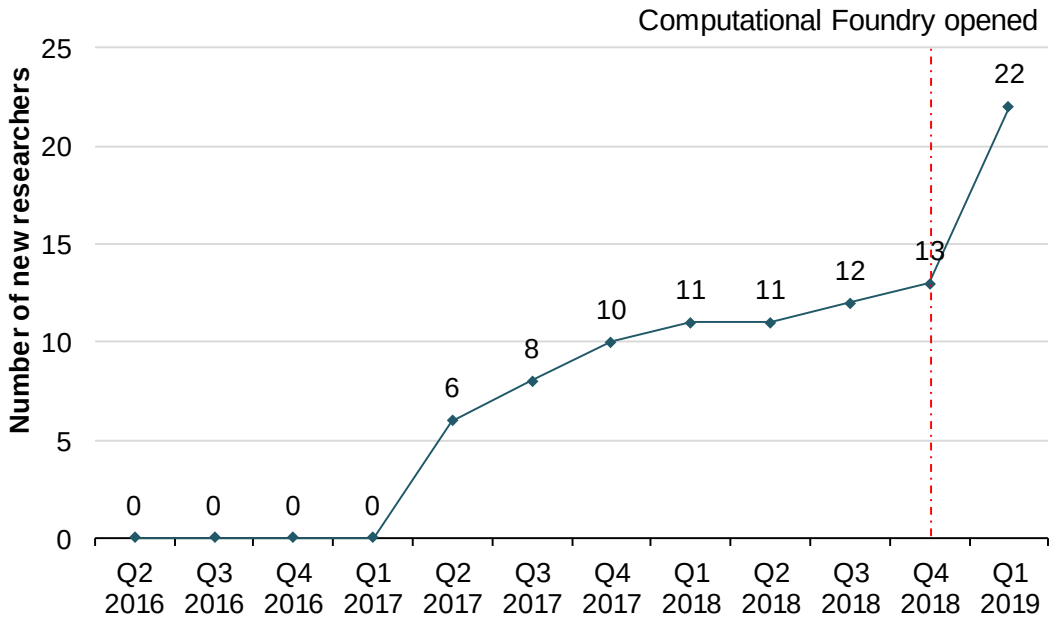
5.14 Taken together, two points are made at this mid-term evaluation stage. First, consistent with the objective of the project to increased collaboration with industry, it is encouraging that the target for '*Enterprises cooperating with supported research institutions*' has been met at this point when only including industrial partners (i.e. over 50 compared to the target of 40). Second, however, it does not appear that the target itself was inappropriate; it was substantially too low at the outset, and arguably should have been revised to remain relevant and appropriate over time: when it became clear the targets was inappropriate (given very significant over delivery), it could have been revised to reflect the achievements of the achievements of the project in practice, and inform constructively activity.

5.15 The evaluators recommend at this mid-term stage that the target is revised for the period to October 2020 to provide a meaningful indicator against which the on-going performance of the project can be assessed on this metric. This should include recording the category of 'enterprise' so that the data can distinguish research and industrial collaboration.

New researchers in supported entities

5.16 As noted above, by March 2019, the project had delivered 22 '*New researchers in supported entities*'. Positively, this was ahead of the profiled target at this point of 15 new researchers. The monitoring data indicate that the original profile for the project anticipated that new staff would be appointed from June 2018 onwards, to align with the completion of the Foundry building. However, as noted above, the delivery of the 'beta labs' enabled the recruitment of staff (both permanent researchers and fixed term researchers) earlier in the project delivery period than anticipated, with the first appointments in Q2 2017.

Figure 5-4: Cumulative number of new researchers in supported entities, Q2 2016- Q1 2019



Source: SQW analysis from Computational Foundry monitoring workbook

5.17 Of the 22 new researchers, analysis by the evaluators (based on a review of relevant university web-pages/lists) indicates that the majority (x18) are researchers based in the Computer Science Department, with four researchers based in the Mathematics Department. There was a broadly even mix between permanent positions (x12), and fixed-term positions (x10).

5.18 One final point is noted in this context: whilst the project was ahead of profile on this indicator by March 2019, to meet the target of 31 new researchers in supported entities by the end of June 2019 will require nine additional outputs to be claimed in Q2 2019. Consultations suggests that recruitment at scale can be challenging, and there is a risk that the target may not be met formally. Performance against this output target will need to be assessed at the final evaluation stage.

Overall assessment

5.19 Taken together, the data indicate that the project has delivered strongly against its agreed ERDF indicators, and remains well on course to meet the agreed targets. Whilst the capital-related indicators have not yet formally been claimed, this is expected following BREEAM accreditation later this year. The revenue-related indicators are all on course to be met or have been exceeded.

5.20 However, the target set for e*nterprises cooperating with supported research institutions* does not appear to be appropriate at the outset, and should have been revised. The variation in the timescale of revenue-related outputs is also arguably somewhat unhelpful in ensuring that the progress of the project can be understood fully, in real-time and at relevant interim and mid-term points. A more consistent approach for the project going forward, and for any similar interventions in the future, should be considered by the university and funding partners.

6. Emerging outcomes

6.1 This section considers the outcomes of the Foundry at this mid-term evaluation stage, drawing on the feedback from consultees, and supporting quantitative evidence for context. This Section also provide an initial qualitative and early-stage assessment of the additionality of the project; that is the extent to which the project has delivered outcomes that would otherwise not have occurred.

Summary of findings

Consultations with academic based at the Foundry suggest the project has led to positive outcomes in relation the scale of research funding sought and secured, and their assessment of the quality of the research undertaken. This is due to an improved physical environment for research activity, better opportunities for collaborative research within the Foundry and the broader Bay campus, and a shift towards more 'applied' research in some cases. The Foundry was also stated to have led to an increasing culture of grant capture'.

The project appears to be influencing collaboration activity, although the nature of this varies across individual academics reflecting their areas of research. Generally, the evidence is that inter-discipline collaborations are at the initial phase of collaboration progressing towards informal conversations, and intra-discipline collaborations are further along the process. Some collaborations with external academics/industry are also occurring because of the Foundry.

The Foundry had improved academics' job satisfaction and for some, led to an increased profile of academics across the research community in Wales.

The Foundry is seen to have (or anticipates will have) a positive outcome on the profile and reputation of the University. Key factors include the role of key senior-level academic staff and the importance of the physical facility as a symbol of the commitment of the University to computational science.

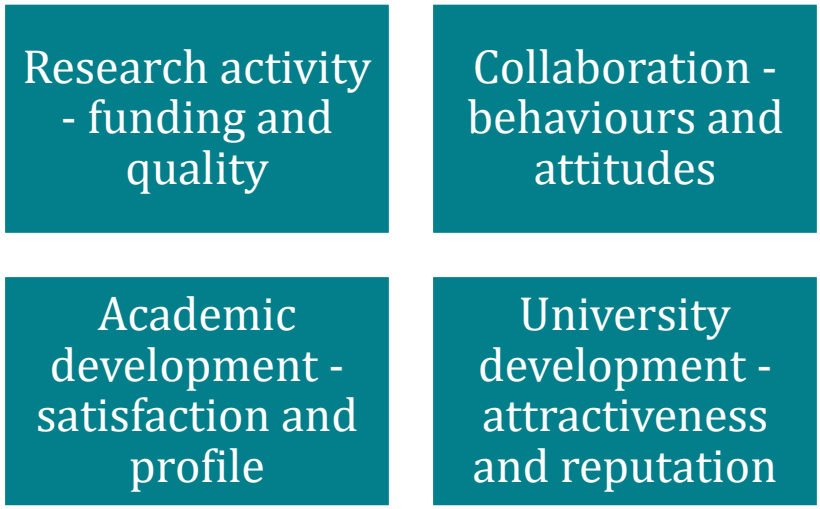
Consultations suggest that progress has been made in developing a 'Foundry Community' enabled by the programme of 'Why my Research Matters' events, the physical layout of the Foundry building and the work of the management team.

Coverage

6.2 The outputs presented in the previous Section go only so far in providing an indication on the effects, and ultimately the value, of the Foundry. As set out in the logic model, the project is also anticipated to lead to changes in behaviours in terms of research activity and collaboration, and wider effects on the computational science offer and capacity of the university. These outcomes are key to the overall potential contribution of the Foundry, in meeting its aim to become a 'beacon' and centre of excellence for computational science research, and the development of the Foundry community.

6.3 At this mid-term evaluation stage, such outcomes have been considered principally through qualitative evidence from partners and stakeholders, including academics working within the Foundry. Drawing on the feedback, four main outcomes themes have emerged at this mid-term stage, as summarised in Figure 6-1 below and set out in more detail in the paragraphs that follow.

Figure 6-1: Outcome themes from the mid-term evaluation



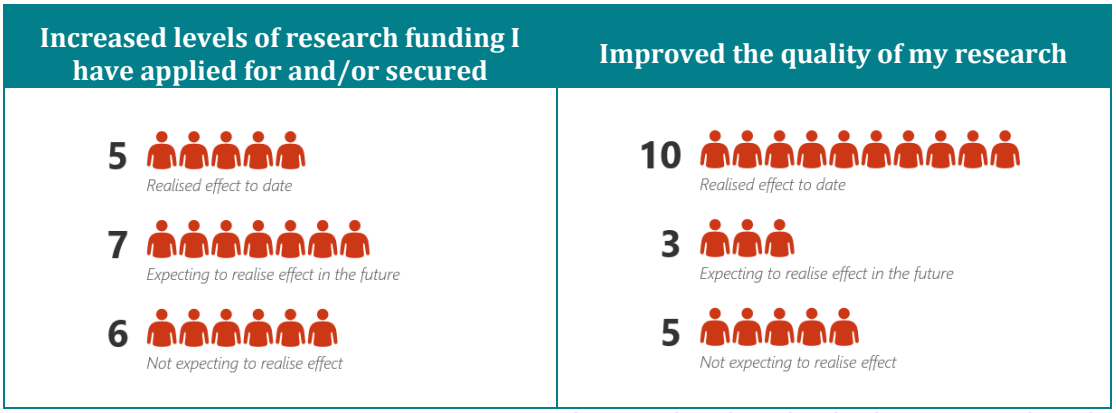
Source: SQW

Outcome themes

Research activity

6.4 Consultations with academics based at the Foundry suggest that the project has led to positive outcomes at this mid-term evaluation stage in relation to research activity. This is both in terms of the *scale* of research funding sought and secured by academics based at the Foundry, and their assessment of the *quality* of the research undertaken. The feedback from the academics consulted on whether these effects have been realised at this point are summarised in Figure 6-2.

Figure 6-2: Self-reported effects on research activity by academics based at the Foundry



Source: Consultations with academics based at the Computational Foundry

6.5 The findings are particularly positive in terms of realised effects on the quality of research, with 10 of the 18 academics based at the Foundry consulted indicating that the project had

led to an improvement in the quality of their research. It is important to recognise this is a self-reported assessment; the REF 2021 will provide robust evidence on the quality of research undertaken by academics within the Foundry. However, the findings are encouraging.

6.6 The ways in which the project was seen to have impacted on the quality of research varied across consultees. However, several themes emerged including the improved physical environment generally for research activity in the Foundry building, the specific facilities and equipment that the Foundry has provided (notably for Computer Science academics), and the opportunities for more collaborative research both between the departments based within the Foundry and the broader Bay Campus community. Consultations with academics based in the Maths also identified a reported shift towards a more 'applied' focus of research within the department that the move to the Foundry has facilitated and helped to stimulate. An example of the benefits of the improved physical environment and how this related to the quality of research was summarise by one academic consultee as follows:

> *"There is space to run exercises. I have confidence in overcoming shortcomings around data [which previously were there]. That can actually lead to improve the quality of research papers because you can devote more effort to those projects where you wouldn't have done so before. In REF terms, it means there are a few more papers each year in the 3- to 4-star range that can be pushed up by 1 or 2 stars." (Computer Science academic)*

6.7 It is notable that the effects of the project on research funding applied for and secured was generally expected rather then realised. This likely reflects the time-paths to impacts from changes in behaviours and perceptions on research leading into higher level of applications and funding capture over the medium term, and is what may be expected at this mid-term evaluation stage.

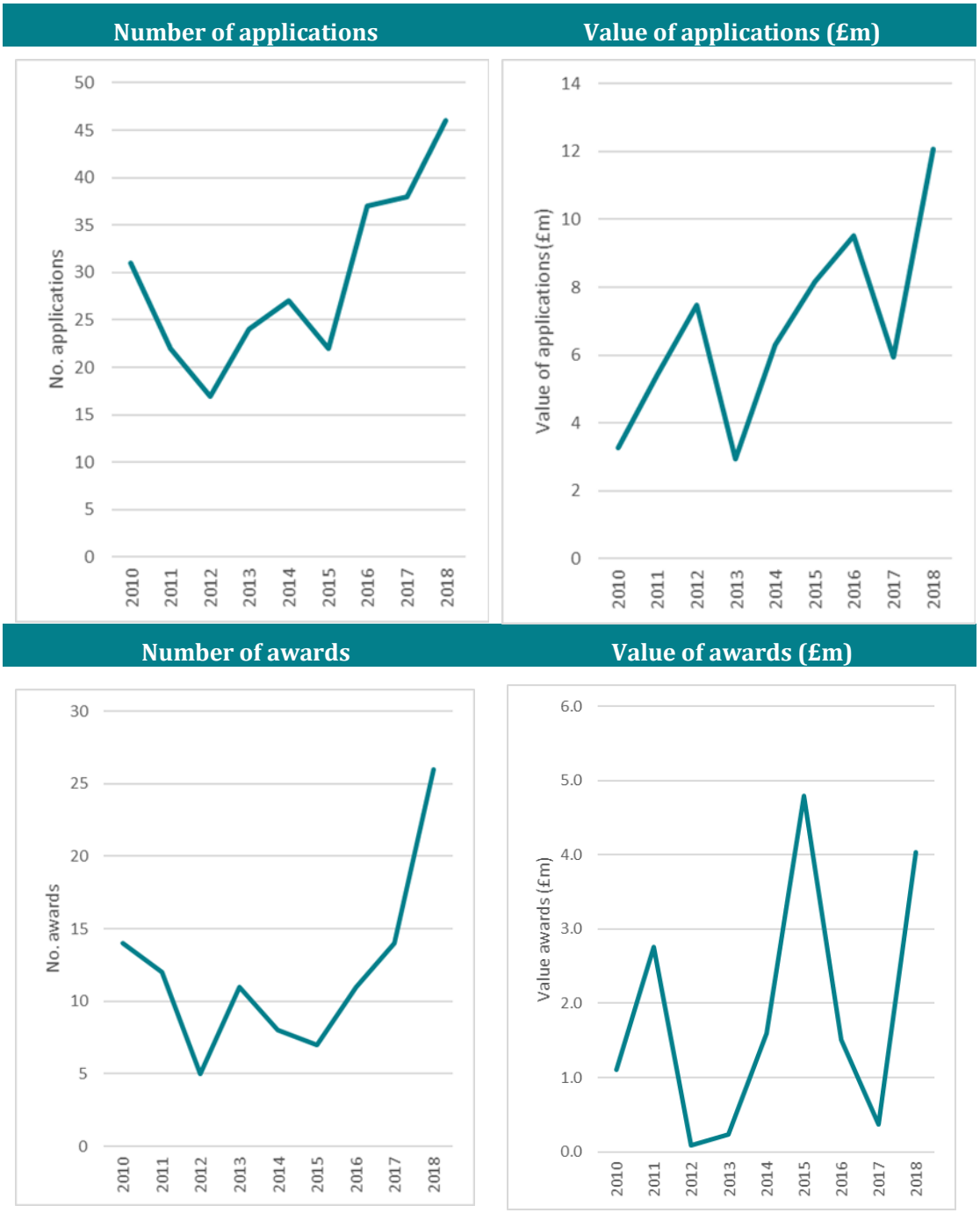
6.8 The ways in which the Foundry had or was expected to lead to changes in research income applications and funding also varied. However, the Foundry project itself was seen as an important asset in helping to 'make the case' for funding and helpful in applications both directly – through facilities and enhanced staff capacity – and indirectly as a demonstration on the ambition of the University. Several consultees also highlighted that the Foundry project had led to an '*increasing culture of grant capture*' within the Foundry community, with major successes – such as CHERISH-DE and the award of the CDT in Enhancing Human Interactions and Collaborations with Data and Intelligence Driven Systems – leading to a 'virtuous circle' i.e. as more funding is awarded, more applications will be made given the confidence and example this provides. As one academic consultee noted:

> *" I am more active in applying for things. With increased applications come more successes. There is a feeling that people are more engaged than they used to be. Particularly with the frequency of putting in interdisciplinary PhD applications." (Maths academic)*

6.9 The qualitative feedback from academics based at the Foundry is largely consistent with the quantitative data set out in Section 5 that indicated the level of research income that has been secured attributable to the Foundry, albeit with a significant reliance on a small number of large applications.

6.10 To provide further context on the potential contribution of the Foundry to the levels of research funding applications and awards, the University provided the evaluators with data for the departments within the Foundry, covering the 2010-2018 period for the volume and value of applications and awards for external research funding. The headline data for the two departments combined are set out in Figure 6-3.

Figure 6-3: Research funding applications and awards for the Maths and Computer Science Departments (combined) 2010-2018



Source: University of Swansea

6.11 The data indicate a consistent annual uplift in the volume of applications from the two departments over the 2016-2018 period (following the launch of the Foundry project), and in turn an increase in the number of successful applications: the average (mean) number of

awards per annum was 17 over 2016-18 compared to 9.5 over 2010-15. The pattern for the value of the applications is more varied reflecting the different sizes of application (in response to demand and availability), but this was also significant higher in 2018 (at approximately £12m) than in all previous years, Further, the average (mean) value of awards per annum was £2.0m over 2016-18 compared to £1.8m over 2010-15, and £1.1m if the CHERISH-DE award is excluded (which has been attributed to the Foundry).[18]

6.12 These data cannot be attributed directly to the Foundry, with time-lags between awards and applications, and the existing staff at the departments prior to the Foundry submitting applications. This said, the data are consistent with the qualitative feedback from academics with the Foundry, and members of the Foundry's leadership team, that the project has contributed to an increase focus on grant capture and increasing the level of research income awarded to support computational science in Swansea.

6.13 A further example of the reported effects of the project on levels of research income is the award of the EPSRC CDT in Enhancing Human Interactions and Collaborations with Data and Intelligence Driven Systems in 2019. Qualitative evidence suggested the Foundry provided the infrastructure and platform to host the CDT, a significant and important factor in supporting and securing 55 doctoral researchers and up to £5m in research income to Swansea. Another successful CDT is the UKRI centre for Artificial Intelligence, Machine Learning and Advanced Computing. This CDT is led by Swansea University and incorporates other universities in Wales (Cardiff, Aberystwyth and Bangor) and Bristol, supported by industrial partners and Supercomputing Wales (SCW). It will support 55 doctoral researchers across the participating institutions.

6.14 The CDT awards were commonly regarded by consultees as evidence of the contribution of the project to re-positioning Swansea as an institution that is able to secure awards of this type, and in turn enhancing both the scale and the research quality and offer of the university across the broad range of computational science disciplines. As one academic noted in relation to the award of the Enhancing Human Interactions and Collaborations with Data and Intelligence Driven Systems CDT:

> *"The Foundry is enabling activity that was not previously possible at the University." (Maths academic)*

Collaboration

6.15 Central to the underpinning case for the Foundry was the need to enhance levels of collaboration in computational science research, both within and between the Computer Science and Maths departments, and with the wider community, in Swansea and elsewhere. The evidence suggests that the project is delivering benefits in this area, even at this early mid-term evaluation stage.

6.16 As shown in Figure 6-4, the feedback from academics at the Foundry was positive: around two-thirds of academics consulted indicated that the Foundry had led to new/improved collaborations with others in the core departments, academics outside of the Foundry (in Swansea or elsewhere), and/or with industry.

[18] This CHERISH-DE award is recorded as £3,864,512 to Swansea University in April 2015 in the data provided to the evaluators.

Figure 6-4: Self-reported effects on collaboration by academics based at the Foundry

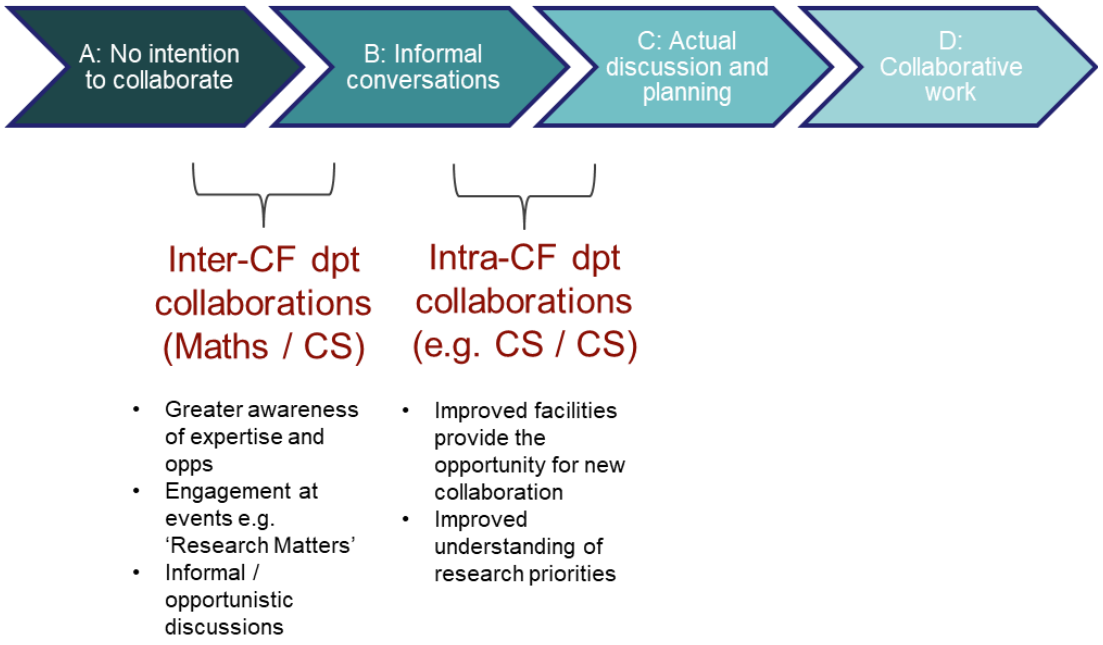
Source: Consultations with academics based at the Computational Foundry

6.17 The nature of collaboration within the Foundry varied across consultees as may be expected reflecting their research interests and the scope for collaboration. This included both new/improved collaboration within a consultees department (e.g. an academic based in the Mathematics Department collaborating with other academics based in that department), and with the 'other' department at the Foundry (e.g. an academic based in the Mathematics Department collaborating with academics based in the Computer Science).

6.18 However, the nature and level of collaboration did appear to be different for these two types of collaboration at this mid-term evaluation stage. For 'inter-departmental' collaboration (i.e. Mathematics/Computer Science collaborations), generally this was at an early stage, with the Foundry helping to initiate initial informal conversations between academics that previously would not have collaborated. For 'intra-departmental collaborations (i.e. Mathematics/ Mathematics or Computer Science/Computer Science), the Foundry appears to have supported progress from these informal conversations to more formal discussion and planning of collaborative activity.

6.19 This 'collaboration journey' is depicted in conceptual terms in Figure 6-5, including setting out the ways in which the Foundry has supported new/improved collaborations. It will take time for these collaborations to involve substantive research activity; the scale and nature of this should be considered in the final evaluation of the project.

Figure 6-5: Collaboration journey and effects of the Foundry



Source: SQW, based on consultations with academics based at the Computational Foundry

6.20 An important factor in the development of the early stage collaborations was the opportunities that the Foundry building allows for meetings between academics. Some examples of the way in which the project is helping to lead to these discussions with longer-term potential are set out below:

> *"The crucible provides a platform where everyone can all sit together and talk new ideas, most of the time there are people there" (Computer Science academic)*
>
> *"There is more talk about what I do and what they do – no immediate collaborations but lots of potential" (Computer Science academic)*
>
> One consultee noted that *they 'run into people more often',* of which they stated*: 'this is not a 'trivial thing', this space increases the probability of that happening" (Mathematics academic)*

6.21 The feedback from Foundry academic consultees regarding the effects of the project collaborations with other academics from outside the core Foundry community – either in the university or in other organisations – and with industry was very varied, reflecting the research focus and collaboration contexts. This said, examples were provided of the co-location on the Bay Campus leading to informal discussions with academics from other departments in the University, and on to discussion and planning, and new collaborations with industry encouraged via the facilities and 'visibility' of the Foundry building. This said, some trade-offs were also identified, with the physical move to the Bay Campus meaning that collaborations with academics based at the Singleton Campus could be harder to sustain given the benefits from proximity. This is not unexpected, but does need to be taken into account in considering the overall effects of the project.

6.22 Consultations with academics from other departments in the university and other institutions provides supporting and corroborative evidence of the effects of the Foundry. Nearly all (13

of the 14) academies consulted indicated that the Foundry has led to new or enhanced collaborations, and in 11 of these cases, this involved the academic consulted directly (in the other two cases this effect was 'observed rather than directly 'experienced').

6.23 The consultations highlighted the different ways in which the Foundry has led to new or enhanced collaborations with external academics for the university including:

- through staff appointed to the Foundry through the project bringing their existing external collaborations to the university
- through the co-location of the Foundry on the Bay Campus leading to the development of new relationships with academics from different departments of the University; one consultee noted that

  "With the building is in the middle of the Engineering Campus, it (the Foundry) has generated excitement and curiosity. As well as the success of the Foundry, there is also the funding of doctoral training which it has led to, this has generated further interest and colleagues from Engineering, who are talking to the Computer Science group more than before."

- through the Foundry project leading to the opportunity for enhanced cross-disciplinary collaboration from existing collaborations with the departments based at the Foundry.

6.24 The consultation with academics at the Foundry also provided some evidence that the project is leading to new/improved collaboration with industry. The role of the new building in providing a more attractive location to engage with businesses was highlighted by consultees as an important factor here, including for hosting events, discussion meetings and the delivery of collaboration R&D activity. As one academic noted:

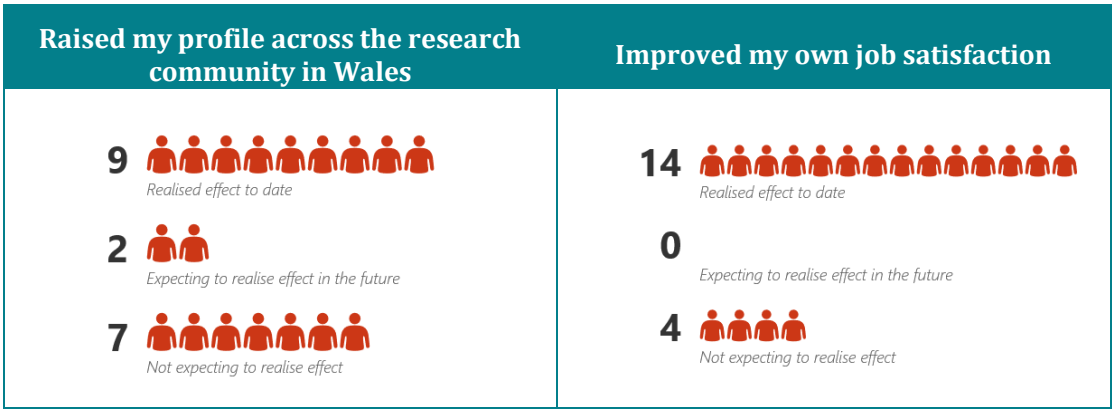
> *"[We] have got in touch with the cyber security cluster, mainly business organisations. We found out about local SMEs and because the crucible is good for meetings, we can easily persuade them to come visit." (Computer Science academic)*

6.25 These findings should not be taken too far at this mid-term evaluation stage; they reflect the experiences of a sub-set of academics based at the Foundry, and the evidence suggest that the main outcomes at this stage relate to improved relationships that have the potential to deliver substantive collaboration research activity, working across research silos, over the longer-term. This said, across the consultations there was a consistent evidence that the Foundry has played a role in stimulating and supporting collaborative activity that would not otherwise have been delivered, which offers significant opportunities for the future.

Academic development

6.26 The consultations with academics and members of the leadership of the Foundry (including the heads of Department and Director), provide encouraging evidence that the Foundry is leading to outcomes for academics. As set out in Figure 6-6, a large majority of the academics consulted indicated that the Foundry project had improved their job satisfaction. There is also some self-reported evidence that the Foundry has led to an increased profile of academics across the research community in Wales.

Figure 6-6: Self-reported effects on academic development by academics based at the Foundry



Source: Consultations with academics based at the Computational Foundry

6.27 The job satisfaction evidence is consistent fully with the wider feedback regarding the quality of the physical space, and how this represents a step-change for both departments from the facilities available at the Single Campus before the project. Some issues were identified related to individual circumstances as may be expected – for example, related to travel time – however, the evidence overall was positive. One theme that emerged from the consultations with academics (particularly from the Mathematics Department) was that there was some initial scepticism regarding the project given the change in existing work patterns and practices that it involves. However, in most cases the consultations indicated these issues had largely been addressed and overcome, offset by the improved environment that the Foundry offers, both in terms of the physical location, and the wider momentum and cultural change that has been sought.

6.28 Two examples of this feedback are set out below:

> *"Overall, people were very sceptical before the building was completed, but have to say that the facilities are great". The consultee "felt involved in the design of the building, and what we asked for we got. Examples include the Mathematics reading room, good quality office space, rolling white boards and functionality for Ipads in teaching." (Mathematics academic)*

> *"Some colleagues were sceptical, but the general feeling is a good thing. Is very much a community now, not too big to feel lost. It feels a bit like from moving from a village to a town, still small enough to say hello, but large enough to feel part of something special." (Mathematics academic)*

University development

6.29 The consultations indicated that those aware of and involved with the Foundry *perceive* that the project has had an effect on the profile and reputation of the university as a location for computational science. This was a consistent message across consultations with external academics, and stakeholders, although in some cases this was anticipated rather than realised at this mid-term evaluation stage, which is not unexpected.

6.30 Two particular themes were highlighted by the consultations:

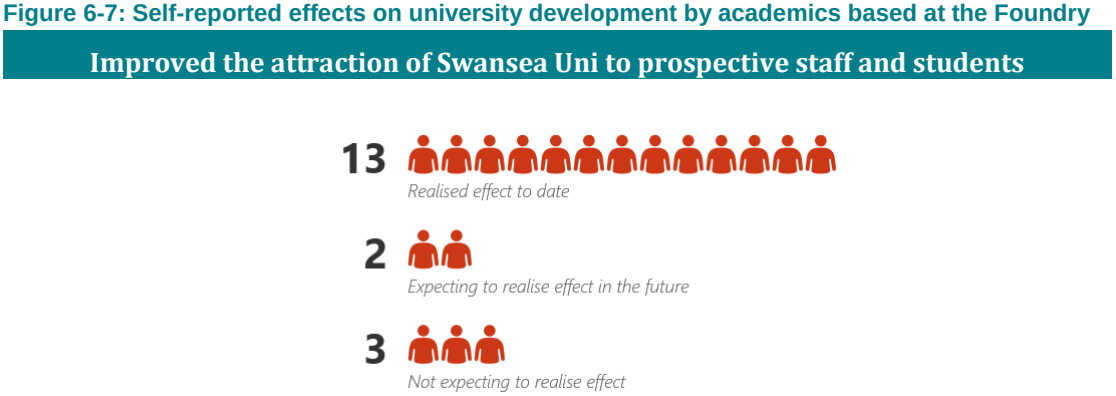
- the crucial role of key senior-level academic staff in the observed effects and potential of the Foundry which have helped to leverage relationships with high-profile partners for events and activities art the Foundry, secure significant research funding

(including the CDT), and the momentum generated through appointments including the appointment of the Director

- the importance of the physical facility – the Computational Foundry building – both as 'evidence of intent' of the university, and practically providing the platform for enhanced levels of research and collaboration, and the delivery of strategically important projects such as CHERISH-DE and Supercomputing Wales (which is located within the Foundry building).

6.31 Linked to this, as shown in Figure 6-7, academics based at the Foundry do generally perceive that the project has had a positive effect on the attractiveness of the university to prospective staff and students. The extent to which this has influenced directly staffing levels and student numbers will need to be considered at the final evaluation stage, including considering the wide range of other factors that may influence these trends over the longer-term and the relative contribution of the Foundry.

Figure 6-7: Self-reported effects on university development by academics based at the Foundry



Source: Consultations with academics based at the Computational Foundry.

6.32 Going forward, the Computational Foundry is regarded by project management and leadership teams and stakeholders as having the potential to generate significant net additional outcomes and impacts over the coming years. This is expected via two routes: *directly*, through enabling a scaling-up of the quantity and quality of research activity and industrial collaboration that would not have been possible without the physical space and equipment that the project enabled, and *indirectly* through its strategic influence on perceptions of Swansea as a location for Computational Science. Indeed, the success of the 'Foundry concept' as part of the wider Bay Campus is seen to be adding value to the Bay Campus with potential for further development given the demand for the Foundry space by users.

Developing the Foundry 'community'

6.33 As noted in Section 1, a particular emphasis of the mid-term evaluation is considering the extent to which the project has made progress in the development of a recognised 'Foundry community'. This is related to collaborative behaviours discussed above, but also more broadly the level informal engagement between the members of the computational science community within the university, and the extent to which there is a change in the culture and identification with a cross-disciplinary approach to research to drive impact.

6.34 The evidence at this mid-term stage is overall positive. The consultations with academics based within the Foundry identified a range of views on the progress made in the development of a Foundry community, which reflected in part whether the academics consulted were working in areas where there were stronger or weaker linkages across computer science and mathematics disciplines and research areas. However, there was some feedback that significant progress had been made as perceived by some academics – for example, one noted that "*we were two identifies previously and this is changing*" – and most of the academics consulted based in the Foundry recognised that levels of engagement, insight and understanding between the staff across the two departments had improved.

6.35 Several factors were identified as important:

- the regular programme of 'Why my Research Matters' events
- the physical layout of the Foundry building, notably the 'Research Crucible' space, which was seen to be important in facilitating informal engagement and discussion between staff across the departments
- the work of the Foundry management team in managing communications, events, and activities to promote collaboration and knowledge sharing between the academics across the Foundry.

6.36 This said it was also recognised that the development of the Foundry community will take time, and needs to be largely 'organic' rather than 'forced' on the academic community in order for a sustainable change in culture. In this context, some academic consultees – notably from the Mathematics Department – did express some concerns over the potential loss of their 'identify' as an independent department within the Foundry, and some differences in departmental cultures that will need to be considered going forward.

6.37 Some feedback from academics regarding the Foundry community – reflecting the feedback from across the consultations – is set out below.

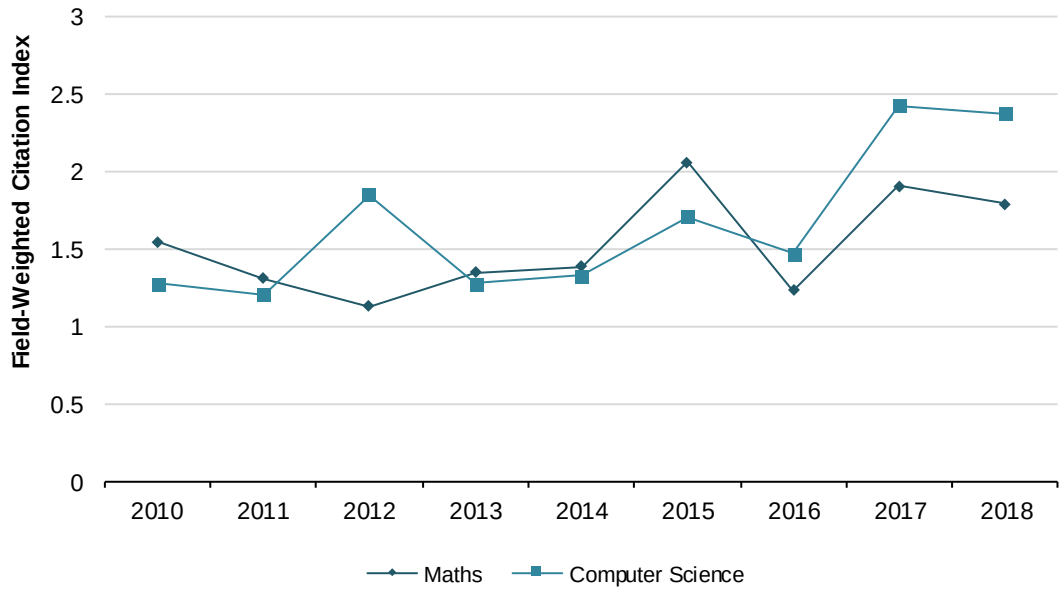
> *"[You] need to recognise that this is a long-term objective and you cannot force the collaboration. The Foundry team are doing good work to try and drive the culture of collaboration, including supporting both the formal sessions (my research matters) and also more informal engagement and meetings which have the potential to change behaviours over the longer-term"*
>
> *"Within [the Foundry] there is stronger community; I see maths more often, but not much more. Might just be the nature of the different departments, not necessarily the collaborations. Is early to tell."*

A quantitative perspective on research quality

6.38 It is too early for the effects of the Foundry on research quality to be assessed formally; as noted above the REF 2021 will be the key source of evidence. However, the evaluation framework developed at the Inception Evaluation stage also recommended that the university track data from the Elsevier Sci Val database to prove an additional insight. Specifically considering the university's Field-Weighted Citation Index (FWCI) for Mathematics and Computer Science (and potentially sub-disciplines).

6.39 For this mid-term evaluation stage, data has been collected on FWCI[19] (and the volume of scholarly outputs) to provide a baseline against which performance can be tracked over the longer term. Data is presented below covering the period from 2010 onwards to provide a long-term perspective on the relative quality (using FWCI as a proxy for quality) and scale of research activity within these areas.

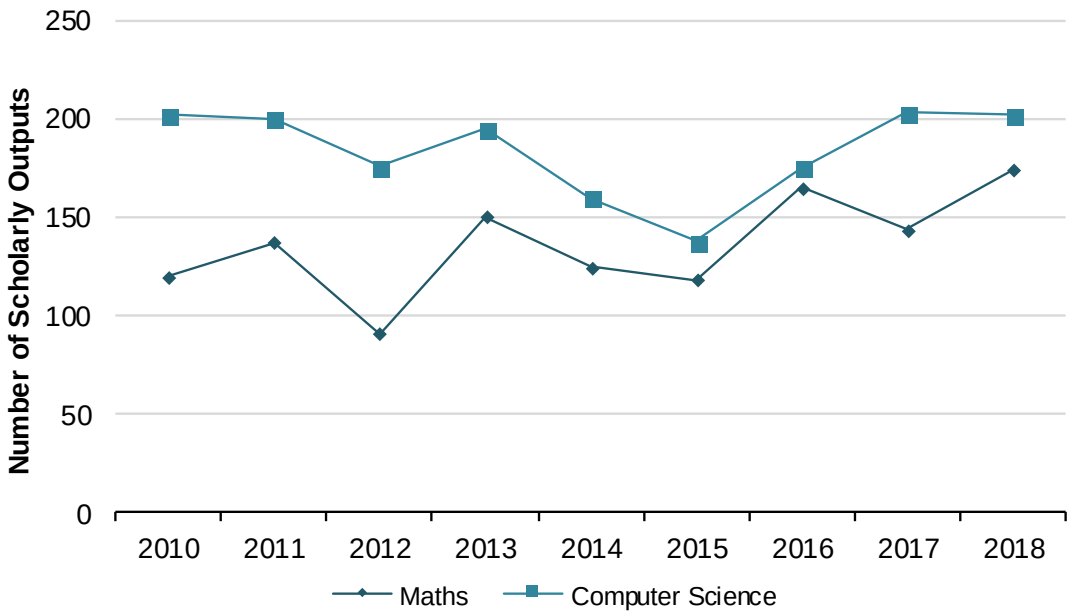
Figure 6-8: Field-Weighted Citation Index for Computer Science and Maths Disciplines at Swansea University, 2010-2018



Source: SQW analysis from SciVal data

[19] Field-Weighted Citation Impact (FWCI) indicates how the number of citations received by an entity/group's publications compares with the average number of citations received by all other similar publications in the data universe. A FWCI of 1.00 indicates that the entity/group's publications have been cited exactly as would be expected based on the global average for similar publications; a FWCI of more than 1.00 indicates that the entity/group's publications have been cited more than would be expected based on the global average for similar publications; for example, a FWCI of less than 1.00 indicates that the entity/group's publications have been cited less than would be expected based on the global average for similar publications.

Figure 6-9: Number of Scholarly Outputs for Computer Science and Maths Disciplines at Swansea University, 2010-2018



Source: SQW analysis from SciVal data

6.40 Although there is some annual variation, for both Computer Science and Mathematics, the FWCI improved gradually over the 2010-2018 period; this improvement was particularly marked for Computer Science. This long-term trend will need to be considered in any subsequent assessment of the potential effects of the Foundry on these metrics at the final evaluation stage. Put simply, the project was delivered in a context where the quality of the research (using FWCI as a proxy) was on an upward curve; this was also true for the scale of outputs for Mathematics.

6.41 More detailed data from Sci Val including FWCI by sub-discipline, and related to academic and industrial collaborations for the relevant disciplines is set out in Annex B. This data provides the baseline against which any change can be assessed at the final evaluation stage, including considering the potential contribution of the project.

Early reflections on additionality

6.42 Finally for this section, evidencing the additionality of a public policy intervention is core to robust evaluation. It enables the adjustment – quantitatively or qualitatively – from 'gross' outputs and outcomes i.e. those things that appear to have happened, to 'net' outputs and outcomes i.e. those things that, in reality, have happened as a result of a publicly-funded intervention.

6.43 A quantitative assessment of additionality is not appropriate in the context of the Foundry; the formal metrics associated with the project cannot be sensibly adjusted from gross to net, given the vary wide range of factors influencing for example levels of research income outside of the project specifically. Further, at this mid-term evaluation stage, it is too early to judge the extent to which the longer-term trends on the scale and quality of the research activity, and the wider capacity of the university in computational science, has been impacted directly

by the project. research quality. This will be an issue to be considered more formally at the final evaluation stage.

6.44 However, some qualitative perspectives on the 'net' effects of the project over and above what would have occurred anyway have emerged from the evaluation. Five points are noted.

- First, in relation to the capital element of the project, without ERDF support for the project it is very likely that the Foundry building would not have been developed at all, or that it would have been developed at a significantly smaller scale owing to the reduced budget available for the construction. This would have failed to provide the improved environment for research activity and the capacity for growth and development of the wider computational science community that the project is facilitating, and staring to impact based on the mid-term evidence.

- Second, and linked to this, the developing relationships between academics within the two departments – albeit remaining at an early stage – and the wider development of the recognised 'community' in computational science is very likely not to have occurred without the project, to the same extent and at the same pace.

- Third, the project is likely to have played a role in attracting academic staff to Swansea – including at a senior level - that would otherwise might not have moved to the university. A wide range of factors will influence decisions by individual academics, however, the scale of additional researchers recruited (22 by the point of the mid-term evaluation) would not have been viable without the support of the project, with some qualitative evidence that the vision of the Foundry and the related development of the new facilities helped to encourage individuals to relocate to the university.

- Fourth, consultations with academics suggest that the project has delivered 'quality' additionality in terms of improving the environment for space to do, and equipment to facilitate, computational science research

- Fifth, whilst the research income reported as attributable to the project cannot be regarded as fully additional to the project – that is, some of this would have been generated in any case without the project – the evaluation does suggest that the project has generated additionality through two principal mechanisms: leading to enhanced levels of application by staff owing to a more clearly defined focus on grant capture and through enabling and supporting the university to secure a number of significant projects (such as the CDTs and CHERISH-DE) that may not have been possible without the project.

6.45 Overall, the mid-term evaluation suggests that the additionality of the project is high, particularly in terms of the 'physical' development of the Foundry and in generating early outcomes related to research and collaboration, Some caution is required here given the timing of the evaluation – at this stage it is too soon to be certain that the anticipated benefits will be realised, and that the observed benefits around changing behaviours and culture will sustain going forward, However, at this point the evidence is encouraging.

7. Perspectives on process and project delivery

7.1 Drawing principally on the consultation evidence, this penultimate Section highlights the key lessons that have emerged from the project's delivery and, in light of the study, external factors that have affected – or are expected to affect – the Foundry's delivery and performance.

Summary findings

Key factors that have influenced the success of the project to date include a dedicated and effective project management team, strong leadership including balancing effective the need to facilitate collaboration and culture change whilst allowing changes to be realised 'organically' – which has helped to ensure buy-in.

The role of the Foundry Director has been important, with the found the additional motivational aspect of the Director role effective in developing the vision and establishing a culture change within the Foundry.

Several areas of clearing for continuous improvement have been identified including in relation to performance management and data collection, communication, and the challenges in recruitment. These can inform any future similar interventions, and in some cases the on-going delivery of the Foundry project.

Management and Delivery

7.2 Good leadership, management, operating structures and systems, and delivery approaches are important contributors to the effective implementation of any intervention. All of these are recognised in the delivery of the project and pointed to as factors in its success to date as evidenced through the mid-term evaluation.

7.3 Specifically, four key points related to these elements from across the evaluation's research are as follows:

- The **dedicated project management team** and its capacity to deliver the project effectively and consistently from 2016 has been important. Given the scale and complexity of the project, the dedicated capacity was regarded as important by consultees, and the management was generally regarded as highly effective, both during the construction stage of the building, and following the hand-over as the project oved to its full 'operational' stage. Practically, the monitoring returns demonstrate the scale of activity that has been delivered, and generally reporting systems and processes have worked well, with clear reporting of milestones, issues, and progress and expenditure. Consultees also generally reported that issues and challenges have been dealt with promptly, helping to secure buy-in and commitment to the project,
- The **approach by the leadership and management of the Foundry** regarding facilitating collaborations across departments. The evaluation suggests that a good

balance between seeking to manage and catalyse this activity, whilst allowing for 'organic' relationships to develop has been adopted. In addition, the team's approach in creating the momentum needed for the Foundry to start achieving its targets by establishing the 'beta labs' during the construction phase of the project, starting the recruitment of researchers earlier than planned, organising workshops to start potential collaborations between academics and industry, and raising the profile of Swansea with international speakers have all been effective in enabling the project to make progress.

- The **focus on cultural change as a core approach to the project,** seeking to support a cultural shift to encourage academics to be more visible with their publications and conference presentations, and use different methods to encourage staff to interact with each other and externals with the events organised.

- An interesting lesson regarding **the role of the Foundry Director** evolved through the appointment of the Director whereby it was realised a motivational role, alongside the core strategic role of a Director to be important. Consultations found the additional motivational aspect of the Director role effective in developing the vision and establishing a culture change within the Foundry.

7.4 With continuous improvement in mind, five learning points in this context were identified:

- In the context of the generally positive feedback regarding the communication to staff by the Foundry team through the project, in some cases consultations with academics did identify some views that more regular communication was required at the start of the process – particularly from Mathematics academics – in order to secure buy-in to the project. This issue seems to have largely been addressed, however, provides learning for any future similar schemes.

- An area where the project management for the Foundry on an on-going basis may be open to improvement is in relation to performance management regarding the scale and nature of industrial engagement. Industrial collaboration is an important component of the project, however, there has not been a consistent and comprehensive system in place to track engagement with industry across the Foundry, to both demonstrate the scale of activity, and identify any key gaps and/or opportunities. A more systematic approach to customer relationship management in relation to industrial engagement is recommended going forward.

- Linked to this point, a number of the metrics agreed at the inception evaluation stage to be tracked have not been recorded by the University. This included for example, data on requests for collaboration from organisations and other research institutions, external academic conferences/events attended by Foundry community members, and research projects undertaken between computational science research groups. In some cases, it was considered by the university that collection of the metrics would not be proportionate. However, the implication is that the evidence at this mid-term evaluation stage in relation to the proposed outcomes is largely qualitative in nature. The university should consider the extent to which there may be scope for some data to be collected, notably in relation to collaborations within the Foundry and across

departments in order to provide robust and comprehensive evidence at the final evaluation stage.

- Recruitment has been a challenge. In part this issue was mitigated with an extended period of recruitment of academic staff, however, the project involved the appointment of a significant number of additional staff, and a senior-level Director, and in all cases the project highlights the time and effort required to secure appropriate appointments. This is not unexpected and is well known to the university. However, the experience of the project does highlight the need for realism by project sponsors and developers when seeking to deliver similar initiatives in the future. Notably in the establishment of targets and profile of delivery. At this stage, delivery against the research target is not known and this will be an important issue to consider for the final evaluation,

- Finally, in this context, as noted in section 5, in some cases the targets set for the project were not appropriate, and revisions should have been made at an earlier stage. This should be addressed going forward to the end of the current project and considered in any similar future interventions.

The importance of place

7.5 As recognised throughout the report, the Foundry project is about 'more than a building'. However, the evidence does indicate that the building does matter fundamentally to the success of the project and has influenced performance and perspectives at this stage. However, there are some mixed messages, which do need to be considered in thinking through the delivery of the project going forward. Three key points are noted:

- Overall, **the quality of the facility is regarded as high, and this has been crucial for the positive wider effects that have been realised**. The commitment to quality in the building was regarded as important, including a focus on the 'little details' that influence day-to-day activity and working environment. The Research Crucible, provides the space and opportunity to enable academics and externals (academics from outside the Computational Foundry and industry) to meet and interact with each other in a formal and informal setting. This has implications not only with building a 'community feel' but can lead to collaborations as a result of informal conversations. In addition, the reading rooms were reported to be an excellent area for Maths students.

- The **physical location of the Foundry** has enabled opportunities to undertake interdisciplinary collaborations with other departments at the Bay Campus. However, it is important to recognise there are trade-offs in relation to collaborations and relationships with department that remain at the Singleton Campus. The location has also had implications on travel times for staff within the Foundry; recognising a trade-off between shorter commutes for some and longer for others.

- **The open-plan nature of the communal offices** is generally deemed useful (drawing on the consultations for the evaluation), to create a collaborative atmosphere and to instigate conversations to improve the working environment for

staff. However, it was also noted not conducive for some consultees where working in quiet spaces is preferred.

7.6 In this context, it is also noted that the mid-term evaluation has not focussed in any detail on the teaching component of the Foundry, given this in non-eligible for the ERDF support, and consistent with the evaluation framework where student engagement was recommended at the final evaluation stage only. There as some feedback regarding the implications of rising student numbers for the Foundry and its staff; these should be considered in more detail in the final evaluation.

Factors influencing the delivery of the Foundry

7.7 The evaluation consultations sought feedback from consultees on the key internal and external factors which have influenced, and will influence the delivery of the Foundry project to date, and expected for the future.

7.8 The key internal factors identified in the consultations included:

- The **continuity and quality of the management and leadership team** in driving the vision of the project and leveraging their (high-profile) networks and relationships has helped drive the success of the Foundry and will continue to do so in the ongoing delivery of the project.
- There is a **willingness by academics to adopt a culture change** and help contribute to the aims and objectives of the Foundry. On consultee added *"as an academic you always need to change and there needs to be willingness, buy-in and enthusiasm - people are excited to be here".*
- The **competency of the Maths and Computer Science departments are already high** and forms a platform for the Computational Foundry to build on, both in theoretical science and applied research.

7.9 The key external factors identified in the consultations included:

- The **implications of Brexit on funding sources** – the political uncertainty of Brexit was reported to have had some effect on the availability of funding and research opportunities offered to academics within the Foundry; thus inhibiting the ability to apply for research funding and collaborate with externals. This could be seen from the start of the Foundry project with some academics making the decision not to apply for EU funding such as Horizon2020. Consultees have also seen a hesitancy in European partners to include UK researchers into their consortium due to the political and economic uncertainty that Brexit brings. On consultee added *"I've not noticed a huge loss of a project because of that but that's a chat between colleagues and there is a concern whether they will be proactively go out and apply for that funding".*
- The **implications of Brexit on researchers** e.g. lecturers and PhD students**.** Feedback from consultees highlight many staff and PhD students are international which may affect recruitment activities for staff and students but also the ability to retain staff. A loss and/or lack of researchers may have implications for achieving the

ERDF indicator of recruiting researchers, and subsequently effects the Foundry's ability to increase the scale and quality of research being undertaken.

- **Current challenges and constraints faced by higher education institutions** in Wales regarding tuition fees and increased costs (amongst other factors) may influence on the capability and growth of the Computational Foundry in terms of staff recruitment.

- **Policies** including the Industrial Strategy and the Digital Strategy highlight a push from government to invest in computational science. This is important for the Foundry as it will raise the number of research opportunities and funding available for computational science in the UK; providing an opportunity for the Foundry to develop the scale of its research. For example, the Future Leaders Fellowship bids was a particular strategic decision made by the central government to seek out people who can do research and have impact on industry.

- Evidence from consultees state there are advances in machine learning and artificial intelligence (AI) already happening, generating a concern on AI's consequences on society. Current public issues on GDPR, especially with Facebook and centralized data are examples of issues currently being faced in the market. **The social element to Computational Science is being recognised in the market**, generating demand for research in Human Computer Interaction, an expertise within the Foundry, and future research in this area does enable the Foundry to have a large potential to make an impact and raise its profile in computational science.

- The **wider development of the Bay Campus** will be important for the Computational Foundry going forward, as it encourages collaborations between the engineering and management schools where there are strong linkages across to the research areas of the Foundry. The completion of the IMPACT building next door will also help with the growth and development of the Foundry.

7.10 These external factors can only be 'anticipated and managed' in terms of any future effects on the Foundry. This said, they do reflect the practical challenges in the delivery of research projects, and will need to be taken into account in the overall assessment of the impact at the point of the final evaluation stage.

8. Conclusions and recommendations

8.1 This final Section sets out the conclusions regarding the Computational Foundry project at this mid-term evaluation stage.

8.2 The evaluator's **overall findings at the Mid-Term stage are positive**, reflecting strong progress in delivering against aims and objectives as stated in the Business Plan and logic model developed during the Inception phase of the evaluation. The project at this stage is largely on budget and has met or is expected to meet its key targets for the ERDF funding. Further, a key theme across the consultations with those engaged in the Foundry, including those that work within the building and as part of the computational science community, was **a genuine sense of pride to be associated with the Foundry**, and a belief that it has played an important role even at this mid-term stage **in re-positioning Swansea as a location for computational science**.

8.3 Central to this conclusion is the successful delivery of the **'bricks and mortar' component of the project**. The construction of the building was slightly over budget relative to the original expectation, however the building was delivered broadly on time, and has generally met the expectations of its academic users. External perceptions of the importance of the building as a symbol of Swansea's commitment in this area was also recognised.

8.4 The physical form of the building – the open plan nature, the Research Crucible and the glass walls – matters fundamentally for realising wider cultural and behavioural change aims and objectives and encouraging and facilitating academics to engage with each other. In addition, the attention to detail and responsiveness to academic need throughout the project starting from the construction phase through to ensuring staff are comfortable in the new building is an important theme identified in the evaluation.

8.5 The evidence gathered during this mid-term evaluation on the behaviours of staff, research activities being undertaken so far and those planned are encouraging and create a useful platform to explore in more detail as part of a final evaluation. Key findings include:

- Feedback from majority of academics consulted suggests **the Foundry has started to positively influence the nature and scale of research activity undertaken**. For some academics, this reflects the beginning of a culture change in actively seeking research income opportunities. The Foundry has supported the university to secure a number of substantial research projects and funding streams that may not have been viable in the absence of the project, helping to support the development of a 'virtuous circle' of grant capture. It is too soon to test the effects of this on the quality of research over the longer-term, however, a strong platform has been established through the Foundry project.

- The **level of collaborative activities is increasing** within and between the core departments, as academics begin to learn more about the work of their colleagues and have informal conversations, facilitated by the Foundry. This provides the potential for more substantive collaboration activity over the longer-term.

- The **Foundry has generated or enabled new and improved collaborations externally**, in part through the networks brought in by the leadership and management team. This is helpful and important in generating confidence in the wider computational science eco-system and provides profile benefits to the Foundry.

- The **development of the 'Foundry community'** is recognised as a priority, and with a strong base on which to build on. Activities to stimulate and encourage a Foundry community are positively recognised by academics within the Foundry. Evidence suggests it helps to create a culture change in the way academics interact with each other and raise awareness of the different aspects of computational science delivered through the Foundry.

8.6 The evaluation highlights the importance of key factors that have enabled the success of the Foundry including **effective project leadership,** which has provided motivation, vision and drive for the project, with a focus on cultural and behavioural change, which is recognised as a long-term game; the leadership of the project has also provided access to the level of important networks and contacts that have enabled the Foundry to raise its profile. The **dedicated project management delivery and capacity** has also been important reflecting the scale and complexity of the project. The level of engagement with academic staff in the design and development of the building that this enabled was important in helping to secure the buy-in and commitment from the academic community.

8.7 Taken together, the mid-term evaluation indicates that **the Foundry represents a significant addition to the research capacity of the Swansea Bay City Region**, and is well placed to deliver against its long term aims and objectives, and support the wider development of the Bay Campus.

Going forward

8.8 In light of the findings of the evaluation, and within the context of the overall strategic focus to ensure that the momentum and enthusiasms regarding the Foundry project that has been generated to date is maintained going forward as far as practical, the following recommendations are made:

- **Recommendation 1**: The Foundry should consider the development of a formal depiction of the 'purpose and vision' of the Foundry going forward, to ensure that there is clarity both internally and externally on its role in the evolving computational science and research and innovation landscape across Wales and the UK. This should include a clear depiction of its 'offer' to industry and the private sector.

- **Recommendation 2**: The University and WEFO should consider revising the target for the 'Number of enterprises cooperating with supported research institutions' for the period to October 2020 to provide a meaningful indicator against which the on-going performance of the project can be assessed on this metric. This should include recording the category of 'enterprise' so that the data can distinguish research and industrial collaboration.

- **Recommendation 3**: To complement the existing programme of events at the Foundry seeking to facilitate and promote collaboration between the computational

science community and other departments at the Bay campus, the Foundry should consider putting in place mechanisms (e.g. regular events, facilitated meetings etc) to ensure that existing collaborations with academics based at the Singleton Campus are maintained and enhanced in the future.

- **Recommendation 4**: The Foundry should consider developing a more formal system to collate information on the scale and nature of its industrial engagement. This will be used to inform the final evaluation, and allow for a robust assessment of the contribution of the Foundry to delivering benefits for the business base and wider economic and social impacts.

- **Recommendation 5**: The Foundry should review the metrics agreed in the Inception Evaluation monitoring and evaluation framework and consider collecting data where possible to inform the final evaluation. The provision of more comprehensive data, for example on the scale of collaborations and engagement with the computational science community will help to evidence the outcomes and impacts of the Foundry at this final stage.

Annex A: Consultees

Consultees from the core computational science community within Swansea University

Table A-1: Consultees from the core computational science community within Swansea University

Name	Role/Department
Project Management/Delivery team	
Prof. Matt Jones	Head of College – Computer Science
Prof. Alan Dix	Computational Foundry Director – Computer Science
Prof. Arnold Beckmann	Head of Department – Computer Science
Prof. Biagio Lucini	Head of Department – Mathematics
Dr. Sherryl Bellfield	Project manager
Jenna Hopkins	Finance officer
Julia Harrison	Marketing and Communications Officer
Eiry Davies	Cross Cutting Themes
Dr. Matt Roach	Senior Lecturer and Development Officer – College of Science
Owen Rees	Estates Team
Academics within the Foundry	
Jen Pearson	College of Science
Berndt Muller	Computer Science
Jingjing Deng	Computer Science
Mark Holton	Computer Science
Phil James	Computer Science
Simon Robinson	Computer Science
Tom Owen	Computer Science
Liam O'Reilly	Computer Science
Pardeep Kumar	Computer Science
Stephen Lindsay	Computer Science
Jay Doyle	Computer Science - CHERISH-DE
Tashi Gyaltsen	Computer Science - CHERISH-DE
Carlo Mercuri	Mathematics
Dmitri Finkelshtein	Mathematics
Elaine Crooks	Mathematics
Eugene Lytvynov	Mathematics
Gibin Powathil	Mathematics

Name	Role/Department
Ian Davies	Mathematics
Jeff Giansiracusa	Mathematics
Martin Crossley	Mathematics
Nelly Villamizar	Mathematics

Source: SQW

Consultees from the wider computational science community

Table A-2: Consultees from the wider computational science community

Name	Organisation	Department	Role in Organisation
Matt Carnie	Swansea University	College of Engineering	Associate Professor
Cinzia Giannetti	Swansea University	College of Engineering	Senior Lecturer
Hans Sienz	Swansea University	College of Engineering	Professor
Gert Aarts	Swansea University	Physics	Professor
Simon Hands	Swansea University	Physics	Professor
Owen Guy	Swansea University	Chemistry	Head of Chemistry
Dr. Mabrouka Abuhmida	University of Wales Trinity Saint David	School of Applied Computing	Lecturer in Software and Microprocessor Development
Richard Picking	Glyndwr University	Computer Science	Professor of Human Computer Interaction
Steve Gill	Cardiff Metropolitan University	Product Design	Deputy Director of Research & Graduate Studies
Alan Chamberlain	University of Nottingham	Computer Science	Senior Research Fellow, Faculty of Science
Owain Huw	Cardiff University	Computer Science	Supercomputing Wales' Programme Manager
Heather Harrington	Oxford University	Mathematics	Royal Society University Research Fellow
Sriram Subramanian	Sussex University	Computer Science	Professor of Informatics
Kewei Zhang	Nottingham University	Mathematics	Professor of Mathematical Analysis

Source: SQW

Stakeholder consultees

Table A-3: Stakeholder consultees

Name	Organisation	Role in Organisation
Adrian Sutton	Vortex IoT	Managing Director
Chris Marshall	Swansea University	Director of Knowledge Economy
Dr Peter Waggett	IBM	Director - Emerging Technology
Harri Mansikkamaki	Gofore	Managing Director
Jacki O'Neill	Microsoft	Senior researcher in Work Practice Technology group
John Baird	EPSRC	Head of the Digital Economy Theme Lead for Cyber Security within the Partnership for Conflict, Crime and Security Research Programme
Mike Galvin	City Deal	Consultant
Professor Richard Harper	Lancaster University	Professor
Rhian East	Waters Creative	Creative Director
Rhian Power	WEFO	Sustainable Development Adviser
Scott Jenson	Google	Product Strategy Specialist
Susan M. Dray	UXPA and CHI Academy	President of Dray & Associates

Source: SQW

Annex B: SciVal analysis

B.1 SciVal allows analysis of the relative quality of research by an institution in certain subject areas, based on citations by other researchers and displays how this has changed over time. Here, the evaluators present data which in its current state should not be interpreted as contributing towards the Foundry's outcomes but more so, providing context for which longer term performance can be tracked and used in the final evaluation.

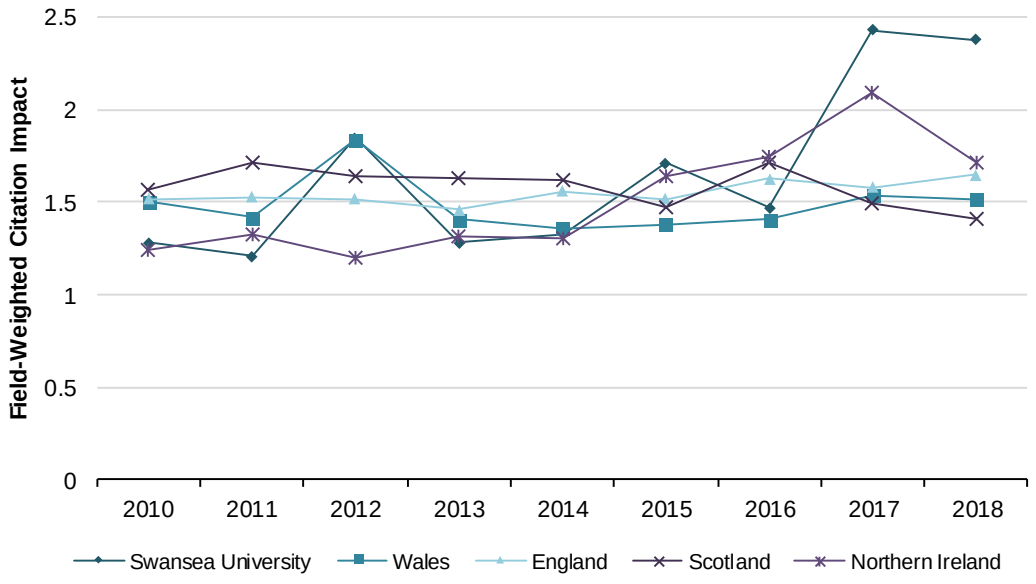
Scale and quality of research

B.2 As highlighted in the main report, data provided by SciVal can enable the Foundry to look at a proxy for the scale of quality of research being conducted and compare it on a national scale. In this subsection, we present data for both Computer Science and Maths disciplines on:

- Field-Weighted Citation Index (FWCI) - an index of how many times publications (in this instance for Maths or Computer Science disciplines) have been cited in relation to a world average for similar publications - a score of above one denotes an above average number of citations
- number (and proportion) of publications in top 10 journal percentiles
- scholarly output - the total count of research outputs[20] published.

Computer Science

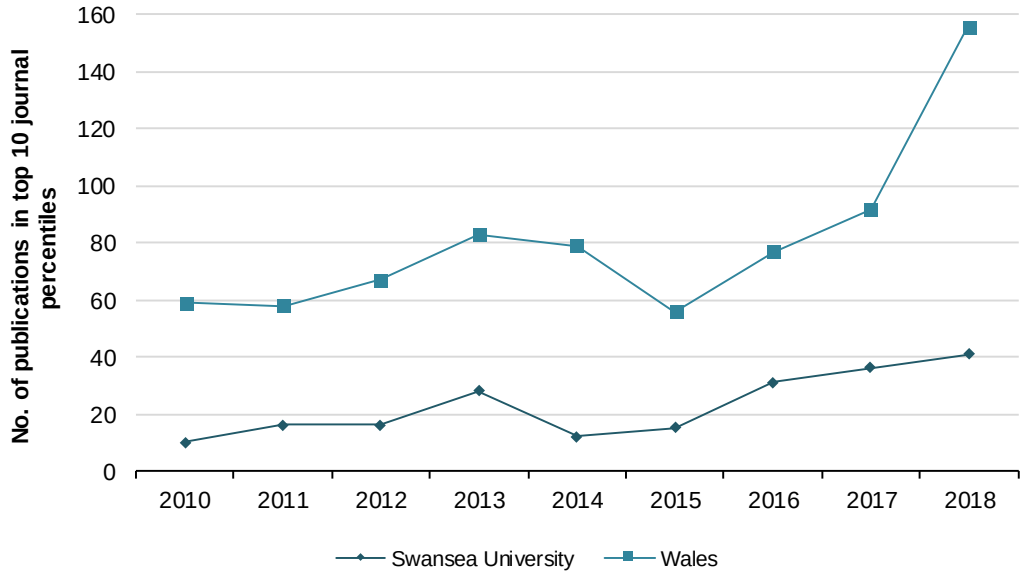
Figure B-1: Field-weighted citation index for Computer Science discipline



Source: SQW analysis from SciVal data

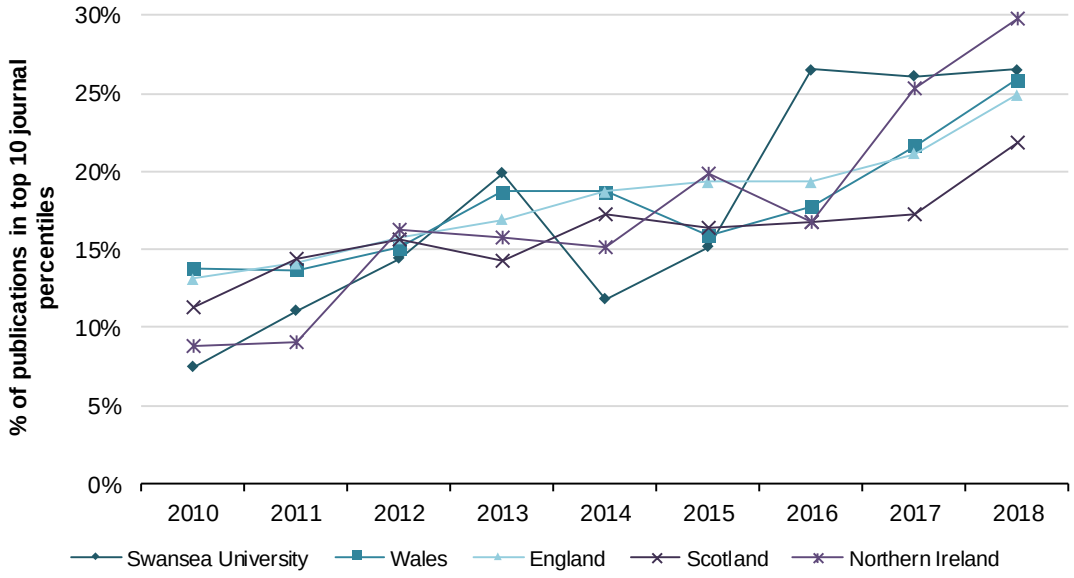
[20] Research outputs include journal publications, book series, standalone books, digital/visual media, exhibitions, performances, reports and software.

Figure B-2: Number of publications in top 10 journal percentiles for Computer Science discipline in Swansea University and Wales



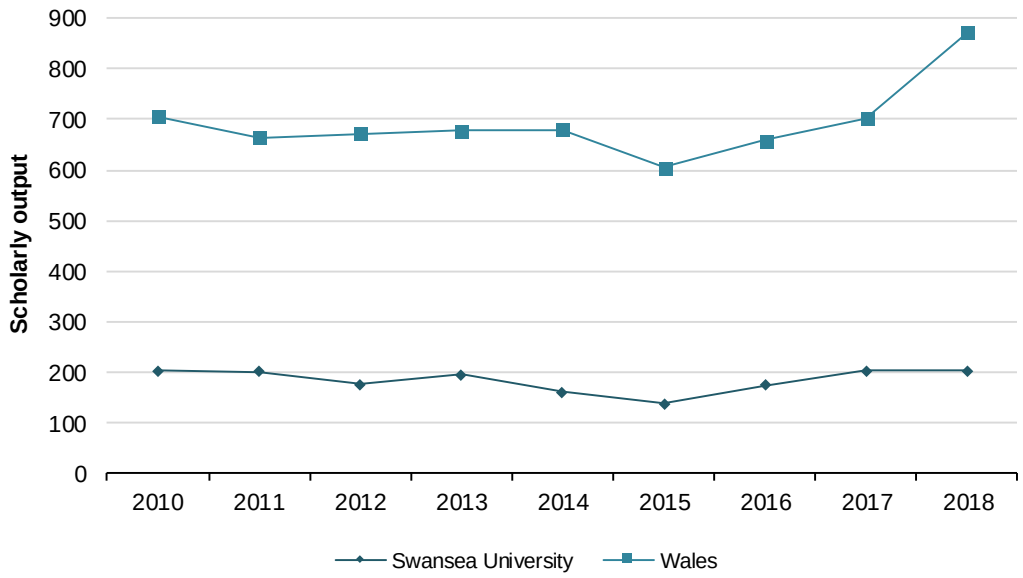
Source: SQW analysis from SciVal data

Figure B-3: Proportion of publications in top 10 journal percentiles for Computer Science discipline



Source: SQW analysis from SciVal data

Figure B-4: Scholarly outputs for Computer Science discipline



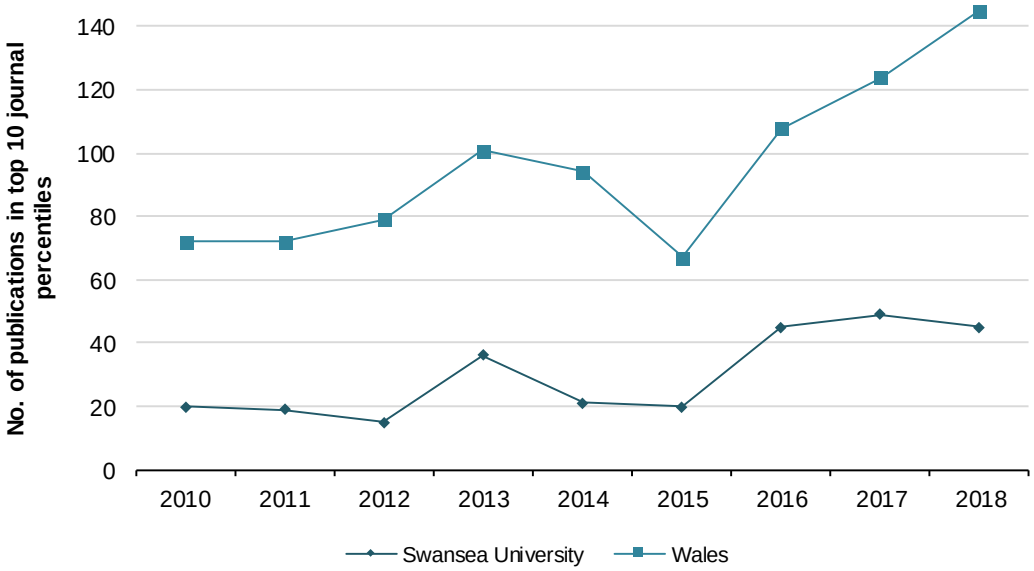
Source: SQW analysis from SciVal data

Maths

Figure B-5: Field-weighted citation index for Maths discipline

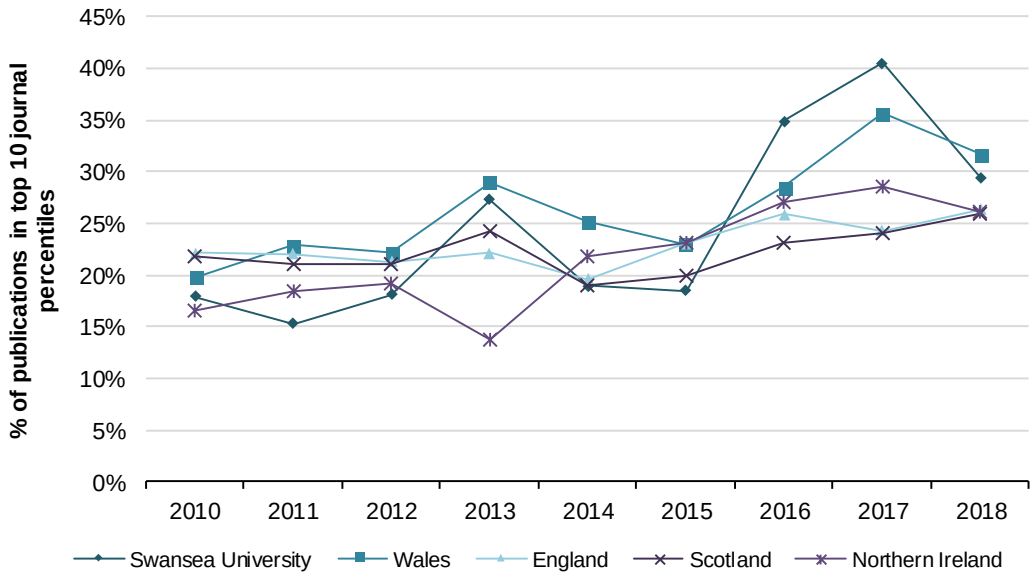
Source: SQW analysis from SciVal data

Figure B-6: Number of publications in top 10 journal percentiles for Maths discipline in Swansea University and Wales



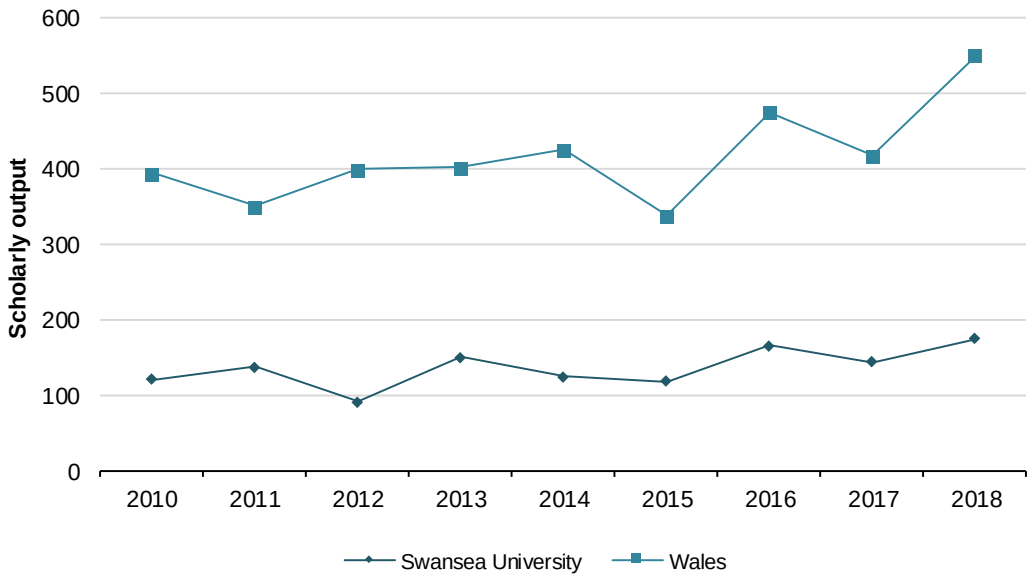
Source: SQW analysis from SciVal data

Figure B-7: Proportion of publications in top 10 journal percentiles for Maths discipline



Source: SQW analysis from SciVal data

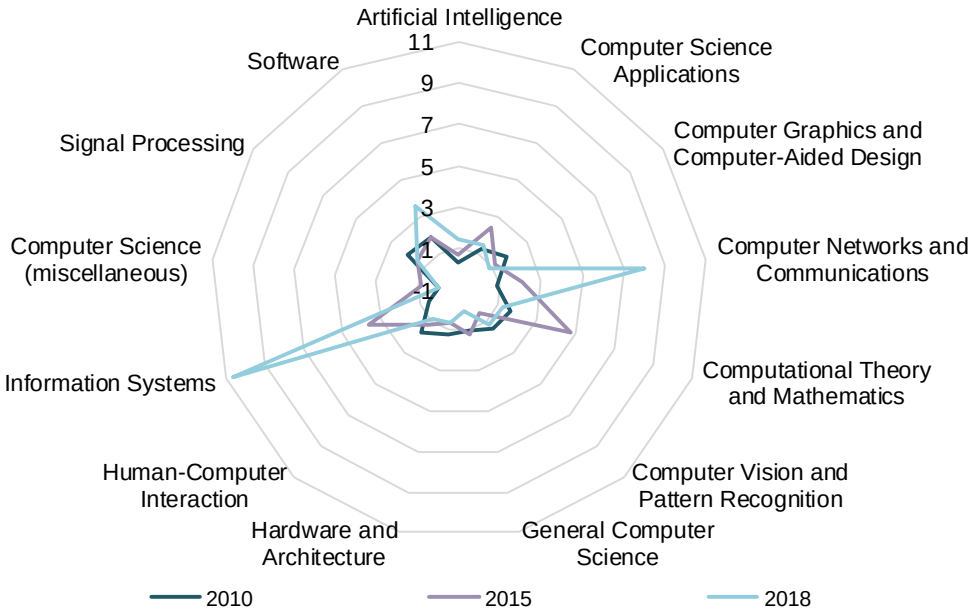
Figure B-8: Scholarly outputs for Maths discipline



Source: SQW analysis from SciVal data

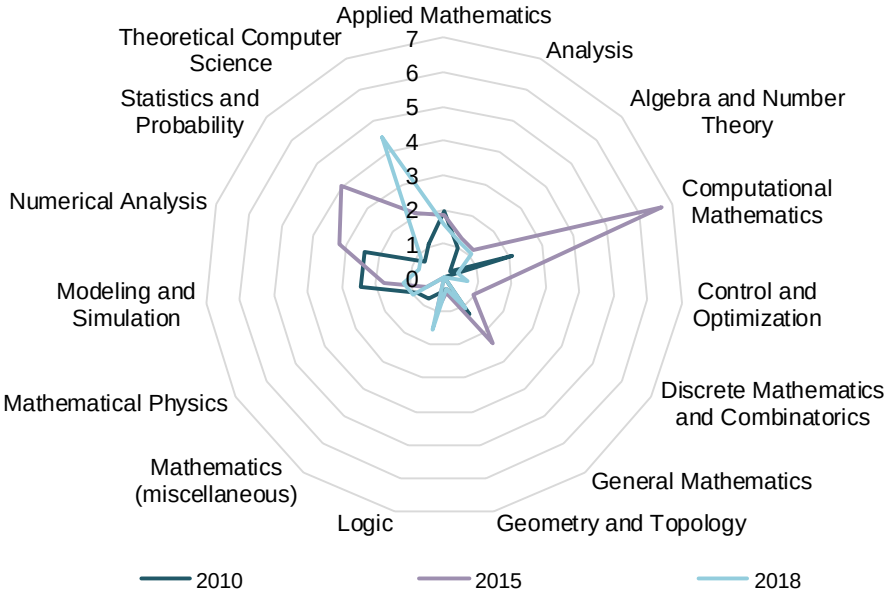
Sub-disciplines within Computer Science and Maths

Figure B-9: Field-weighted citation index for Computer Science sub-disciplines



Source: SQW analysis from SciVal data

Figure B-10: Field-weighted citation index for Maths sub-disciplines



Source: SQW analysis from SciVal data

Collaborative activity

B.3 This sub-section presents the cumulative number and location of collaborations undertaken by Computer Science and Maths disciplines with:

- academic collaborators between 2015-2018
- corporate collaborators between 2016-2018

B.4 The difference between the two-time periods is due to data availability at the time of downloading the information.

Computer Science

Figure B-11: Cumulative academic collaborations for Computer Science disciplines in the UK (2015-2018)

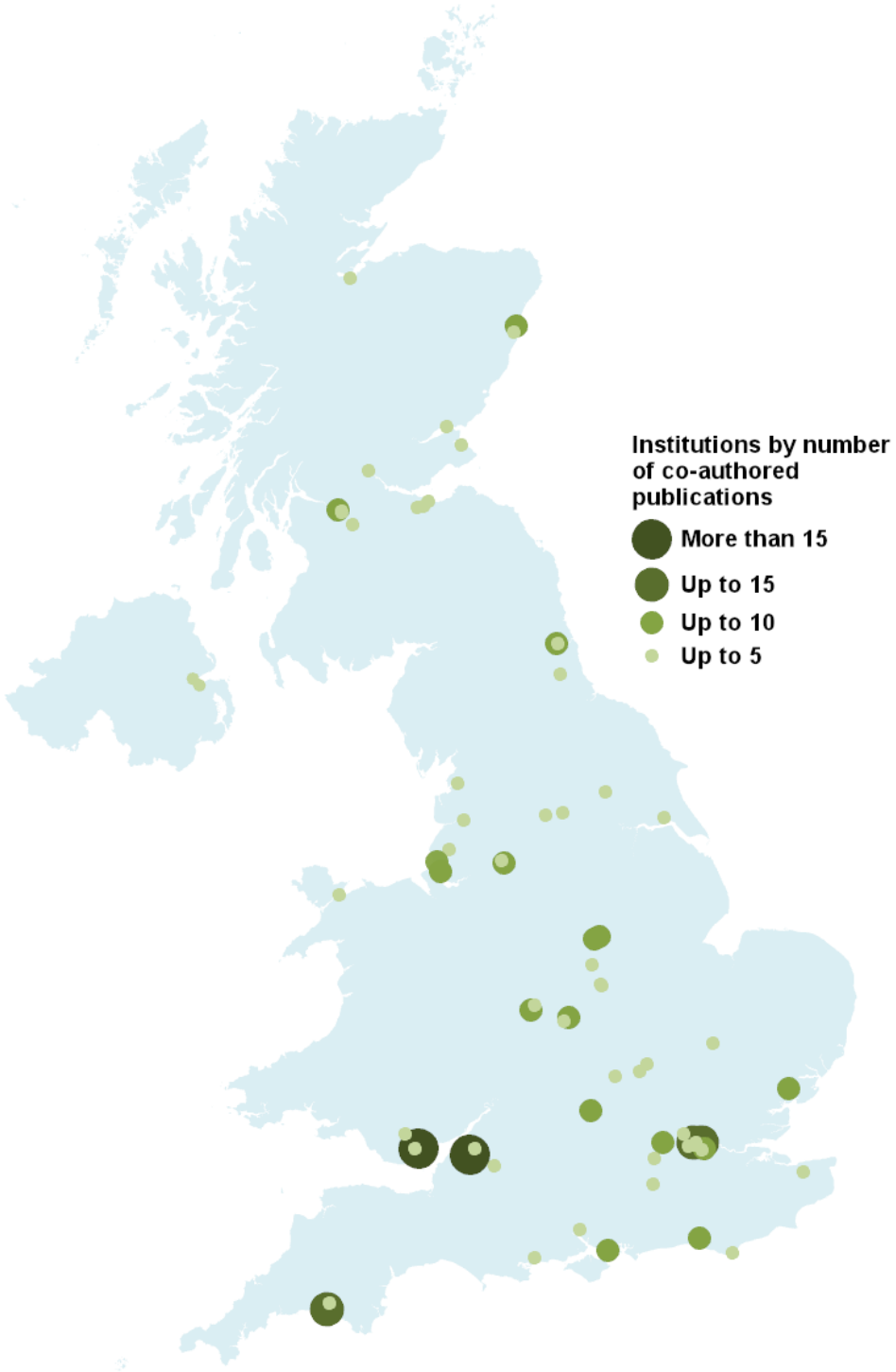


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Figure B-12: Cumulative academic collaborations for Computer Science disciplines outside the UK (2015-2018)

Country	No. of co-authored publications	No. of institutions	Institution(s) with most co-authored publications (if > 2)
China	150	47	South China University of Technology (24)
United States	65	38	University of Arizona (6)
Germany	53	32	Karlsruhe Institute of Technology (4) University of Rostock (4)
France	53	29	Universite de Rennes 1 (5) Universite Grenoble Alpes (5)
Italy	40	13	Italian Institute of Technology (7)
Poland	37	10	Polish Academy of Sciences (8) Wlodzimierz Trzebiatowski Institute of Low Temperature and Structure Research of the Polish Academy (8)
India	30	12	Indian Institute of Technology, Delhi (7)
Canada	29	10	Concordia University (10)
Australia	27	17	Royal Melbourne Institute of Technology University (5)
Spain	26	11	Polytechnic University of Catalonia (7)
Jordan	15	3	Al-Balqa Applied University (11)
Austria	13	8	Vienna University of Economics and Business Administration (4)
Netherlands	12	5	Delft University of Technology (8)
South Africa	12	5	University of Cape Town (4)
Finland	11	5	University of Turku (3) University of Lapland (3)
Russian Federation	9	5	RAS (3)
Denmark	9	4	Copenhagen Business School (3) University of Southern Denmark (3)
Hong Kong	8	4	Hong Kong University of Science and Technology (5)
Japan	7	5	max. 2
Sweden	7	5	max. 2
Brazil	6	4	max. 2
Belgium	4	4	max. 1
Malaysia	4	4	max. 1
Norway	4	4	max. 1
United Arab Emirates	4	4	max. 1
Other	93	56	max. 6
Total	**728**	**344**	

Other = Armenia, Colombia, Iraq, New Zealand, Portugal, Saudi Arabia, Switzerland, Argentina, Chile, Czech Republic, Ireland, Kuwait, Pakistan, Qatar, Singapore, Vietnam, Bangladesh, Bulgaria, Egypt, Ghana, Greece, Honduras, Indonesia, Iran, Israel, Malta, Namibia, Oman, Romania, Serbia, South Korea Taiwan, Thailand

Source: SQW analysis from SciVal data

Table B-1: Cumulative corporate collaborations for Computer Science disciplines (2016-2018)

Country	No. of institutions	No. of co-authored publications	Institution with the most co-authored publications (if total > 5)
United States	8	12	Microsoft USA (5)
United Kingdom	2	7	BBC (4)
Netherlands	2	2	
Turkey	1	2	
China	1	1	
Denmark	1	1	
Germany	1	1	
Japan	1	1	
Total	**17**	**27**	

Source: SQW analysis from SciVal data

Maths

Figure B-13: Cumulative academic collaborations for Maths discipline in the UK (2015-2018)

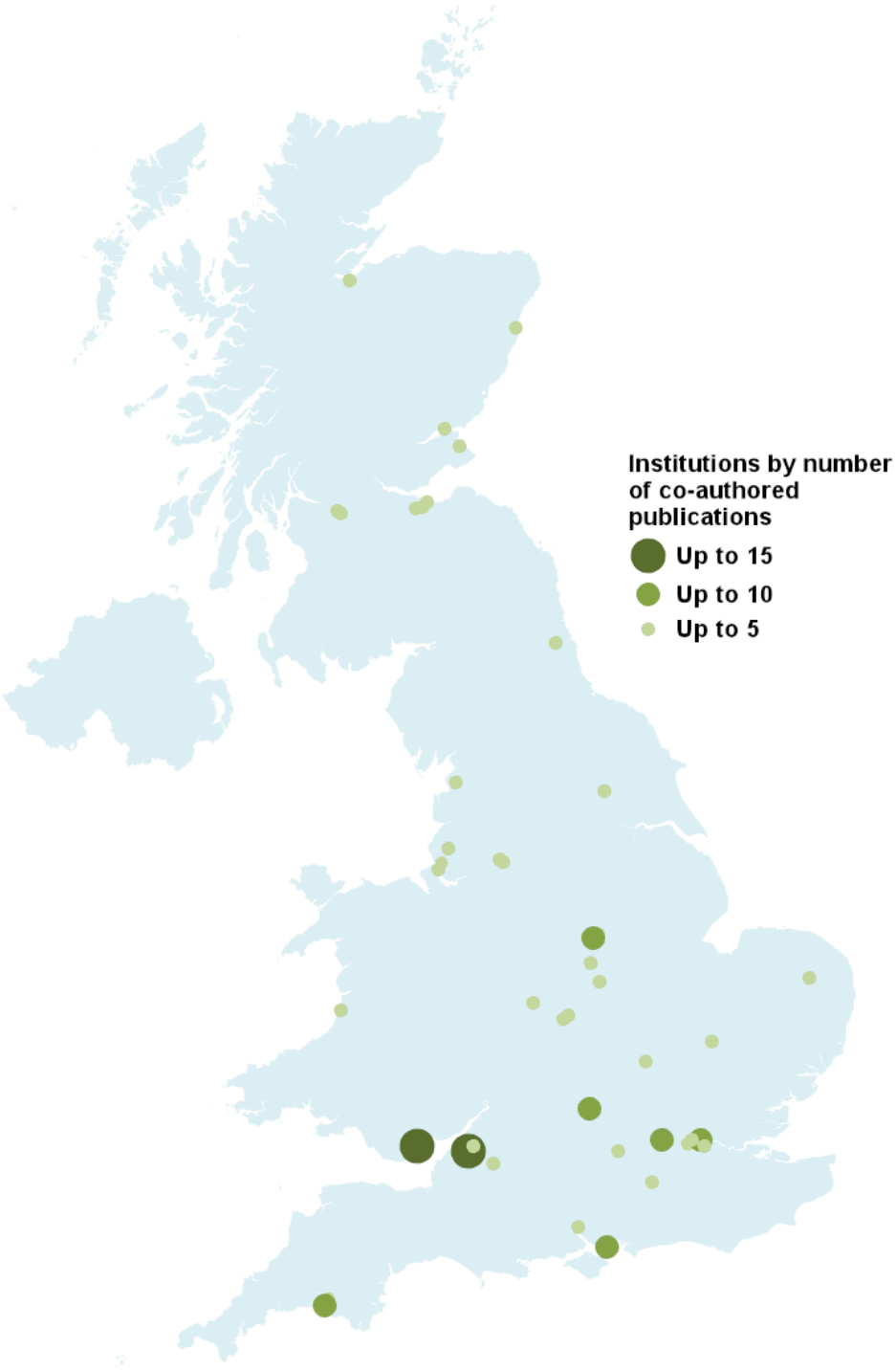

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Figure B-14: Cumulative academic collaborations for Maths disciplines outside the UK (2015-2018)

Country	No. of co-authored publications	No. of institutions	Institution with most co-authored publications (if > 2)	Country	No. of co-authored publications	No. of institutions	Institution with most co-authored publications (if > 2)
China	146	50	Tsinghua University (14)	**Canada**	12	7	McMaster University (3) Simon Fraser University (3)
United States	69	46	University of California at San Diego (5)	**Austria**	11	8	University of Vienna (3)
Poland	40	12	Polish Academy of Sciences (9)	**Netherlands**	11	4	Delft University of Technology (8)
Italy	39	20	University of Naples Parthenope (10)	**Brazil**	7	5	max. 2
Germany	37	24	Bielefeld University (6)	**Finland**	7	5	University of Turku (3)
France	36	23	ComUE Paris-Saclay (4)	**South Africa**	7	4	University of South Africa (3)
Spain	25	10	Polytechnic University of Catalonia (9)	**Iran**	6	4	max. 2
Russian Federation	22	9	Higher School of Economics (6) RAS (6)	**Portugal**	6	4	University of Lisbon (3)
Australia	16	12	Royal Melbourne Institute of Technology University (3)	**Saudi Arabia**	4	4	max. 1
India	13	7	Indian Institute of Technology, Madras (4)	**Other**	**110**	**63**	max. 7

Other = Denmark, Hungary, Iraq, Japan, Jordan, Malaysia, Norway, Sweden, Argentina, Armenia, Belgium, Chile, Hong Kong, New Zealand, Qatar, South Korea, Switzerland, United Arab Emirates, Bangladesh, Bulgaria, Cyprus, Czech Republic, Egypt, Ghana, Indonesia, Israel, Kuwait, Macao, Macedonia, Mexico, Nepal, Oman, Romania, Serbia, Singapore, Slovenia, Vietnam

Source: SQW analysis from SciVal data

Table B-2: Cumulative corporate collaborations for Maths disciplines (2016-2018)

Country	No. of institutions	No. of co-authored publications	Institution with the most co-authored publications (if total > 5)
United Kingdom	4	7	Rolls-Royce (3)
United States	5	5	max. 1
China	1	1	
Denmark	1	1	
India	1	1	
Japan	1	1	
Netherlands	1	1	
Turkey	1	1	
Total	**15**	**18**	

Source: SQW analysis from SciVal data