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Appendix H The Data Lab

ADDITIONAL RESEARCH

March 2023

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Appendix H. The Data Lab (TDL).

1 Introduction.

The Data Lab was awarded funding as part of the Innovation Centre programme in 2014 and became fully operational in 2015. The Data Lab's mission is "to help create economic and social benefit for Scotland through the use of Data Science"[1]. The data science focused Innovation Centre recognised that there were global market opportunities in the growth of 'Big Data' and that Scotland had academic expertise in computer science and analytics that could be harnessed to support industry across a broad range of sectors.

2 Development and approach.

2.1 Main elements of Phase 1 proposal.

The Phase 1 proposal centred around three pillars of activity:

1. Collaborative Innovation Projects - projects offerings of 1-1 Industry/Academia projects and Data Lab delivered Data Science projects;
2. Skills and Talent - an MSc Programme, Industrial Doctorate Programme, online learning and CPD and Executive Education; and
3. Community Building - building Scotland's data science community through a range of activities, including DataFest, a festival of innovation incorporating a Data Summit and Data Talent recruitment event. The pillar activity also included executive leadership, talks, guest lectures, workshops, summer fairs and support for international trade activity and sponsorship.

Collaborative Innovation projects were delivered across Scotland, with the University of Stirling and Robert Gordon Universities very active, in addition to the host University of Edinburgh. Stakeholders praised the role of The Data Lab in providing the wrap around support associated with the MSc programme [72], for example and the role of The Data Lab in facilitating 1-1 industry/academia collaborative projects [7]. The Data Lab's contribution to building the data science community, notably through DataFest was also valued [48, 10].

2.2 Main findings from Phase 1 due diligence.

The due diligence report prepared by Optimat in 2018 said "In Phase 1 The Data Lab has successfully established itself although it did take some time to "get up to speed", an issue experienced by many similar organisations"[2]. It provided feedback on each of the pillars of activity. In relation to Collaborative Innovation Projects, the report said that whilst the target number of projects was not reached, the projects supported nonetheless "delivered significant value to participating companies". For Skills and Talent, the MSc and PhD programmes were successfully developed and "established a pipeline of experts to support the development of data science in industry in Scotland". For Community Building, the success of DataFest was particularly highlighted.

The Phase 2 due diligence report states that The Data Lab has quickly "become the focal point for data science in Scotland and the key representative of Scotland in the international community" and that there were strong arguments for the continuation of its activities. The due diligence report did however note that The Data Lab, in going forward in Phase 2, needed to be clearer about strategic and

[1] The Data Lab Phase 2 Business Plan
[2] Phase 2 Due Diligence report, Optimat and PKF and FPM, for Scottish Enterprise,, 2018

transformational projects (which were set to be included) and to consider sectoral needs analysis, rather than over reliance on demand-led activities. It also said the evidence for demonstrating economic impacts should be stronger.

2.3 Main elements of Phase 2 business plan.

Phase 2 for The Data Lab very much continued in the same vein as Phase 1, with activities continuing to be focused around the three pillars identified in Phase 1. The Phase 2 Business Plan states that feedback from stakeholders and governance boards supported this approach, as did positive feedback from industry. Rather, The Data Lab in Phase 2 sought to evolve and grow the support under each pillar, significantly scaling up activity and impact.

The Phase 2 Business Plan recognised that the world of data had evolved rapidly since The Data Lab's inception in 2014. Phase 2 therefore introduced a subtle but important change to context and messaging (and focus) to be both Data Science and Artificial Intelligence. Phase 2 added the following activities:

- Collaborative Innovation Projects - The Data Lab expanded the Phase 1 offerings of 1-1 Industry/Academia projects The Data Lab-delivered Data Science projects with a broader collaborative offering which added:
  a) 1-many projects between academia and industry consortia, and
  b) additional funding routes to support/underpin Scottish participation in national/ international funding calls/ opportunities
- Skills and Talent - under Phase 2 The Data Lab sought to focus on two core areas:
  - New Talent - which continued the MSc and Industrial Doctoral Programmes, as well as the online/MOOC support. Cohorts of students continued to receive the soft skills training as part of their MSc support, as well as a week-long get together for cohorts which included an Innovation Challenge and access to Industry Placements. The Data Lab also continued to support new talent through the community building Data Talent recruitment activity;
  - Professional Development - continuing and expanding the CPD and Executive Education offering.
- Community Building - growing and building on the range of activities identified for Phase 1. During Phase 2 there has been a growing community of alumni from the MSc and PhD support programmes who have continued to have a relationship with The Data Lab, plus a growing international community connected to The Data Lab online. The Data Lab are therefore growing and actively formalising their support for this wider community of data scientists [16].

2.4 Evaluation Logic model.

The logic model for The Data Lab reflecting Phase 2 anticipated inputs, activities, outputs, outcomes and impacts is presented below (see Figure A. 1).

Figure A. 1 The Data Lab logic model.

Context

The Data Lab's mission is "to help create economic and social benefit for Scotland through the use of Data Science". It operates at the interface of industry, academia and government. The Data Lab recognises the massive economic growth and public service efficiency potential of the sector with International Data Corporation (IDC) forecasting worldwide revenues from Artificial Intelligence (AI) increasing from $8 billion in 2016 to $47 billion in 2020 with a Compound Annual Growth Rate (CAGR) of 55%. The key growth areas will be in Machine Learning, Machine Vision, Robotics and Autonomous Vehicles, and Natural Language Processing.

The focus of Phase 1 was to demonstrate impact to all key stakeholders of the potential economic and social value of data and to promote data-related opportunities and awareness across Scotland. In Phase 2, The Data Lab continued its focus on three pillars - Collaborative Innovation; Skills and Talent; and Community Building - with the objective to further scale the impacts from these – and to add sub-elements. Phase 2 also focused on both Data Science and Artificial Intelligence, reflecting the rapidly evolving global market, which has moved from Business Intelligence to Data Science to Artificial Intelligence.

Objectives

1: Collaborative Innovation – facilitating industry/public sector and academic collaboration .

2: Skills and Talent – nurturing a skills pipeline of talent in Scotland.

3: Community building – supporting and growing the data community in Scotland.

4: Investing in value chains using biotechnology

5: Skilling the necessary workforce

Main beneficiaries and activities

Collaborative Innovation Projects

Academic and Industry collaborative projects; The Data Lab and Industry collaborative projects; Facilitating multi-company initiatives/ transformational projects and/or leverage Beneficiaries: SMEs/industry, academics through exposure to industry, public sector services

Skills and Talent

MSc Programme including wrap-around support, soft skills training, Innovation Challenge for students; Industrial Doctorate Programme; Online/MOOC and CPD/ Executive Education. Beneficiaries: students, industry and public sector receiving students

- Community Building

Data Fest, Executive away days, other academic support (workshops etc.), international and sponsorship. Beneficiaries: students, industry, public sector

Inputs (Phase 2)

Funder inputs:	
SFC	£9.5m
SE	£2.5m
HEI	£0.5m
SG Digital Directorate.	£1.0m
Total	**£13.5m**
Other:	
Industry/other	£4m

Main outputs

Phase 2 targets

- 78 1-1/1-many CI projects
- 18 Data scientist projects
- 16 multi-company C&RI projects
- 725 companies assisted through signposting (less than 4 hrs)
- 60 companies (more than 4 hrs)
- 34 pathfinder projects
- 465 MSc
- 20 industrial doctorates
- 10 online courses
- 450 CPD courses
- 15,750 attendees at DataFest
- 60 events, targeting demand side.

Outcomes

- Turnover created/safeguarded
- Jobs supported/created

Plus,

- PhD and MSc students employed as data scientists in post in Scotland

Overall impact

Net Jobs Created

Net GVA

Wider impacts – reduced CO_2 emissions, improved health outcomes

Source: adapted from The Data Lab Phase 2 Business Plan

3 Market failure and strategic fit.

3.1 Market failure rationale.

Based on experience from Phase 1 delivery, The Data Lab identified the following as key market failures in relation to the data sector in Scotland:

- **Lack of understanding at a corporate leadership level** on the growing importance of data as an organisational asset that can be leveraged to be competitive in the digital economy. The Data Lab observed that for many organisations data innovation "does not have a leadership sponsor to drive change and deliver commercial benefit".
- **The data sector is in its infancy and is rapidly changing** – making it difficult for firms to keep up-to-date and understand the opportunities (e.g., of Artificial Intelligence, including machine learning).
- The commercial exploitation of Data Science and Artificial Intelligence requires **highly skilled personnel** who are currently few in number and therefore in high demand globally.
- Industry is **unaware of the strengths that exist in academic institutions and research institutes**, and/or have been frustrated with previous engagements. Therefore, they do not invest the time to source this expertise. Industry thinks academia is slow to release IP, that research is in silos, whereas commercial opportunities require cross disciplinary inputs in order to be met.
- In the **public sector, resistance to change** and adoption of new approaches and technologies.

Section 2.2 of the main report identifies a strong equity rationale at the Programme level. There is also a **strong** *equity rationale* for The Data Lab given that the IC has a very strong focus on supporting SMEs as opposed to large firms and therefore those with lower levels of BERD. The Data Lab is also supporting indigenous firms, as opposed to foreign-owned firms. As with other ICs, there is less evidence to suggest the IC is specifically benefitting Local Authorities with lower levels of BERD spend per population head, other than to raise BERD per head levels across Scotland as a whole. It is worth noting here that The Data Lab had limited reach and no impact in the Highlands and Islands region in Phase 1, with no HIE investment into The Data Lab in Phase 1. Phase 2 sought to address this through the employing a range of means, including support for a local Business Development executive post and project budget funding.

The Data Lab also has a strong efficiency rationale, as far as it creates *positive externalities* though supporting research and development leading to new solutions, many of which apply beyond the supported business itself and where there are wider economic, environmental and societal benefits that are not exclusively received by the businesses and organisations that innovate. The Data Lab is active across a range of sectors, for example including public health and so there are wider societal benefits that arise, reflected in the contribution of The Data Lab to UN Sustainable Development Goals (see wider impacts).

Further, The Data Lab addresses *information failures* (clearly identified by The Data Lab from their feedback from industry) by helping businesses and organisations connect with academics and The Data Lab data scientists. The lack of information amongst SMEs in relation to data science and AI is particularly acute, given the rapid changes constant in the sector, highlighted above. The Data Lab therefore plays a key role for supported businesses and organisations in overcoming information barriers, which for many SMEs is about understanding what is possible with data, and how to apply this in practice [7], a finding borne out by the survey data below. The Data Lab supported organisations may well also not have the capacity and/or knowledge to engage with universities and colleges. Similarly, The Data Lab addresses the issues of *market power* by supporting SMEs to innovate, illustrated in the outcomes section of this Appendix. Finally, in relation to public goods, The Data Lab provides a range of activities that cannot provide a commercial return including network development, shaping/ influencing public policy and providing advice and signposting support to businesses.

The Data Lab also plays a role in addressing *environmental* market failures, with data science solutions helping move to a greener economy with greater levels of automation and reduced waste. There are *coordination* market failures addressed, too, with The Data Lab very active in collaboration with a wide range of different sectors and organisations, where The Data Lab has "got the message out" about what benefits using data can bring for businesses and organisations [48, 16].

The survey of The Data Lab clients emphasises several particular factors were considered significant in constraining their establishment's innovation activities before working with The Data Lab (these were broadly consistent with IC clients as a whole). '**Lack of qualified personnel or specialist project / programme support'** was the most frequently cited constraint on the establishment's innovation activities before working with The Data Lab (36%), followed by '**availability of finance**, including awareness of funding opportunities' (29%). **'Direct innovation costs'** (19%) and '**lack of access to academic expertise** or other partnership opportunities' were also frequently cited (16%). These factors align with the market failures identified by The Data Lab, notably the need for skilled personnel and access to academic expertise. In this regard, 'information failure' is supported as a significant market failure.

Fewer than one in five The Data Lab clients (19%) reported there were no constraints to their innovation activities prior to working with The Data Lab, implying the vast majority experience barriers. This indicates the widespread market failures facing The Data Lab clients prior to support.

3.2 Strategic fit.

The Data Lab demonstrates a clear strategic fit with Scottish Government priorities. It has also played an instrumental role in shaping some of this policy. The strongest example of this is Scotland's AI Strategy[3] 'Trustworthy, Ethical and Inclusive', launched in March 2021 where The Data Lab were invited to oversee the development process for Scottish Government. This is testament to the expertise that resides within The Data Lab and the importance of the IC to the development of the sector. The AI Strategy seeks to deliver Trustworthy, Ethical and Inclusive AI, and to make Scotland 'Fairer', 'Greener'. 'More Prosperous' and 'Outward Looking' through:

- Establishing collective leadership through the Scotland AI Alliance;
- Creating the foundations for success; and
- Building an AI powerhouse.

The values of the AI Strategy are close to the overall values of the Scottish Government, particularly around fairness and net zero ambitions.

Many stakeholders cited the profile and prominence of The Data Lab in helping shape and drive priorities for Data Science and AI in Scotland [48, 10, 16]. There is a very strong fit between the objectives of The Data Lab and the ambitions of the Edinburgh and South East Scotland City Region Deal (ESESCRD) which seeks to make Edinburgh the Data Capital of Europe. Increasingly, The Data Lab is also involved in strategic data projects, such as the Cancer Innovation Challenges, which has a strong fit with the preventative and wider healthcare agenda, with the NHS, Farr Institute and Administrative Data Research Centre cited as health sector partners. The Data Lab continues to demonstrate a strong strategic fit with Scottish Government priorities and is an active partner in projects with a number of Government agencies, including the Enterprise Agencies.

3.3 Covid response.

In line with all ICs, The Data Lab experienced a challenging operating environment during the period 2020-22 as a consequence of the Covid-19 pandemic. However, its strong understanding of, and extensive use, of data and technology allowed The Data Lab not only to deliver IC services and activities effectively during the pandemic, but also to play a strong role in supporting sectors to move

[3] About — Scotland's AI Strategy (scotlandaistrategy.com)

to remote working and to develop other online solutions required by successive lockdowns. The Data Lab works across many different sectors (including hospitality, FinTech, tourism, public health, energy) and helped offer solutions to remote working and other business challenges caused by the pandemic.

In terms of pivoting services and activities online, The Data Lab was successful in delivering its annual 2021 DataFest conference, this time online and over a series of events.

Further, The Data Lab developed additional online platforms and resources, notably the online Community Platform which has grown in membership since its introduction and is an opportunity for anyone interested in being involved in the data science community to participate. The platform started to enable support and connectivity to various networks and began to extend The Data Lab's ability to make impactful change through the pandemic, particularly latterly in 2021/22. It also enabled The Data Lab provide services and support to more organisations and offered a way to bring other tools and support to market quickly and efficiently. This has been a real influence of The Data Lab on the ground, as one Board member put it "this has been a real strategic influence of The Data Lab. It is hard to quantify the impact of this – but it goes to heart of the fabric of society" [16].

At a more strategic level, The Data Lab continued to influence and shape policy, notably the development of the Scottish Government's AI strategy, launched in 2022. This complemented the suite of Covid emergency digital programmes, such as the Digital Enablement Grant administered by Highlands and Islands Enterprise. The Data Lab have facilitated the AI strategy development, bringing together Scotland's considerable strength in AI.

The importance of The Data Lab and its services to the pandemic recovery was recognised by Scottish Government and resulted in a further investment of £1m for The Data Lab to assist helping SME's in their recovery, specifically "to help businesses to invest in more advanced technologies such as data analytics and artificial intelligence".

4 Inputs, activities and outputs.

4.1 Funder Inputs.

The table below confirms the funding that the Scottish Funding Council (SFC), Scottish Enterprise (SE) and Highlands & Islands Enterprise (HIE) have provided to The Data Lab across Phase 1 and Phase 2 to date. This indicates total funder expenditure of £19,522,585 to date over Phases 1 and 2, the largest proportion (93%) of which has been from SFC, with a further £1.0 million contribution by the Scottish Government Digital Directorate to Phase 2. Neither SE nor HIE made a financial contribution to Phase 1 core costs, although SE did invest £220,000 in DataFest in Phase 1.

Table A. 1 The Data Lab inputs to March 2023.

	Phase 1 Spend	Phase 2 Award	Phase 2 Actual to Date*	Total Spend to Date
SFC	£11.2 million	£9.5 million	£7.4 million	**£18.6 million**
SE	-	£2.5 million	£1.3 million	**£1.3 million**
HIE	-	£0. 5 million	£0.25 million	**£0.25 million**
SG Digital Directorate	-	£1.0 million	£1.0 million	**£1.0 million**
Total	**£11.2 million**	**£13.5 million**	**£9.95 million**	**£21.15 million**

*Source: SFC, SE, HIE correspondence ('Summary funders awards and drawdowns to date', excel spreadsheet, Feb 2023). Phase 2 Award and Actual to data excludes £768,000 for the standalone TORCH SME business consultancy project. * Note, The Data Lab report that due to the University of Edinburgh finance system having been unavailable since August '22, spend shown to date for Phase 2 only covers until end July 22, although funder drawdown is for Phase 2 to end of December 2022.*

4.2 Activities and outputs.

The Data Lab has increased the number of engagement events it has led or delivered in Phase 2, with 286 events by the end of Year 3. Although The Data Lab were involved in 870 events in Phase 1, these were not necessarily those led or delivered by the Innovation Centre. Nonetheless, clear event activity took place in Phase 1, not least associated with the Data Fest, initiated in 2018, where there were 3,000 attendees across 50 or so events. This was started in the Highlands and Islands, in Inverness, with other events across Scotland and was widely regarded as a success, and The Data Lab have since continued to deliver Data Fest (including a Data Summit and Data Talent recruitment component) since this date (moved online during COVID and now delivered as a hybrid face-to-face and online series of events).

Whilst there are 286 events recorded under this indicator in the MEF, The Data Lab are involved in additional event activities. In Phase 2 to date (up to the end of Year 3), The Data Lab has led 407 'general events targeting demand-side companies', 192 in the H&I and 215 in the SE area (which is an SE funding target). The Data Lab estimate more than 6,000 companies have attended events in Phase 2.

Table A. 2 The Data Lab: number of engagement events led or delivered by IC.

Level	Phase 1	Phase 2 (to Year 3)	Total
> 100 Attendees	N/A	N/A	**N/A**
10-100 Attendees	N/A	N/A	**N/A**
< 10 Attendees	N/A	N/A	**N/A**
Total	**870***	**286**	**286**

*Source: MEF; * these are total events that The Data Lab participated in Phase 1 and not those necessarily led or delivered.*

Skills and Talent is one of the three central pillars of The Data Lab support, and its MSc Programme is particularly well regarded by stakeholders [38][72]. The wrap-around support includes The Data Lab facilitated matched industry placement and employability 'industry readiness' support. The Data Lab supported 412 MSc students in Phase 1 and has supported 528 to date in Phase 2 (to January 2023). This is a strong performance although The Data Lab was forecast to support 155 per annum in Phase 2, with the Covid-19 pandemic and Brexit have affected these volumes. Whilst The Data Lab successfully negotiated the challenges of the pandemic (pivoting to remote placements), Brexit has had a more profound impact.

The Data Lab has significantly increased both its online and CPD elements within this Pillar in Phase 2. After trialling a one-day executive education CPD course in 2017, reaching 665 participants, activity in Phase 1 reached 15,745 CPD participants in total. In Phase 2 some 88,432 CPD beneficiaries have been supported, including via MOOCs. The number of Industrial Doctorates will fall in Phase 2 and The Data Lab has closed the PhD programme, given the challenges facing industry in supporting a four-year placement (where demand has dipped post Covid). Rather, The Data Lab offered 60 PhD placements to industry (rather than supporting the whole multi-year PhD), which has been viewed by The Data Lab as offering much greater value for money, based on industry feedback.

Table A. 3 The Data Lab: number of entrants to education/training.

Level	Phase 1	Phase 2 (to January 2023)	Total
PhD/EngD	24	13	**35**
MSc	412	528	**955**
HND/HNC		0	**0**
Other (CPD Beneficiaries)	15,745	88,432	**104,177**
Total	**437**	**553**	**990**
Total (including CPD)	**16,182**	**88,985**	**105,167**

Source: MEF;

In Phase 1, The Data Lab supported 93 collaborative innovation projects, the majority of which (73) were academic/IC projects involving more than one Scottish business. The Data Lab also supported 148 MSc Placement projects and 25 PhD projects. A further 13 projects were collaborations with the public sector, with seven of these Involving at least one business, so that 266 projects were completed in Phase 1 in total.

The Data Lab operated from three Hubs in Phase 1: 41% of Phase 1 projects were facilitated by the Edinburgh Hub, 39% from the Glasgow Hub, and 20% from Aberdeen. Inverness was added in Phase 2.

There has been an increase in collaborative project activity in Phase 2. As of January 2023, there were 403 new collaborative projects, as well as 33 continuing collaborative projects, with 348 completed projects. The is an increase in the academic/IC to business and public sector activity compared to Phase 1 and a strong reflection of The Data Lab's ongoing ability to extract expertise from the academic base. This includes the Inverness hub serving the Highlands and Islands, established as part of Phase 2 funding, with a Business Development function in the region delivering activity and impact. The increase in the number of collaborative projects is encouraging particularly given that at the same time The Data Lab has also been involved in a greater number of transformational projects in response, a desire from funders to see The Data Lab involved in more strategic projects as well as smaller ones.

Table A. 4 The Data Lab collaborative projects.

Level	Phase 1	Phase 2 (to January 2023)		
	No. of collaborative projects (including completed)	No. of new collaborative projects	No. of continuing collaborative projects	No. of completed collaborative projects
Academic/IC to business (involving at least 1 business in Scotland)	73	42	12	30
Academic/IC to business (involving no businesses in Scotland)	-	-	-	-
Academic / IC to Academic	-	-	-	-
Business to business (involving at least 1 business in Scotland)	-	38*	0	38
Academic/IC to public sector (involving no businesses in Scotland)	13	8	4	4
Academic/IC to public sector to business (involving at least 1 business in Scotland)	7	2	1	1
Total	**93**	**90**	**17**	73

Source: MEF. *; *includes Pathfinder projects identified, TORCH Projects - Business to Business projects relate to TORCH.*

Table A. 5 Other collaborative project activities.

Other Activities	Phase 1	Phase 2 (to January 2023)		
	No. of collaborative projects (including completed)	No. of new collaborative projects	No. of continuing collaborative projects	No. of completed collaborative projects
Individual Projects	-	3	1	**2**
External Funding/ Grants Projects	-	33	6	**5**
MSc Placement Projects	148	268	0	**268**
PhD Projects	25	10	10	**0**
Total	**266**	**403**	**33**	**348**

Source: MEF. *Note: External Funding/Grants Projects; projects related to MSc student placements with Industry/Public Sector (148 in Phase 1 and 268 Phase 2 to date), PhD projects (25 in Phase 1 and 10 in Phase 2 to date) .*

Information supplied by The Data Lab suggests that there had been 20 follow-ons by the end of Year four from completed collaborative projects, almost half to the private sector, although 11 were

signposted to follow-on support from the public sector. Of these 11, three had been signposted to SE and two to HIE. The number of completed projects will increase as more of the 271 new and continuing projects complete, and so follow-on numbers will also increase considerably in the future.

Table A. 6 The Data Lab: follow on from completed collaborative projects.

Level	Phase 1	Phase 2 (by Year 4)	Total
Signposted to SE	N/A	3	**N/A**
Signposted to HIE	N/A	2	**N/A**
Signposted to other public funding/support body	N/A	6	**N/A**
Signposted to private sector	N/A	9	**N/A**
IC supported follow-on project planned or underway	N/A	0	**N/A**
Direct to market (by a business in Scotland)	N/A	0	**N/A**
Projects not taken forward	N/A	0	**N/A**
Total	**N/A**	**20**	**N/A**

Source: MEF

Of the 266 Phase 1 projects, 123 had led to the intention to launch commercially or lead to commercial application. The Phase 1 collaborative projects led to new or improved products (9), processes (41), services (19), business models (11) and improved delivery of a service (28). Of the new, completed and ongoing Phase 2 collaborative projects an increased number of projects (623) have led to the intention to launch commercially or lead to commercial application.

Table A. 7 The Data Lab: number of IC collaborative projects leading to intention to commercial launch/application.

Level	Phase 1	Phase 2	Total
New or improved products developed (with/for a business in Scotland)	9	103	**112**
New or improved processes (with/for a business in Scotland)	41	195	**236**
New or improved services developed (with/for a business in Scotland)	19	112	**131**
New or improved business models (with/for business in Scotland)	11	64	**75**
New or improved delivery of a public service in Scotland	28	26	**54**
Total	**108**	**500**	**608***

Source: MEF * *Includes Collaborative Innovation Projects, TORCH and External Funding Projects. Excludes data from projects related to MSc student placements with Industry/Public Sector (148 in Phase 1 and 268 Phase 2 to date) and PhD projects (25 in Phase 1 and 10 in Phase 2 to date)*

Some 895 students have gained a qualification as a result of The Data Lab support since the inception of the IC (excluding CPD beneficiaries), a strong skills development programme, the vast majority of which is via the MSc Programme, with the number set to increase as more of the entrants identified above complete their course and gain their qualification. The Data Lab also delivers the Data Skills for Work programme on behalf of the Edinburgh and South East Scotland City Region Deal. The MSc Programme numbers have halved (from circa 145 per annum to around 70 per annum) since the end of EU (ESF) funding, as a result in the reduction of EU funding available, although the total number of MSc students gaining qualifications will still be higher in Phase 2 compared to Phase 1.

Table A. 8 The Data Lab: number of individuals gaining new qualifications/skills.

Level	Phase 1	Phase 2 (to January 2023)	Total
PhD/EngD	*0	*9	**9**
MSc	412	453	**865**
HNC/HND	0	0	**0**
Other (CPD Beneficiaries)	891	6,286	**7,177**
Total (including CPD)	**1,303**	**6,739**	**8,042**

Source: MEF; *Note: *24 PhD/EngD student were funded in Phase 1 and 13 in Phase 2. 9 of students funded from Phase 1 have completed in Phase 2. The remaining 28 will complete in Phase 2 or Phase 2I. There are also 53 PhD placements that have occurred in Phase 2 (not included in table above)*

A number of findings from the beneficiary surveys related to activities and outputs are noted below.

In terms of engagement with The Data Lab, just over four in 10 of respondents (41%) first interacted with the IC on or before 2018 (broadly consistent with Phase 1) with a larger proportion (59%) involved in 2019 or more recently, consistent with the fact that there was a relatively slow start for The Data Lab. Over eight in 10 clients (83%) are still involved with The Data Lab.

There are high levels of engagement of The Data Lab clients with postgraduate internships, placements, or secondments, with 61% reporting involvement in this way. Almost four in 10 of The Data Lab clients (39%) were involved with training or other skills development activities (e.g., seminars or workshops) provided by, or supported by, The Data Lab.

There are good levels of academic, business and IC collaborative project involvement activity. For The Data Lab, 24% of respondents were involved in a collaborative project between more than one partner, and 28% were in collaboration projects with one other partner**.** A further 9% were involved in consultancy projects.

Many clients have also accessed lower intensity support e.g., 32% for advice and signposting and 18% conferences and events.

For collaborative project support, 15% had accessed four or more rounds of IC funding. More typically clients accessed one or two rounds of IC support (53%). The Data Lab survey beneficiaries also often engaged with engaged with other ICs, with 17% of The Data Lab clients also engaging with CENSIS.

The client survey demonstrates The Data Lab client engagement across a wide range of universities. Survey data indicates the Data Lab clients tend to engage most often with the University of Edinburgh (34%), as the host institution of the IC but not exclusively so. There is a good engagement with University of Strathclyde (18% of The Data Lab client survey beneficiaries), University of Glasgow (12%), University of Stirling (10%), University of Aberdeen (10%) and Robert Gordon University (7%). There was lower levels of engagement with University of Highlands and Islands (2% of The Data Lab survey beneficiaries). In all, 5% of The Data Lab client survey beneficiaries were located in the Highlands and Islands, lower than the pro-rata share of the population or business base.

Data supplied by The Data Lab shows an even broader range of University engagement by total investment (in skills and collaborative projects), with 17% of Phase 1 and 2 investment in the University of Strathclyde, 13% of investment in the University of Stirling, 13% into Robert Gordon University and 11% into the University of Glasgow. In all, 2.4% of The Data Lab investment has been in the University of the Highlands and Islands; the Innovation Centre investing in 14 Universities in total.

Engagement with colleges is on a smaller scale, with most respondents indicating they did not work with a college. Of the five The Data Lab respondents who did work with a college, the most commonly cited was Edinburgh College. Nonetheless, The Data Lab has engaged significantly with Colleges in a variety of ways not covered by the survey. This includes the development of two online courses via The Data Lab online learning fund, one Teaching Data Science in Colleges (through the College Development Network & Stirling University) and the Youth Work & Data Course at Fife College launching later in 2022.

The survey of students benefiting from The Data Lab-supported master's and Post Doctorates indicate the wide geographic spread of students, with the largest proportion of respondents from the University of Stirling (27%), followed by the University of Strathclyde (20%), University of Glasgow (12%) and Robert Gordon University. Whilst one in four (25%) were involved in addressing a fundamental problem, nine in 10 (90%) were involved in process, product, service and method improvements (multiple responses were allowed). Further, more than a third were involved in developing a business solution (26%) or a societal issue solution (11%).

The MEF provides evidence of the considerable programme of activity around engagement, networking and collaborative project activity between academia and industry. It also shows the very

substantial role The Data Lab plays in skills development activities, particularly at MSc level, including placements. A survey of The Data Lab clients supported MEF evidence of widespread collaborative engagements between industry and academia, with The Data Lab reach extending well beyond the Central Belt, in particular to Stirling and the North East. The Data Lab has also developed collaborative projects with other ICs. There has been a considerable increase in engagement and networking activities in Phase 2, as well as a continuation of the very strong skills development programme, despite challenges associated with Brexit and Covid impacting upon delivery.

5 Outcomes and impacts.

5.1 Main findings from MEF.

A total of 467 new jobs were reported for Phase 1 against a target of 248 (188% of the Phase 1 target). This is a strong performance for The Data Lab, particularly given the slow start to establishing Innovation Centre.

The Data Lab also met its target for turnover supported and/or created, which was 100% of target, so that £105m turnover was reported.

Phase 2 targets for jobs are far higher than in Phase 1, with the target for turnover twice that for Phase 1 and the jobs target 225% that for Phase 1. The Data Lab is on track to exceed its jobs target with 982 jobs created and safeguarded by January 2023 , close to the full Phase 2 target of 1,055. This is a strong performance from The Data Lab, so that 1,522 jobs have been created and safeguarded to date across the two Phases. These figures are derived from business forecasts at the end of projects (over an unspecified time period). Figures are 'gross' and do not take account of the counterfactual (i.e., not 'net additional'), and do not include any optimism bias assumptions. This was not required in the MEF.

Table A. 9 The Data Lab Outcomes.

Level	Phase 1			Phase 2* (to end of Jan 2023)			Total (to end of Jan 2023)
	Planned	Actual	%	Planned	Actual	%	Actual
[Anticipated] Jobs Supported and/or Created							
Created	-	-	-	593	631	-	-
Safeguarded	-	-	-	462	351	-	-
Total	**248**	**467**	**188%**	**1,055**	**982**	-	**1,522**
[Anticipated] Turnover Supported and/or Created							
Created	-	-	-	-	-	-	-
Safeguarded	-	-	-	-	-	-	-
Total	**£105m**	**£105m**	**100%**	**£214m**	**-**	**-**	**-**
Posts Created in Scottish HEIs, Colleges and the Public Sector							
Posts in HEIs to support A2B Projects		-		2			
Posts in Colleges to support A2B Projects		-		0			
Posts in Public Sector to support A2B Projects		-		3			
Total				**11**			

Source: MEF: *Phase 1, Jobs: 154 from projects, 288 from MSc students (70% of total number of MSc students), 25 PhD jobs (100% of PhD students). Phase 2. 317 jobs from MSc students (70% of total MSc student number), 314 from completed projects and 351 safeguarded from completed projects. No jobs have been added from Grants/External Funding or CPD/MOOC entrants.*

REVENUE: Phase 1. £81.9M from projects, 20.6M from MSc students (50K per student), 2.5M from PhDs (100K per student) Phase 2, £107.3M from CI projects, £27.15M from MSc students, £1M from PhDs, £3.8M from companies participating in TORCH (38@100K), £75M from Smart Manufacturing Hub project (1,500 companies participating @100K). No revenue added for

CPD/MOOC or other external projects. We believe revenue on the table has been underestimated due to lack of process to value financial impact.

5.2 Main findings from survey of beneficiaries.

5.2.1 Outcomes

In terms of influence on relationships with innovation partners, The Data Lab has played a significant role in developing client relationships with a wide range of bodies relevant to the innovation ecosystem. Selected findings are:

- More than a third (34%) of respondents indicate The Data Lab has significantly supported clients to developed better relationships with universities or colleges. There is a strong correlation between those undertaking collaborative projects and outcomes/ impacts, and involvement in a collaborative project leads to strengthened relationships.
- 15% of respondents indicate The Data Lab has significantly supported relationships with government or public research institutes.
- 12% of respondents indicate The Data Lab has significantly supported relationships with conferences, trade fairs, or exhibitions.
- 10% of respondents indicate The Data Lab has significantly supported relationships with private sector clients/customers.

The Data Lab client establishments also invest in a wide range of innovation activity. Thus, some 56% of those surveyed carried out internal R&D since they started working with The Data Lab with more than four out of 10 of these (41%) saying The Data Lab played a significant role in supporting this activity. A further 37% undertook training or skills development for innovative activities (with again around four in 10 of these saying that the IC played a significant role in supporting this activity).

Over quarter of The Data Lab clients have introduced new or significantly improved services since they started working with the IC (27%) and, of these, more than two thirds (67%) report they received significant support from The Data Lab with this, a high proportion relative to other ICs. A quarter had either introduced new or improved goods (14%) or introduced new processes (11%). Again, where these have occurred, the IC has typically played a significant role (around six of out 10 respondents stating this). The Data Lab had not played a significant role in the small number of start-up and spin-out businesses, or new patent applications amongst client survey respondents.

A range of other networking benefits were cited (where The Data Lab played a significant role), including:

- New academic contacts - 29% of respondents reporting this. This is a two-way benefit from academic-business interaction, with academics also reporting benefits from working with The Data Lab and business as part of collaboration projects.
- New business contacts - 26%.
- New public sector contacts – 20%.
- Joint venture with business - 16%.
- Joint venture with academic institution- 13%.
- Joint venture with public sector - 10%.g

The Data Lab clients also identified a range of knowledge benefits, including:

- Improved technical understanding of priority technology areas in my sector – 24%.
- Improved awareness of academic capabilities – 27%.
- Improved employee skills and ways of working – 22%.
- Improved market understanding of priority technology areas in my sector- 20%.
- Improved cross-industry collaboration – 17%.

For the majority of the networking and knowledge benefits it is clear a large number of The Data Lab clients are benefiting from The Data Lab support Improved employee skills and ways of working, at 22% is higher than the all-IC average of 19% suggesting the nature of knowledge benefits for The Data Lab clients is slightly different. There is a greater relative importance of service improvements (compared to products) compared to other ICs, and a greater benefit in terms of working practices in supported clients.

It is noted that, in line with other ICs, those clients involved in collaborative projects through The Data Lab have typically started at the lower end of the TRL scale (it is noted this may include project work before IC involvement). Some 72% of projects were at TRL 1-3 at the start, with 25% at TRL 4-6. For research of an applied nature, this may be considered somewhat low on the scale. It is also worth noting that other clients will be developing processes/services internally through, say, smarter use of data and this may not translate to a TRL scale rating.

Interestingly, when clients look forward to the next three years, those at TRL 7-8 are expected to account for 34% of the total, with just 14% at TRL 1-3. Half of The Data Lab clients thought The Data Lab was 'very' or 'extremely important' in advancing their project TRL.

Client respondents were also asked to indicate **sales benefits** gained as a result of working with The Data Lab, and the most cited benefits were:

- 9% entered or grew in Scottish market;
- 7% entered or grew in other UK market; and,
- 2% entered or grew in international markets.

Finally, respondents were also asked to indicate **financial benefits** gained as a result of working with The Data Lab, and the most cited benefits were:

- 7% gained improved investment readiness;
- 7% secured cost savings or more efficient and effective processes;
- 5% new equity investment (e.g., venture capital, angel investors); and
- 5% secured new public sector investment.

In relation to student beneficiaries of The Data Lab supported courses, more than six in 10 (61%) stated that The Data Lab supported course had helped them find employment relevant to their studies, with 37% strongly agreeing this was the case. Almost seven in 10 (68%) felt The Data Lab supported course had opened new career opportunities. Seven in 10 (70%) felt The Data Lab supported course had helped them to connect with other students.

Almost six in ten (58%) were in employment at the time of the survey, two thirds of whom were in the business enterprise sector (in a wide range of sectors beyond information and communications to include finance, health, education and utilities) and 13% in the government sector. The vast majority of these posts were full time, and 71% were in Scotland. For more than eight in 10 (82%) their job was related to The Data Lab supported course they had benefited from. Almost two thirds (64%) were involved in research and development activities in their role (on average for around 35%-40% of their time) with more than one in 10 (11%) involved in patent development or other IP creation and 7% involved in this activity leading to a commercialised product or process, or licensed application.

5.2.2 Impact

This section discusses the impacts of The Data Lab in terms of employment and Gross Value Added (GVA). The analysis of impacts includes an assessment of additionality (as outlined in appendix A).

Analysis of the employment data provided by respondents to the client survey reveals a net employment peak of 13, or 23 with the addition of a suitable multiplier. When these figures are grossed up to the total businesses supported by The Data Lab it delivers net additional employment of 191, or

with the multiplier 343. These are moderate levels of net additional employment, consistent with the relatively low proportion of The Data Lab clients reporting sales and finance benefits.

Gross Value Added was calculated using the net additional employment figures and The Data Lab will facilitate £18.1m of cumulative net additional GVA or £32.5 million with the multiplier. As explored in the value for money section, this represents a moderate return on public expenditure on The Data Lab, when measured by GVA and employment criteria alone.

A further question on additionality was included in the client survey. In all, 12% say they would not have achieved any of the benefits without The Data Lab support (absolute additionality), whereas just 3% say they would have achieved the same benefits at the same time and scale without The Data Lab support (zero additionality).

However, the majority of additionality is through increasing the scale of benefits, or bringing forward the timing of benefits. The greatest percentage of respondents (31%) say they would have achieved a significantly smaller range of benefits, at a reduced scale, and it would have taken longer to achieve them. A further 21% say they would have achieved a slightly smaller range of benefits and at a reduced scale and it would have taken longer to achieve them. The remainder, 31% report more limited benefits.

For the students surveyed, one in four would have found similar employment anyway without The Data Lab supported course, reflecting that many MSc and PhD students were already employable in the marketplace. However, three in four report that they would not have been employed at all without The Data Lab supported course (8%, absolutely additionality), be employed in their field (17%), or that it would take them longer to find employment (30%) or that they would have been employed with a lower salary (17%).

5.2.3 Wider impacts

The Data Lab is delivering a range of wider impacts, notably in relation to the human health agenda. The Cancer Innovation Challenge (CIC), and partnership working with the NHS, is a key area of activity for The Data Lab who are seeking to develop more strategic projects (see CIC case study) so that The Data Lab is helping to better utilise data to improve health outcomes. This is welcomed by a number of stakeholders [10], although this will take time to feed through, The Data Lab work may lead to improved health outcomes as cancer and other treatments improve as a result of the project. The work of The Data Lab with UNICEF on Data Collaboration for Children initiative is another area of strategic activity where data is driving social benefits, in this case internationally.

Many projects contribute to a reduction in CO2 emissions, either directly as an objective of the project (e.g., smarter processes) or indirectly, where there are environmental benefits despite the project having other primary objectives. Much of the work of The Data Lab data scientists is involved in improving the efficiency or processes using data/AI, and this brings environmental benefits to the business or organisation. This is consistent with the 'greener' element of the AI Strategy.

Arguably, these wider benefits could be greater, or rather, they could be quantified more to evidence the wider impacts. Some stakeholders [49] also consider that The Data Lab could move into even more sectors. As a rule, The Data Lab is more cross-sector than other ICs (with projects across several sectors), however there are other parts of the economy (e.g., parts of food and drink, animal health) where some feel The Data Lab could be more active.

In considering the wider benefits of The Data Lab support of clients, clients were asked which, if any, of the UN Sustainable Development Goals (SDGs) had their establishment made a significant contribution to, as a result of working with the Innovation Centre . A wide range of benefits are cited by The Data Lab clients, particularly in relation to:

- Quality education (e.g., promoting lifelong learning and access to education) (21%).
- Industry, innovation and infrastructure (e.g., adoption of new medium-high, and high technologies) (15%).

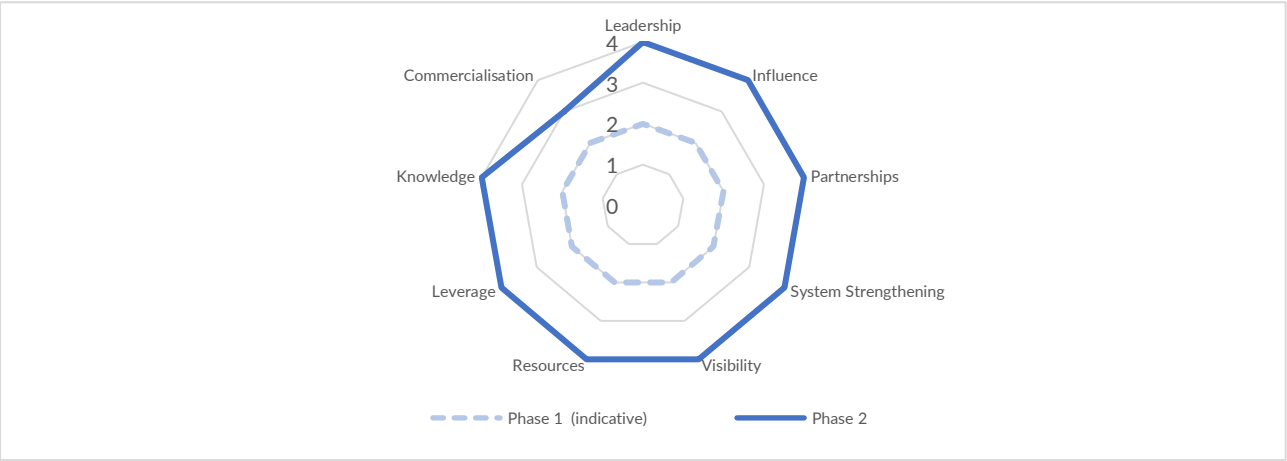
- Climate action (e.g., reducing CO2 emissions) (12%).
- Good health and wellbeing (e.g., ensuring healthy lives, promoting wellbeing, COVID response) (12%).
- Reduced inequalities (e.g., supporting disadvantaged groups or regions) (11%).
- Gender equality (e.g., empowering women and girls) (11%).

The case studies below provide further insights into the nature of wider impacts derived from The Data Lab activities.

5.3 Assessment of innovation ecosystem benefits.

The evaluation objectives include an assessment of how effective each IC has been in building engagement in its own ecosystem. The approach to assessing the role of ICs within the wider innovation ecosystem is set out in Appendix A, and summarised for The Data Lab Figure A. 2 (authors' scoring).

Figure A. 2 The Data Lab innovation ecosystem benefits.



Source: authors

System Leadership

Leadership

- The Data Lab started slowly but has since established itself as a strategically important resource for Scotland, championing data science and AI, connecting businesses to academia (and vice versa), supporting the pipeline of data scientists and building the data community. It has demonstrated strong leadership for the sector, with stakeholders universally praising the first The Data Lab Chief Executive and the appointed successor, promoted from within The Data Lab.
- The trust of the Scottish Government in The Data Lab is demonstrated in their appointment as overseers of the AI Strategy development process. The Data Lab is a highly valued partner of SG and has engaged extensively with other public partners and projects [7][72]. The Data Lab also leads on several areas of critical interest to the Scottish Government, notably through managing funding calls. Examples include Applying Space Data to the Net Zero Economy call where SE's Space National Programme and Scottish Government have announced funding for 12 projects with 11 companies. Other calls have been taken forward in partnership with other ICs (see partnerships below).
- When questioned directly, 18% of The Data Lab clients stated that The Data Lab had been a significant source of support for the wider innovation ecosystem in terms of providing strategic

leadership for the sector or technology area. This is strong feedback, given that The Data Lab works across so many different sectors. In addition, more than a third (36%) of The Data Lab clients stated that The Data Lab had been a significant source of support for their establishment in terms of acting as a source of sector or technology expertise.

Influence

- The role of The Data Lab in helping to deliver the AI Strategy should not be underestimated, and the influence of the AI Strategy on the data science and AI sector will increase over time. Progress towards the implementation of the Strategy is reported upon annually (see for example[4]), with a forward from the Scottish Government, including progress against eight Programmes of activity, from the AI Playbook (including refresh of the Data Capabilities directory) and the Developing Scotland's approach to AI and Children.
- The Data Lab's influence has gone beyond Scotland. The IC has worked Alan Turing Institute on a major UNICEF project that sits under the 'Developing Scotland's approach to AI and Children' part of the AI Strategy, demonstrating that The Data Lab is successfully moving into the larger and more strategic projects, with benefits that go well beyond economic benefits. As The Data Lab matures, it can further increase its influence through an even greater range of strategic projects).
- Questioned directly, a moderate level of 16% of The Data Lab clients stated that The Data Lab had been a significant source of support for the wider innovation ecosystem in terms of effective policy or strategic influence. This is likely to increase over time; the implementation of the AI strategy, launched last year, should help more The Data Lab clients understand the role The Data Lab is playing with regards policy and strategic influence.

Partnerships

- The Data Lab are also very good at partnership working and collaboration. As one independent Board member for The Data Lab puts it "The Data Lab are outstanding at collaboration" [72]. This takes the form of building links and support for SMEs, microbusinesses and students through its network and (now) new online community platform to building links and partnerships with international organisations (like UNICEF) and global data leaders (JP Morgan, Accenture etc.). The Data Lab have a very "can do" style, making it easy for organisations to do business with them, and with a solutions-driven ethos.
- The Data Lab is a key partner in the delivery of the Edinburgh and South East Scotland City Deal (ESESCD) and has become part of the Bayes Centre eco-system in the City Region, allowing The Data Lab to work with new partners. It has also strengthened its partnership working with Colleges, including via Data Skills Gateway collaboration. The Data Lab's 'Data Skills for Work'[5] and Data Education in Colleges are developing a working relationship where The Data Lab has access to (and is repurposing) new College level courses (NPA, PDA) for work training.
- The extent of collaborative activity is evident through the MEF, where more than 200 collaborative projects have been completed, with more ongoing. These are drawn from a variety of Universities and across a wide range of sectors.
- The Data Lab is active in partnering with other ICs, with examples that include: the Michelin Innovation Challenge 2 call (with CENSIS and Dundee City Council) funding for four projects with five companies; the launch of collaborative innovation academic Calls, one in support of DHI's Healthy Ageing Innovation Cluster and the other in collaboration with CENSIS on energy

[4] State of AI Report 21-22 — Scottish AI Alliance

[5] Data Driven Innovation (DDI) Data Skills gateway, and delivered by The Data Lab. The programme provides a Data Skills Credits Scheme which provides funding to support individuals to upskill and reskill, and employers to develop their workforce and increase managerial understanding of data science, machine learning and AI.

management. The Data Lab has approval for SE's Personalised Nutrition Innovation Challenge Call (within SE's Health for Wealth National Programme) in partnership with HIE (a £100,000 investment).

- The Data Lab has also developed a specific Partner Programme, which now has eight members (with a value of £178,000), with verbal agreements with a further three organisations and advanced discussions with a further four.
- Questioned directly, almost one in four (23%) of The Data Lab clients stated that The Data Lab had been a significant source of support for the wider innovation ecosystem in terms of acting as a strategic partner e.g., developing or sustaining new strategic or longer-term partnerships. In addition, 20% of The Data Lab clients stated that The Data Lab had been a significant source of support for their establishment in terms of supporting the development of trust between their organisation and other organisations in their sector/technology area. In all, 16% of clients indicated a joint venture with business, 13% with an academic institution and 10% with the public sector.

System Strengthening

- In working across a wide range of activities and partners, The Data Lab is system strengthening the ecosystems as it continues to be build a stronger data community in Scotland. There is a growing alumni, which is combining with others to expand the data community, which is starting to go beyond Scotland internationally. It now (Feb 2022) has 2,371 members from 55 different countries, growing 17% in the latest quarter 'a true international community' [72] which is starting to lead to its own third party data networks (there are now four external sub-communities for Scottish Government, SE (space), Edinburgh College and Glasgow Caledonian University). The Data Lab is extremely strong in terms of its networking opportunities for clients and students, including through the annual Data Talent event, which typically attracts more than 300 delegates, an opportunity for The Data Lab-supported students to showcase their placement work and for businesses to exhibit and recruit.
- The pandemic has shown what can be done remotely and The Data Lab have increased their online offering as it continues to strengthen the data science/AI community. The Data Lab is growing its resources, from CPD and Executive Education to its own platform for online learning (rather than via HEIs where The Data Lab have limited control over outputs/processes) as well as its resource and support for the broader data community. The Data Lab is already considering its next phase, which may include a Data Academy approach.
- When asked directly, 27% of The Data Lab clients stated that The Data Lab had been a significant source of support for the wider innovation ecosystem in terms of fostering synergies and networking within their sector or technology area. The survey of The Data Lab clients also pointed to engagement with a wide range of higher education institutions, particularly the University of Edinburgh, but more widely with the University of Strathclyde, Glasgow University, Heriot-Watt University, University of Aberdeen, Robert Gordon University and the University of Stirling.
- The survey of The Data Lab clients also demonstrates a positive contribution to a collaborative culture with The Data Lab playing a significant role in developing client relationships with a wide range of bodies relevant to the innovation ecosystem, e.g., 34% of respondents indicate The Data Lab has significantly supported clients to developed better relationships with universities or colleges, and 15% with government or public research institutes. The client survey also shows the value of The Data Lab in promoting networking benefits to The Data Lab clients 29% of clients cite new academic contacts and 26% new business contacts.

System Resources

Visibility

- The Data Lab also scores highly in terms of visibility, with stakeholders praising their work across Scotland, including their work in the Highlands and Islands, where the first DataFest was launched (in Inverness in 2018) which was a great success [70] (with further fringe events across Scotland and the main Data Summit in Edinburgh). The Data Lab have benefited from strong Business Development manager activities, although this continues to need to be invested in, to continue and develop relationships [70]. Still, The Data Lab are visible at many levels, from Scottish Government to academic institutions to the business community, and increasingly through its online Community Platform.

- Events over the two Phases are too numerous to mention, however these have covered a wide range of topics and issues, from Data Engineering (Silicon Valley Data Science), Machine Learning (BigML) and Data Science skills (The Data Incubator). Stakeholders frequently highlighted the ongoing (and growing) visibility of DataFest [48, 10], most recently a hybrid online and face-to-face week-long event (including two-day Data Summit) in November 2022.
- When questioned directly, 35% of The Data Lab clients stated that The Data Lab had been a significant source of support for the wider innovation ecosystem in terms of raising the profile of the sector/technology area within Scotland. In addition, 15% of The Data Lab clients stated that The Data Lab had been a significant source of support for the wider innovation ecosystem in in terms of raising the profile of the sector/technology area internationally. Further, 24% of The Data Lab clients stated that The Data Lab had been a significant source of support for their establishment in terms of supporting improved visibility within sector/ technology area.

Resources

- The Data Lab continues to build resources which are available to supported clients. The development of online course content has already been highlighted and The Data Lab offers a broad range of MOOC and CPD and Executive Training courses. The IC also provides support to students as part of The Data Lab supported MSc and PhD courses with The Data Lab helping connect students to others (70% of students reported this positive outcome from support). There is a growing alumni, as highlighted, which benefits from resources made available by The Data Lab for members.

- Amongst The Data Lab clients, 17% stated that The Data Lab had been a significant source of support for their establishment in terms of supporting the sharing of common resources. Many of the resources are made available (e.g., via events) through the four The Data Lab hubs of Glasgow, Edinburgh, Inverness (covering the Highlands and Islands) and Aberdeen). The number of clients benefitting (directly and indirectly) from The Data Lab resources is likely to increase as the AI Strategy is implemented and further resources are available to the private and public sectors.

Leverage

- The Data Lab works with a very wide range of private and public sector partners. Leverage includes from contributions from major international organisations, such as UNICEF, and major private sector businesses, such as JP Morgan. These strategic players are contributing more than their direct contribution to collaborative projects, they are bringing expertise and insight into collaborations with SMEs and to the wider work of The Data Lab. The Data Lab Partner Programme (with eight partners currently which may become 15 in the near future) will have value of more than £250,000.

- The Data Lab is increasingly involved in strategic projects and a good example is the £53.8m Manufacturing Made Smarter Challenge (UK Government Industrial Strategy Challenge Fund) project to create a Smarter Manufacturing Innovation Data Hub (SMIDH). This is led by the

University of Ulster with a range of partners including University of Cambridge, Energy Systems Catapult, Manufacturing Northern Ireland, Sector Development Wales, Scottish Engineering, ATOS and others. The Data Lab has secured some £884,000) to lead the delivery data science and community parts of the project and the project puts The Data Lab at the heart of a major UK project to facilitate Smarter Manufacturing which includes a £5m Innovation Fund within it (and where The Data Lab can maximise Scotland's benefit within the consortium). As The Data Lab matures, it can further increase its influence and leverage in further public and private investment in these ways, and clearly has the market and stakeholder credibility to achieve this. Public sectors partners clearly trust DataLab to deliver for them, with the IC delivering the TORCH SME consultancy programme for Scottish Enterprise as a stand-alone project, supporting 39 projects.

- Questioned directly, a modest level of The Data Lab clients (14%) stated that The Data Lab had been a significant source of support for the wider innovation ecosystem in terms of promoting investment and leverage of resources into the sector/ technology area from within Scotland, with 11% stating that The Data Lab had done so from outside Scotland.

Knowledge

- The Data Lab is making excellent use of the knowledge that exists in the academic base, as well as growing its resources internally through its Data Scientists. Further, The Data Lab has also been very active across a number of skills development areas, including:

    - The Data Lab Masters (which was relaunched in October 2022 as The Data Lab Academy). The Data Lab has supported more than 800 master's students across 12 universities since 2015, as well as 30 data and AI courses in Scotland which provide employability and skills training to help students to enter the world of work. The Data Lab estimate 300+ have been placed into industry in Scotland on paid internship with over a quarter of these continuing with the host organisation into longer term employment. This is supported by the evaluation survey evidence.
    - The industrial doctorate programme has provided co-funding with industry partners to provide fully funded PhD and EngD scholarships.
    - Professional Development, including the Data Leaders Programme and Women in Data Science, a partnership between The Data Lab, Equate and CodeClan.
    - Data Skills for Work (funded by the Data Driven Innovation (DDI) Data Skills gateway) and delivered by The Data Lab. Since 2020, 460 learners have received funding to support their learning via Data Skills Credits, either directly or via their employer, with 32% of those having identified as BAME.
    - A wide range of additional dissemination and engagement events.

- When asked directly, 27% of The Data Lab clients stated that The Data Lab had supporting knowledge development and dissemination (e.g., new courses, university or college networks, attraction of talent). Further, a range of knowledge benefits are identified by The Data Lab clients, as discussed above, for example, 24% indicate improved technical understanding of priority technology areas in their sector. Further, almost one third of The Data Lab clients (32%) stated that The Data Lab had been a significant source of support for their establishment in terms of supporting diffusion of knowledge and good practices.

Commercialisation

- With regard to supporting activities leading to commercial or public sector exploitation, the client survey has demonstrated a wide range of innovation investment by The Data Lab clients. As highlighted above, some 56% of The Data Lab clients have invested in internal R&D, with The Data Lab playing a significant role for 41% of these, and 27% had introduced new or

significantly improved services. The client survey therefore supports the view that The Data Lab support plays a significant role in much of this activity.

- The fostering of new technologies and experimentation with clients is also evidenced by a strong contribution to the advancement of project TRLs, with 50% of clients stating that The Data Lab was 'very' or 'extremely important' in advancing their project TRL.

- In all, 15% of The Data Lab clients stated that The Data Lab had been a significant source of support for the wider innovation ecosystem in terms of encouraging experimentation and commercialisation in Scotland (e.g., start-ups, spin-outs, testing of new technologies, demonstrating new technology or processes). This is a moderate level although it reflects that much of the project work is of internal benefit to supported clients.

- The Data Lab also provides skills support for commercialisation. The Data Driven Entrepreneurship (DDE) is an online course developed by The Data Lab and Edinburgh Innovations which focuses on the entrepreneurial journey, giving insights on what it takes to be successful and the role that data and AI can play in supporting that success.

6 Delivery and value for money.

6.1 Governance and management arrangements.

After the award of funding in 2014, The Data Lab became fully operational in 2015, and has been hosted by the University of Edinburgh since this time, providing a continuity of host arrangements. In common with other ICs, the University of Edinburgh, as host institution, employs all The Data Lab staff and handles all financial matters, including the receipt of core funding, the contracting and financing of all research funds, and others matters.

The Data Lab is subject to University of Edinburgh policies and procedures on Human Resources and Finance and falls within the scope of University of Edinburgh audit and compliance arrangements.

All matters of strategy and operation are under the control of The Data Lab Governance Board, which takes decisions on HR, financial, audit, risk and compliance issues as required in line with University policies, drawing on professional advice from relevant University staff when required. The University of Edinburgh has representation on The Data Lab Governance Board. There is high calibre representation on The Data Lab Board, and those consulted were enthusiastic and motivated to help support and steer The Data Lab and 'to help continue the good work of The Data Lab to date' [10].

As well as the Governance Board, and Responsible for formulating, directing and guiding the implementation of the policies and strategies, The Data Lab has:

- Innovation Advisory Board, responsible for advising on collaboration project activity, reporting to the Governance Board ("IAB"); and the
- Education Advisory Board, responsible for advising on educational activity, reporting to the Governance Board ("EAB").

The Data Lab also has a Management Board, responsible for implementing the policies and strategy as well as all day-to-day management, reporting to the Governance Board. Board members praised the strength of the Management Team, including the role of the new Chief Executive, Brian Hills, following the 'very excellent' contribution of the previous Chief Executive, Gillian Doherty [48, 10]. The Data Lab Management Team was praised for its timeliness and depth of information of its Board Papers.

Stakeholders noted challenges in recruitment and retention (a common theme across ICs), in particular, challenges associated with offering competitive salaries. This can be a particular issue for The Data Lab, especially in relation to salaries in the private IT sector and related sectors (e.g., finance).

Recruitment has also been a challenge given the success of The Data Lab in drawing in additional funding, requiring new activity to be delivered (e.g., recruitment for the Smarter Manufacturing project). As with other ICs, the view of stakeholders was that it would be beneficial for the organisation to have a longer funding window to ease planning and staffing considerations [48].

There are very high satisfaction levels with The Data Lab support amongst supported clients, notably:

- 100% satisfaction with IC membership (paid or free).
- 100% satisfaction with business development support.
- 100% satisfaction with support for a consultation process.
- 98% satisfaction with training and development support.
- 96% satisfaction with post-graduate placements.
- 96% satisfaction with IC conferences and events.
- 94% satisfaction with advice and signposting.
- 92% satisfaction with collaborative project support (one partner).
- 87% satisfaction with collaborative project support (more than one partner).

Marginally lower levels of satisfaction (although still high):

- 72% satisfaction with consultancy support projects.
- 50% satisfaction with lab, test or demonstration facilities (small number of cases).

The high levels of client satisfaction reflect the high levels of professionalism amongst The Data Lab team and staff. Satisfaction levels are also high amongst students participating in The Data Lab supported courses. In all, there was 76% satisfaction with the support provided by The Data Lab through the duration of their course.

6.2 Monitoring and evaluation.

Throughout Phase 1 and Phase 2, the funders received quarterly progress reports, and monitoring data has been readily made available. The Data Lab has provided funders with range of quantitative metrics providing both internal and external stakeholders with regular KPI updates, typically at appropriate levels of detail. There has been a greater level of detail supplied in relation to activities across the three key pillars of support (collaborative projects, skills and talent, community), with particularly strong reporting around the community engagement activities, compared to outcomes (jobs and turnover). Jobs included in the reporting are those (gross) forecast by supported projects.

An SE stakeholder acknowledged that there was a challenge in developing a MEF that supported adequate governance at the same time as being consistent across ICs and straightforward enough for practical use. The issue is regarded as “not fully cracked” [30]. Board members have praised the level of information (and dashboard style presentation) of KPIs and progress towards these.

In line with other ICs, reporting of often significant wider benefits is solely qualitative in nature at this time and the programme MEF would benefit from revision to capture wider benefits though the identification of appropriate qualitative and quantitative indicators and methods.

6.3 Value for money.

This section of the report sets out the main findings of the evaluation with regard to value for money.

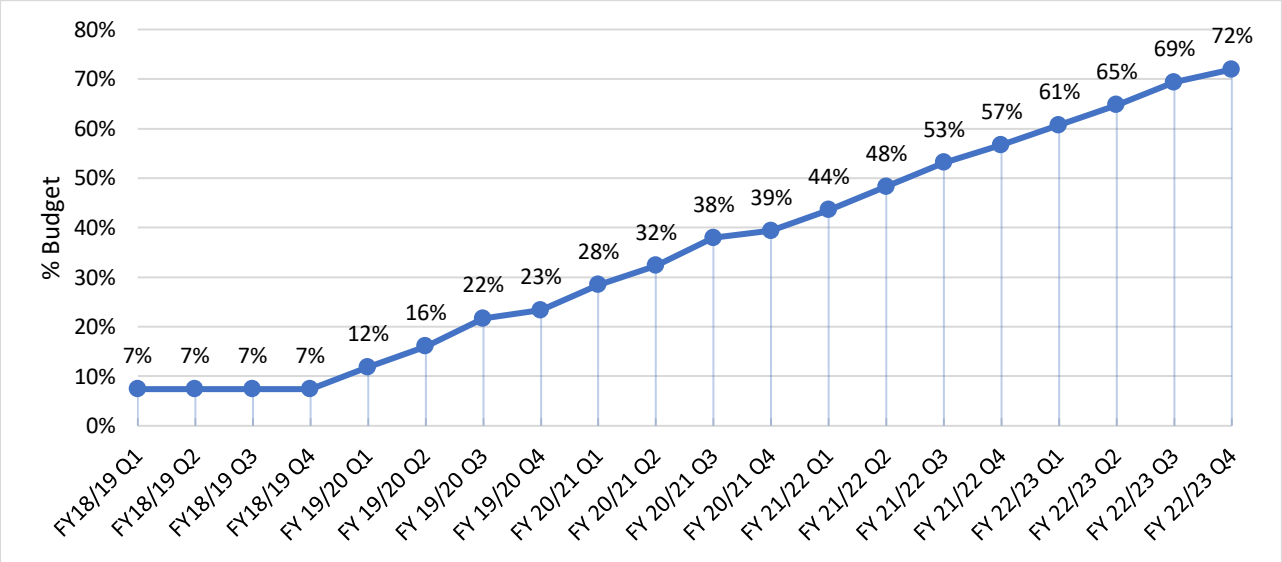
6.3.1 Limitations.

The overall programme MEF provides a limited framework of quantitative metrics that can be used to assess VfM. The main body of the report discusses the limitations in greater detail. This report uses the latest financial data available, i.e., to Dec 2023 and /or March 2023.

6.3.2 Budget execution.

Total Phase 1 spend is as £11.2 million. Funder budget drawdown is used as a proxy for expenditure. Phase 2 budget execution is noted in the table below (see Table A. 12). Quarterly drawdown is approximate. Some 72% of the funder budget has been drawn down for the period up to March 2023 with IC spend on track for the remainder of Phase 2.

Table A. 10 DataLab budget execution.



*Source: SFC, SE, HIE correspondence ('Summary funders awards and drawdowns to date', excel spreadsheet, Feb 2023). * funders indicate awarded at outset of Phase 2.*

6.3.3 Finance mobilised.

Finance mobilised (public or private) is not recorded as a specific MEF indicator. Here, it is assessed as all recorded MEF commitments (project and centre combined), excluding all funder commitments. MEF commitments are presented as supplied by the IC.

On this basis, some £13.4 million was mobilised over Phases 1 and 2. Of this, 66% was industry finance. Comparing funder inputs (to Dec 2022) to finance mobilised, this indicates an estimated leverage of £20.5 million to £13.4 million, or 0.78:1 (benefit to cost ratio). For industry finance mobilised this is 0.4:1 (see below).

Table A. 11 Finance mobilised TDL, to Dec 2021/22.

	Phase 1	Phase 2	Total
Higher Education Institutes	£1,897,795	£300,000	£2,197,795
Other Public	£-	£-	£-
Industry	£4,759,411	£4,000,000	£8,759,411
Other	£2,415,181	£-	£2,415,181
Total	**£9,072,387**	**£4,300,000**	**£13,372,387**

Source: MEF.

6.3.4 Cost per impact measure.

It is important that value for money assessments consider programme effectiveness, that is, the relationship between the intended and actual results of public spending. In other words, what are the higher-level outcomes / impact of the programme and at what cost. In this regard, two impact measures are examined: jobs and GVA. It is acknowledged that all ICs to a greater or lesser extent,

have a focus on wider environmental, health, social benefits, and therefore these impact measure do not capture all of the benefits of ICs.

However, assuming costs as funder inputs of £20.5 million to December 2022, The Data Lab net additional peak employment of 343 equates to £59,833 per additional job. Similarly, funder input to net additional GVA equates to a benefit to cost ratio of 1.6:1.

Table A. 12 **Cost per job, The Data Lab.**

	Employment	Cost per job
Net Additional Employment (peak)	343	£59,833
Net Additional Employment (peak) (no multiplier)	191	£107,448

Source: authors.

Table A. 13 **GVA ratio, The Data Lab.**

	GVA	Benefit: cost Ratio
Cumulative Net Additional GVA , Constant Prices, Discounted	£32.5m	1.6:1
Cumulative Net Additional GVA (no multiplier), Constant Prices, Discounted	£18.1m	0.9:1

Source: authors.

6.3.5 Equity.

Analysis of responses to the client survey reveals that respondents operate across a wide range of sectors, with the most frequently cited being information and communication (22% of respondents), professional, scientific and technical activities (14%); public administration and defence (8%); manufacturing (6%); education (6%); and human health and social work activities (6%).

The respondents were also distributed across Scotland with 53% from the cities of Edinburgh and Glasgow; 10% from Aberdeen City and Shire, and 5% from the six Local Authority areas within the Highlands and Islands. Students attended The Data Lab-supported courses across Scotland, with the highest proportion of respondents from University of Stirling (27%), followed by the University of Strathclyde (20%), Robert Gordon University (12%) and University of Glasgow (12%), indicating the reach of The Data Lab across Scotland.

7 Progress against targets and objectives

7.1 Targets.

As of Phase 2, year three Q3, The Data Lab has exceeded a large proportion of its 5-year targets (for more than two thirds of the indicators, The Data Lab is on track, or has already exceeded its 5-year targets). Below, 22 of the 35+ indicators are presented, with good progress against targets for consortia bids and leverage, business support projects (including Pathfinder projects), signposting and events. Progress has been more challenging for the skills and talent activity, given Brexit and Covid which have reduced demand. Despite these challenges, a strong skills development programme has been supported, with MSc and CPD qualifications on track or ahead of target and with a growing suite of activity with Colleges (see below).

Table A. 14 The Data Lab, Progress against targets.

KPI (selected)	Phase 2 to Jan 2023	full-life 5 year target	Status
Transformational Projects & Leverage			
Project Consortia Bid Supported (*excluding MSc and PhD projects*)	125	106	Exceeded
Transformational Projects	1	10	Not yet achieved*
Leverage into Projects	53.4m	20.0m	Exceeded
Business Support and B2B Projects (to year 3 quarter 3)			
Companies assisted through signposting (< than 4 hours)	1113	1475	On track
Companies assisted through signposting (> than 4 hours)	181	193	On track
Pathfinder Projects identified	31	25	Exceeded
Pathfinder Projects Identified and Supported	21	20	Exceeded
General Events targeting demand side businesses	311	232	Exceeded
Other Collaborative Projects (to year 3 quarter 3)			
Total Collaborative Projects	55	104	Not yet achieved
Academic Collaborative Projects	38	48	On track
Total Business CI projects (data scientists)	22	34	Not yet achieved
Total Projects Occurring in HIE area	14	10	Exceeded
Skills and Talent			
Number of MSc Entrants to Training/education	528	665	Not yet achieved
Number of PhD Entrants to Training/education	13	20	Not yet achieved
Number of MSc Entrants Gaining a Qualification	453	575	On track
Number of students completing MOOCs	6286	6500	On track
Community and Events (to year 3 quarter 3)			
Engagements with Data Assets and Infrastructure	138	100	Exceeded
Scottish Businesses Attending DataFest events	1652	1000	Exceeded
Events targeting demand side businesses (SE area)	238	182	Exceeded
Events targeting demand side businesses (HIE area)	184	86	Exceeded
Events featuring The Data Lab speaker (outside Scotland)	57	36	Exceeded
Number of SDI International Projects Supported**	5	10	Not yet achieved

*Source: The Data Lab (2022) CEO Report to Funders, Q3, 2021/22; * The Data Lab report 19 possible transformational projects; The Data Lab, the Board and Funders have not as yet agreed what constitutes a transformational project, this will be determined at a later date; ** SDI International Projects are typically International Learning Journeys that The Data Lab partner on, these have been impacted upon by the Covid-19 pandemic.*

7.2 Assessment of achievements against objectives.

As outlined in main report, the author's identified 10 objectives at programme level, taking the objectives set out in the Phase 1 Call for Proposals and Phase 2 Business Planning guidance as a starting point. The table below explores The Data Lab's focus on these 10 programme objectives (see below).

Table A. 15 The Data Lab achievements against objectives

Objective		Explanation of rating
O1: Direct businesses to support	High	The Data Lab supports collaborative projects, both involving one partner and more than one partner. Its Data Scientists mean the IC can support project activity that is a The Data Lab/business project, and allows the IC to provide a range of different support, including consultancy.
O2: Build and promote ecosystems & sectors	High	The Data Lab has grown the data community and supporting ecosystem considerably in the latter stages of Phase 1 and into Phase 2. It has forged links with many sectors - and as a cross-sector IC - this is appropriate. There are close links with finance and human health sectors, but also activity across housing, energy and engineering/manufacturing. The Data Lab can continue to grow these links. The Data Lab's Community Platform is an innovative approach to growing the data science ecosystem that now has 2,000+ members and four sub-communities. The Data Lab Partner Programme is another example of growing the ecosystem and of deepening relationships and developing its service offering that goes beyond the partner and which benefits the wider ecosystem.
O3: Drive business growth	High	The Data Lab makes some very important differences to supported businesses and organisations, for both businesses and the public sector in terms of efficiencies. It improves processes and reduces costs in many projects; there could arguably be an even greater focus on driving business growth as part of the project support.
O4: Win external funding	High	The Data Lab has secured a number of important contributions from external organisations, including the NHS and UNICEF, and is participating in the £54m SMART manufacturing project taken forward by Northern Ireland HEIs. This is a new phase of activity for The Data Lab - and it can grow and nurture its strategic project activity. The new The Data Lab Partner programme is securing additional partner funding and the IC has secured additional partner funding through a variety of Calls (including in the Space and Health spheres)
O5: Solve industry problems	High	The Data Lab projects are very much about identifying solutions, whether this is looking at how data is used to do thinks better, or whether new data and data analytics can help find new solutions (e.g., in cancer innovation).
O6: Address major policy priorities	High	The Data Lab has been at the forefront of the development (and now delivery) of the AI Strategy. Its challenge is to be of maximum relevance across the policy priorities of Government- however it is well placed to take this forward.
O7: Secure inward investment	Moderate	There is considerable partnership working between The Data Lab and industry, including major players in finance and data. It can translate more of these connections into inward investment in the form of facilitating larger business investment, including into collaborative projects with SMEs The Data Lab have worked closely with SDI throughout supporting inward investment enquiries and have been active with and without SDI in London and North America in particular,
O8: Enhance public services	Moderate	The IC works extensively with industry, and this is its principal focus. Nonetheless, there are projects which have benefited public services and between a quarter and a fifth of The Data Lab collaborative projects are with the public sector. There are major projects with public sector partners that include the NHS and The Data Lab continues to be a valued partner of Scottish Government. Going forward, further strategic projects could be developed that explicitly look at societal issues and public service provision.
O9: Develop skills	High	The skills development programme of The Data Lab is a major area of work for the IC and one that is valued by both students and industry. Engaging businesses to participate as placement hosts on the MSc programme is an important success; this has ensured the MScs are industry-relevant, has given the student a fuller MSc with real industry experience, and often resulted in a job at the end benefitting both employer and student, keeping talent in Scotland.
O10: Develop next generation	High	The IC is looking constantly at innovative process that enable Scotland to realise its future ambitions, including those relating to a fairer society and net zero ambitions. It is harnessing academic and industry expertise in support of this.

Source: authors

8 Impact case studies.

8.1 Case 1. Trade in Space.

Introduction.

Trade in Space was founded in 2019 that uses satellite and distributed ledger technologies to deliver 'Transactionable Insights' to supply chain organisations, enabling them to make critical supply chain management and sourcing decisions and to establish direct access to global markets. The company started by working with South Australian grain farmers and "quickly included coffee and cacao into our verticals". Their flag-ship product, Sustainimaps, helps maintain deforestation free supply chains for some the largest coffee and cacao producers. The company has knowledge in sustainable supply-chain monitoring systems, and blockchain applications.

Engagement.

Trade in Space had some awareness of The Data Lab prior to engaging with them, given their close physical proximity in Glasgow's Innovation District, although the company did not initially take up support. Trade in Space had been focused on cereal production but were encouraged (by what is now a major investor) to look at applying their technology to coffer production – and it was at this point that Trade in Space made contact with The Data Lab. The company needed machine learning algorithms to help detect coffee in fields, using data from satellite imagery.

Support for collaboration.

Trade in Space therefore approached The Data Lab with a targeted research problem. Critically, The Data Lab were able to accelerate the project with the company working alongside The Data Lab on a collaborative project. The potential new investor (seeking to apply the project to the coffee market) put in £20,000 and the overall project value was in the region of £50,000. The project 1) developed the machine learning algorithm to detect quantities of coffee in the fields, which needed a specific format to add to the exist technology of Trade in Space and 2) developed the product framework.

Crucially for the company, The Data Lab project only took a couple of months. The Data Lab were able to suggest the right academics to do the project. Trade in Space admit they would not have known who within the University sector to ask. The project required dedicated and specific expertise i.e., an ability to develop an algorithm utilising data to identify the exact combination of four different bands of colour which mark the presence of coffee.

Market failure rationale

The Data Lab project helped overcome a critical market failure for Trade in Space who would not have known who to approach within the University sector for the specialist support they needed (information failure). Trade in Space naively thought that having an interesting project would be sufficient to engage an academic; whereas academics have existing commitments and priorities. The Data Lab were able to navigate this space and involve the right academics. The funding available through the project also helped to bring down the costs of innovation, particularly given that the company was at an early stage and needed to prove the new algorithm could work effectively.

Satisfaction

Trade in Space were extremely satisfied with the support provided by The Data Lab. The IC were able to identify and broker the right academic input, and the project was sufficiently timely to meet the demands of the potential investor. The project was a big milestone for the company: "it gave us a solid understanding" of the required machine learning output, sufficient to develop a product that worked with different satellite images with higher resolution.

Innovation benefits.

As a result of The Data Lab project, the potential investor who contributed £20,000 to the collaborative project indicated they would make seed investment in Trade in Space. This was the start of a journey of growth for Trade in Space. The company has subsequently invested more in internal R&D and invested further in training and skills development for innovative activities. The project directly led to the introduction of new products and processes.

Wider benefits.

The project has the potential to deliver considerable wider sustainability benefits. The major interest in identifying the exact location of coffee using the Trade in Space technology is that more sustainable approaches to coffee (and now cocoa) production can be adopted. By pinpointing the exact location of coffee, producers can locate closer to existing transport links and labour supply and avoid the need for deforestation. This is the true 'prize' from The Data Lab collaborative project: sustainable coffee and cocoa production that brings very major carbon reduction benefits internationally.

Impacts and additionality.

Trade In Space report the idea of working with coffee companies "would have fizzled out without The Data Lab". The Data Lab project has been critical to the growth of the company and Trade in Space is still using the outputs from the collaborative project in working with other clients. The company now has nine employees (it was a young start-up company when it first engaged with The Data Lab) and is expecting another growth spurt from another round of fund raising expected later in 2023. One employees is based in Colombia and the company is now exploring East Africa as a new market opportunity.

The sustainability benefits of the technology are now taking centre stage and it is the ability of producers to say (with certainty) that they are sustainable producers that is giving the technology the market edge. The investor company has committed to a Corporate Sustainability Policy and is seeking to understand better how the environmental regulatory landscape works internationally to be able to sell the approach to more producers. Interestingly, the company has gone back to the academic pool accessed by The Data Lab to source this expertise.

Conclusion.

The Trade in Space academic to business collaborative project facilitated by The Data Lab has been a considerable success that has directly led to seed investment and turnover and employment growth. It was both the importance of the technology developed – and the speed at which the solution was developed – that was of critical important to its success.

8.2 Case 2. Cancer Innovation Challenge

Introduction.

The Data Lab have been encouraged by funding partners to increase their involvement in strategic, transformational projects which may have wider societal benefits as well as economic ones. The Cancer Innovation Challenge is an example of such a project.

The project was designed "to tackle one of the most important health challenges of our time – caring for people with cancer. Its aim was to help the NHS in Scotland use data to refine diagnosis, select treatments and improve the experience for patients"[6]. The Cancer Innovation Challenge brought together The Data Lab with the Digital Health and Care Institute (DHI) and Precision Medicine Scotland (then called Stratified Medicine Scotland). It received £1 million of funding from the Scottish Funding Council

[6] The Data Lab.

Engagement.

Two open innovation funding competitions formed the core of the Cancer Innovation Challenge. Using the Innovate UK Small Business Research Initiative framework, two-phased funding calls were issued to organisations for:

- New approaches to record and integrate cancer patient reported data; and
- Innovative data science solutions to improve cancer care and outcomes in Scotland.

More than a hundred registrations of interest were received, and 48 applications were submitted from companies across Scotland, UK and the EU. Eight companies were funded for the Phase 1 feasibility stage and three companies were funded to continue to Phase 2 to develop and evaluate their solution.

Alongside the funding competitions, the Challenge also included a programme of activities and events involving industry, the public and a variety of stakeholders in the wider health sector range. These included public engagement events, hackathons and technical and stakeholder workshops.

Support for collaboration.

This competition asked the question "How can data science be applied to existing NHS Scotland data to improve cancer patient care and outcomes?" The Data Lab were heavily involved in this part of this part of the competition. Scotland provides a unique test bed for exploration into innovative technological solutions to accessing large volumes of data pertaining to patients' demographics as well as their pathways to diagnosis, treatment and long term follow up.

The goal of this challenge was to develop solutions using existing NHS Scotland data to improve cancer patient care and outcomes in Scotland. Proposed solutions were expected to achieve at least one of the following broad objectives:

- Enable analysis of unstructured data (e.g., clinical notes, medical imaging)
- Enable data driven clinical decisions.
- Enable data driven service improvement in the NHS.
- Enable data driven recruitment for clinical trials.
- Enable the adoption of precision medicine approaches.

Innovative approaches to these challenges were expected to incorporate data science techniques from fields such as predictive analytics, visualisation, machine learning, natural language processing; and processing of structured and unstructured data.

Three projects were awarded Phase 1 funding for a three-month feasibility study which ended in June 2018. One project was awarded further Phase 2 funding for the development and evaluation of their solution. Phase 2 commenced in July 2018

Market failure rationale.

The market does not find it easy to develop solutions for which it cannot readily charge for good, and services produced, and developing patient reported outcome and experience measures in relation to cancer treatment and recovery does not lend itself to chargeable services, although there may be downstream commercial applications of the solutions developed. Rather, the Cancer Innovation Challenge sought to overcome the market failures associated with the high innovation costs of developing solutions and the wider 'public good' and societal benefits associated with improving cancer treatment and recovery.

Satisfaction.

Companies benefiting from the Phase 1 and Phase 2 CIC funding benefited from the financial support available to develop solutions, and the support of The Data Lab (and the other two ICs) in supporting project activity. Project beneficiaries greatly appreciated the opportunity to develop solutions. The projects were:

- Jayex, who engaged with NHS National Services Scotland (NSS) and NHS Lothian stakeholders to design and build a Clinical Access Platform (CAP) able to integrate with the national data infrastructure and Scottish Cancer Registry. It complemented its functionality through real-time cancer data access for clinicians and policymakers, and focused on haematology cancers where there was limited existing data;
- Sharpe Analytics, with a project to estimate the life-expectancy of patients suffering from metastatic cancers, using state-of-the-art machine learning techniques and harnessing the power of Scottish Cancer Registry and in-patients data sets; and
- Canon Medical Research's Automatic RECIST measurement in mesothelioma by deep learning project, working with mesothelioma physician and researcher, Professor Kevin Blyth, from the University of Glasgow, Canon Medical Research developed what was at its time the first fully automated system for measuring the mesothelioma tumour volume on CT, and ultimately the volumetric change during treatment.

Five companies were also supported in the other competition for new approaches to record and integrate cancer patient reported data, including My Clinical Outcomes (MCO), a health technology platform to help doctors remotely track patients' quality of life in between clinic visits and OWise, an award-winning mobile app and website developed to support people with breast cancer and more recently also prostate cancer. Sitekit sought to increase patient-reported data to improve the treatment, care, and personal outcomes for young people with cancer.

Innovation benefits.

Those undertaking supported projects delivered a wide range of innovation benefits, from increased levels of internal R&D in their business to greater levels of skills development for innovative activities. Companies delivering projects were able to grow their applied knowledge of data and health, improving their technical understanding of priority technology areas.

Wider benefits.

The purpose of the Challenge was to develop solutions to the challenges presented by those suffering from and/or recovering from cancer. As such, all outcomes from the competition were geared to improving health outcomes in society. The projects have led to varying levels of application in the healthcare sector, with some notable impacts described below.

Impacts and additionality.

Many of the supported projects have gone to become further developed. For example, Sitekit, since the CIC, has developed its own datastore and is involved in several large-scale interoperability projects to enable the infrastructure for connected, untethered personal health records. Sitekit has added functionality to eRedbook (electronic Personal Child Health Record, running on the Lifebook platform) that enables local health authorities to send digital application forms and questionnaires to parents,

The challenge also delivered a world first in Canon Medical Research Europe's deep learning powered automated RECIST assessment for Mesothelioma. The system, which is based on deep learning, was trained, optimised and then externally validated using a more comprehensively annotated, and larger set of CT images than any previous semi-automated algorithms developed for this task.

Since the completion of the Challenge project, it has been presented at multiple conferences including Data Talent Scotland, the SINAPSE annual conference and the CDT in Applied Photonics annual conference. It has been the topic of discussion at multiple booths, and the focus of several news articles and television reports. Since completing phase II, the technical approach developed was presented at Bioimaging 2020, and published in extended conference proceedings. The two Ph.D. students working on the project have since completed their doctorates new potential research leader.

Conclusion.

The Cancer Innovation Challenge is an example The Data Lab administering and supporting innovation competitions in the data science space. The Data Lab were able to provide support to project applicants and connect them to academia. The success of the Challenge has resulted in public sector partners, including Scottish Government, SE and HIE to support The Data Lab to run further calls for projects, such as in the area of Space.

8.3 Case 3. Grand Bequest

Introduction.

Founded in February 2020, Grand Bequest Ltd aims to save vacant buildings to be redeveloped and put back into use. The process of reusing buildings has largely been disconnected and so, in a bid to tackle the current system and the number of old buildings currently falling into disrepair, the property tech company sought to help homeowners and city councils overcome the financial and operational obstacles of restoring historical real estate to their former glory. Grand Bequest claims to be "the world's first AI-driven platform for vacant buildings to be redeveloped and put back into use".

Engagement.

The COVID pandemic was an extremely challenging time to be starting a business. The Chief Executive had already established Grand Bequest as a B Corp (see below) but was aware that they needed a data platform and required technical expertise to take the idea forward. The company engaged The Data Lab and participated in a collaborative project in order to design and develop the data platform. Grand Bequest have also benefited from The Data Lab's skills development of pipeline and through wider activities and support, for example in relation to data science community connections.

Support for Collaboration.

The Data Lab developed a technical roadmap to turn Grand Bequest into an integrated, modern data platform - making it much more accessible. Getting connected to the right suppliers, finding funding and data expertise was essential to scale the business. "The Data Lab [...] really believed in how data could be used to solve this social problem".

The data platform brings together members (enthusiastic individuals, owners or community group members wanting to get involved and move a project forward), partners (professionals looking for exciting projects to work on) and sponsors (Stakeholders seeking to help and have social impact in communities). The Data Lab project (and the business idea) is designed to remove the complexity and support members "in every step of the process".

Market failure rationale.

The Grand Bequest is aware of the benefits of data, perhaps more than many other young companies. Their nine strong team includes two data scientists and a data analysis, alongside other functions such as marketing. However, the company needed support to help maximise the use of data and to ensure that data underpinned the business. The costs of developing the innovative solution was prohibitive but the company did not know how to navigate the Scottish funding landscape. As importantly, Grand Bequest did not know where to go to access the right data science expertise in the right form.

Satisfaction.

The Grand Bequest have been highly satisfied with the support from The Data Lab. "I have been able to get grant funding, people and PR. The Data Lab is like my fairy godmother!" says the Founder. The Data Lab provided a high quality and timely solution, facilitated increased data science capacity in the business and showed the company what was possible.

Innovation Benefits.

The 8-9 strong team includes two data scientists and a data analysis, alongside other functions, a team that has been bolstered as a result of engaging with The Data Lab. Several innovation benefits are evident from the Grand Bequest working the IC including greater levels of internal R&D, training and skills development for innovation, recruitment for innovative activities, design activities and market introductions of innovation.

Wider benefits.

The company has achieved B Corp Certification which "doesn't just evaluate a product or service; it assesses the overall positive impact of the company that stands behind it". The Grand Bequest is part of the B Corp community which means the company has achieved the highest standards of social and environmental impact. The Data Lab project has contributed to the company's growth and objectives (by helping develop the data platform) and in turn to its ability to deliver wider impacts.

Further, Grand Bequest has benefited from.

- market and technical understanding of its priority technology areas;
- understanding of growing the business;
- awareness of other public sector support;
- awareness of academic capabilities;
- employee skills and ways of working;
- cross-industry collaboration;
- industry or technology foresighting; and
- awareness of wider societal goals.

Impacts and additionality.

Funding and guidance from The Data Lab allowed Grand Bequest to trial different software and undertake data science training – gaining critical learnings in the early days of the company. They received support with promotion, networking, as well as guidance on navigating the Scottish funding landscape to find the cash needed to build the product.

Following an introduction by The Data Lab, Marc van Neerven joined Grand Bequest as Chief Technology Officer who helped to move their database onto the new integrated Azure platform.

Participating in The Data Lab's MSc and PhD placement programmes introduced data analytics and statistical knowledge to the company. It has allowed them to go from a start-up founded just before the pandemic to being a team of eight individuals – all working together to promote the redevelopment of the many vacant buildings that exist in Scotland and give them a new lease of life.

Conclusion.

Grand Bequest has benefited hugely from the support from The Data Lab for their collaborative project and through the additional data skills capacity The Data Lab were able to bring to the business. The company effectively utilises data and The Data Lab have helped show them the power of data for driving and achieving business growth.

9 Conclusions.

The conclusions and lessons are structured around the seven high level objectives of the evaluation.

Assessing the extent to which ICs have delivered routes to economic benefits through increased levels of collaboration between industry and academia.

The Data Lab is providing routes to economic benefits through its collaborative activities, and many clients report that The Data Lab is increasing internal R&D and leading new and improved services (and to a lesser extent products). The Data Lab's MSc Programme is valued by businesses/

organisations and by students; this is providing a pipeline of Data Scientists which has benefited from industry readiness work provided by the IC. The work of The Data Lab in developing the data community is continuing to grow and develop. Net additional jobs and GVA impacts amongst supported clients are moderate, and job impacts from The Data Labs skills development support are good.

The Data Lab has a strong rationale for supporting data science and AI activities in Scotland, given the considerable market opportunities and Scotland's expertise in computer science. Phase 2 represents a scaling up of activities from Phase 1 and the three central pillars of the approach - collaboration between academic/The Data Lab and industry/public sector, skills and talent support and building the data community remain in place. The continuation of the pillars of support into Phase 2 are a recognition of the appropriateness of the approach. As well as an increase in activities in Phase 2, there has been a conscious effort to undertake some strategic/ more transformational projects, indicative of the expertise within The Data Lab.

Assessing the role each IC has played in supporting colleges and universities to maximise their value to Scotland.

The evaluation provides evidence of the considerable programme of activity around engagement, networking and collaborative project activity between academia and industry. Completed collaboration projects have grown in number in Phase 2 (348 date) when compared to 266 in the whole of Phase 1, with The Data Lab also involved in deeper, more transformational projects, further making use of academic expertise. The review also highlights the very substantial role The Data Lab plays in skills development activities, particularly at MSc level, including placements, despite challenges associated with Brexit and Covid impacting upon delivery.

Projects supported by The Data Lab are wide-ranging, touching on many different sectors, illustrating how wide data and the use of data have become to all businesses. This presents both an opportunity and a challenge for The Data Lab in seeking to reach more businesses in more sectors and to connect them to even more academic capabilities. However, through its community building and skills development activities, there is an ever-expanding network of data scientists in Scotland, which can help position Scotland well for the future.

The Data Lab has successfully grown the Data Science and AI community in Scotland, both directly through its project, skills development and community building activities, and more indirectly in terms of shaping policy and making links between organisations and sectors. Some stakeholders directly attribute the increase in industry knowledge about the potential of data (in moving beyond simple spreadsheet approaches to data management) to something far more advanced, effective and embedded [7].

Examining performance against targets and achievement of objectives.

The Data Lab is performing well against targets, with many of the 5-year business engagement and events, collaborative projects and business support targets already met. The Data Lab is also continuing to deliver a very strong skills development programme of activity in challenging circumstances. The Data Lab have centred their activities in Phase 1 and 2 on three central pillars: Collaborative Innovation Projects; New Skills and Talent; and Community Building. This has been an effective approach, with The Data Lab Data Scientists providing project support to industry and public sector service providers, as well as connecting with the strong academic base that exists in Scotland.

This report concludes that The Data Lab delivers good value for money when MEF outputs and survey outputs are considered for unit costs in relation to entrants to education in particular. There is good additionality – and good job outcomes – in relation to students into employment following The Data Lab-supported MSc and PhD support which is not fully reflected in the net additional jobs reported by The Data Lab clients. Rather, it is clear that The Data Lab is playing a strong role in the employment readiness of students and in strengthening the wider sector for data science and AI.

Exploring how effectively each IC builds engagement with the innovation ecosystem.

The Data Lab have established themselves as an extremely important resource for the Data Science and AI community. The Data Lab has effectively engaged in the ecosystem and actively supported Universities and Colleges to maximise their value for Scotland through some 500+ collaboration projects between business and academia. The Data Lab have been able to communicate the value of data that goes beyond what was previously more basic business intelligence for many businesses. The IC has worked across many sectors, and with both the core SME base and larger private and public sector organisations. It has established a good reputation with Scottish Government and with funders and stakeholders. The Data Lab is helping to shape and deliver strategic support for data science and AI in Scotland.

Identifying wider impacts

The Data Lab has delivered a broad range of wider benefits, both for clients, in terms of progressing levels of TRL and business solutions and in terms the *societal benefits of data driven approaches*. The Data Lab increasing its influence and involvement in transformational projects. It has helped oversee the development of Scotland's AI Strategy and will is key its implementation. The Data Lab has moved, in Phase 2, into more strategic project activity, in the spheres of children's data, health and smart manufacturing, and there is scope to develop more strategic projects whilst retaining core benefits for SMEs and industry more generally. The Data Lab can develop stronger links with even more sectors, building on the activities to date. The Data Lab has delivered support across Scotland, and events and projects in the HIE area are ahead of target.

Assessing the degree to which IC benefits have reached all parts of Scotland.

A survey of The Data Lab clients supported MEF evidence of widespread collaborative engagements between industry and academia, with The Data Lab reach extending well beyond the Central Belt, in particular to Stirling and the North East. Whilst just over half of the surveyed clients responding were from the cities of Edinburgh and Glasgow, one in 10 was from Aberdeen City and Shire, and one in 20 from the six Local Authority areas within the Highlands and Islands. Students attended The Data Lab-supported courses across Scotland, with the highest proportion of respondents from University of Stirling (27%), followed by the University of Strathclyde (20%), Robert Gordon University (12%) and University of Glasgow (12%), indicating the reach of The Data Lab across Scotland

Identifying lessons learned from IC operations.

There is strong feedback from stakeholders on the benefits of The Data Lab, which has evolved as the sector evolves. It must continue to do so, and to ensure that there remains a focus on the impact of its activities, which can be and should be monitored effectively. The Data Lab has learned from the experience in Phase 1 and extended its reach to more collaborative projects, and to a larger number of transformational projects. It is building a strong wider network through the Community Platform and developing deeper relationships through its Partner Programme.

The Data Lab continues to build its reputation and has strengthened its relationship with the Scottish Government, its agencies and partners beyond Scotland, including international charities such as UNICEF. It has learned the value of participating in major strategic projects, notably the multi-partner SMART manufacturing project and of working to promote Scotland internationally, either directly with SDI or through its own activities. The Data Lab has continued to deliver its skills pipeline activity, continuing to recognise its value, and has learned that the industry-readiness component of support – and the placement activities – are of greatest value to industry. The Data Lab has continued to translate academic expertise in data science and AI into more sectors of the Scottish economy.