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Appendix C. CENSIS.

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1 Introduction.

CENSIS is Scotland's Innovation Centre for sensing, imaging and Internet of Things (IoT) technologies. The Centre works with private and public organisations of all sizes to de-risk and accelerate innovation and overcome technology barriers to achieve business transformation.

CENSIS was established in 2013 following a successful application to the IC programme co-ordinated by the University of Glasgow. The centre delivered Phase 1 activity between 2013 and 2018 and when this evaluation was complete, CENSIS was concluding their Phase 2 period, with a funding extension taking it through to July 2024.

The main report and appendices draw on a range of evidence, primarily MEF data, survey evidence, stakeholder feedback, and case studies. For some individual ICs, the number of survey responses is comparatively low, and the associated results are indicative. Please see Appendix A for further detail.

2 Development and approach.

2.1 Main elements of Phase 1.

The University of Glasgow responded to the Call for Proposals issued by Scottish Funding Council (SFC) and submitted a detailed proposal[1]. The proposal focussed on sensor and imaging systems (SIS) and highlighted that in 2012 the Scottish SIS industry generated approximately £2.3 billion per annum from a base of 130 companies.

The proposal highlighted that "*the potential for growth is substantial if we can accelerate innovation in our companies with the support of our academic community, whose combined research portfolio relevant to this sector is valued at approximately £70 million across 90 research groups*". The proposal articulated a vision for the Centre as an "*internationally renowned, business-driven centre for innovation in sensor and imaging systems, recognised for the economic impact achieved by the creative partnership between its industrial, academic and user community member*".

Targets offered for the five-year Phase 1 period included:

- Delivering a minimum of 150 collaborative R&D projects valued at £13 million.
- Supporting growth in the number of SMEs working with HEIs, delivering at least 45 R&D projects, leading to 18 instances of IP licensing and nine new products to market.
- Helping Scottish businesses secure a minimum of 75 grants.

The proposal requested £11 million from SFC and predicted that leveraged funding would equate to £69 million, with a Gross Value Added (GVA) forecast impact of between £223 million and £778 million. A detailed Operating Plan for 2013 to 2018 was also submitted which included programmes and resource plans for major workstreams including marketing, collaborative project activity and governance. The Plan included detailed financial forecasts.

[1] Source: Scottish Funding Council (2012) Call for Proposals

2.1 Main findings from Phase 2 due diligence.

The core funding partners of SFC, Scottish Enterprise (SE) and Highlands & Islands Enterprise (HIE) commissioned Optimat to review the Innovation Centre's Phase 1 activity to inform the funding allocation for Phase 2. Their Technical and Commercial Due Diligence Report was produced in October 2017[2]. The report was completed in the last year of Phase 1 and presents analysis of actual and forecast performance.

Key findings included:

- The Centre experienced a slow start from an operational perspective and had to invest considerable effort to inform and educate industry on sensors and imaging systems.
- The project value and centre income targets had been met, with the exception of in-kind contributions.
- The Centre's monitoring and reporting activity was fragmented. Optimat reported that '*the gathering, monitoring and evaluation data does not provide sufficient information to robustly analyse the economic impact.*'
- The Centre planned to extend its focus in Phase 2 to encompass all IoT technologies and shifting its emphasis from the supply side to the demand side with a view to increasing the number, scale and scope of projects.

Optimat concluded that the Centre has '*developed a strong reputation and is regarded as a valuable asset by the industry and academic community. It is believed to offer added value both a technical perspective. There is strong support for CENSIS to receive continued funding for the next 5 years.*'

2.1.1 Main elements of Phase 2 business plan.

A short-form business plan[3] was finalised in March 2018 and took account of feedback from the Due Diligence Report and feedback from SFC, SE and HIE.

The plan highlighted that the IoT market size for Scotland has an estimated value of between $12 billion and $37 billion by 2025. CENSIS highlighted that their experience from Phase 1 suggests that '*companies will frequently engage in a small, confidence building and de-risking, project to begin with, followed by a more substantial first collaborative development.*' Phase 2 activity would include a focus on second and third stage project development with the aims to: create awareness; build capacity; reduce risks; and accelerate execution.

The plan committed CENSIS to the delivery of 181 projects of which 80 (44%) would involve CENSIS working directly with industry without involvement of academics. This reflects a significant income generation target of £3 million. The plan contained a commitment to continue to leverage the academic base as a '*major engine for industrial innovation.*' CENSIS received a Phase 2 extension to July 2024 with SFC providing an extra £1.1 million; SE an extra £0.325 million; and HIE an extra £0.05 million.

2.1.2 Evaluation Logic model.

CENSIS's current approach is summarised in the figure below (see Figure A. 1). The model was developed by the authors and was informed by a detailed activity map developed in partnership with CENSIS.

[2] Source: Optimat (2017) Technical and Commercial Due Diligence: CENSIS Phase 2
[3] CENSIS (2018) CENSIS Phase 2 Revised Short Form Business Plan

Figure A. 1 CENSIS logic model.

Source: authors

As detailed in the logic model in Figure A. 1, CENSIS addresses a range of market failures and makes a strong contribution to the Innovation Centre programme's focus on increasing the number of domestic SMEs engaged in collaborative R&D. CENSIS makes a strong contribution to eight of the ten identified programme objectives developed by the authors to support the evaluation. The logic model shows that CENSIS has a lower focus on objectives nine and 10. In relation to objective nine CENSIS opted to stop supporting an MSc programme in Phase 2. As such their work to support the next generation of innovators (objective 10) has also been marked by the authors as an area of lesser focus compared to the other eight objectives.

3 Market failure rationale and strategic fit.

3.1 Market failure rationale.

As briefly summarised in the logic model, CENSIS appears to contribute to the Innovation Centre programme's equity objectives, and addresses a range of established market failures.

The authors were not provided with management data detailing the profile of clients supported by CENSIS, and this limited the depth of analysis that could be undertaken to underpin the assessment of market failure. The analysis of market failure therefore draws on information provided by CENSIS and the analysis of responses to the client survey. it is noted the Phase 2 business plan submitted by CENSIS did not explicitly highlight market failures.

Firstly, in relation to **equity objectives**:

- Business size: there is a strong rationale to support smaller firms as businesses with over 400 employees accounted for over half of Business Enterprise Research and Development (BERD) expenditure in Scotland. CENSIS appears to have a strong focus on supporting smaller businesses. It is noted there has been a focus as time has gone on of joining up with a wider consortium of medium-large businesses as shown on the Strength in Places Digital Dairy project, as well as continuing to support smaller businesses. The Centre often utilises its in-house engineering team to help businesses undertake their first innovative project. CENSIS regularly works with small businesses, building their innovation capability and capacity to the point where they can undertake collaborative R&D activities with academia and the public sector.
- Business ownership: as outlined in Chapter 2, over half of R&D expenditure in Scotland was from foreign-owned firms. CENSIS do not routinely collect data on business ownership and the client survey did not seek this information either. It is therefore not possible to draw any meaningful conclusions on this matter.
- Business location: as outlined in Chapter 2, the cities of Edinburgh and Glasgow account for nearly half of Scottish BERD spending. CENSIS works across Scotland and has a staff member based in the Highlands, directly supporting the agenda of Highlands & Islands Enterprise. The client survey asked respondents to provide their location and analysis reveals that 43% were from the cities of Edinburgh and Glasgow; 9% from the six Local Authority areas within the Highlands and Islands; and 44% from elsewhere in Scotland. So, whilst four in 10 clients are based in the two major cities, six in 10 are based elsewhere suggesting CENSIS is supporting businesses in areas with lower levels of BERD spend.
- Business sector: as highlighted in Chapter 2, BERD expenditure in the 'Professional, scientific and technical activities' sector (£460 million) accounted for almost a third (32.0%) of the Scottish total with 'Manufacturing' accounting for almost a quarter of the Scottish total (24.9%). BERD is therefore dominated by a small number of sectors and there is a rationale to focus support on sectors with low levels of innovation expenditure. Analysis of client survey data highlights that 21% of respondents operate in either 'Professional, scientific and technical activities' or 'manufacturing.' 3% of respondents didn't know which sector they operated in of the remaining 76% most were in 'other' (21%) followed by 'information and communication' (18%); with the rest spread across another six sectors. On this basis CENSIS does appear to be supporting sectors that typically display lower levels of BERD expenditure.

Then in relation to **efficiency** CENSIS directly addresses the following market failures:

- Externalities - the completion of successful research and development leading to the development of new products, services and processes can deliver wider economic, environmental and societal benefits that are not exclusively received by the businesses and

organisations that innovate. Stakeholders were able to identify a range of wider societal and environmental benefits arising from collaborative project supported by CENSIS. Client survey respondents were asked whether they had made a significant contribution to the United Nation's Sustainable Development Goals as a result of working with CENSIS, and: 18% of respondents cited a significant contribution to climate action; 14% of respondents cited a significant contribution to good health and well-being; and 14% of respondents cited a significant contribution to sustainable cities and communities.

- Information failures – stakeholders identified that CENSIS understands how businesses and academics operate and brings them together and support collaborative R&D. This addresses imperfect and asymmetric information failures. Respondents to the client survey were asked which of a series of potential barriers had significantly constrained their innovation activities before working with CENSIS. 41 respondents answered this question, and many barriers relate to information failures including: 'lack of information on technology' (27% of respondents); 'lack of information on markets' (18% of respondents); and lack of access to academic expertise (16% of respondents).

- Public goods – CENSIS enables collaborative R&D which delivers benefits that are not commercial in nature and flow beyond the individual organisations and businesses involved. Examples include offering advice to universities and public sector organisations; referring these groups to wider sources of support; and informing the development of Government policy. Stakeholders highlighted numerous such examples including one who outlined that CENSIS had supported them to deploy sensors as part of an environmental monitoring scheme which seeks to improve understanding to inform water extraction rates [30].

Finally, CENSIS supports **wider objectives** relating to institutional failures; co-ordination failures; and opportunity. CENSIS is particularly effective at addressing co-ordination failures through the formation of innovation activity that includes industry, academia and the public sector. In relation to opportunity, CENSIS is directly supporting the improvement of public services and assisting in the transition to net zero.

3.2 Strategic fit.

The phase 2 Business Planning guidance issued by SFC, SE and HIE set out that Centres should '*deliver routes to economic benefits through increased levels of collaboration between business and academia which target business or sectoral growth and/or improved delivery of public services in Scotland.'*

CENSIS facilitates increased levels of collaboration between business and academia, and supports the improved delivery of public services in Scotland. This view is supported by interviews with stakeholders. An academic stakeholder stated that '*in my experience CENSIS has the most effective engagement and support model. CENSIS achieves a seamless integration of academia and industry*' [27]. In relation to public services, another academic stakeholder stated that *'CENSIS has been successful in engaging the academic base to work on major challenges including mitigating climate change'* [31]. Another stakeholder highlighted that CENSIS had supported them to deploy sensors as part of an environmental monitoring scheme which seeks to improve understanding to inform water extraction rates [30].

As highlighted in the logic model (Figure A. 1) CENSIS makes a strong contribution to eight of the ten programme/evaluation objectives. CENSIS achieves an effective balance across the objectives. For example, the Centre delivers a range of activities which boost the ecosystem. This includes the annual Tech Summit which in 2022 had Andy Stanford-Clark, IBM's Distinguished Engineer for the Internet of Things, Master Inventor and Quantum Technical Ambassador as the keynote speaker. CENSIS also established CENSIS Technology Solutions (CTS) which aims to establish new products, new markets and build new supply chain and commercial opportunities for local companies. CTS takes proof-of-

concept solutions and IP developed by CENSIS and partners and produces certified, production-established designs then licenses them to the market.

Over Phase 2 CENSIS has increased its focus on supporting Scottish Government to deliver national priorities. CENSIS is directly contributing to numerous Scottish Government key strategies and plans, including:

- Safe, Secure and Prosperous: A Cyber Resilience Strategy for Scotland (2015).
- Life Sciences Strategy for Scotland (2017).
- Scottish Government Economic Action Plan (2018).
- Cyber Resilient Scotland: Strategic Framework (2021).
- A Digital Strategy for Scotland (2021).

CENSIS works closely with the Scottish Government's Digital Directorate and is involved in the delivery of major national programmes including the Cyber Security programme and CivTech – an initiative which works with organisations across Scotland to define complex problems and convert them into challenges which businesses are invited to bid for funding to develop solutions.

3.3 Covid response.

CENSIS, like the other Innovation Centres, experienced a challenging operating environment during the period 2020-22 as a consequence of the Covid-19 pandemic. Prior to the pandemic the CENSIS staff team were delivering considerable face-to-face engagement and had to modify their approach considerably.

CENSIS focussed on informal outreach and created meetings focussed on a chat over coffee. These virtual meetings typically attracted around 30 people and a diverse range of topics were covered including the effective use of technology in forestry and use of technology in cycling. These coffee chats enabled CENSIS to reach out informally and reach people they had not previously engaged with. The coffee chats are still running and continue to enable CENSIS to maximise outreach.

One of CENSIS's major successes throughout the pandemic was the co-design and joint delivery of the Countdown to COP26 online event. The event was delivered in partnership with Scotland's other Innovation Centres in the programme and the Herald and explored innovation, inclusive growth and cultural change around climate action. The event, held in November 2020, was Chaired by Scottish Enterprise's Head of Climate Enterprise and included plenary speakers, themed sessions, presentations, panel discussions, Q&As, networking and virtual exhibitions. Over 2,000 people attended the Countdown to COP26 event, and it was recognised by stakeholders interviewed for this evaluation as a major success in that it fostered increased collaboration across the Innovation Centres and focused effort on addressing climate change.

In February 2021, CENSIS published a document setting out its focus and priorities for economic recovery. The document highlights a plan to '*drive productivity improvements, create and safeguard high-value jobs, and contribute to a fairer, greener, more resilient and more entrepreneurial economy and society.*' The document commits CENSIS to thre areas:

- Accelerating impactful partnerships – with a focus on areas including creating multiple higher and further education engagement activities with industry and public sector.
- Contributing to missions – namely tackling the climate change emergency; developing future healthcare; and, enabling missions through digitalisation and IoT adoption.
- Supporting exploitation of place – with a focus on seizing opportunities to use digitalisation and IoT innovation to support economic development and population growth, retain talent and attract investment.

4 Inputs, activities and outputs.

4.1 Inputs.

The table below confirms the funding that Scottish Funding Council (SFC), Scottish Enterprise (SE) and Highlands & Islands Enterprise (HIE) have provided to CENSIS across both Phases.

Table A. 1 CENSIS inputs to March 2023

	Phase 1 Spend	Phase 2 Award*	Phase 2 Actual to Date	Total Spend to Date
SFC	£11.3 million	£7.30 million	£6.3 million	**£17.6 million**
SE	-	£1.70 million	£1.5 million	**£1.5 million**
HIE	-	£0. 25 million	£0.20 million	**£0.20 million**
Total	**£11.3 million**	**£9.25 million**	**£7.93 million**	**£19.3 million**

*Source: SFC, SE, HIE correspondence ('Summary funders awards and drawdowns to date', excel spreadsheet, Feb 2023). * Excludes Phase 2 extension amounts of £1.7 million (SFC, SE, HIE). Total £10.93 million award inclusive of extension.*

4.2 Activities and outputs.

Skills.

As highlighted in Table A. 2 below CENSIS has supported an increased number of PhD students in Phase 2 (10 compared to four in Phase 1) but has not supported any master's students in Phase 2, as they opted to stop the MSc programme. Table A. 3 shows that as of June 2022 CENSIS has reported one individual gaining new qualifications or skills. As highlighted earlier, CENSIS is not supporting master's in Phase 2 but has supported 10 PhDs. One of these 10 PhDs has completed within the period reported.

It is noted that CENSIS have delivered a range of additional, broader skills related activities:

- Curriculum Development.
- Co-Funded PhD projects.
- Student Projects & Mentoring (including master's programme).
- Student Hackathons.
- Hands-on Technical Workshops (cross industry-academia).
- Student Entrepreneurship Training.
- Internships.
- Guest Lectures.
- Best practice guides and whitepapers.
- College course development (IoT Installers).
- Online learning course development (e.g., NMIS).
- University Advisory boards participation.
- Drop-in IoT Centre & Vision Lab.
- STEM outreach presentations.
- STAC business support for spin-outs.

Table A. 2 CENSIS: number of entrants to education/training.

Level	Phase 1	Phase 2 (up to June 2022)	Total
PhD/EngD	4	10	**14**
MSc	46	0	**46**
HND/HNC	0	0	**0**
Other	0	0	**0**
Total	**50**	**10**	**60**

Source: MEF

Table A. 3 CENSIS: number of individuals gaining new qualifications/skills.

Level	Phase 1	Phase 2 (as of June 2022)	Total
PhD/EngD	4	1	**5**
MSc	46	0	**46**
HNC/HND	0	0	**0**
Other	0	0	**0**
Total	**50**	**1**	**51**

Source: MEF

Networking and ecosystem linkages.

As highlighted in Table A. 4 below, CENSIS has delivered a significant uplift in the number of engagement events delivered in Phase 2 (up to June 2022). The number of events with between 10 and 100 attendees has risen by 111% (from 54 to 114).

In Phase 1 CENSIS signposted 120 businesses to other innovation ecosystem partners. In Phase 2 the number of businesses signposted to the funders has dropped significantly and CENSIS report that this reflects that the majority of supported firms are already connected to Scottish Enterprise or Highlands and Islands Enterprise. However, a large rise in signposting to the market is indicated with 49 businesses receiving this follow-up in Phase 2 up to June 2022, compared to just six in Phase 1.

It is noted that these figures are for post-project delivery/follow on from completed collaborative projects and do not capture signposting earlier in the relationship, that is at for pre-project / pipeline activities, where introductory meetings may result in a referral or third party introduction. The authors note that HIE do not view incoming referrals from CENSIS as a key target, and instead HIE refers businesses to CENSIS and maintains close communication to assess progress.

Table A. 4 CENSIS: number of engagement events led or delivered by IC.

Level	Phase 1	Phase 2 (up to June 2022)	Total
> 100 Attendees	5	11	**16**
10-100 Attendees	54	114	**168**
< 10 Attendees	0	0	**0**
Total	**59**	**125**	**184**

Source: MEF

Table A. 5 CENSIS: follow on from completed collaborative projects.

Level	Phase 1 (138 projects delivered)	Phase 2 (up to June 2022) (129 project delivered)	Total
Signposted to SE	54	2	**56**
Signposted to HIE	6	0	**6**
Signposted to other public funding/support body	24	3	**27**
Signposted to private sector	12	0	**12**
IC supported follow-on project planned or underway	12	19	**31**
Direct to market (by a business in Scotland)	6	49	**55**
Projects not taken forward	6	2	**8**
Total	**120**	**75**	**195**

Source: MEF

Collaborative projects.

Table A. 6 below highlights the number of collaborative projects reported by CENSIS through MEF returns. Two rows have been marked with no information available (NIA) as CENSIS does not record information on academic-to-academic collaborations or individual projects. As can be seen the activity levels have risen in Phase 2 compared to Phase 1. The largest relative rise being academic to public sector (from 11 to 20) and academic to public sector to business (from 11 to 25). CENSIS completed 138 projects in Phase 1 and has nearly exceeded this figure as at the of June 2022 with 129 completed collaborative projects. The authors understand that as of October 2022 CENSIS has completed 198 collaborative projects.

Please note that the top two rows in the table refer to Academic/IC to business and the figures include businesses supported solely by CENSIS. Of the 113 Academic/IC to business (involving a Scottish business) projects, 26 have been CENSIS-funded CR&D projects with Scottish HEIs as lead partners. Two of these projects also involved the CENSIS Tech Team in collaborating with the HEI partners to reach an end deliverable for the company partner, in addition to the provision of project management. In the 113, there were another 22 externally-funded projects with CENSIS collaborating with HEIs to work with companies, up to July 2022, including a £24.9 million Strength in Places project with two universities and a college partner, and a £12.5 million Industrial Strategy Challenge Fund project with the University of Edinburgh.

As well as the Academic/IC to business (involving a Scottish business) category, it is important to note that some of the "Academic/IC to public sector to business (involving at least one business in Scotland)" projects have also had CENSIS supporting HEIs work with companies or supporting spin-outs from the HEI base.

Table A. 6 CENSIS: collaborative projects.

	Phase 1	Phase 2 (up to June 2022)		
	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 a Scottish business)	112	113	0	75
Academic/IC to business	1	15	0	13
Academic / IC to Academic	N/A	N/A	N/A	N/A
Business to business (involving a Scottish business)	3	8	0	8
Academic/IC to public sector	11	20	0	13
Academic/IC to public sector to business (involving a Scottish business)	11	25	0	20
Individual Projects	N/A	N/A	N/A	N/A
Total	**138**	**181**	**0**	**129**

Source: MEF

Commercialisation.

Table A. 7 below, highlights the number of collaborative projects that led to commercial launch or application. In Phase 1 CENSIS enabled 120 collaborations through to launch and up to June 2022 the Centre has reported 140 in total. CENSIS has increased the number of collaborative projects that led to new products (72 to 87), processes (6 to 15) and improved public services (6 to 12) but there has been a reduction in the number of new services (24 to 19) and business models (12 to 7).

Given the data below we can state that the completion of 129 collaborative projects in Phase 2 (up to June 2022) has led to the intention to launch 87 new or improved products (67% of all completed projects); 19 new or improved services (15% of total completed projects); and 15 new or improved processes (12% of total completed projects).

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

Level	Phase 1	Phase 2 (as of June 2022)	Total
New or improved products developed (with/for a business in Scotland)	72	87	**159**
New or improved processes (with/for a business in Scotland)	6	15	**21**
New or improved services developed (with/for a business in Scotland)	24	19	**43**
New or improved business models (with/for business in Scotland)	12	7	**19**
New or improved delivery of a public service in Scotland	6	12	**18**

Source: MEF

Further activity insight is drawn from the client survey. In terms of engagement with CENSIS, under half of respondents (46%) first interacted with the IC in or before 2018 (broadly consistent with Phase 1). 80% of client respondents stated that they were still involved with CENSIS, and over a third (35%) have been involved with the IC for five years or more.

There are good levels of collaborative project involvement activity with clients. For CENSIS, 43% of respondents stated that they were involved in a collaborative project between more than one partner including a university or college. 30% stated that they were in collaboration projects between themselves and one partner (again including a university or college). 52% were involved in consultancy projects reflecting demand for, and effective use of, CENSIS's in-house engineering team. The data suggests that CENSIS is indeed engaging with academia in the delivery of R&D projects, as well as making good use of the in-house team.

Just 2% of respondents had taken postgraduate internships/ placements/secondments. Many clients have also accessed lower intensity support e.g., 30% for advice and signposting, 55% conferences and

events, 9% training and development support. Overall, relatively few (14%) had accessed lab, test or demonstration facilities.

For collaborative project support, 25% had worked on four or more projects with CENSIS. More typically clients accessed one or two rounds of IC support (60%). As shown in Figure 2.12, CENSIS clients indicated that they worked with other Centres, particularly TDL (18%) and BE-ST (11%).

The client survey demonstrates engagement with a wide range of universities. Respondents detailed working with 13 Universities in total with the greater level of engagement reported with:

- University of Glasgow (27% of respondents);
- University of Edinburgh (9% of respondents);
- Edinburgh Napier University (7% of respondents);
- University of the West of Scotland (7% of respondents);
- Glasgow Caledonian University (5% of respondents); and,
- Heriot-Watt University (5% of respondents).

A respondent reported that they worked with the University of the Highlands & Islands (UHI) and confirmed that this involved four campus locations: UHI Shetland; Orkney; Outer Hebrides; and Inverness. Only two respondents identified that they were working with colleges through CENSIS, the colleges being the City of Glasgow College and Dumfries & Galloway College.

The client survey data suggests that there is an opportunity to expand the Centre's work with colleges. Particularly given the success achieved in the modest number of engagements to date. For example, a partnership with the City of Glasgow College led to the development of Aquabot - a remotely operated vehicle (ROV) deployed with a range of sensors on a catamaran hull which can be used on large bodies of inland water to enhance water quality monitoring and sampling. An initial prototype was developed by a student at the College, and CENSIS then provided £35,000 which advanced the prototype to a marketable product between June 2020 and October 2021.

5 Outcomes and impacts.

5.1 Main findings from MEF.

Table A. 8 identifies the jobs that CENSIS has reported as having been created and safeguarded for Phase 1 and up to June 2022 in Phase 2. Please note that the figures are estimates obtained by CENSIS from collaborative R&D project applications, and are not verified by beneficiaries. This approach understates forecast jobs as it does not include other activities supported by CENSIS, just collaborative R&D project applications. CENSIS has confirmed that of the 492 jobs created and 178 jobs safeguarded in Phase 2 (up to June 2022) 484 jobs created and 149 jobs safeguarded relate to 26 collaborative R&D projects.

However, as can be seen there is a significant rise (257%) in jobs created (138 to 492) across the two phases, and a modest reduction in jobs safeguarded. The analysis of data from the client survey reveals a net employment peak of 127, or 228 with the addition of a suitable multiplier. If these figures are representative of the population of clients supported by CENSIS, then this would suggest CENSIS delivers net additional employment of 793, or with the multiplier 1,427 On this basis the forecasts provided by CENSIS of 1,002 jobs created or safeguarded across Phases 1 and 2 do not appear unrealistic, and if anything, are understated.

Table A. 8 CENSIS: anticipated jobs supported/created.

Level	Phase 1	Phase 2 (up to June 2022)	Total
New jobs generated (by business in Scotland)	138	492	**630**
Existing jobs safeguarded (by business in Scotland)	194	178	**372**
Total	**332**	**670**	**1,002**

Source: MEF.

Table A. 9 below identifies the new turnover generated and existing turnover safeguarded reported in Phases 1 and 2. The figures are expressed as millions for legibility. In Phase 1 CENSIS used a multiplier on the employment figures to arrive at the turnover figures. In Phase 2 CENSIS obtained forecast turnover figures directly from collaborative R&D project applications. However, the level of turnover forecast at outset of project has risen from £21 million in Phase 1 to £218 million in Phase 2, whereas forecast turnover safeguarded has fallen by £35 million.

In Phase 1 CENSIS used a figure of £154,500 of turnover per job created and a figure of £200,000 of turnover for job safeguarded to arrive at the turnover figures shown above. Dividing the Phase 2 Turnover by jobs created suggest £442,175 of turnover per job created, and the same calculation for jobs safeguarded leads to £22,753 per job safeguarded. This crude calculation may appear to suggest that the Phase 2 new turnover forecast figure provided by collaborative R&D applicants is too high, and suffers from considerable optimism bias. However, rigorous testing would involve scrutiny of each applicant which is outside of scope. There was insufficient turnover data from the client survey to provide any meaningful analysis.

Across both phases CENSIS has only reported two jobs created to support demand led academia-business projects. In the authors' opinion this appears to be an under-representation of the number of jobs created in Universities, colleges and the public sector to support projects facilitated by CENSIS, and reflects the considerable effort that would be involved in accurately collecting such data. This belief is informed by interviews with stakeholders operating in Universities, colleges and the public sector with several highlighting jobs they have created to work on projects supported by CENSIS. Five stakeholders in these sectors indicated more than the two jobs reported by CENSIS between them.

Table A. 9 CENSIS: anticipated turnover supported/created.

Level	Phase 1 (£m)	Phase 2 (£m) (up to June 2022)	Total (£)
New turnover generated (by business in Scotland)	£21,321	£217,550	**£238,871**
Existing turnover safeguarded (by business in Scotland)	£38,800	£4,050	**£42,850**
Total	**£60,121**	**£221,600**	**£281,721**

Source: MEF

5.2 Main findings from survey of beneficiaries.

In terms of influence on relationships, CENSIS has played a role in developing client relationships with a wide range of bodies relevant to the innovation ecosystem. For example:

- 34% of respondents indicate that CENSIS has assisted them to develop relationships with suppliers of equipment, materials, services, or software.
- 32% of respondents indicate that CENSIS has assisted them to develop better relationships with other clients or customers from the public sector.
- 30% of respondents indicate that CENSIS has assisted them to develop relationships with clients or customers from the private sector.

- 20% of respondents indicate that CENSIS has supported them to develop relationships with government or public research institutes.
- 18% of respondents indicate that CENSIS has assisted them to develop relationships with universities or colleges.

Whilst these figures may initially appear low (typically a third of respondents identify that CENSIS assisted them to develop relationships) it should be noted that when asked what barriers they faced to innovation only 16% selected the option 'lack of access to academic expertise or other partnership opportunities.' Furthermore, the figures above, and all figures in this section include 'don't know' responses. Were these 'don't know' responses removed the figures would rise considerably.

This appears to indicate that whilst the role of Innovation Centres in enabling access to academia is highly valued, it is only one of numerous barriers that Centres help clients address. This in turn may support an argument that asking the Centres to focus narrowly on linked businesses to academia would limit their ability to address the wide range of barriers identified by businesses.

CENSIS's clients invest in a wide range of innovation activity. For instance, nearly a third (27%) of client respondents engaged in design activity of some form. Two-thirds (66%) carried out internal R&D since they started working with the IC (and 48% of respondents stated that CENSIS played a significant role in this activity).

A quarter of the client survey respondents reported that they have introduced new or significantly improved services since they started working with the IC and a fifth (20%) new or improved goods. A further 14% had introduced new processes. Respondents also identified whether CENSIS played a significant role in these innovations as follows:

- 20% of respondents in relation to new or significantly improved services.
- 16% of respondents in relation to new or significantly improved products.
- 11% of respondents in relation to new or significantly improved processes.
- 36% of respondents did not introduce any of the listed innovation outcomes.

The Phase 2 MEF data suggests that 129 completed collaborative R&D projects have led to 19 new or improved services (14% of total projects); 87 new or improved products (67% of total projects); and 15 new or improved processes (12% of total projects). On this basis the creation of new or improved products cited in the client survey appears considerably lower than the figure in the MEF. However, the sample size from the client survey was modest with 37 respondents and therefore forms just a small set of the 267 collaborative R&D projects completed across Phases 1 (138) and 2 (129).

In addition, a range of other **networking benefits** were cited (where CENSIS played a significant role):

- New business contacts: 48% of clients.
- New public sector contacts: 36% of clients.
- Joint venture with business: 23% of clients.
- New academic contacts: 32% of clients.
- Joint venture with academic institution: 14% of clients.

Clients also identified a range of **knowledge benefits** including:

- Improved technical understanding of priority technology areas in my sector: 59%.
- Improved market understanding of priority technology areas in my sector: 41%.
- Improved employee skills and ways of working: 25%.
- Improved awareness of academic capabilities: 23%.

Those clients involved in collaborative projects through CENSIS have typically started towards the lower end of the TRL scale with 84% between TRL 1 and 3, and of this 55% between TRL 1 and 2 at

the start (it is noted this may include project work before IC involvement). Respondents identified that by the end of the project, just 10% of respondents were still at TRL 1 to 3 with:

- 30% at TRL 4: small-scale prototype.
- 20% at TRL 5: large-scale prototype.
- 30% at TRL 7: demonstration system.
- 10% at TRL 8: commercially ready.

This indicates that CENSIS has played a major role in assisting clients to advance their innovations with 60% having at least a large-scale prototype at project completion. Crucially, 58% of respondents state that CENSIS has been either very or extremely important in advancing the TRL.

Respondents were also asked to indicate **sales benefits** gained as a result of working with CENSIS, and the most cited benefits were:

- 35% entered or grew in Scottish market.
- 15% entered or grew in other UK market.
- 15% entered or grew in international markets.

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

- 12% gained improved investment readiness.
- 15% secured new public sector investment.
- 12% secured cost savings or more efficient and effective processes.

Respondents were asked whether they would have achieved these benefits without support from CENSIS. In all, 13% say they would not have achieved any of the benefits without support from CENSIS (absolute additionality), whereas 5% say they would have achieved the same benefits at the same time and scale without the IC support (zero additionality).

However, the additionality statement with the highest response (36%) was that '*we would have achieved a significantly smaller range of benefits and at a reduced scale and it would have taken longer to achieve them.*'

5.2.1 Economic impact.

Analysis of the employment data provided by respondents to the client survey reveals a net employment peak of 127, or 228 with the addition of a suitable economic multiplier. If these figures are representative of the population of clients supported by CENSIS, then this would suggest CENSIS delivers net additional employment of 793, or with the multiplier 1,427. However, the estimate is based on a relatively small sample, including a number of very large employers, and should be treated as indicative. Also, these estimates assume a significant degree of direct, indirect, and induced benefits in the economy via the application of economic multipliers (which the MEF estimates do not).

Gross Value Added was calculated using the net additional employment figures. The authors calculate that CENSIS facilitated £157.4 million of cumulative net additional GVA (over 10 years) or £283.3 million with the multiplier. As explored in the value for money section, this represents a strong return on public expenditure on CENSIS, and total expenditure including private sector sources.

5.2.2 Wider impacts.

Stakeholders were asked in the one-to-one interviews if they could identify benefits for each of the main groups that CENSIS supports. A snapshot of identified benefits are provided below:

- Businesses - removal of real and perceived barriers to R&D; translation service which helps businesses understand how Universities operate and vice versa; and increased capacity and capability to undertake future R&D and innovation, with increased technical knowledge.

- Universities - completion of research which boosts Universities' reputation and can be included in Research Excellence Framework (REF) submissions; increased recognition as centre for effective applied research; and support to increase economic, environmental and societal impact.
- Public sector organisations –development of prototypes to achieve proof of concept; support to develop policy and strategy; and support to design, develop and deliver programmes.
- Students – exposure to potential future employers; opportunities to present work at high-profile Tech Summit boosting personal reputation and providing enhanced network of contacts; and development of valuable skills that boost employability and earning potential.

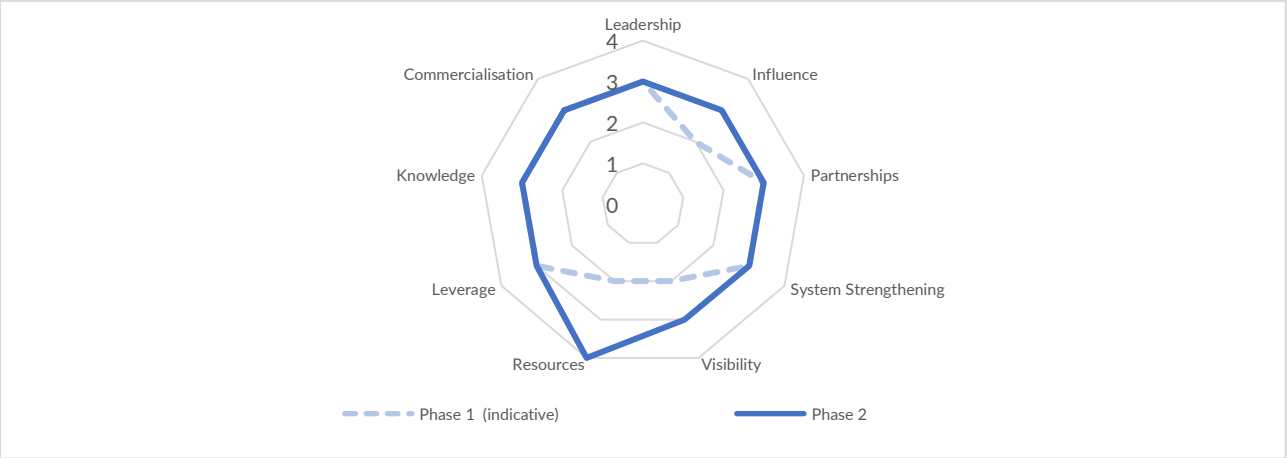
There is evidence that CENSIS is delivering wider societal and environmental benefits. Client survey respondents were asked whether they had made a significant contribution to the United Nation's Sustainable Development Goals as a result of working with CENSIS, and:

- 18% of respondents cited a significant contribution to climate action;
- 14% of respondents cited a significant contribution to good health and well-being;
- 14% of respondents cited a significant contribution to sustainable cities and communities;
- 11% of respondents cited a significant contribution to affordable and clean energy; and,
- 11% of respondents cited a significant contribution to decent work and economic growth.

5.3 Assessment of innovation system benefits.

The approach to assessing the role of ICs within the wider innovation ecosystem is set out in Appendix A, and summarised for CENSIS in Figure A. 2 (authors' scoring). Please note an indicative score has been provided for Phase 1 based on a review of the Phase 1 Due Diligence report, analysis of stakeholder interviews and client survey data.

Figure A. 2 CENSIS innovation ecosystem benefits.



Source: authors

System Leadership

Leadership

- This category explores the extent to which Centres provide strategic leadership and acts as a catalyst for their technologies and sectors.
- Stakeholders were strongly of the view that CENSIS is effective at providing strategic leadership and acting as a catalyst for businesses in a wide range of sectors. For example, an

academic stakeholder highlighted the leadership CENSIS demonstrates in designing and delivering the annual Tech Summits commenting '*individual Universities would not have had the idea for the Tech Summits, and could not have pulled it off to the same extent*' [24].

- Stakeholders identified that senior CENSIS staff sit on a range of Advisory Groups and Boards including for South of Scotland Enterprise (SOSE). Stakeholders also the leadership involved in identifying gaps and filling them with CTS and Scotland's Smart Things Accelerator (STAC).
- 20% of respondents to the client survey stated that the Centre 'provides strategic leadership for the sector or technology area.'

Influence

- This category explores the extent to which Centres inform strategy and action including encouraging partners to commit to shared strategic resources. The MEF data provided by CENSIS highlights that the Centre is involved in some significant projects including the £24.9 million Digital Dairy programme.
- A stakeholder from the lead applicant for this programme interviewed by the authors highlighted that CENSIS played a key role in locating, securing and influencing a range of partners and suggested that 'the programme would have been more one dimensional without CENSIS's involvement' [54]. The stakeholder went onto say that 'CENSIS provides a critical friend role, and this is very useful. They provide advice and are willing to be critical in a constructive way. The networks we are involved in would be nowhere as successful without them' [54].
- Stakeholders highlighted that CENSIS is effective at informing and influencing strategy. An academic stakeholder stated that '*CENSIS has a good relationship with Government, and is close to the Digital Directorate. Government should continue to foster this relationship*' [24].
- A review of qualitative feedback from the client survey reveals the following unprompted comment in relation to influence:
    - '*CENSIS are a very valued partnership to the Digital Office for Scottish Local Government, and as a consequence, Local Government across Scotland. We work in partnership to help accelerate the uptake of IoT in local government to deliver savings and improved outcomes for Councils, and to help to stimulate growth of the sector in Scotland within this important sector*' [the respondent represents a public sector organisation].
- It is noted that 'The Countdown to COP' and 'Contribution to COP' conferences were developed and funded by CENSIS.

Partnerships

- This category explores the extent to which Centres have developed new strategic partnerships, new longer-term partnerships, and facilitated sharing leading to the identification of collaborative opportunities and the diffusion of good industry practices.
- Analysis of the client survey data reveals that respondents are working with a wide range of partners through CENSIS. 43% of respondents stated that they were involved in a collaborative project between more than one partner including a university or college; and a further 30% were collaborating with one partner. Respondents reported working with 13 Universities in total with the majority working with the University of Glasgow, the University of Edinburgh, and Edinburgh Napier University.
- A range of stakeholders stated that CENSIS demonstrates strong partnership working. An academic stakeholder highlighted that CENSIS are supporting them to explore how to mitigate climate change through the study of different land uses [31]. Another academic stakeholder

highlighted that CENSIS '*genuinely seeks to work in partnership, and this includes sending me emails with ideas and opportunities to pursue*' [30].

System Strengthening

- This category tests the extent to which ICs create synergies and facilitate academic to industry networking.
- Stakeholders were of the view that CENSIS is effective at operating the triple helix model and bringing industry, academia and the public sector together creating synergies and facilitating academic-industry networking.
- Analysis of the client survey data reveals that 34% of respondents are of the view that CENSIS is effective at '*fostering synergies and networking within sector or technology area.*' As highlighted earlier client survey respondents identified working with 13 Universities across Scotland and two colleges.
- A review of qualitative feedback from the client survey reveals the following unprompted comments in relation to system strengthening:
    - '*My project is a large multi-partner project that seeks even wider participation - and the excellent network of businesses and academics linked to CENSIS is invaluable - this was also evident in the recent CENSIS conference that we had a stand at*' [the respondent represents a University].
    - '*We have had 3 successful projects with CENSIS and a university partner involving an end user. The project would not have been possible without CENSIS' support. The projects have been a success and results in the project receiving an innovation award*' [the respondent represents a business].
    - '*They have been a key player in the innovation support ecosystem in the Highlands & Islands area*' [the respondent represents a public sector organisation].

System Resources

Visibility

- This category explores the extent to which Centres act as the voice of the sector regionally, nationally and internationally. The category also examines whether Centres support inward investment and engagement in international R&D projects.
- A number of stakeholders specifically highlighted CENSIS's role in delivering the Countdown to COP26 event, and the annual Tech Summits as an effective way to boost the voice of the sector nationally and internationally.
- A review of the client survey data reveals that 45% of respondents believe that CENSIS is 'raising the profile of the sector/technology area within Scotland' with a further 20% stating the Centre is 'promoting investment and leverage of resources into the sector/ technology area from within Scotland.'

Resources

- This category explores the extent to which Innovation Centres have developed physical research and innovation infrastructure and environments or improved organisational capacities or ways of working.
- CENSIS has an in-house engineering team that support businesses and public sector organisations with challenges that do not necessitate academic involvement. A review of qualitative comments from the client survey reveals the following unprompted comments about this team within CENSIS – '*very professional team that exactly met our requirements*' [a business]; '*CENSIS has provided expert advice in technology, introduced us to manufacturers and*

other to enable us to exploit the potential of our project activity' [a third sector organisation]; and '*very switched-on and knowledgeable about developments in technology areas and how it might be applied - and then in hands on support*' [a University].

- Analysis of client survey data reveals that 64% of respondents state that CENSIS has 'acted as a source of sector or technology expertise' in a significant manner.
- In March 2021 CENSIS created CENSIS Technology Services (CTS) as an accelerator for CENSIS to increase the levels of commercial third-party income. CTS enables exploitation of knowledge and market knowledge to develop, certify and license products.
- An industry stakeholder highlighted that the Scotland's Smart Things Accelerator (STAC) that CENSIS helped design and establish is a '*game-changer*' [28]. A member of CENSIS's staff team outlined that STAC is '*a major addition to the ecosystem. CENSIS doesn't incubate businesses, it helps businesses develop products, but STAC is incubating businesses. The first cohort of 10 companies has been supported, and the second cohort has commenced*' [33].

Leverage

- This category explores the extent to which Centres engage across the UK and beyond; bring businesses and academia together to apply for funding; and provide financial and other incentives to mobilise partners' and stakeholders' resources.
- CENSIS reports a total commitment of supported activity for projects of £80.893 million and significant sums have been leveraged by CENSIS and others from a range of sources. It should be noted that this MEF figure includes total project values where CENSIS have had a role in delivery only rather than in receiving award. For example, £50.448 million (62% of total commitments) is other public financial contributions (including £24.9 million secured for the Digital Dairy programme of which £75,000 was awarded to CENSIS). Industry financial contributions total £17.617 million (22% of total commitments) and include £6.5 million of private match in the Blackwood Project.
- Stakeholders were positive about CENSIS'S work in attracting external funding for collaborative R&D projects. For example, an academic stakeholder highlighted that '*support from CENSIS helped keep the spin out moving forwards, and led to a University putting forward a million pound proposal to the Research Council*' [29]. A stakeholder with a background in investment highlighted two businesses supported by CENSIS that went on to secure investment from the Scottish National Investment Bank [28].
- As reported earlier, 43% of client survey respondents stated that they were involved in a collaborative project with more than one partner (including a university or college); and a further 30% were collaborating with one partner. Further analysis of the client survey data reveals that a range of barriers related to finance with 20% citing that 'direct innovation costs were too high'; 14% citing challenges relating to the 'availability of finance and awareness of funding opportunities'; and 11% identifying the high 'cost of finance.' When asked whether CENSIS had helped resolve these issues 16% stated the Centre had helped overcome the barrier that 'direct innovation costs were too high'; 7% stated that the Centre helped address the 'availability of finance and awareness of funding opportunities' and the same percentage stated that the Centre had overcome the high 'cost of finance.'

Knowledge

- This category explores how the Centre affects how knowledge is created and spread between actors and applied in the system.
- Analysis of client survey data reveals that knowledge represented a significant barrier to innovation before respondents engaged with CENSIS, specifically:

  - 41% of respondents cited a 'lack of qualified personnel.' 32% of respondents stated that the Centre helped them address this failure.
  - 27% cited a 'lack of information on technology' and 25% of respondents stated that CENSIS helped them address this failure.
  - 18% cited a 'lack of information on markets' and 7% stated that the Centre helped them address this failure.
  - 16% cited a 'lack of access to academic expertise or other partnership opportunities' and 14% stated that CENSIS helped them address this failure.
  - 5% cited 'perceived uncertain demand for innovative goods or services' and 2% stated that the Centre helped them address this failure.

- The data suggests that CENSIS has been effective in supporting businesses facing knowledge barriers to innovation.
- Several stakeholders commented on the role that CENSIS plays in skills development. For example, an academic stakeholder highlighted that CENSIS had built knowledge amongst their team in relation to how sensors can be used to monitor water volume in catchment areas, and this has changed how her Department now approaches site monitoring. A member of staff at CENSIS highlighted that the Centre runs workshops for students with partners including CodeClan and Mazaars [33].
- An academic stakeholder commented that '*without CENSIS firms would only be able to progress R&D if they knew who to approach and have deep pockets. There would be none of the hand holding that CENSIS provide. CENSIS can take a very broad idea and help businesses refine it into a product addressing a particular challenge*' [24].
- Another academic stakeholder stated that CENSIS is an '*effective translator of research opportunity into business need. They provide a translation service between businesses and Academics bringing partners together and using their detailed awareness of the ecosystem to progress ideas*' [31]. Another stakeholder concurred stating that '*SMEs get a perceived barrier removed. SMEs appear to be fearful of approaching academics. This requires an effective facilitation service from ICs. There is a fear and lack of understanding amongst SMEs*' [27].
- Only two students responded to the student survey, and it is therefore not possible to complete meaningful analysis. However, one had completed their studies and obtained their qualification and the other was still studying. One student engaged with a business as part of their studies and reported being 'somewhat satisfied' with this experience, the other engaged with a public sector organisations and reported that they were 'extremely satisfied.' Both were extremely satisfied with their interaction with CENSIS.
- The authors note that CENSIS regularly employ interns in Phase 2, and is working on a skills piece examining industry skill need and the role the Centre may be able to play in addressing them.
- While the number of research students supported by CENSIS is limited in number to date, as reported above, the Centre's contribution to wider range of skills development activities is noted (see section 4.2 above).

Commercialisation

- This final category explores how Centres are supporting activities leading to commercial or public sector exploitation. This includes the fostering of new technologies, applications, or markets; supporting new company establishments; and helping existing companies experiment.

- As highlighted earlier, MEF data provided by CENSIS shows that the completion of 129 collaborative projects in Phase 2 (up to June 2022) has led to the intention to launch 87 new or improved products (67% of all completed projects); 19 new or improved services (15% of total completed projects); and 15 new or improved processes (12% of total completed projects).
- Respondents involved in collaborative projects through CENSIS have typically started towards the lower end of the TRL scale with 84% between TRL 1 and 3, and of this 55% between TRL 1 and 2 at the start. By the end of the projects, just 10% of respondents were still at TRL 1 to 3 with: 30% at TRL 4: small-scale prototype; 20% at TRL 5: large-scale prototype; 30% at TRL 7: demonstration system; and 10% at TRL 8: commercially ready. This indicates that CENSIS has played a major role in assisting clients to advance their innovations with 60% having at least a large-scale prototype at project completion. Crucially, 58% of respondents state that CENSIS has been either very or extremely important in advancing the TRL.
- Stakeholders repeatedly identified that CENSIS is effective at supporting activities leading to commercial or public sector exploitation.

6 Delivery and value for money.

6.1 Governance and management arrangements.

Established in April 2013 CENSIS was one of the first Innovation Centres to become operational. Hosted by the University of Glasgow, CENSIS has a Governing Board which plays a strategic role in increasing technology innovation and adoption across Scotland. Comprising experienced industrialists and leading academics, the Board has accountabilities for all financial and funding activities.

The Board is supported by detailed governance processes aligned with the University of Glasgow's policies and also the good practice guidance issued by the funding partners, including a strengthening of the Equality and Diversity policy and training requirements.

CENSIS's Senior Team reports to the Board providing thorough updates of progress against key performance indicators.

In March 2021 CENSIS incorporated CENSIS Technology Services (CTS) as a company limited by guarantee. CTS was created as an accelerator for CENSIS to increase the levels of commercial third-party income. CTS enables exploitation of knowledge and market knowledge to develop, certify and license products, which CENSIS in its current form is not able to do. CTS is a not-for-profit organisation and any surplus generated is used to support CENSIS' core economic growth objectives. It is estimated that between August 2023 and July 2024, at least £337,000 of the income from CTS will flow to CENSIS.

Stakeholders noted that CENSIS has a strong and positive relationship with the host University, and highlighted that this relationship has improved over the course of Phase 2 delivery. Stakeholders did not identify any challenges relating to management and governance. Similarly, no issued were raised in relation to CENSIS' capacity and ability to recruit skilled staff. The calibre of CENSIS' team was highlighted by several stakeholders, as was their pro-active approach to partnership working.

6.2 Monitoring and evaluation.

The Phase 1 due diligence report completed by Optimat highlighted that CENSIS's approach to monitoring and evaluation was fragmented, stating that '*the gathering, monitoring and evaluation data does not provide sufficient information to robustly analyse the economic impact.*'

CENSIS provided MEF data to the authors and answered a number of queries on it. The authors understand that CENSIS routinely collect the following information on supported clients:

- Account name;
- RDA region;
- Legal entity;
- Industry classification and sector; and,
- Employee banding.

The authors note that the jobs (created and safeguarded) and turnover data is provided by applicants to CENSIS, and clients do not receive follow-up to confirm and evidence jobs created and safeguarded, or turnover gains.

There was a consensus amongst stakeholders representing CENSIS, academic partners, industry partners and funders that the MEF is not effective at conveying the true extent of Innovation Centres' impact. The MEF has not kept up with CENSIS's evolving approach and doesn't capture the innovation system benefits highlighted above. Reporting of these 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 appropriate targets.

6.3 Value for money.

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

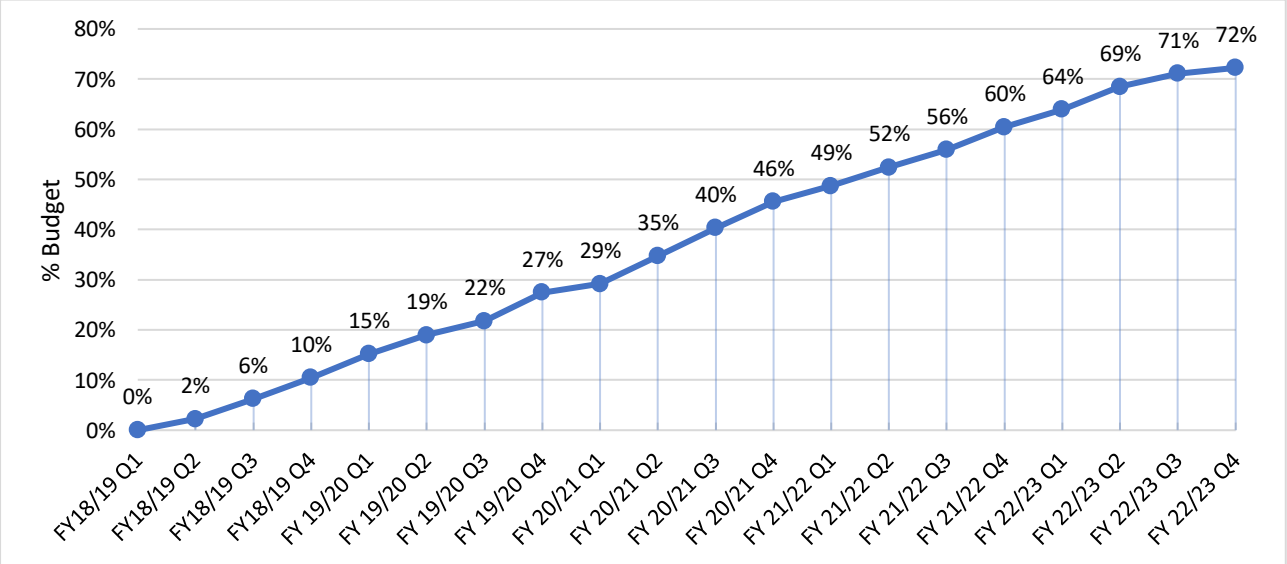
6.3.1 Limitations.

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 as provided by the Funding Partners.

6.3.2 Budget execution.

Total Phase 1 spend is as £11.3 million. Funder budget drawdown is used as a proxy for expenditure. Phase 2 budget execution is noted in the table below (see Table A. 10). 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. Extension figure excluded.

Table A. 10 CENSIS 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 £85.3 million was mobilised over Phases 1 and 2. Of this, 29% was industry finance. Comparing funder inputs (to Jun 2022) to finance mobilised, this indicates an estimated favourable leverage of £18.4 million (Phase 1 and 2) to £85.3 million, or 4.6:1 (benefit to cost ratio). For industry finance mobilised this is a lower 1.3:1 (see table below).

It is noted that CENSIS reported some particularly large commitment figures including £58.9 million of other public financial contributions. This comprises of externally funded collaborative R&D projects, and as noted above, these figure include total project values where CENSIS have had a role in delivery only rather than in receiving the total award. For example, £24.9 million secured for the Digital Dairy programme of which £75,000 was awarded to CENSIS. This method of MEF recording therefore overstates leverage in comparisons with other ICs.

Table A. 11 Finance mobilised, CENSIS, to Jun 2021/22

	Phase 1	Phase 2	Total
Higher Education Institutes	£212,394	£240,822	£453,216
Other Public	£8,309,801	£50,590,034	£58,899,835
Industry	£5,748,135	£18,957,831	£24,705,965
Other	£-	£1,285,965	£1,285,965
Total	**£14,270,330**	**£71,074,652**	**£85,344,982**

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 regards, 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. In addition, it is emphasised that the employment levels relate to a relatively small sample of IC beneficiaries and that the grossed up figures presented are indicative. Also, these estimates assume a significant degree of direct, indirect, and induced benefits in the economy via the application of economic multipliers (which the MEF estimates do not).

Nonetheless, assuming costs as funder inputs of £19.2 million to December 2022, CENSIS net additional peak employment of 1,427 equates to £13,421 per additional job. Similarly, funder input to net additional GVA equates to a benefit to cost ratio of 8.2:1.

Table A. 12 Cost per job, CENSIS.

	Employment	Cost per job
Net Additional Employment (peak)	1,427	£13,421
Net Additional Employment (peak) (no multiplier)	793	£24,151

Source: authors.

Table A. 13 GVA ratio, CENSIS.

	GVA	Benefit: cost Ratio
Cumulative Net Additional GVA , Constant Prices, Discounted	£283.3m	14.8:1
Cumulative Net Additional GVA (no multiplier), Constant Prices, Discounted	£157.4m	8.2:1

Source: authors.

6.3.5 Equity.

The authors have not had sight of detailed management data which would enable a full assessment of the extent to which CENSIS is addressing the equity considerations detailed in the main report. As presented earlier, the authors have attempted to analyse CENSIS' contribution to equity objective using MEF and client survey data. The key findings, presented earlier, are briefly summarised below:

- Business size: the client survey did not ask for business size and as noted above, data on the size of businesses supported by CENSIS was not available.
- Business ownership: whilst CENSIS collects data on legal status they do not routinely collect data on business ownership and the client survey did not seek this information either. It is therefore not possible to draw any meaningful conclusions on this matter.
- Business location: the client survey asked respondents to provide their location and analysis reveals that 43% were from the cities of Edinburgh and Glasgow; 9% from the six Local Authority areas within the Highlands and Islands; and 44% from elsewhere in Scotland. So, whilst four in 10 clients are based in the two major cities, four in 10 are based elsewhere suggesting CENSIS is supporting businesses in areas with lower levels of Business Enterprise Research and Development (BERD) spend.
- Business sector: analysis of client survey data highlights that 21% of respondents operate in either 'professional, scientific and technical activities' or 'manufacturing.' 3% of respondents didn't know which sector they operated in of the remaining 76% most were in 'other' (21%) followed by 'information and communication' (18%); with the rest spread across another four sectors. On this basis CENSIS does appear to be supporting sectors that typically display lower levels of BERD expenditure.

7 Progress against targets and objectives

7.1 Targets.

Table A.36 below highlights CENSIS's progress on Phase 2 targets as of June 2022. It should be noted that Phase 2 started 1st August 2018 and was due to finish 31st July 2023, however an extension (6th year) was given until 31st July 2024. Of 14 detailed targets, four exceeded, three on track, seven off track. Off track areas, are mainly linked to follow-on from completed commercial projects, and skills development.

Table A. 14 CENSIS: progress against Phase 2 output targets.

MEF outputs	Phase 2 target	Phase 2 actual (up to June 2022)
Follow on from completed collaborative projects		
Signposted to SE	81	**2**
Signposted to HIE	9	**0**
Signposted to other public funding/support body	36	**3**
Signposted to private sector	18	**0**
IC supported follow-on project planned or underway	18	**19**
Direct to market (by a business in Scotland)	9	**49**
Projects not taken forward	9	**2**
Total	**36**	**75**
Number of IC collaborative projects leading to intention to commercial launch/application		
New or improved products developed (with/for a business in Scotland)	109	**87**
New or improved processes (with/for a business in Scotland)	36	**15**
New or improved services developed (with/for a business in Scotland)	9	**19**
New or improved business models (with/for business in Scotland)	18	**7**
New or improved delivery of a public service in Scotland	9	**12**
Total	**181**	**140**
Number of individuals gaining new qualifications/skills		
PhD/EngD	4	**0**
MSc	15	**0**
Total	**19**	**0**

Source: MEF

7.2 Objectives.

As outlined in Chapter 2, the evaluation team 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 briefly explores CENSIS's focus on these 10 programme objectives.

As shown above CENSIS is significantly behind on outputs relating to referrals. As reported earlier the client survey data suggest that CENSIS is helping respondents build meaningful relationships with partners. For example: 32% of respondents indicate that CENSIS has assisted them to develop better relationships with other clients or customers from the public sector; and 20% of respondents indicate that CENSIS has supported them to develop relationships with government or public research institutes. These figures were calculated including 'don't know' responses. The authors are of the view that the seemingly poor performance on referrals reflects that this data isn't routinely recorded, and does not indicate that this work is not occurring.

CENSIS has exceeded four of the output targets, and has not yet achieved the remaining 10 outputs. It looks highly likely that CENSIS will not achieve the output targets relating to businesses signposted to SE, HIE and other public funding and support bodies. CENSIS may not achieve outputs focussed on new or improved processes or new and improved business models.

The Phase 2 short-form business plan developed by CENSIS commits that the Centre will '*create value through digital enablement, supporting Scottish industrial digitalisation that underpins economic growth, productivity improvements and the creation of new types of high value jobs.*' The plan sets out CENSIS's

value proposition to industry, academia and innovation partners. It does not contain specific strategic objectives, but it sets out key technologies that the Centre will support including:

- Sources & Sensors;
- Machine Learning and Artificial Intelligence; and,
- Robotics and Automation.

The plan contains some specific targets including that the Centre will support 181 collaborative R&D projects of which 80 (44% of the total) will just involve CENSIS supporting businesses; 74 (41% of the total) will involve academia; and 27 (15% of the total) will be business to business. As outlined earlier analysis shows that of the 113 Academic/IC to business (involving a Scottish business) projects completed up to June 2022, forty-eight have involved Scottish Universities. This represents 43% of the total suggesting that CENSIS is engaging academia in line with the targets set out in the Phase 2 business plan.

Table A. 15 CENSIS Achievements against objectives.

Objectives and strength of focus		Explanation of rating
O1: Direct businesses to the right support	High	Stakeholders highlighted that CENSIS is an effective member of the innovation support ecosystem, and demonstrates its commitment by directing businesses to sources of support. Interviews were conducted with five members of staff, and it was clear that the team routinely refers businesses that make enquiries to other sources of support. The client survey data indicates that CENSIS is assisting clients to build strong relationships with a range of partners. Unsolicited qualitative comments from the client survey include '*very supportive throughout both directly in developing the technology and indirectly in making connections with other relevant companies/organisations*' [private sector respondent]; and '*my project is a large multi-partner project that seeks even wider participation. The excellent network of businesses and academics linked to CENSIS is invaluable*' [University respondent].
O2: Build and promote innovation ecosystems & sectors	High	Stakeholders cited the annual Tech Summit as one of the ways CENSIS builds and promotes the ecosystem and supports a wide range of sectors. The MEF records the number of engagement events delivered by CENSIS. In Phase 2 to date 11 large events and 114 smaller events have been delivered. The client survey data reveals that 55% of respondents had attended '*conferences or events provided by, or supported by CENSIS*' and 92% of respondents reported being satisfied with the conferences or events. Open comments provided by survey respondents included '*they have been a key player in the innovation support ecosystem in the HIE area*' [public sector respondent].
O3: Engage industry and academics in collaborations that drive business growth	High	The MEF records new jobs created and existing jobs safeguarded in businesses, along with increased turnover. The job figures that CENSIS provides are based on initial information provided and are not verified, and turnover is derived using a multiplier. In Phase 2 to date CENSIS reports 492 jobs created and 178 safeguarded. Stakeholders reported that CENSIS is highly effective at developing and facilitating collaborative R&D projects which drive business growth. Analysis of client survey data reveals that a net employment peak of 127, or 228 with the addition of a suitable multiplier. If these figures are representative of the population of clients supported by CENSIS, then this would suggest CENSIS delivers net additional employment of 793, or with the multiplier 1,427.
O4: Secure external innovation funding	Moderate	A number of stakeholders highlighted how CENSIS helped them secure funding. Several stakeholders highlighted the recent successful Strength in Places bid as an example of a funding bid that was enhanced through CENSIS's involvement. MEF data provided by CENSIS notes that the Centre has helped secure £58.488 million of other public financial contributions to the system, and £17,617 million of industry financial contributions. Analysis of the client survey data shows that respondents cited a range of finance benefits with 12% gaining improved investment readiness; 15% securing new public sector investment; and 12% secured cost savings or more efficient and effective processes. These figures include 'don't know' responses in the calculation of the percentage figures.
O5: Exploit academic base to solve industry problems	High	This objective encourages Centres to exploit academic research to solve industry-defined problems. The Phase 1 Call for Proposal and Phase 2 Business Plan set out clear challenges that CENSIS tackles. Stakeholders highlighted that CENSIS is highly effective at leveraging academic expertise to support businesses, and is a highly effective intermediary. They also highlighted that CENSIS's in-house delivery team provides vital support to businesses and public sector organisations. Analysis of client survey data reveals that 43% of respondents stated that they were involved in a collaborative project between more than one partner (including a university or college); and 30% were in collaboration projects between themselves and one partner (again including a university or college). 52% were involved in consultancy projects. The MEF data shows that across both phases up to June 2022, CENSIS has completed 267 collaborative R&D projects. Open comments provided by survey respondents included: '*we have had three successful projects with CENSIS and a university partner involving an end user. The project would not have been possible without CENSIS' support.*

O6: Address major policy priorities	High	*The projects have been a success and results in the project receiving an innovation award*' [private sector respondent]. Stakeholders highlighted that during Phase 2 CENSIS has demonstrated close alignment with Government's major policy priorities. Stakeholders were able to identify economic, environmental and societal benefits flowing from CENSIS's work. 45% of client survey respondents stated that CENSIS is 'raising the profile of the sector/technology area within Scotland' and 20% stated that the Centre is 'providing strategic leadership for the sector or technology area.' Unsolicited comments in the client survey included: '*CENSIS are a very valued partnership to the Digital Office for Scottish Local Government, and as a consequence, Local Government across Scotland. We work in partnership to help accelerate the uptake of IoT in local government to deliver savings and improved outcomes for Councils, and to help to stimulate growth of the sector in Scotland within this important sector.*'
O7: Secure inward investment	Moderate	The MEF doesn't record number of businesses assisted to relocate or establish new facilities in Scotland. Stakeholders did not highlight inward investment as an area that they see CENSIS delivering strongly. Interviews with staff did include reference to relevant work, and highlighted that in promoting the ecosystem with events like Tech Summit, the Centre is raising Scotland's profile internationally.
O8: Enhance public services	High	The MEF records the number of collaborative projects leading to new or improved delivery of public services. In Phase 1 CENSIS reported six such projects, and in Phase 2 to date they have delivered 12 projects. Stakeholders were able to name several major collaborative projects which will lead to new or improved public services, as were staff interviewed as part of the evaluation. Client survey respondents were asked to provide examples of projects supported by CENSIS that contribute to the UN's Sustainable Development Goals, examples given include: • '*We are working on technology that will enable independent living and longer healthier lives especially for people from disadvantaged backgrounds.*' • '*Developed technology that will help to reduce public sector emissions and wastage.*' • '*Changing the learning culture of the social care sector.*' • '*We are delivering a CivTech project with Stirling Council, Perth and Kinross Council, Scottish Government and Loch Lomond and the Trossachs National Park which is helping to manage visitors at remote and rural locations, providing a positive impact on communities, the economy and the environment.*' • '*We are helping Police Scotland use drone technology to find missing people. The aim was to develop AI algorithms to be applied to drone video to ease the cognitive burden of Police officers during searching.*'
O9: Develop skills addressing industry needs	Moderate	The MEF records 51 people gaining new qualifications over Phase 1 and 2. A number of stakeholders highlighted that they perceive significant skills gaps and would welcome a greater focus on supporting individuals to gain practical skills in working with sensors, imaging systems, IoT and analysing data derived from these sources. This is balanced by the fact that several stakeholders commented on the role that CENSIS plays in skills development. For example, an academic stakeholder highlighted that CENSIS had built knowledge amongst their team in relation to how sensors can be used to monitor water volume in catchment areas, and this has changed how her Department now approaches site monitoring. A member of staff at CENSIS highlighted that the Centre runs workshops for students with partners including CodeClan and Mazaars [33]. Only two students responded to the student survey, and it is therefore not possible to complete meaningful analysis. The authors note that CENSIS regularly employ interns in Phase 2, and is working on a skills piece examining industry skill need and the role the Centre may be able to play in addressing them.
O10: Develop next generation of innovators	Moderate	The tenth objective encourages Centres to '*grow an environment to develop the next generation of business innovators, academics and entrepreneurs.*' The MEF does not include any measures that enable us to assess CENSIS's focus on this objective. Stakeholders tended to suggest that CENSIS did not have a major focus on skills development, but staff were able to identify specific activities that help young people develop entrepreneurial and innovation skills. For example, a member of staff at CENSIS highlighted that the Centre runs workshops for students with partners including CodeClan and Mazaars [33].

Source: authors

8 Impact case studies.

8.1 Introduction.

The following three case studies were informed by in-depth interviews with a selection of CENSIS's clients and also draw on responses to the client survey where possible.

8.2 Case 1 Krucial.

Business summary: Krucial's stated mission is to digitize the planet. They have developed technology that removes blind spots enabling businesses and organisations to access the data they need from anywhere — more efficiently and easily than ever. The technology utilises satellite communications and cellular technology, incorporating the Internet of Things to provide clients with resilient communications infrastructure.

Engagement aims.

Krucial's founders had previously worked at Clyde Space and identified an opportunity to harness predicted developments in satellite communications with cellular technology to provide rich data to businesses and organisations with assets in remote locations. Their aim was to develop technology that could provide real-time data to clients even in areas with no cellular signals.

The founder's began investigating sources of support to help them validate and progress their concept. A Krucial owner contacted the Business Gateway, and they referred him to Scottish Enterprise who provided support through the high growth track. Krucial contacted CENSIS in 2018 with the following aims:

- Test whether the business idea was viable from a technological and commercial perspective;
- Develop a more detailed understanding of Internet of Things (IoT) technology and how it could be integrated with satellite and cellular data.
- Develop a more detailed understanding of the potential demand for the proposed product including use cases and target sectors.
- Develop a Minimum Viable Product (MVP) that could be tested with customers.

Support provided.

CENSIS worked closely Krucial and developed an MVP over the course of nine months. As part of the development of this prototype two patents were secured, and the ownership was retained by Krucial – these patents form the core basis of Krucial's commercial product range.

The completion of the MVP enables Krucial to secure its first customers and this in turn enabled further testing and refinement to be completed. Funding of £0.4 million was secured from the European Space Agency to enable Krucial to progress the MVP to a full commercial product. This development work was done by Krucial following recruitment of specialist engineers.

CENSIS have remained in close contact with Krucial following the completion of the MVP and have assisted the business to secure demonstration contracts with a range of organisations in different sectors including environmental protection, the water and aquaculture industries. CENSIS have referred Krucial to a number of highly useful contacts which have led to new commercial relationships and private investment.

Krucial have also engaged with two other Innovation Centres – SAIC and the Data Lab. The engagement with SAIC began following Krucial's engagement with Grieg Seafood which solved the connectivity issues they were experiencing with their salmon farms in the Shetland. SAIC provided funding through the Sea Food Innovation Fund and the Data Lab have provided specific expertise relating to integrating data into the commercial product.

CENSIS assisted Krucial to secure funding from Scottish Enterprise, and this was used to purchase time from CENSIS's team to address each of the aims listed above.

Innovation benefits.

Krucial can identify a wide-ranging set of direct benefits from the work with CENSIS:

- Validation of the technological viability of the business idea;
- Identification of use cases, target markets and connections to potential customers;
- Development of MVP which enabled customers to be secured enabling Krucial's first sales;
- Support with funding bid securing investment from the European Space Agency;
- On-going business development support and referrals to valued contacts.

CENSIS played a major role in the development of the product which Krucial formally launched into the market in May 2022. CENSIS's support overcame a number of information and technical barriers faced by Krucial and the quality of the prototype led to the securing of Krucial's first customers.

Wider benefits.

CENSIS has also facilitated opportunities for Krucial to test the product in a range of sectors thereby helping to refine the use case. CENSIS has assisted Krucial to access the formal and informal innovation ecosystem and one of CENSIS's Board members has acted as an Adviser, going onto invest in the business.

Impact.

Krucial highlighted that CENSIS undoubtedly accelerated their development from initial concept through to first sales through the MVP. The business now employs 25 staff and is focussed on increasing sales in 2023. Krucial highlighted that they would have still sought to progress their business concept, in the event that CENSIS did not exist Krucial's establishment and growth would at the very least have been slowed down, and it is possible that many of the spin-off benefits, including valuable introductions which enabled product refinement, would not have occurred.

Feedback.

"CENSIS have been instrumental in the development and growth of our business. It is hard to quantify all the wider benefits we have gained working with CENSIS, and they remain a highly valued partner." Senior representative, Krucial.

8.3 Case 2. Spirit Aerosystems.

Business summary.

Spirit AeroSystems is one of the world's largest manufacturers of aerostructures for commercial airplanes, defence platforms, and jets. With expertise in aluminium and advanced composite manufacturing solutions, the company's core products include fuselages, integrated wings and wing components, pylons, and nacelles. The company has a base in Prestwick which was previously BAE Systems Aerostructures before its acquisition in 2006.

Engagement aims.

Spirit Aerosystems approached CENSIS to seek support in the progressing a new concept they had developed to produce composite parts in a more cost-effective and energy efficient approach, replacing the traditional autoclave 'curing' process with an intelligent and tailored heating tool. The company had undertaken initial work on the new heating process with the Massachusetts Institute of Technology, with further work then undertaken in partnership with the University of Strathclyde.

The University of Strathclyde had prior experience of working with CENSIS and recommended that Spirit Aerosystems contact them to determine how they could help. Spirit Aerosystems had the following ambitions for the collaboration work:

- Progress the initial concept from Technology Readiness Level (TRL) 3 to 4.
- Investigate a number of challenges experienced with the current proof of concept model including the effectiveness of heat transfer.
- Develop a heating tool with Outer Mould Line (OML) and Inner Mould Line (IML) capabilities providing multi-zone heating and sensing.
- Develop a control system providing real-time information on the transfer of heat to the composite materials.

Support provided.

Spirit Aerosystems developed an application identifying a total cost if £180,000 to achieve the aims listed above. Following a successful application CENSIS provided £50,000 of funding enabling Spirit Aerosystems to commission a University of Strathclyde academic to work closely with staff to develop the heating tools and control system.

The project was delivered as a collaborative partnership with the University of Strathclyde academic leading on technical development; CENSIS providing funding and technical advice; and Spirit Aerosystems the materials to be heated and cured, the facilities to deliver the work and internal expertise.

The original aims of the project were delivered in full. Sprit Aerosystems gained an advanced proof of concept at TRL 4 with the following features:

- Heating tool with OML and IML capabilities providing multi-zone heating and sensing.
- A bespoke control system providing real-time information on the progress of the heat transfer process, enabling staff to direct the exothermic reaction.
- The creation of a system that removes the need for an autoclave, which typically represents around US$4 million in upfront capital expenditure.
- The creation of a system, that depending on a component's geometry, could reduce operating costs by as much as 50%, through reduced CAPEX, factory space and energy consumption, while cutting cycle times by up to 40%.

Trials were conducted using the new double-sided heating system and Spirit Aerosystems were able to examine the influenced that the new approach had on the curing process of their composite materials.

Innovation benefits.

Spirit Aerosystems gained an innovative heating system with a bespoke control system capable of replacing the traditional autoclave 'curing' process. The system, developed with CENSIS's support, directly heats composite materials, whereas autoclaves heat the air surrounding the materials and the new uses considerably less energy, and delivers significant costs savings.

At the present time Spirit Aerosystems is not seeking to progress the system beyond TRL 4 and is instead focussing on priorities including a £20 million involvement in the Airbus Wing of Tomorrow programme. However, Head of Research & Technology at the company highlighted that Spirit Aerosystems gained considerable knowledge, experience and skills through the collaborative working with CENSIS and the University of Strathclyde which are being used directly in the Wing of Tomorrow programme.

Wider benefits.

The collaborative project built a new relationship between Spirit Aerosystems and CENSIS, and further enhanced the relationship with the University of Strathclyde.

Impact.

The project progressed a highly innovative heating system to TRL 4 and provided Spirit Aerosystems with a valuable tool that has directly informed recent work, and can be developed in the future. Krucial highlighted that the scale of investment from CENSIS was significant and if this support had not been forthcoming it would have led to considerable delay which in turn may have meant that the University of Strathclyde academic was not available.

An academic from the University of Strathclyde highlighted that the solution developed '*has the potential to revolutionise the sector and the knowledge exchange between both organisations has been key to the success of the development.*'

Feedback

"The collaborative project we completed with CENSIS, and the University of Strathclyde has been a foundational stone for our business and is informing our work on the Airbus Wing of Tomorrow programme in partnership with the National Composites Centre. We have used just 10% of the energy we would have required if using the traditional autoclave approach and this helps cement our reputation as a major innovator in the aerospace sector." Senior representative, Krucial.

8.4 Case 3. Thales.

Business summary.

Thales is a leader in the aerospace; defence and security; and digital identity and security sectors. Thales has maintained a significant presence in Scotland for over 100 years and employs over 700 people across two main sites in Glasgow and Rosyth. Thales's Glasgow site formally established as Barr & Stroud Ltd in 1888 is the oldest element of Thales in the UK, with expertise in producing complex electro-optical systems for land, air, and sea. The team at Thales in Glasgow have also established an armoured vehicle centre of excellence, building on decades of experience in complex military vehicle integration by highly skilled engineers and manufacturing employees.

Engagement aims.

Thales first became involved with CENSIS following Scottish Funding Council's (SFC) call for the establishment of Innovation Centres. Thales sat on the Advisory Board that shaped the submission that secured funding from SFC to establish CENSIS.

Thales have completed three projects in collaboration with CENSIS and the University of the West of Scotland (UWS). Thales' aim across all three projects was to engage with CENSIS and an Academic partner in order to:

- Develop in-house expertise in machine learning, Artificial Intelligence (AI), state-of-the-art sensors and imaging technology.
- Develop innovative new products and test potential use cases with potential customers.
- Foster strong connections in the innovation ecosystem.

Support provided.

The first project focussed on using machine learning techniques to improve detection and visualisation, with the aim to achieve automatic target recognition. Thales developed the project concept and approach CENSIS to help them identify an academic partner with sufficient expertise; provide technical expertise on state-of-the-art sensors and imaging technology; and secure financial support.

CENSIS delivered a workshop with potential academics and helped Thales select the most appropriate partner. CENSIS provided funding and technical expertise, and project management support. USW developed the technology and the Intellectual Property (IP) with Thales providing the data and in-house technical expertise. The work culminated with the production of an AI system capable of

automatically recognising different types of vehicles and people, based around the concept of deep learning which mimics the way human brains behave to create AI that learns on the job.

The second and third projects involved Police Scotland and sought to develop prototype drones with visual and thermal cameras integrated with AI to help detect missing people with a visual feed onto either a mobile phone or tablet. CENSIS delivered a range of support including:

- Funding to support the cost of engaging UWS.
- Project management and co-ordination support.
- Technical expertise on state-of-the-art sensors and imaging technology.
- An engineer seconded to Thales for several months to deliver knowledge transfer to the business's staff.

Police Scotland provided access to data; the drones on which the systems were mounted; and testing to ensure the technology operated effectively. USW again provided the academic expertise needed to develop the AI components and created the IP.

A working prototype was built for both projects – firstly using visual cameras with a visual stream of AI data on a mobile phone for Police Scotland. The data gathered in the development process was used to improve the detection system. The second prototype incorporated thermal cameras with a real-time AI stream onto a tablet in line with Police Scotland's requirements. The system proved capable of detecting a person, animal or vehicle from just a handful of pixels in a huge moving colour image. A representative of Police Scotland's air support unit commented that the system with help the police 'find people who need our help or people who are lost.'

Innovation benefits.

Thales gained the following direct benefits as a result of engaging with CENSIS:

- Connection to academic expertise at a University that it had not previously engaged with but now has a strong relationship with.
- Development of in-house expertise in machine learning, Artificial Intelligence (AI), state-of-the-art sensors and imaging technology with knowledge transfer supported by an engineer seconded from CENSIS.
- Development of three working prototypes with progression from Technology Readiness Level (TRL) 2 to 6, with prototypes tested with potential customers.

Thales reported that CENSIS's support overcame a number of innovation barriers they faced including: Availability of finance, including awareness of funding opportunities; lack of qualified personnel; and lack of access to academic expertise.

Wider benefits.

Thales report a range of wider benefits including:

- Creating two PhD posts secured in partnership with CENSIS;
- Securing of £0.5 million of funding for air to ground products enabled by the track record gained through the CENSIS, UWS and Police Scotland collaboration.
- Gaining extensive positive publicity including features on BBC News which led to direct contact from new potential national and international customers.
- Developing strong connections in Scotland's innovation ecosystem facilitated by CENSIS including the opportunity to present at CENSIS's Tech Summits.
- Creating AI architecture that is informing the development of new products.

Impact.

Thales have not yet launched commercial products from the three collaborative projects, but a representative highlighted that the development and delivery of the three projects helped build and maintain momentum for Thales' focus on developing in-house AI machine learning capability. The representative highlighted that Thales would not have achieved any of the innovation or wider benefits without CENSIS's support.

Feedback.

"CENSIS has played a crucial role in connecting us with academic expertise and providing direct support to build our in-house capability in machine learning, artificial intelligence and imaging systems. Our three collaborative projects with CENSIS have helped us secure new skills; develop ground-breaking prototypes; win innovation awards; and gain considerable positive publicity." Senior representative, Thales.

9 Conclusions.

This section summarises conclusions structured using the seven key lines of enquiry provided in the brief for this study.

To what extent does CENSIS deliver routes to economic and wider benefits through increased levels of collaboration between industry and academia?

CENSIS has an in-house engineering team, and they report that this team typically support clients with initial projects that are less complex, and typically engage Academics on follow-on projects, particularly those that are more complex.

There is a range of evidence available that suggests that CENSIS is engaging effectively with Higher Education Institutions. Firstly, 43% of the Academic/IC to business (involving a Scottish business) projects completed up to June 2022 in Phase 2 have involved academia.

The evidence from the client survey shows that 52% of respondents accessed consultancy support, and 73% engaged in a collaborative project with either one partner (30%) or more than one partner (43%) in both cases including a university or college. The survey didn't ask respondents to indicate where they accessed consultancy support and an Academic. However, the data seems to suggest that CENSIS is striking a balance between engaging academia, and utilising its own in-house team of experts. As noted earlier it is interesting to see that only 16% of survey respondents identified access to academic expertise as a barrier that prevented them from innovating, before their engagement with CENSIS.

The Phase 2 MEF data suggests that 129 completed collaborative R&D projects have led to 19 new or improved services (14% of total projects); 87 new or improved products (67% of total projects); and 15 new or improved processes (12% of total projects). The authors conclude that the collaborative projects are generating direct innovation benefits.

Stakeholders were of the view that CENSIS is effective at operating the triple helix model and bringing industry, academia and the public sector together creating synergies and facilitating academic-industry networking. Analysis of data from the client survey reveals that CENSIS is supporting beneficiaries to deliver a range of intermediate benefits including:

- 48% of respondents gained new business contacts and 36% gained new public sector contacts.
- 59% of respondents gained improved technical understanding of priority technology areas in their sector.
- 41% of respondents gained an improved market understanding of priority technology areas in their sector.

There are visible qualitative benefits including assisting beneficiaries to advance through Technology Readiness Levels (TRLs). Respondents involved in collaborative projects through CENSIS have typically started towards the lower end of the TRL scale with 84% between TRL 1 and 3, and of this 55% between TRL 1 and 2 at the start (it is noted this may include project work before IC involvement). By the end of the projects, just 10% of respondents were still at TRL 1 to 3 with:

- 30% at TRL 4: small-scale prototype;
- 20% at TRL 5: large-scale prototype;
- 30% at TRL 7: demonstration system; and,
- 10% at TRL 8: commercially ready.

This indicates that CENSIS has played a major role in assisting clients to advance their innovations with 60% having at least a large-scale prototype at project completion. Crucially, 58% of respondents state that CENSIS has been either very or extremely important in advancing the TRL.

To what extent does CENSIS support colleges and Universities to maximise their value to Scotland?

CENSIS engages effectively with Higher Education Institutions. Although CENSIS has a stronger focus on Universities, the authors are aware of examples of engagement with colleges. This includes a partnership with the City of Glasgow College which to the development of Aquabot - a remotely operated vehicle (ROV) deployed with a range of sensors on a catamaran hull which can be used on large bodies of inland water to enhance water quality monitoring and sampling. An initial prototype was developed by a student at the College, and CENSIS then provided £35,000 which advanced the prototype to a marketable product between June 2020 and October 2021.

In relation to engagement with Universities stakeholders from Universities highlighted that CENSIS has a pro-active approach and has a well-developed engagement and delivery approach. For example, an academic stakeholder stated that '*in my experience CENSIS has the most effective engagement and support model. CENSIS achieves a seamless integration of academia and industry*' [27]. Analysis of client survey data reveals that 43% of respondents completed a collaborative project with more than one partner from a university or college and CENSIS; and a further 30% of respondents completed a collaborative project with one partner from a university or college and CENSIS.

How has CENSIS performed against targets and objectives?

A review of outputs achieved up to June 2022 in Phase 2 reveals that CENSIS is exceeding, or is on track to meet the majority of outputs including:

- IC supported follow-on project planned or underway: target is 18 with 19 already reported;
- New or improved products developed: target is 109 with 87 already reported;
- New or improved processes: target is 36 with 15 already reported;
- New or improved services developed: target is nine with 19 already reported;
- New or improved business models: target is 18 with seven already reported; and,
- New or improved delivery of a public service in Scotland: target is nine with 12 already reported.

In relation to additionality, the majority of respondents (36%) stated that they 'would have achieved a significantly smaller range of benefits and at a reduced scale and it would have taken longer to achieve them.' 13% of respondents stated that they would not have achieved any of the benefits without support from CENSIS (absolute additionality), whereas only 5% say they would have achieved the same benefits at the same time and scale without the IC support (zero additionality). The evaluation concludes that CENSIS is delivering strong additionality and enabling businesses to deliver significant

employment and GVA outcomes. On this basis there is a strong argument for on-going public funding to enable CENSIS to continue addressing market failures and unlocking economic benefits.

The evaluation concludes that CENSIS delivers strong value for money when MEF outputs are considered and impact data from the survey is considered.

To what extent does CENSIS build engagement with the innovation ecosystem?

CENSIS focuses on enabling technology which has applications in a wide range of sectors. Data from the client survey illustrates that CENSIS engages with businesses from numerous sectors including: information and communication (18% of respondents); manufacturing (15%); human health and social work activities (9%); public administration and defence (9%); and professional, scientific and technical activities (9%). Given this sectoral breadth CENSIS has a complex role to fulfil and seeks to build both the business support and innovation ecosystem, and the ecosystem surrounding sensing, imaging and the Internet of Things.

Evidence from businesses that engaged in case study interviews, beneficiaries who completed the client survey and stakeholders (both through a survey and through one-to-one interviews) highlights that CENSIS is engaging very effectively in these ecosystems. As highlighted in the section 'innovation system benefits' the authors find that CENSIS is performing particularly strongly in relation to resources which tests the extent to which Centres have developed physical research and innovation infrastructure and environments or improved organisational capacities or ways of working. CENSIS scores highly on all other innovation system benefits.

Through the one-to-one interviews a number of stakeholders specifically highlighted CENSIS's role in delivering the Countdown to COP26 event, and the annual Tech Summits as an effective way to boost the ecosystems nationally and internationally. Stakeholders were strongly of the view that CENSIS is effective at providing strategic leadership for businesses in a wide range of sectors.

What wider benefits has CENSIS delivered?

As reported earlier, client survey respondents were able to identify how their projects, supported by CENSIS, were addressing several of the United Nation's Sustainable Development Goals (SDG). The most frequently cited Goals were climate action; good health and well-being; sustainable cities and communities; affordable and clean energy; and decent work and economic growth.

Respondents were asked to illustrate how their collaborative R&D projects were addressing the SDGs and a wide range of examples were provided including:

- '*We are working towards a healthcare technology solution to improve hand hygiene for the global population*' [University respondent].
- '*We have established an Upland Digital Hub and are expanding the use of digital technology especially with regard to Life on Land, Climate Action and Sustainable Agriculture*' [University respondent].
- 'We are improving the ability of people to live in their own homes longer and more efficiently' [business respondent].

The evaluation concludes that in addition to delivering direct routes to economic benefits, CENSIS is also making a good contribution to wider societal and environmental benefits.

To what extent have benefits reached all parts of Scotland?

As highlighted earlier, in relation to the spread of benefits analysis of responses to the client survey reveals that respondents operate across a wide range of sectors. Respondents were also distributed across Scotland with 43% from the cities of Edinburgh and Glasgow; 9% from the six Local Authority areas within the Highlands and Islands; and 44% from elsewhere in Scotland.

The main report includes maps which indicate the geographical breadth of benefit, this level of analysis is not possible at individual Innovation Centre level given the small sample sizes available in the client survey. The authors would ideally analyse management data to address this line of enquiry, but such data was not available.

What lessons can be learned from CENSIS's operation?

CENSIS has a clear purpose and strong rationale. The Centre has matured over the course of Phases 1 and 2 and has overcome major operational challenges presented by the COVID-19 pandemic. Stakeholders were unanimously supportive of the Centre's work, with key themes including:

- CENSIS provides a critical intermediary role and understands how academics and industry both operate. For example, an academic stakeholder commented that '*CENSIS staff are phenomenal facilitators. They have technical knowledge and are very effective at translating what businesses want into language that academics understand and vice versa*' [27].
- CENSIS values effective partnership working and puts this into practice.
- CENSIS is focussed on major societal and environmental challenges in addition to helping clients overcome barriers to innovation.

There are a number of elements of CENSIS's operation that other Innovation Centres may wish to consider. For example, the Centre has its own in-house engineering team can assist clients to develop prototypes and work on initial projects developing them to the point that academic input would add value.

The Centre formed CENSIS Technology Solutions (CTS) to establish new products, new markets and build new supply chain and commercial opportunities for companies. CTS takes proof-of-concept solutions and IP developed by CENSIS and partners and produces certified, production-established designs then licenses them to the market.

The Centre has also partnered with others to help establish Scotland's Smart Things Accelerator (STAC) identified by stakeholders as a '*game-changer*'.