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Innovation Centre Programme Evaluation

Final Report

Appendix F. PMS IC.

ADDITIONAL RESEARCH

March 2023

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Appendix F. PMS-IC (Precision Medicine Scotland Innovation Centre).

1 Introduction.

Precision Medicine Scotland Innovation Centre (PMS-IC) is Scotland's national centre for accelerating the advancement and adoption of precision medicine. Precision medicine seeks to develop better diagnostics and earlier intervention; help health service providers select optimal treatments; and support the development of more effective medicines. As set out in PMS-IC's Phase 1 Operational Plan *'this approach depends critically upon information; the integration of existing data sets to form a comprehensive personal healthcare record and the generation or new data describing patient characteristics (genotype and phenotype) to permit stratification.'*

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 proposal.

The University of Glasgow responded to the Call for Proposals issued by Scottish Funding Council and submitted a detailed proposal. The Phase 1 Operational Plan highlights the Centre's **vision** to be a *'world-class centre of research, innovation and commercialisation in stratified medicine'* and a **mission** to *'transform management of chronic disease globally by accelerating biomedical research, high quality health care provision and economic growth.'*

The Plan highlights that the mission requires a long-term commitment, and that the Centre will initially focus on *'scalable, whole genome clinical sequencing with linkage to biomedical data assets and bioinformatics.'* The Centre's **purpose** is articulated as being *'to prove the principle of smart (or stratified) clinical trials... achieved through a series of exemplar projects.'* The ultimate goal being to *'create physician-based and patient-centric tools to aid in diagnosis, streamlining of patient pathways, therapy selection and patient self-management.'*

The Plan offered a range of **Key Performance Indicators** (KPIs) for Phase 1 including:

- 31 SMEs engaged (excluding businesses engaged in the Centre's formation).
- 64 active projects with industry of which 40 (67% of total) involve SMEs.
- 6 new products, services or processes developed.
- 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.

The Plan requested £8 million from SFC with match from four partners: University of Glasgow; GlaxoSmithKline; Life Technologies; and Arhidia. Total Phase 1 funding of £10.3 million was allocated as follows:

- Exemplar Programmes: £4.1 million.
- Skills Development & Exchange: £3.0 million.
- Core Team: £2.0 million.

- Technologies & Assets: £1.1 million.

In relation to **governance** the Plan sets out that the University of Glasgow will be the Host University and lead the Centre for legal and fiduciary purposes. An Executive Board would be created with its role including to *'provide entrepreneurial leadership, set strategy, and review management performance.'* The Board members were drawn from core partners, with each founding partner entering into a contract regulating their contribution to the Centre, and the benefits they would receive in return. The Plan outlines that an Industry Forum has been established and tasked with *'ensuring that the voice of industry, especially of SME partners, influences the research programme and collaborations.'*

An economic impact assessment estimated that the Centre would generate 334 new industry jobs (direct and indirect) and more than £68 million Gross Value Added over the five-year Phase 1 period with a target of 20% accruing to SMEs.

2.2 Main findings from Phase 2 due diligence.

SFC and partners commissioned Frontline to review the Centre's Phase 1 activity to inform the funding allocation for Phase 2. The report was published in August 2019. Key findings included:

- Precision Medicine presents a significant opportunity for Scotland, with unique assets including some of the *'best linkable health service datasets in the world, due in part to the adoption in the 1970s of a centrally maintained unique identifier.'*
- Stakeholders agreed that there was a definite requirement for a research centre which brought industry, academia and the NHS together to capitalise on the opportunity that Precision Medicine presents.
- The report states that *'to date industry relationships have been deep with a small number of companies aligned to the exemplar projects resulting in the current and potential GVA benefits being lower than expected. Exemplar projects are also in the lower TRL levels which take longer to achieve commercial benefits.'* Frontline concludes the main cause is this narrow engagement *'is the lack of specific projects and funding to encourage business engagement.'* Frontline highlight that *'it will be important to include increase reference to commercial outcomes'* in Phase 2.
- The Centre learnt valuable lessons from Phase 1 and experienced a number of operational challenges including turnover of staff. Stakeholders identified areas that needed improvement including: vision and communication of it; development and measurement of objectives and KPIs; engagement with industry; visibility in the NHS; governance; and health data management systems.
- In relation to the Monitoring and Evaluation Framework (MEF) Frontline highlight that *'it has been difficult to assess progress against targets due to a lack of a completed Phase 1 MEF and no formally agreed 5-year metrics.'*
- Frontline suggest that the Centre needs to *'ensure that it has a strong brand and value proposition and clarity on the role it will play in each to support the growth and development of the PM ecosystem.'*

2.3 Main elements of Phase 2 business plan.

The Business Plan, covering the period from 2019 to 2024 outlines four strategic objectives for Phase 2:

- Enable precision medicine innovation to be demonstrated and adopted.
- Build maturity into programme delivery.
- Enable economic development.

- Build a balanced diet of funding from different sources.

In relation to the first objective the Plan outlines PMS-IC's focus on building a Service Broker Model to *'provide a service catalogue that will enable the further growth and development of a Precision Medicine Ecosystem.'* The Plan outlines how the Centre's *'partnership with Aridhia has enabled the development of the Centre's technology platform that has been tested and refined using the exemplar projects.'* The Plan sets out four Use Cases for the Service Broker Model including the secure transfer of data from NHS databases.

In relation to the third objective the Plan outlines plans for a commercialisation team at the Centre to *'identify large scale, high value, international collaborations with the Biopharmaceutical industry'* but it is also acknowledged that SMEs *'are a vital part of the ecosystem and provide a mechanism for translation and commercialisation of early-stage research'* and commits to support smaller firms.

The Plan explains the *'need to increase the number of projects coming into the Innovation Centre and, in particular, significantly increase pharma/biotech deal flow'* and commits to raising *'the level of our outbound and inbound marketing.'* The Plan outlines that the Centre is *'working to ensure better engagement from our academic partners, given the number of grant calls that have a focus on stratified medicine.'* There is acknowledgement that the governance arrangements with a consortium of ten partners which *'puts liability for all of the Centre's activity onto all consortium partners'* has resulted in *'some prolonged contractual negotiations, which has hindered our agility at some points.'* The Centre committed to a governance review and re-structure.

The importance of developing a *'continuous stream of graduates with the necessary skills required to meet the future needs of industry'* is acknowledged, and the Plan commits to the continuation of the master's programme, and to support PhDs. The Plan includes detailed financial forecasts and an aim to *'deliver a 50%/50% public/ private funding model shortly after 2019/20, with a clear pathway to 100% self-sustainability.'* Revenues are forecast to grow from £0.6 million in 2018/19 to £2.3 million by 2021/22, with 85% of this income from: collaboration workspace with enhanced functionality and the healthcare landing zone.

2.4 Evaluation logic model

PMS-IC's current approach is summarised in the figure below. The model was developed by the authors and was informed by the review of the Centre's business plans.

Figure A. 1 PMS-IC logic model.



Source: Authors with inputs including the Phase 2 Business Plan

3 Market failure and strategic fit.

3.1 Market failure rationale.

The analysis of market failure draws on information provided by PMS-IC and the analysis of responses to the client survey.

The first potential driver for public sector investment focusses on **equity**, specifically whether Scotland, or groups within Scotland, compare poorly relative to other places or groups.

- **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. The client survey did not ask for business size and as noted above, data on the size of businesses supported by PMS-IC was not available.
- **Business ownership:** as outlined in Chapter 2, over half of R&D expenditure in Scotland was from foreign-owned firms. PMS-IC 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. The client survey asked respondents to provide their location. 16 respondents provided details of their location and 13% were from outside Scotland with 63% from Glasgow; 13% from Edinburgh; 6% from West Dunbartonshire, and 6% from other locations. None of the respondents were located in the Highlands and Islands. This suggests that PMS-IC is not strongly delivering on an equity objective to support innovation outside of Edinburgh and Glasgow.
- **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 12 respondents provided data and 33% operate in either 'Professional, scientific and technical activities' or 'manufacturing.' On this basis PMS-IC does appear to be supporting sectors that typically display lower levels of BERD expenditure.

The second potential rationale for Government intervention relates to **efficiency** considerations. This requires a consideration of whether there are imperfections or faults in the market that can only be resolved with public sector intervention. PMS-IC addresses the following market failures related to efficiency:

- **Externalities** – there are significant positive externalities that arise from a precision medicine approach including improved health outcomes; reduced waste; and reduced costs for the NHS and Exchequer. These benefits do not flow to industry or academia but to wider society. Stakeholders acknowledged that long-term societal outcomes are likely to arise from collaborative project supported by PMS-IC. 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 PMS-IC, and: 38% of respondents cited a significant contribution to Industry, innovation and infrastructure; 25% of respondents cited a significant contribution to good health and well-being; and 14% of respondents cited a significant contribution to decent work and economic growth.
- **Information failures** – one of PMS-IC's major work areas relates to providing easier access to complex health data to industry and academia. SMEs in particular, are likely to lack the capacity

and knowledge to unlock data that they can use to develop valuable new precision medicine products, services and processes. In this respect PMS-IC is helping to overcome a major barrier to the development of precision medicine in Scotland. Respondents to the client survey were asked which of a series of potential barriers had significantly constrained their innovation activities before working with PMS-IC. 16 respondents answered this question but only a very small proportion identified barriers related to information failures with just 6% highlighting a 'lack of information on technology.' The largest barrier identified was 'lack of qualified personnel or specialist project / programme support' with 38% of the 16 respondents citing it as a barrier.

Finally, there are wider drivers for intervention beyond the equity and efficiency considerations summarised above:

- **Institutional failures** – the triple helix model acknowledges that traditional role of academia lies in teaching and research, yet they possess significant innovation assets. PMS-IC seeks to bring academia together with industry and the public sector to foster economic development.
- **Co-ordination failures** – PMS-IC provides easier access to complex health data to industry and academia, and provide project management services which stakeholders highlighted is highly valued.
- **Opportunity** – as outlined above, precision medicine represents an opportunity for Scotland given its assets. PMS-IC is uniquely well-placed to help Scotland secure the opportunity.

The evidence from the evaluation is that market failures continues to exist including securing effective information and guidance on accessing academic support and NHS market access. There are positive externalities to be derived from innovation in the digital health and care sector.

3.2 Strategic fit.

PMS-IC is closely aligned to national policy priorities and has a strong profile with Government. PMS-IC is contributing to a range of key strategies and plans, including:

- Scottish Government – Programme for Government 2018/19.
- Health & Social Care Delivery Plan.
- Technology Enabled Care Delivery Plan.
- Life Science Strategy for Scotland: 2025 vision.
- Realistic Medicine.
- Scottish Government Economic Action Plan 2018-20.

Scotland's National Performance Framework (NPF) sets an overall purpose and vision for Scotland: '*it seeks to create a country that's success is not judged solely on the performance of our economy... but instead on a wider range of measures... Scotland will become a more successful country with opportunities for all to flourish through increased well-being.*'

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.*' Whilst PMS-IC does support collaboration between business and academia, the number of projects completed is modest and the majority of projects appear to involve large multi-national businesses, rather than domestic SMEs.

PMS-IC has a stronger focus on improved delivery of public services than it does on business growth. As highlighted in Frontline's Due Diligence Report the exemplar projects completed in Phase 1 were '*in the lower Technology Readiness Level (TRL) which take longer to achieve commercial benefits.*' This view is supported by analysis of stakeholder interviews with the majority of interviewees able to identify how PMS-IC supported large pharma and academia to develop new diagnostics and treatments, but

fewer able to identify a significant focus on business growth. One stakeholder commented that *'in Phase 1 PMS-IC was not focussed enough on translating research into clinical benefit and economic benefit through commercialisation of technology'* [51]. Another stated that PMS-IC should *'move towards innovation and implementation, rather than just research'* [57].

PMS-IC's Phase 2 Business Plan contained four strategic objectives which included *'to enable economic development.'* Outlining this strategic objective, the Plan states that *'the Innovation Centres were established as part of Scottish Governments plans for supporting innovation-led economic growth, the primary focus of the IC programme is on economic and social impact while improving treatments for patients.'* PMS-IC's attempt to increase innovation-led economic growth were significantly hampered by Covid-19 which prevented projects from proceeding, and on-going challenges in recruiting staff. A number of stakeholders cited a lack of capacity within PMS-IC with comments including *'they need more resource, more staff, more hands on deck.'* [53] and *'PMS-IC are great to work with, they are very collaborative, but are thin on the ground and people don't know who they are and what they do'* [58].

Overall PMS-IC is well aligned to Scottish Government policy priorities but is arguable less well-aligned to the Innovation Centre programme with only a modest focus and impact evident on the aim to *'deliver routes to economic benefits through increased levels of collaboration between business and academia which target business or sectoral growth'* and a stronger, but long-term contribution to the aim to support the *'improved delivery of public services in Scotland.'*

3.3 Covid response.

The outbreak of Covid-19 presented major operational challenges for PMS-IC which are still on-going. Covid had a pronounced impact on PMS-IC in that all projects required patient involvement which was paused for 18-24 months. The Centre received confirmation of the Phase 2 funding on the 30th September, with Phase 2 starting on the 1st October 2020. PMS-IC held a launch event in February 2020. However, all PMS-IC's research studies had to stop as the focus within the NHS and partners was on developing vaccines. PMS-IC provided their laboratory for use as a Lighthouse Lab, and the laboratory will not be available for PMS-IC until March 2023. PMS-IC had to identify and commission a new lab – it is smaller, and the space is not designed as effectively. Furthermore, PMS-IC staff were seconded across to the Lighthouse Lab thereby significantly reducing the Innovation Centre's capacity.

It should also be noted that PMS-IC have found it challenging to recruit new staff during the pandemic. The uncertainty around the length and depth of the impact of the pandemic on the Centre's operations has acted as a barrier to potential recruits.

PMS-IC focussed on activities that could still be delivered and this included completing a remote scoring system to inform pathology reviews. The Centre moved events, engagement and skills and training programmes online, and helped partners to respond. However, PMS-IC was disproportionately impacted by Covid-19 compared to the other Innovation Centres, losing infrastructure and staff to support the development of vaccines.

In February 2021 PMS-IC produced their report on *'Contributing to Scotland's recovery in the emergency years.'* In this report PMS-IC outlined a range of measures that they will take to contribute to recovery including alignment to NHS Scotland's Re-mobilise, Recover, Re-design Framework which seeks to effectively mobilise the NHS to a better health and care system through: innovation and integration; ensuring equity of access; and, achieving better outcomes for people in Scotland, and their families.

PMS-IC also highlight their contribution to the successful SIFP bid which was awarded to University of Glasgow for £38 million to develop the Living Lab.

4 Inputs, activities, outputs.

4.1 Funder inputs.

The table below confirms the funding that Scottish Funding Council (SFC) and Scottish Enterprise (SE) have provided to PMS-IC across Phases 1 and 2. Please note that Highlands & Islands Enterprise (HIE) have not provided any funding to the Centre.

It should be noted that all the funding received in Phase 2 has been solely for infrastructure, with the majority focussed on laboratory and IT infrastructure. The Phase 2 allocation has not included any funding for projects, so PMS-IC has only been able to deliver collaborative R&D projects by attracting external funding.

Table A. 1 PMS-IC inputs to March 2023.

| | Phase 1 Spend | Phase 2 Award | Phase 2 Actual to Date | Total Spend to Date |
|--------------|----------------------|---------------------|------------------------|----------------------------------|
| SFC | £12.0 million | £7.5 million | £2.4 million | £14.4 million |
| HIE | - | - | - | - |
| SE | - | £2.0 million | £0.4 million | £0.4million |
| Total | £12.0 million | £9.5 million | £2.9 million | £14.9 million[‡] |

Source: SFC, SE, HIE correspondence ('Summary funders awards and drawdowns to date', excel spreadsheet, Feb 2023). ‡ 14.9 due to rounding.

4.2 Activities and outputs.

Skills

Table A. 2 shows the number of entrants to education or training that PMS-IC has delivered in Phases 1 and 2, with Phase 2 reflecting the position up to and including 30th October 2022. In addition, the number of individuals gaining new qualifications is indicated. Data was not available for Phase 1 and Phase 2 data is accurate up to 30th October 2022.

Table A. 2 PMS-IC: number of entrants to education/training.

| Level | Phase 1 | Phase 2 | Total |
|--------------|------------|------------|------------|
| PhD/EngD | - | - | - |
| MSc | 140 | 105 | 245 |
| HND/HNC | - | - | - |
| Other | - | 2 | 2 |
| Total | 140 | 107 | 247 |

Source: MEF data provided by PMS-IC

Table A. 3 PMS-IC: number of individuals gaining new qualifications/skills.

| Level | Phase 1 | Phase 2 | Total |
|--------------|----------|------------|------------|
| PhD/EngD | - | - | - |
| MSc | - | 105 | 105 |
| HNC/HND | - | - | - |
| Other | - | - | - |
| Total | - | 105 | 105 |

Source: MEF data provided by PMS-IC

Networking

Table A. 4 shows the number of events that PMS-IC has delivered in Phase 2 up to 30th October 2022. Please note data was not available for Phase 1. The Phase 1 due diligence report confirmed that

Frontline were unable to ‘*assess progress against targets due to a lack of a completed Phase 1 MEF and no formally agreed 5-year metrics.*’ Table A. 5 below shows the follow-on from completed collaborative projects. Phase 1 projects were academic exemplar projects, and it was not appropriate to refer the partners to the organisations listed in the table below.

Events delivered by PMS-IC in Phase 2 include:

- Virtual Event on precision medicine at the Innovation Centre’s pre-COP 26 conference with over 80 attendees.
- University of Dundee event to showcase collaboration opportunities with PMS-IC with over 30 delegates.

The Centre is currently planning a 10 year anniversary PMS-IC Summit for 28th September 2023, and over 200 delegates are anticipated.

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

| Level | Phase 1 | Phase 2 | Total |
|------------------|---------|-----------|-----------|
| > 100 Attendees | - | 0 | - |
| 10-100 Attendees | - | 10 | 10 |
| < 10 Attendees | - | 0 | - |
| Total | - | 10 | 10 |

Source: MEF data provided by PMS-IC

Table A. 5 PMS-IC: follow on from completed collaborative projects.

| Level | Phase 1 | Phase 2 | Total |
|--|----------|----------|-----------|
| Signposted to SE | - | - | - |
| Signposted to HIE | - | - | - |
| Signposted to other public funding/support body | - | - | - |
| Signposted to private sector | 2 | 2 | 4 |
| IC supported follow-on project planned or underway | 4 | 2 | 6 |
| Direct to market (by a business in Scotland) | 1 | 1 | 2 |
| Projects not taken forward | - | - | - |
| Total | 7 | 5 | 12 |

Source: MEF data provided by PMS-IC

Collaborative projects

The table below indicates that PMS-IC completed eight collaborative projects in Phase 1 and over Phase 2, up to the end of October 2022, has eight new collaborative projects.

Table A. 6 PMS-IC: collaborative projects.

| Level | Phase 1 | | Phase 2 | |
|--|---|-----------------------------------|--|---|
| Level | No. of collaborative projects (including completed) | No. of new collaborative projects | No. of continuing collaborative projects | No. of completed collaborative projects |
| Academic/IC to business (involving at least 1 business in Scotland) | - | - | - | - |
| Academic/IC to public sector (involving no businesses in Scotland) | - | 3 | 4 | 1 |
| Academic/IC to public sector to business (involving at least 1 business in Scotland) | 8 | 5 | 4 | 1 |
| Total | 8 | 8 | 8 | 2 |

Source: MEF data provided by PMS-IC.

Commercialisation

Table A. 7 shows the number of collaborative R&D projects that PMS-IC has supported that have led to the development of new, or improved products, processes, services, business models or public services. This data was not collected in Phase 1, and Phase 2 data is accurate up to 30th October 2022.

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

| Level | Phase 1 | Phase 2 | Total |
|--|---------|---------|-------|
| New or improved products developed (with/for a business in Scotland) | - | 3 | 3 |
| New or improved processes (with/for a business in Scotland) | - | - | - |
| New or improved services developed (with/for a business in Scotland) | - | - | - |
| New or improved business models (with/for business in Scotland) | - | - | - |
| New or improved delivery of a public service in Scotland | - | 1 | 1 |
| Total | - | 4 | 4 |

Source: MEF

The client survey also provides additional insight into IC activity. It is firstly worth noting that the sample size for PMS-IC is very small with just 16 respondents identifying it as the main Centre they had worked with. The findings that follow can only therefore be illustrative.

In terms of engagement with PMS-IC, over half of respondents (63%) first interacted with the PMS-IC in or before 2018 (broadly consistent with Phase 1). Some 50% of client respondents have been involved with the Centre for five years or more.

Some 56% of respondents were involved in a collaborative project between more than one partner, whereas 31% were involved in projects between themselves and one partner. Only 6% reported being involved in consultancy projects.

For collaborative project support, the majority of respondents (36%) reported that they had undertaken one collaborative project, with 27% reporting two projects and 18% reporting three. It is also the case that survey beneficiaries have often engaged with engaged with other ICs, particularly CENSIS, DHI and IBioIC.

In relation to lower intensity support only 6% reported attending accessing other advice or signposting provided by PMS-IC; but 25% reported that they had attended conferences or events provided by, or supported by, the Centre. Relatively few (13%) had accessed lab, test or demonstration facilities.

14 respondents answered a question in the client survey asking them to confirm whether they had worked with any Universities through PMS-IC. Two respondents that they hadn't worked with any Universities with the remaining respondents identified the following:

- University of Glasgow: 63% of responses (8 respondents);
- University of Edinburgh: 50% of responses (6 respondents);
- University of Dundee: 44% of responses (5 respondents);
- University of Aberdeen: 31% of responses (4 respondents); and,
- University of Strathclyde: 6% of responses (1 respondent).

Clients do appear to have worked with multiple Universities through PMS-IC, but the sample size is too small to draw robust conclusions. No client survey respondents reported engaging with a college through PMS-IC.

5 Outcomes and impacts.

5.1 Main findings from MEF.

The MEF seeks data from Innovation Centres on the following potential outcomes:

- New jobs created and jobs safeguarded by businesses in Scotland.
- New turnover generated and existing turnover safeguarded by businesses in Scotland.
- New posts created in Scottish universities and colleges and the public sector to support demand led academia-business projects.

It is important to note that the MEF does not contain any outcomes directly relating to the long-term outcomes that PMS-IC seeks to deliver including improved diagnosis and treatment of major health conditions with resulting savings for the NHS and national Exchequer, alongside significant societal benefits including an increase in healthy life expectancy.

Table A. 8 shows jobs reported as created and safeguarded by PMS-IC across Phases 1 and 2. Please note that Phase 2 data reflects the position up to and including 30th October 2022. PMS-IC confirmed that the jobs figures are those created by Centre beneficiaries and directly relate to work undertaken. The figures are reported by the beneficiaries.

Table A. 8 PMS-IC: anticipated jobs supported/created.

| Level | Phase 1 | Phase 2 | Total |
|--|-----------|-----------|-----------|
| New jobs generated (by business in Scotland) | 19 | 9 | 28 |
| Existing jobs safeguarded (by business in Scotland) | 18 | 3 | 21 |
| Total | 37 | 12 | 49 |

Source: MEF data provided by PMS-IC

The Phase 2 period of 36 months is 55% of the Phase 1 period of 65 months. 12 jobs created or safeguarded in Phase 2 represents 32% of the amount achieved in Phase 1. On this crude measure PMS-IC appears to be enabling jobs at a reduced rate in Phase 2, reflecting the operational challenges it has encountered.

Table A. 9 below shows new turnover enabled through projects supported by PMS-IC. Phase 2 data reflects the position up to and including 30th October 2022. Data is reported in millions of pounds. In relation to turnover PMS-IC confirmed that the figures are a mixture of those supplied by beneficiaries and research that staff at the Centre complete on Companies House gathering information pre and post-completion of collaborative projects.

Table A. 9 PMS-IC: anticipated turnover supported/created.

| Level | Phase 1 (m) | Phase 2 (m) | Total (m) |
|--|--------------|--------------|--------------|
| New turnover generated (by business in Scotland) | £0.95 | £1.64 | £2.59 |
| Existing turnover safeguarded (by business in Scotland) | - | - | - |
| Total | £0.95 | £1.64 | £2.59 |

Source: MEF data provided by PMS-IC

Table A. 10 below shows new posts in Scottish universities, colleges and public sector organisations created to support demand-led academia-business projects. The data for Phase 1 is not available. Phase 2 data reflects the position up to and including 30th October 2022.

Table A. 10 PMS-IC: posts created in Scottish HEIs/colleges/public sector.

| Level | Phase 1 | Phase 2 | Total |
|--|---------|-----------|-----------|
| New posts (in Scottish HEIs) created to support demand led academia-business projects | - | 5 | 5 |
| New posts (in Scottish colleges) created to support demand led academia-business projects | - | - | - |
| New posts (in Scottish public sector) created to support demand led academia-business projects | - | 8 | 8 |
| Total | - | 13 | 13 |

Source: MEF data provided by PMS-IC

5.2 Main findings from survey of beneficiaries.

5.2.1 Outcomes.

In terms of influence on relationships:

- 31% of respondents indicate that PMS-IC supported their relationships with other clients or customers from the private sector.
- 25% of respondents indicate that PMS-IC supported their relationships with universities or colleges.
- 25% of respondents indicate that PMS-IC supported their relationships with Government or public research institutes.
- 19% of respondents indicate that PMS-IC supported their relationships with professional and industry associations.
- 19% of respondents indicate that PMS-IC supported their relationships with other clients or customers from the public sector.

On this basis PMS-IC appears to play an important role in the implementation of a range of innovation activities. For instance, a quarter of client respondents engaged in design activity of some form (however no respondents stated that the Centre played a significant role in this activity). A half of those surveyed carried out internal R&D since they started working with the IC (in five out of 16 cases the clients indicate that the Centre played a significant role in this activity).

Just under a third (31%) of PMS-IC clients have introduced new or significantly improved services since they started working with the IC, but no respondents reported the introduction of new or improved goods. However, a further 19% had introduced new processes. In relation to new services two of 16 said the Centre played a significant role, and in relation to processes none of the respondents stated that the Centre played a significant role.

The relatively low levels of respondents that ascribe a significant role to PMS-IC in the delivery of innovation benefits suggests that additionality is low.

It is noted some 44% of respondents did not introduce any of the listed innovation outcomes. However, 19% stated that a new start-up or spin out businesses had launched, and 13% cited new patent applications with 6% identifying that new patents had been granted.

A range of **networking benefits** were cited (where PMS-IC played a significant role):

- Academic contacts: reported by 38% of clients.
- Business contacts: reported by 31% of clients.
- Developed project or joint venture with a business: reported by 25% of clients.

Clients also identified a range of **knowledge benefits**, though the scale of benefits appears modest:

- Improved awareness of academic capabilities: 19% of respondents.
- Improved market understanding of priority technology areas in my sector: 19% of respondents.
- Improved awareness of private sector support: 19% of respondents.

Those clients involved in collaborative projects through PMS-IC have typically started at the lower end of the TRL scale (it is noted this may include project work before IC involvement). 44% of projects were at TRL 1-2 at the start, with a further 11% at TRL 3. As PMS note, life sciences typically take 10-15 years to bring commercially viable products to market, so within this context the project trajectory is better understood¹.

Client survey respondents were also asked to identify whether they received **sales benefits** as a result of working with PMS-IC. 38% of respondents stated that they received no such benefits, but 25% stated that they entered or grew in other UK market; 13% that they entered or grew in Scottish market; and 13% that they entered or grew in international markets. However, only eight respondents answered this question in relation to PMS-IC.

Client survey respondents were also asked to identify whether they received **finance benefits** as a result of working with PMS-IC. Again, only eight responses were received and 38% of respondents selected 'not applicable' and a further 38% stated that they had not received such benefits. 13% of respondents cited improved investment readiness, and 25% of respondents stated that they secured new public sector investment.

The client survey asked respondents to identify the extent to which they would have gained the benefits listed above in the event that PMS-IC did not exist. 29% of respondents stated that they would not have achieved any of the benefits without PMS-IC support (absolute additionality). 14% of respondents say they would have achieved a significantly smaller range of benefits, at a reduced scale, and it would have taken longer to achieve them. A further 14% say they would have achieved the same benefits at the same time and scale without the IC support (zero additionality).

Finally, whilst the sample size is very small, the feedback from respondents on support from PMS-IC is positive:

- 100% satisfaction with postgraduate internships and placements (2 respondents).
- 100% satisfaction with accessing Innovation Centre laboratory, test or demonstration facilities (2 respondents).
- 78% satisfaction with collaborative project support with more than one partner (8 respondents).
- 75% satisfaction with conferences or events (3 respondents).
- 60% satisfaction with collaborative project support with one partner (5 respondents).

5.2.2 Impact.

Respondents to the client survey were asked to provide confirm how many employees were on payroll for financial years up to 2022, and then estimate employment levels in the event they had not accessed support from PMS-IC. Respondents were then asked to provide a forecast for total employment in 2025 with and without PMS-IC support.

In total respondents identified 27 jobs which when grossed up to the total population supported by PMS-IC equates to 405 jobs. However, the respondents did not attribute these jobs to support from PMS-IC. Accordingly, when the gross to net calculation is completed the net additional jobs is zero. On this basis it is not possible to calculate a Gross Value Added figure for Precision Medicine Scotland Innovation Centre.

A further question on additionality was included in the client survey. In all, 29% stated that they would not have achieved any of the benefits without PMS-IC support (absolute additionality). 14% of respondents say they would have achieved a significantly smaller range of benefits, at a reduced scale, and it would have taken longer to achieve them. A further 14% say they would have achieved the same benefits at the same time and scale without the IC support (zero additionality).

5.2.3 Wider impacts.

As highlighted earlier PMS-IC has a stronger focus on delivering routes to economic benefit through improved delivery of public services in Scotland, than through business or sectoral growth. Stakeholders were asked in the one-to-one interviews if they could identify benefits for each of the main groups that Innovation Centres typically support. A snapshot of identified benefits are provided below:

- Businesses – assistance for SMEs to engage with the NHS, Universities and large pharma; opportunity for SMEs to demonstrate their expertise; opportunity for large pharma to access valuable data; and support for businesses to develop new diagnostics and medicines.
- Universities – support to engage with the NHS; identification of businesses to partner with; funding for academic time; support with funding applications; resolution of legal challenges involved in access to sensitive data and ownership of findings; access to Data Commons and curated data; receipt of an effective Project Management service; and receipt of staff time from PMS-IC to complete technical tests.
- Public sector organisations – development of new diagnostics and treatments for the NHS; and support to develop policy and strategy.
- Students – arrangement of work placements; exposure to potential future employers; and development of valuable skills that boost employability and earning potential.
- Ecosystem – focal point for precision medicine research.

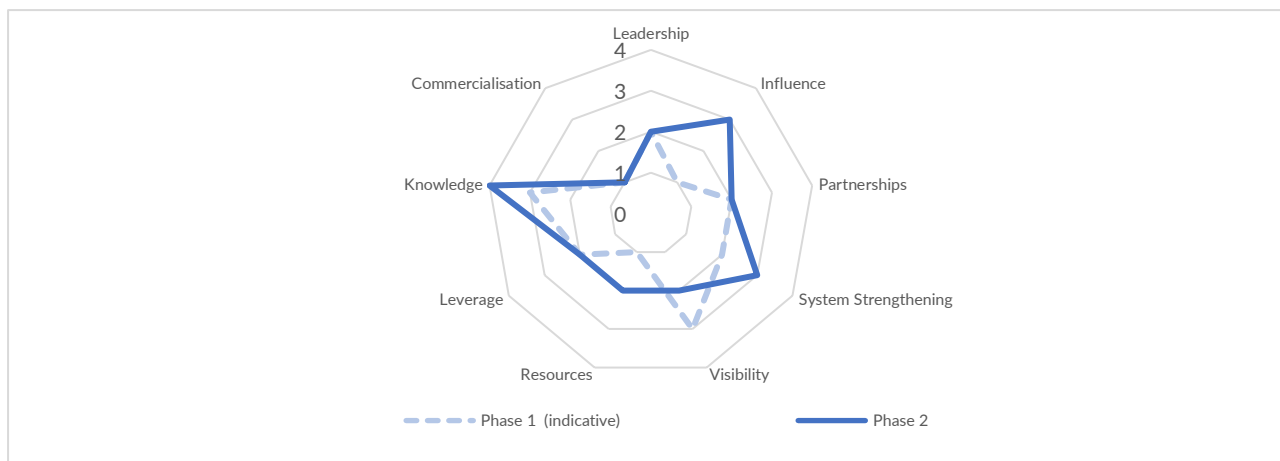
In considering the wider benefits of PMS-IC support, clients were asked which, if any, of the UN Sustainable Development Goals (SDGs) had their establishment made a significant contribution to, as a result of working with the Innovation Centre. A wide range of benefits are cited, particularly in relation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

- 38% of respondents identified industry, innovation and infrastructure.
- 25% of respondents identified good health and well-being.
- 19% of respondents identified decent work and economic growth.
- 13% of respondents identified reduced inequalities.
- 13% of respondents identified quality education.

5.3 Assessment of innovation ecosystem benefits.

The evaluation objectives include an assessment of how effective each IC has been in building engagement in its own ecosystem. The approach to assessing the role of ICs within the wider innovation ecosystem is set out in Appendix A, and summarised for PMS-IC 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 PMS-IC Innovation Ecosystem Benefits



Source: authors

System Leadership

Leadership

- Considering the results of the client survey, stakeholder survey and stakeholder interviews it is hard to conclude that PMS-IC is currently playing a strong leadership role in the ecosystem.
- Stakeholders did not identify any examples of PMS-IC providing strategic leadership and acting as a catalyst via development of a sector or technology area strategy. A key theme that emerged from stakeholder interviews was that PMS-IC currently lacks the capacity to be truly pro-active. Only three respondents to the client survey highlighted that they ‘attended conferences or events provided by, or supported by, PMS-IC, including ‘innovation clusters’ and no respondents stated that they engaged with PMS-IC in order to ‘support a consultation process on strategy in your sector or technology area’.
- Several stakeholders highlighted the work PMS-IC has completed in creating Data Commons as a significant step in addressing a major barrier to research into precision medicine.

Influence

- As highlighted above, PMS-IC informs Scottish Government policy. A Board member stated that ‘the Centre has put Precision Medicine on map of Scotland. Nicola Sturgeon has talked about the importance of Precision Medicine at major conferences. There have been a number of pan-Scotland meetings focussed on Precision Medicine’ [52].
- However, stakeholders that were independent of PMS-IC did not identify influence as a particular area of strength. Stakeholders typically cited capacity challenges and questioned how visible PMS-IC is in the precision medicine space.
- The influence category also examines the extent to which Centres ‘carry out or stimulate activity that defines the distinctive roles of partners; get partners to commit to shared strategic objectives; and influence partners to allocate their funds accordingly.’ It is clear from interviews with stakeholders and the case studies that PMS-IC has initiated collaborative projects with a range of partners each with clearly defined roles working to shared objectives. An example being PMS-IC approaching the University of Edinburgh to identify opportunities to advance precision medicine which led to the creation of a data commons to enable the investigation of Non-alcoholic fatty liver disease (NAFLD) with a £1.7 million grant from Innovate UK. The initial collaborative project led to a further £0.7 million being secured to interpret patient data to predict when NAFLD is likely to progress into dangerous conditions such as cirrhosis of the liver and liver cancer.

- A Board member highlighted the role PMS-IC played in securing funding to establish the Living Laboratory - an *'incubator for SMEs, enabling them to discuss ideas with clinicians, access data and develop solutions'* [52].
- The authors are aware of the important work that PMS-IC complete in informing Scottish Government policy and this is reflected in the score allocated to leadership.

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.
- In Phase 1 PMS-IC issued a call for exemplar projects and selected projects following the appraisal of applications. PMS-IC's approach to collaborative projects in Phase 2 has been hampered by operational challenges resulting from the COVID-19 outbreak and limited capacity.
- The majority of stakeholders did not raise partnership as an area of strength or weakness for PMS-IC. A Board member stated that *'the Centre has created good relationships with academia and NHS'* [51] but an academic stakeholder expressed a view that *'not many people know who they are and what they do'* [58]. An academic stakeholder commented that PMS-IC has worked well in partnership to support Master students - *'PMS-IC are effective at sourcing 12 week placements, and it often needs a personal contact to be able to encourage a business to take a student on'* [54].
- A number of stakeholders expressed a view that PMS-IC is under-resourced, and this has reduced awareness of their offer and the amount of engagement and partnership work they can undertake.
- Analysis of the client survey data highlights that 56% of respondents were involved in a collaborative project between more than one partner, whereas 31% were involved in projects between themselves and one partner. 36% of respondents reported that they had undertaken one collaborative project, with 27% reporting two projects and 18% reporting three. Furthermore, survey respondents have often engaged with engaged with other ICs, particularly CENSIS, DHI and IBioIC.
- This suggests that PMS-IC has facilitated the identification of collaborative opportunities. However, this needs to be tempered by the finding that relatively few respondents attribute a significant role to PMS-IC in relation to direct innovation benefits. For example, whilst just under a third of respondents introduced new or significantly improved services only 13% said the Centre played a significant role in this.
- The available evidence suggests that PMS-IC is effective at enabling collaborative projects focussed on precision medicine, but the scale of the impact is limited by capacity constraints and operational challenges encountered.

System Strengthening

- This category tests the extent to which ICs create synergies and facilitate academic to industry networking. A number of academic stakeholders outlined collaborative projects that PMS-IC had supported [51, 54 & 58]. Examples include a cancer screening project involving PMS-IC and AstraZeneca and a project using Artificial Intelligence to develop predictive tools to improve the prognosis of non-alcoholic fatty liver disease.
- Stakeholders highlighted that PMS-IC has played a number of roles including funding academic time, locating partners, analysing data and providing project management services. A

stakeholder highlighted that PMS-IC helps scientists engage with the NHS and they would know how to go about this [58].

- As reported earlier, analysis of client survey data highlights that 31% of respondents indicate that PMS-IC supported their relationships with other clients or customers from the private sector; and 25% of respondents indicate that the Centre supported their relationships with universities or colleges. 14 respondents answered a question in the client survey asking them to confirm whether they had worked with any Universities through PMS-IC. Eight respondents stated they had worked with the University of Glasgow and six that they had worked with the University of Edinburgh. The Universities of Dundee, Aberdeen and Strathclyde were mentioned by five, four and one respondents respectively.

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.
- Academic stakeholders did not identify visibility as a benefit that PMS-IC delivers. A Board member commented that PMS-IC has '*helped put Precision Medicine on map of Scotland*' [52] and staff members were able to identify ways in which the Centre is developing national visibility of precision medicine.
- There was reference in stakeholder interviews to the attraction of AstraZeneca to the Ovarian Cancer project, but the role PMS-IC directly played is a little unclear, and the authors understand that AstraZeneca approached Scottish Government and the Chief Scientist expressing their interest in work supported by Scotland's Electronic Health Records.
- It is not possible to conclude based on the analysis of feedback from stakeholders and clients that visibility has been a significant strength for PMS-IC.

Resources

- This benefit explores the extent to which Innovation Centres have developed physical research and innovation infrastructure and environments or improved organisational capacities or ways of working. Several stakeholders identified that PMS-IC provides a valuable project management service in collaborative R&D projects [51, 54 & 58]. One academic stakeholder commented that PMS-IC staff '*have an understanding of funding and project management, and an understanding of science - this is a very bespoke set of skills*' [58] and another stated that '*it was really, really helpful for PMS-IC to project manage our three collaborative projects*' [53].
- An academic stakeholder commented that '*PMS-IC made libraries for RNA sequencing, and integrated and curated the clinical data and pathology data - our project used PMS-IC infrastructure*' [53]. However, concerns were raised by several stakeholders about PMS-IC's capacity and a number of stakeholders highlighted that whilst the Data Commons is a major asset, significant investment is required to develop an effective interface with strong functionality.
- Looking at the client survey only 13% of respondents stated that they had accessed lab, test or demonstration facilities. Only 6% reported attending accessing other advice or signposting provided by PMS-IC; but 25% reported that they had attended conferences or events provided by, or supported by, the Centre.

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.
- Academic stakeholders highlighted that PMS-IC assisted them to secure funding from a range of sources. Examples given included grants in excess of £1.5 million from national funding sources so these are significant projects. These stakeholders also gave examples of PMS-IC funding academic time to engage in collaborative R&D projects. One academic stakeholder stated that the funding PMS-IC allocate *'plays an important role in pump priming and enabling work to proceed rapidly. This initial research led to additional work funded by other sources'* [57].
- A Board member stated that in Phase 2 PMS-IC has had a greater focus on 'helping Universities leverage funding from sources include Innovate UK' [58].
- Analysis of the client survey data confirms that the Centre has brought businesses and academia together. The case studies include some examples of PMS-IC assisting partnerships to secure collaborative project funding, and the Centre has provided project management and co-ordination support to several such projects.
- The Centre has influenced a range of significant funding awards including the Living Lab (£38 million); the Cancer Research Centre (£14 million); and INTERPRET NAFLD (£0.7 million).

Knowledge

- This category explores how the Centre affects how knowledge is created and spread between actors and applied in the system.
- An Academic stakeholder highlighted how the master's programme which PMS-IC helped shape and supports is unique as it is delivered by five Universities throughout Scotland. The stakeholder commented that *'it is a great master's programme, with a variety of teaching from the best lecturers from a range of Universities'* [54]. The stakeholder outlined that PMS-IC play an important role in organising work placements.
- An academic stakeholder highlighted that she supervises PhD students who are deliver research on projects that PMS-IC helped establish. Another highlighted that business benefits from a greater knowledge of how medicine they are developing may work in practice. An industry stakeholder highlighted that they had a master's student placed with them to work on a collaborative R&D project, and in subsequent projects they have had PhD placements. The stakeholder highlighted that the students *'gain knowledge that will help them become effective clinicians – this forms training for the next generation of clinicians'* [57].
- PMS-IC retains a strong focus on supporting young people to gain the skills and knowledge needed to work in precision medicine with 105 master's completed up to October 2022 in Phase 2.

Commercialisation

- This final category explores how Centres are supporting activities leading to commercial or public sector exploitation. As highlighted earlier, PMS-IC has had a greater focus on delivering routes to economic benefits through improved delivery of public services, as opposed to targeting business or sectoral growth. PMS note they have a low number of high impact projects, one of which has gone into translation into a new service for the NHS (and all generally with relatively long timelines).
- One academic partner that has completed several projects supported by PMS-IC stated that the projects have just been completed and *'have not realised tangible benefits yet. But all the SMEs have each got very targeted exploitation plans and I can see where the companies will go*

commercially' [53]. Two of the SMEs are in discussion with potential investors, and one is focussed on getting their technology adopted by the NHS in Scotland.

- A Board member highlighted the role PMS-IC played in securing funding to establish the Living Laboratory which will be an *'incubator for SMEs, enabling them to discuss ideas with clinicians, access data and develop solutions'* [52]. A stakeholder suggested that the establishment of the Living Laboratory has complicated the landscape and made it harder for PMS-IC to define their role working with business.
- Another Board member highlighted that *'more recently SMEs have become partners on bigger projects, and can help commercialise an output. PMS-IC is starting to generate more SME opportunities'* [51]. This Board member works in industry and highlighted that a firm he founded that received support from PMS-IC was bought by a foreign firm, and added that *'if Scotland can focus on getting the key components in place including data access it will be an attractive proposition for foreign investment'* [51].
- Analysis of the client survey data suggests that the Centre has had a modest role in enabling the delivery of activities that lead to commercial or public sector exploitation. For example, just under a third (31%) of PMS-IC clients have introduced new or significantly improved services since they started working with the IC and a further 19% have introduced new processes. However, only 13% of the respondents that introduced new services stated that the Centre played a significant role, and in relation to processes none of the respondents stated that the Centre played a significant role.

6 Delivery and value for money.

6.1 Governance and management arrangements.

PMS-IC was established in 2013 by a consortium of partners from four Scottish NHS Health Boards, four Scottish Universities and two industrial partners in informatics: Aridhia Ltd and in genetics with ThermoFisher Scientific Ltd. PMS-IC is based at the Queen Elizabeth University Hospital (QEUH) in Glasgow and the Centre has been hosted by the University of Glasgow since inception.

In common with other ICs, the University of Glasgow, as host institution, employs all PMS-IC staff and handles all financial matters, including the receipt of core funding, the contracting and financing of all research funds, and others matters. PMS-IC is subject to the University's policies and procedures on Human Resources and Finance and falls within the scope of University's audit and compliance arrangements. Stakeholders did not raise any issues about the relationship between the University and the Innovation Centre.

PMS-IC's Board is composed of representatives from the Consortium, including from NHS Scotland and the Universities of Glasgow, Edinburgh, Aberdeen and Dundee in Scotland. The Board is Chaired by Dr David Bunton, CEO of Reprocell Europe, a life sciences company based in Glasgow. There are three Board observers from Scottish Funding Council, Scottish Enterprise and the Chief Scientists Office.

PMS-IC's current governance arrangements are unique across the IC programme in that they provide individual Consortium members significant influence over PMS-IC's operational priorities and delivery. The Centre's public sector funding partners were not comfortable with this arrangement and the Phase 2 funding allocation included a condition of grant that a new governance approach was developed and implemented.

The current governance arrangements has had numerous negative implications. Firstly, seeking to resolve the situation has absorbed considerable capacity at PMS-IC and the public sector funders – this represents an opportunity cost. Secondly, marketing and engagement activity has been curtailed until PMS-IC is in a position to re-launch – a number of stakeholders highlighted that PMS-IC currently

doesn't cut through with partners unclear what services they offer. The current arrangement also appears to have reduced the speed at which PMS-IC can respond to opportunities. One stakeholder stated that *'the governance structure has had led to time delays and barriers. PMS-IC had to wait to get agreement from their own Board, and if Board disagree then this holds the proposed project up. The Board don't appear to meet often enough to be agile.'* These factors have combined to limit PMS-IC's activity and impact.

6.2 Monitoring and evaluation.

The Phase 1 due diligence report published in August 2019 commented on limitations in the MEF reporting for Phase 1. It is noted that PMS provided a limited MEF via its IC board papers (with changes in personnel noted as a constraining factor). In addition, a MEF return was made available during the evaluation and included data for all core MEF metrics with the exception of some activities supported in Phase 1.

The authors understand that PMS-IC routinely collect the following information on supported clients:

- Contact name and email address;
- Company name and address; and,
- Brief notes from meetings including follow-up actions.

It was evident from discussion with stakeholders that PMS-IC delivers outcomes over a longer time-frame than some other ICs, and these outcomes are not typically centred around job creation, but can deliver substantial delivery savings. The MEF in its current form does not provide an effective way to capture the long-term benefits that PMS-IC will deliver. Neither does PMS-IC report on a supplementary set of indicators that capture this activity. 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 through the identification of appropriate qualitative and quantitative indicators and appropriate targets.

6.3 Value for money.

6.3.1 Limitations.

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

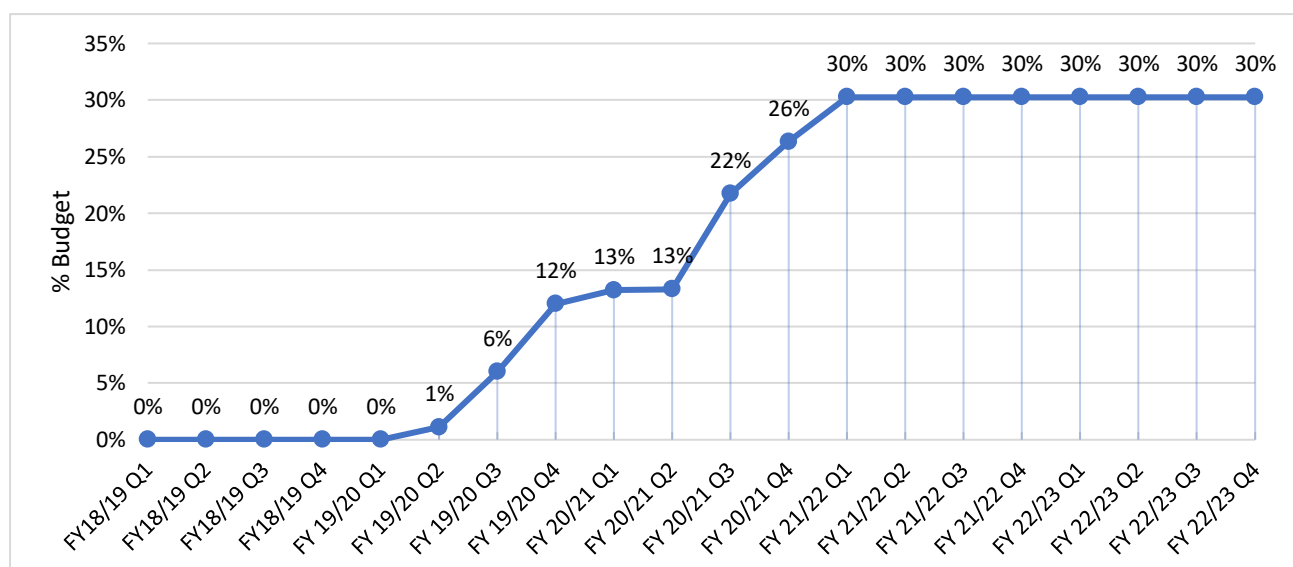
6.3.2 Budget execution.

Total Phase 1 spend is as £12.0 million. Funder budget drawdown is used as a proxy for expenditure. Phase 2 budget execution is noted in the figure below. Quarterly drawdown is approximate. Some 30% of the funder budget has been drawn down for the period up to March 2023 with IC spend considerably below originally planned levels, as discussed elsewhere.

PMS-IC's Phase 1 period ran for 65 months and dividing the SFC investment by the number of months highlights that the average monthly spend by PMS-IC was £184,385. The Phase 2 period up to December 2022 for PMS-IC is 38 months and the dividing the investment to date by SFC and SE highlights that average monthly spend has been £75,605 which is less than half the Phase 1 figure, indicative of considerably lower activity.

To a significant extent, the budget execution reflects the disruption caused by the COVID-19 pandemic, as discussed above. It is noted that PMS-IC demonstrated its agility and expertise by volunteering their labs and offices to be turned into the Lighthouse Lab for Scotland's covid-19 testing and their Lab Manager headed up that lab operationally. PMS Lab staff also worked in the Lighthouse Lab. The Lighthouse Lab is scheduled to close in March 2023.

Table A. 11 PMS-IC 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 £12.7 million was mobilised over Phases 1 and 2. Of this, 29% was industry finance. Comparing funder inputs (to nearest period of Dec 2022) to finance mobilised, this indicates an estimated leverage of £14.9 million to £12.7 million, or 0.9:1 (benefit to cost ratio). For industry finance mobilised this is 0.2:1. Considering Phase 2 alone, £4.6 million finance mobilised against to £2.9 million of funding represents a benefit to cost ratio of 1.5:1.

Examples of funding mobilised include:

- AstraZeneca- £1.5 million..
- CRUK (ovarian cancer project) - £2 million.
- UKRI Strength in Places Fund (SIPF)- £38 million ('The Living Lab' consortium funding).
- Roche- £1.5million.

Table A. 12 Finance mobilised PMS-IC, to Dec 2021/22

| | Phase 1 | Phase 2 | Total |
|-----------------------------|-------------------|-------------------|--------------------|
| Higher Education Institutes | £- | £- | £- |
| Other Public | £5,964,208 | £3,069,000 | £9,033,208 |
| Industry | £2,138,000 | £1,525,000 | £3,663,000 |
| Other | £- | £- | £- |
| Total | £8,102,208 | £4,594,000 | £12,696,208 |

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 generally examined across ICs: 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 measures do not capture all of the benefits of ICs. In the case of PMS-IC, given the very low jobs and GVA measures identified and that these impacts were not strongly aligned with PMS objectives, we have not included these estimates here.

6.3.5 Equity.

As presented earlier, the authors have attempted to analyse PMS-IC's contribution to equity objective using MEF and client survey data. The key findings, presented earlier, are briefly summarised below.

Some 16 client survey respondents provided details of their location and 13% were from outside Scotland with 63% from Glasgow; 13% from Edinburgh; 6% from West Dunbartonshire, and 6% from other locations. None of the respondents were located in the Highlands and Islands. However, this reflects a small sample, and it is noted that PMS have had projects in Aberdeen in Phase 1 and Dundee in Phase 2. In addition, all of the PMS health projects require clinical academic input which is typically only possible through large teaching hospitals. Some five of the IC's recent projects are pan-Scotland involving Aberdeen, Dundee, Edinburgh and Glasgow¹.

It is noted that greater representation in the HIE area is something PMS are actively addressing. Engagement with Highland Islands Health Board has commenced, and the IC are exploring potential collaborations. PMS notes that as their projects tend to involve complex clinical innovation, most of their project would need to involve a teaching hospital. Several projects that are pan-Scotland (e.g., SteatoSITE involved patients from Aberdeen, Dundee, Glasgow and Edinburgh)¹.

7 Progress against targets and objectives

7.1 Targets.

PMS-IC did not establish formal MEF targets for Phase 1 or Phase 2. It is therefore not possible to comment on whether PMS-IC is on track to achieve agreed objectives and targets.

However, to assess progress the authors reviewed the Phase 2 Business Plan submitted by PMS-IC. The Phase 2 Business Plan Appendix offered seven performance indicators (KPIs) that PMS-IC would strive to achieve. The KPIs do not map onto the MEF outputs, and several measure inputs rather than outputs and outcomes.

The Appendix to the Business Plan contained three logic models. Outputs from these models that are most closely aligned to the MEF are replicated below:

Supporting effective implementation of precision medicine into the NHS:

- 23 collaborative projects involving industry, academia and the NHS worth £6.7 million.
- 12 companies in Scotland supported to trial and evaluate new PM products, technologies and approaches with 11 companies in the rest of the UK.
- 35 master's students supported per annum with 12 Apprenticeships supported over five years.
- 3 inward investments supported per annum achieving £10 million per investment.

Supporting growth of Scottish Life Sciences Sector:

- Develop pipeline of precision medicine companies which rises from 36 to 100.

A pipeline of sustainable exemplar projects funded by industry or grants:

- Award one large grant (over £0.5 million) per annum.

¹ PMS correspondence March 2023.

On the first set of outputs PMS-IC reports that in Phase 2, up to October 2022, it has completed 16 collaborative projects, and 13 of them involved industry based in Scotland (others involved industry based on the rest of the UK or internationally). The Centre reports that they have commenced eight new collaborative projects in Phase 2, and five of them involve industry. Reflective of the COVID impact on activities outlined above, PMS-IC is not currently on track to deliver 23 collaborative projects involving industry, academia and the NHS.

There is no data available to examine whether PMS-IC is on track to support 12 Scottish companies to trial and evaluate new PM products. PMS-IC reports 140 master's entrants to education achieved up to October 2022 and the Centre is therefore on track with this logic model output. There was no data available on the number or value of inward investments reported.

The Business Plan suggests that over Phase 2, PMS-IC would support 141 new jobs, achieve added value of £114 million and a GVA of almost £76 million. In practice PMS-IC has reported nine new jobs and three safeguarded jobs in industry and 13 jobs in academia. It is therefore not possible to conclude, given disruption to the IC's operations, that the Centre is delivering at the scale forecast in the Phase 2 Business Plan.

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 on the following page explores PMS-IC's focus on these 10 programme objectives.

Table A. 13 PMS-IC achievements against programme objectives developed by authors.

| Objectives and strength of focus | Explanation of rating |
|--|---|
| O1: Direct businesses to the right support | Low Whilst stakeholders were able to identify examples of businesses supported by PMS-IC the analysis of interviews does not reveal any references to PMS-IC playing a key role in the business and innovation support ecosystem. The MEF data suggests that PMS-IC has signposted two businesses to the private sector in Phase 2 up to October 2022. PMS-IC is focussed more on collaborative projects in precision medicine than building the business support and innovation ecosystem and therefore scores low on this objective. |
| O2: Build and promote innovation ecosystems & sectors | Moderate Stakeholders were able to identify valued assets and services that PMS-IC provides including a Data Commons, data analysis services, bidding and project management services. However, analysis of interview transcripts does not reveal a sense that PMS-IC is building and promoting innovation support ecosystems and industry sectors. As highlighted earlier, PMS-IC doesn't score highly on wider benefits related to the ecosystem. identified. |
| O3: Engage industry and academics in collaborations that drive business growth | Low MEF data shows that PMS-IC has supported nine new jobs and helped safeguard three jobs in industry. Analysis of client survey data reveals that whilst respondents stated 27 jobs had been created, these jobs were not attributed to support from PMS-IC. Some stakeholders were able to cite examples of how PMS-IC has assisted businesses to grow but many stakeholders also highlighted that PMS-IC appeared to have limited capacity and this restricted the scale of work with businesses. Taking the feedback from stakeholders, the MEF data and the client survey data into account a low score is allocated to this objective. |
| O4: Secure external innovation funding | Moderate Stakeholders identified a number of projects which involved businesses where external funding was secured. A Board member stated that the establishment of the Living Laboratory would not have occurred without the establishment of PMS-IC, but the Living Laboratory was not identified by any other stakeholders interview by the authors. The MEF data suggests that PMS-IC has secured £1,051,000 of other public funding in Phase 2 up to October 2023, and this represents £0.43 for every £1 of funding invested by SFC and SE. Whilst it is clear that PMS-IC is focussed on winning external funding and increasing the work it does with industry, the current scale of this work results in the moderate rating. |
| O5: Exploit academic base to solve industry problems | Low Stakeholders highlighted that access to clinical data is an area where PMS-IC has sought to solve industry-defined problems, though a view was expressed that further investment is required in order to deliver commercially attractive products. Several stakeholders highlighted that PMS-IC focussed on exemplar projects in Phase 1 to demonstrate the value of precision medicine, and whilst the Centre committed to increase their work with industry in Phase 2, this commitment has been eroded by Covid-19 and capacity challenges resulting in the low rating. |
| O6: Address major policy priorities | High Stakeholders highlighted that PMS-IC is close to Scottish Government and is playing an important role in influencing national policy. PMS-IC is enabling the delivery of significant social and environmental benefits which will emerge in the long-term including improved health outcomes and less wastage manufacturing treatments with limited efficacy. |
| O7: Secure inward investment | Low A small number of stakeholders commented that PMS-IC acts as a focal point for precision medicine in Scotland, and extends Scotland's appeals as a potential destination for foreign firms. PMS-IC's Phase 2 Business Plan included an aim to support the attraction of three foreign firms per annum achieving £10 million per investment. Subsequent events including the pandemic and Brexit have created a less favourable environment for inward investment. |
| O8: Enhance public services | High Stakeholders consistently identified that PMS-IC is focussed on progressing precision medicine which will enhance the delivery of services provided by the NHS. Stakeholders highlighted that PMS-IC performs a variety of roles in collaborative R&D projects including locating partners, bidding for funding and providing project management services. |
| O9: Develop skills addressing industry needs | High PMS-IC supports the delivery of the unique Precision Medicine (with specialisms) master's programme and identifies businesses to host work placements thereby enhancing the experience and employability of students. |
| O10: Develop next generation of innovators | Moderate This objective asks that Innovation Centres grow an environment that develops the next generation of business innovators, academics and entrepreneurs. PMS-IC supports this objective through the support for the master's programme and by supporting academics to engage in collaborative R&D projects. The modest rating reflects the scale of this work and the relatively light focus on develop business innovators. |

Source: authors

PMS-IC appears to deliver strongly against a small number of programme objectives, and is weak in relation to objectives focussed on the business support and innovation ecosystem, business growth, supporting working with industry and securing inward investment. This reflects the Centre's focus on precision medicine and securing long-term outcomes that will deliver societal benefits including improved health and reduced spend and waste on treatments.

It is noted that the PMS business plan objectives and targets, which were the basis of funders approval, are being used until governance changes are implemented. These are presented in the limited MEF via the IC Board papers. The Phase 2 Business Plan contains three strategic objectives and a brief comment on each is provided below.

Strategic objective one - Enable precision medicine innovation to be demonstrated and adopted across Scotland:

The Plan highlights that the Centre is *'adopting a Service Broker Model to provide a service catalogue that will enable the further growth and development of a Precision Medicine Ecosystem in Scotland.'* The Plan goes on to state that PMS-IC will *'leverage existing assets and developing new services to reduce barriers to entry for the adoption of precision medicine approaches.'* The development of the SteatoSITE data commons in Phase 1 is an example of this approach and as highlighted in the first case study below, the development of this resource enabled the development and completion of the INTERPRET-NAFLD project. On this basis PMS-IC is addressing this objective, though not a considerable scale. Several stakeholders identified that the data commons would need considerable development work in order to become a viable product, but they stressed that there is strong commercial potential.

Strategic objective two - Build maturity into programme delivery:

This objective sets out that PMS-IC will seek to gain ISO accreditation on the assumption that the Centre will *'increasingly provide fee for service work for organisations or projects requiring genetic testing. Where this data is required for regulatory submissions, ISO accreditation may be required.'*

As explored in earlier sections PMS-IC has faced unique operational challenges following the COVID-19 outbreak, and is struggling with insufficient capacity with difficulty recruiting staff with the required skill sets. The authors conclude that this objective is still relevant and PMS-IC's delivery approach requires further development.

Strategic objective three - Build a balanced diet of funding from different sources.

The Business Plan contains an ambition to *'deliver a 50%/50% public/ private funding model shortly after 2019/20, with a clear pathway to 100% self-sustainability.'* Revenues are forecast to grow from £0.6 million in 2018/19 to £2.3 million by 2021/22, with 85% of this income from: *collaboration workspace with enhanced functionality and the healthcare landing zone.'*

The expenditure data in Phase 2, up to October 2022, suggests that PMS-IC is a considerable way off achieving this aim as a result of the COVID disruption to the IC business plan.

8 Impact Case Studies.

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

8.1 Case 1. SteatoSITE and INTERPRET-NAFLD.

Project background.

Non-alcoholic fatty liver disease (NAFLD) affects millions of people worldwide. Around one in four people have NAFLD which is often unnoticed and undiagnosed, and around 5% of the population will develop a more progressive form of liver disease (non-alcoholic steatohepatitis (NASH)) that can lead to cirrhosis, liver cancer and premature death. Currently, there are no tests to determine which people with NAFLD might develop NASH or progress to cirrhosis, and there are no medicines available to treat NAFLD.

Engagement aims.

The Chief Executive Officer for what was then Stratified Medicine Scotland Innovation Centre and is now Precision Medicine Scotland Innovation Centre (PMS-IC) invited former colleagues from the

University of Edinburgh to work in partnership with the Innovation Centre to identify areas of opportunity in relation to precision medicine. Researchers from the University of Edinburgh worked with the IC to scope out the creation of a unified data system that allows investigation and sharing of pathology, genetic and clinical information from patients with NAFLD – making it more accessible for further research.

Edinburgh academics and wider partners worked to develop an application to Innovate UK. Funding totalling £1.7 million was awarded to the Innovation Centre; Eagle Genomics (an Artificial Intelligence (AI) augmented knowledge discovery company); the University of Edinburgh, NHS Scotland and Glasgow and Edinburgh's MRC Molecular Pathology Nodes.

Whilst the development of the SteatoSITE data commons was in development, project academics were made aware of the EUREKA: Singapore Open Competition run by Innovate UK which sought projects that can deliver a new product, industrial process or service that are innovative and involve a technological risk. The funding competition required a lead partner from the UK and a lead partner from Singapore. An application was made with the following partners – Bering, Biodev, the University of Edinburgh and HistoIndex. The INTERPRET-NAFLD project was awarded funding of £0.690 million and sought to utilise the SteatoSITE data commons to interpret patient data to predict when NAFLD is likely to progress into dangerous conditions such as cirrhosis of the liver and liver cancer. The ultimate long-term aim was to enable the development of diagnostic tools for liver disease affecting millions worldwide.

Support provided.

PMS-IC played a crucial role in developing the concept for the SteatoSITE data commons, sourcing partners and accelerating development work culminating in the successful funding bid. Staff at the Innovation Centre played a crucial role in the development of the data commons with work including:

Provided overall project management, co-ordinated all ethics/governance approvals, and facilitated the work of the partners, namely: Eagle Genomics; the University of Edinburgh; NHS Scotland; and Glasgow and Edinburgh's MRC Molecular Pathology Nodes.

- Developed libraries for the RNA sequencing.
- Integrated and curated the pathology, RNA-sequencing and clinical data into a secure searchable platform.
- Provided IT solutions related to data cleaning, website development and data access.

The INTERPRET-NAFLD project was predicated on the availability of data through SteatoSITE, and Precision Medicine Scotland Innovation Centre was the entry point to the data commons. In addition, staff at the Centre again provided overall project management - a role that partners valued highly.

Innovation benefits

The aim of the SteatoSITE data commons was ultimately to gather multimodal multiscale “big data” relating to NAFLD from around 1,000 patients across Scotland, to clean and integrate it and make it available to researchers. The project was successfully delivered, and a website is now available enabling researchers and companies to apply for access to the resource which comprises: RNA sequencing data, whole-slide histology scans; pathology scoring (NASH-CRN fibrosis stage and NAFLD Activity Score (NAS) assigned by a Consultant Histopathologist panel) and digital quantification of liver fat and scarring; and linked clinical data from Electronic Health Records and other national datasets.

The INTERPRET-NAFLD project could not have proceeded without the SteatoSITE data commons. Work on INTERPRET-NAFLD commenced in October 2020 and was completed in November 2022. Each partner played an active role, and the businesses gained the opportunity to test and develop their capabilities as follows:

- HistoIndex utilised their unique AI-based digital pathology approach to analysing liver tissue sections without staining and linked tissue features to patient outcomes.
- Biodev² cleaned the data and developed software tools to read and analyse it more easily.
- Bering deployed AI techniques on the entire dataset and developed clinical decision support tools.

Whilst the project has only just finished each of the businesses has a clear commercialisation plan in place. Project academics identified the following direct innovation benefits:

- The SteatoSITE data commons is in place to facilitate future research.
- Each partner has benefitted from knowledge exchange utilising the triple helix approach bringing together industry, academia and the NHS.
- A NAFLD prediction tool has been created which appears highly accurate at predicting outcomes and will now be tested in other patient populations.
- Bering developed this tool and have experienced early business growth taking on additional staff.

Wider benefits

A project academic highlighted that the SteatoSITE data commons has '*enormous potential, it contains a wealth of information – the challenge now is to increase ease of access for commercial firms to investigate it. The projects SteatoSITE can facilitate will change clinical care.*' The INTERPRET-NAFLD project has yielded a prediction tool that may be utilised within secondary care in a matter of years, and with adaptation can be used in primary care.

Impact

The same project academic highlighted that PMS-IC were instrumental in the creation of the SteatoSITE data commons, and without this the INTERPRET-NAFLD project could not have proceeded. The SteatoSITE data commons will support academic research for many years to come, with the potential for further break throughs.

The AI-based prediction tool could have substantial utility in the primary care setting. The tool can predict mortality using routine data and the next step is to demonstrate if it can predict outcomes in NAFLD using data from patients in the real world. As was explained by a project academic, '*the bigger picture is that the tool will help extend patients' lives and extend healthy years of life. Prevention is better than cure and the tool will identify patients at an early stage of developing NAFLD and will support their early treatment. The tool will enable a precision medicine approach enhancing patient care and making best use of the NHS budget.*'

Feedback

"Working with Precision Medicine Scotland Innovation Centre we have developed an incredibly rich resource to support research into a disease which has a disproportionate impact in Scotland. Working with the Centre and industry partners a tool has been developed which may revolutionise diagnosis and treatment of a disease which affects one in four people." Project academic, University of Edinburgh

8.2 Case 2. Ovarian Cancer research

Project background.

² It is noted that Biodev – a Scottish based SME was also a partner on INTERPRET-NAFLD. Company has secured further work as a result of this project and has taken on additional staff.

Ovarian cancer is often known as the silent killer because its symptoms can be mistaken for other less harmful conditions, or simply put down to changes in the body due to ageing. This means around seven in ten cases are diagnosed at a late stage, by which time the cancer has often spread or is difficult to cure. There are different types of ovarian cancer, with High Grade Serous Ovarian Cancer (HGSOC) being the most common, accounting for 70% of cases. Despite improvements in treatment over the past few decades, prognosis for HGSOC is still poor, with only 41% of patients surviving beyond five years.

Engagement aims.

When Precision Medicine Innovation Centre (PMS-IC) was first formed (and called Stratified Medicine Scotland Innovation Centre) it launched a call for exemplar projects with one of the priority themes focussed on sequencing. An academic from the University of Edinburgh developed a project concept to gather and sequence data relating to Ovarian Cancer in partnership with the Universities of Glasgow, Dundee and Aberdeen and NHS Trusts across Scotland.

Whilst sequencing work was underway AstraZeneca approached Scottish Government and the Chief Scientist expressing an interest in work in four key areas utilising Scotland's Electronic Health Records. One of these areas was ovarian cancer. The Edinburgh University based project academic developed the project concept involving the Scottish Genome Partnership, PMS-IC and the University of Edinburgh. This second collaborative project explored whole genome sequencing for high grade serous ovarian cancer tumours using a combination of frozen and newly collected samples.

Support provided.

PMS-IC played a crucial convening role in the first project and secured the involvement of NHS Trusts thereby gaining access to the samples needed for the project to proceed. A project academic commented that *'the Innovation Centre team were very helpful and broke down barriers to obtaining tissue.'* PMS-IC also provided funding worth £0.750 million.

The Innovation Centre also provided a project management and co-ordination role which was highly valued by the partners. Finally, PMS-IC also completed panel sequencing work on data from 250 patients focussed on genes identified by the partners.

In relation to the collaboration with AstraZeneca PMS-IC again provided a valued project management and co-ordination role, facilitating the collaboration between the University of Edinburgh and AstraZeneca. AstraZeneca provided funding totalling £1 million with matched funding from the Scottish Genome Partnership.

Innovation benefits

The first project led to initial findings on how genetic mutations in High Grade Serous Ovarian Cancer tumours affect the way they respond to treatment. The commencement of this work put the University of Edinburgh in a position to secure AstraZeneca's involvement in the follow-on project and this used the latest approach focussed on whole genome sequencing. A project academic identified the following direct innovation benefits:

- Securing of extensive research resource which is supporting the work of several PhD students and will continue to do so over the coming years.
- Strong relationships built with effective knowledge exchange between Universities, Scottish Genome Partnership, the NHS and industry.
- Publication of research papers in respected journals with findings including that whole genome sequencing provides a stronger indication for which patients will benefit most from PARP inhibitor drugs.

Wider benefits

The work on the two collaborative projects has led to a series of significant wider benefits:

- The Universities of Edinburgh and Glasgow were able to demonstrate a close working relationship and secured an uplift of £2 million in funding from Cancer Research UK (CRUK) for their joint national Cancer Research Centre³.
- One colleague of a lead project academic working at the Institute of Genetics and Cancer was able to renew a £2 million grant based on the work undertaken through the two collaborative projects.
- Enhanced reputations for both Universities and direct input into the Research Excellence Framework (REF).

Impact

The lead project academic highlighted that the first sequencing project would have, at best, been considerably delayed without the crucial support from Precision Medicine Innovation Centre. This in turn would have meant that the University of Edinburgh would not have been in a position to secure AstraZeneca's involvement which has led to considerable breakthroughs.

The projects have directly led to increased knowledge of Ovarian Cancer and have accelerated the individualisation of care relating to Ovarian Cancer.

Feedback

"Precision Medicine Innovation Centre has been the glue that has held our collaboration together. Without the Centre we could not have secured the involvement of AstraZeneca and completed whole genome sequencing providing vital new insights which have the potential to transform treatment for High Grade Serous Ovarian Cancer." Lead project academic, University of Edinburgh

8.3 Case 3. Biopta.

Business background.

Biopta was founded in 2002 as a spin-out from Glasgow Caledonian University with investors in the businesses including Braveheart Investment Group, Tri Cap and Scottish Enterprise's Scottish Co-investment Fund. Biopta used human tissue in pre-clinical studies for major pharmaceutical companies in Europe, Japan and North America. Biopta was purchased by Reprocell in 2015 in order to strengthen the drug discovery aspect of its business. Reprocell employs over 100 scientists across the United Kingdom, United States of America and Japan, and offers a wide range of services including clinical stem cell services, clinical laboratory services, genomic services and diagnostic services.

Engagement aims.

As part of the development work for what was then Stratified Medicine Innovation Centre, and is now Precision Medicine Innovation Centre (PMS-IC), senior academics convened workshops with key stakeholders. The lead project researcher was invited to represent small and medium-sized enterprises (SMEs) involved in precision medicine and this informed PMS-IC establishment and focus.

The lead project researcher was made aware of the Innovation Centre's call for exemplar projects and Biopta developed a project concept. An application was submitted to PMS-IC in partnership with Glasgow Biorepository and Biopta was awarded £300,000 which they matched pound-for-pound. The aims of the exemplar project were to seek to:

- Identify groups of patients that respond, and don't respond to drugs used to treat Chronic Obstructive Pulmonary Disease (COPD) and Irritable Bowel Disease (IBD).

³ It is noted that this was achieved against a background of CRUK cutbacks on research (correspondence with PM, March 2023.).

- Understand how and why groups of patients respond or don't respond to drugs.
- Demonstrate to pharma companies that the knowledge gained on responders and non-responders can be used early in the drug discovery and development process to design effective clinical trials; identify the likely size of the patient group that will respond to proposed drugs; and thereby improve decision-making.
- Complete the first Phase of research which could lead diagnostic tools for clinicians and support efforts to develop a precision medicine approach to the treatment of COPD and IBD.

Support provided.

PMS-IC provided considerable funding enabling the project to proceed. The Centre also provided next-generation gene sequencing of tissue samples filling a crucial gap which Biopta was not in a position to provide. The Centre also facilitated access to human tissue samples from Scotland's biorepositories – vital to enable the research to proceed.

Innovation benefits.

The exemplar project was delivered in a comprehensive partnership including PMS-IC; the University of Dundee and the University of Edinburgh; all four of Scotland's biorepositories; and three SMEs including Biopta. The partners worked together to:

- Analyse 25 tissue samples relating to COPD and 25 tissue samples relating to IBD.
- Identify a group of patients that responded to drugs and a group that did not.
- Utilise Electronic Health Records and the gene sequencing data to seek factors that may influence the identified response outcome.
- Critically review the approach and findings with strong support from identified experts at the two Universities.
- Complete publications on key findings and provide open access to data generated through the exemplar project to facilitate future research.

The exemplar project succeeded in demonstrating that the analysis of even a small sample of human tissue could enabling responders and non-responders to be identified. Biopta gained a range of direct innovation benefits including:

- The opportunity to demonstrate their ability to identify responders and non-responders to drugs for two major disease areas for Scotland, and of critical importance, identify the factors that influence the response outcome.
- The opportunity to develop new and existing relationships with a range of partners including academics and other small businesses.
- The publication of papers in respected journals enhancing their visibility and building their reputation.
- Increased demand for their services particularly in relation to IBD leading to securing new work with pharma companies driving turnover and profitability.

The lead project researcher highlighted that support from PMS-IC helped Biopta to overcome a number of innovation barriers they faced including: the high costs associated with innovation; the lack of qualified personnel and equipment needed to undertake gene sequencing; and challenges procuring suppliers and partners.

Each of the partners in the exemplar project gained innovation benefits. For example, the two other SMEs were able to demonstrate the effectiveness of their micro-RNA analysis and bioinformatics. The Universities benefitted from participation in high profile research with papers published in esteemed journals.

Wider benefits

As a result of successfully delivering the exemplar project Biopta, now part of Reprocell, secured in-kind funding from the Hartree Centre in Daresbury. This follow-on project concludes in early 2023 and will see the launch of Artificial Intelligence (AI) software which can interrogate data on COPD and IBD, and deliver the results that Biopta and partners had to complete manually in the exemplar project. The launch of this AI software will mark the new Phase of commercialisation work.

The lead project researcher cited additional wider benefits for partners and stakeholders. Pharma companies now possess the ability to undertake effective pre-clinical trials to scope out proposed drugs and identify the target population that may benefit from them. Patients now face the prospect of accelerated development of diagnostic tools and a precision medicine approach to COBD and IBD. In turn the health system and the taxpayer will ultimately benefit from more effective, targeted treatments with less waste and cost, and fewer side effects.

Impact

Biopta, through Reprocell is now focussed on the imminent launch of a Minimum Viable Product AI software that will accelerate the process of identifying responders and non-responders to a wide range of drugs. The business is also committed to developing an IBD diagnostic tool which can identify which drugs a patient should be prescribed based on their individual genetic structure and medical history. To support these aims the business will complete longitudinal studies and is working in partnership with a Medical Institute in Maryland in the United States of America.

The lead project researcher highlighted that with Precision Medicine Innovation Centre the '*exemplar project would, at best, have been considerably delayed but may not have happened at all. The funding and capabilities provided by the Centre lowered the innovation barriers to the point where the project could proceed.*'

Feedback

"Precision Medicine Innovation Centre's support and expertise enabled us to conduct vital, practical research on the treatment of two major disease areas which represent particular challenge for Scotland's population. As a result of our exemplar project delivered in partnership with academia, the NS and industry we have secured new work for the business and are about to launch a commercial product developed directly through our work with the Innovation Centre." Lead project researcher – Reprocell Europe.

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 PMS-IC deliver routes to economic and wider benefits through increased levels of collaboration between industry and academia?

PMS-IC has had a challenging Phase 2 with the Covid-19 outbreak dramatically reducing the actual delivery period. The MEF data shows that PMS-IC completed eight collaborative projects in Phase 1, and a further eight new collaborative projects in Phase 2 up to October 2022.

Analysis of data from the client survey reveals that PMS-IC is supporting beneficiaries to deliver some intermediate benefits, and of the 14 respondents that answered the question:

- 38% of respondents gained new academic contacts.
- 31% gained new business contacts.

- 19% of respondents gained an improved market understanding of priority technology areas in their sector; improved awareness of private sector support; and improved awareness of academic capabilities.

However, the client survey did not reveal that the Centre is delivering new jobs or Gross Value Added.

The Due Diligence report published by Frontline highlighted a number of challenges that still appear to be relevant. For example, the Due Diligence report stated that *'to date industry relationships have been deep with a small number of companies aligned to the exemplar projects resulting in the current and potential GVA benefits being lower than expected. Exemplar projects are also in the lower TRL levels which take longer to achieve commercial benefits.'*

Analysis of the client survey data suggests that the Centre has helped clients to progress through TRLs. Respondents involved in collaborative projects through PMS-IC have typically started at the lower end of the TRL scale (it is noted this may include project work before IC involvement). 44% of projects were at TRL 1-2 at the start, with a further 11% at TRL 3. There is a visible trend of progressing through TRLs based on respondents' data, but the sample sizes are too small to draw meaningful conclusions.

Frontline suggested that the main cause of narrow engagement seen in Phase 1 *'is the lack of specific projects and funding to encourage business engagement'* and concluded that *'it will be important to include increase reference to commercial outcomes'* in Phase 2. It does not appear that this genuinely held ambition has been possible to date.

The Due Diligence report highlighted operational challenges including turnover of staff and stakeholders that fed into the report identified a number of areas that needed improvement including: vision and communication of it; development and measurement of objectives and KPIs; engagement with industry; visibility in the NHS; governance; and health data management systems.

The case studies highlight the excellent work that PMS-IC has enabled and supported, but they also reveal how the Centre has supported projects that have a major focus on research with considerable uncertainty about whether commercial products, services or processes will be developed. Where commercial outcomes may be delivered the route to market and the length of time this may take are also highly uncertain.

The authors conclude that PMS-IC has delivered against the aim to establish routes to economic and wider benefits through increased levels of collaboration between industry and academia, but at a modest scale to date.

To what extent does PMS-IC support colleges and universities to maximise their value to Scotland?

MEF data provided by PMS-IC indicates that PMS-IC supported the completion of eight collaborative projects in Phase 1 with businesses with each involving either an Academic or the Centre. In Phase 2, a further eight projects have been initiated up to October 2022, all engaging with the public sector and five also involved businesses partners.

Some 14 respondents answered a question in the client survey asking them to confirm whether they had worked with any Universities through PMS-IC. Two respondents that they hadn't worked with any Universities with the remaining respondents identified working with five Universities (with the University of Glasgow and the University of Edinburgh being the most commonly cited). So, whilst clients do appear to have worked with multiple Universities, the sample size is too small to draw robust conclusions; and no client survey respondents reported engaging with a college through PMS-IC.

Feedback from stakeholders suggested that the Centre would benefit from a greater focus on translating research into clinical benefit and economic benefit through commercialisation of technology.

The case studies highlight how exemplar projects completed in Phase 1 have facilitated increased levels of collaboration between industry and academia. They also highlight how some of PMS-ICs work is enabling and will take considerable time to flow through into new products and services. The

evaluation concludes that PMS-IC's focus to date will deliver some economic benefits but over considerable timescales, and perhaps a fairer measure of the value of their work can be gained by considering societal benefits.

How has PMS-IC performed against targets and objectives?

PMS-IC did not establish formal MEF targets for Phase 1 or Phase 2. The business plan objectives and targets, which were the basis of funders approval, are being used until governance changes are implemented. These are presented in the limited MEF via the IC Board papers. Accordingly, Phase 2 Business Plan contained reference to outputs with those most closely aligned to the MEF being:

- 23 collaborative projects involving industry, academia and the NHS worth £6.7 million.
- 12 companies in Scotland supported to trial and evaluate new PM products, technologies and approaches with 11 companies in the rest of the UK.
- 35 master's students supported per annum with 12 Apprenticeships supported over five years.

Analysis of performance in Phase 2 up to October 2022 reveals the following performance:

- Eight completed collaborative projects (of which five involve industry. Funding leveraged of £12.7 million was mobilised, with positive contributions to larger consortium funding packaged (e.g., £38 million SiPF fund noted above).
- 3 new or improved products developed and one new or improved delivery of a public service.
- 105 individuals gained new qualifications (MSc).

It is noted that PMS have met a key objective of Phase 2, that is, translation into the NHS of an innovation (the development from the Precision Panc project which led to the development of an assay for Cancer (GPOL)). Funding was secured in 2020 to allow that assay to move into the NHS Labs in Glasgow and it is now going through the regulatory process to enable its use in a clinical setting.

However, the evaluation concludes that PMS-IC appears to have some work to do in order to achieve the outputs forecast in the Business Plan. As documented earlier, the Covid-19 pandemic was far more operationally disruptive for PMS-IC than other Innovation Centres and this is an important consideration.

In relation to outcomes unfortunately only two respondents to the client survey provided employment data, and neither attributed any change in employment to engagement with PMS-IC. The evaluation team were therefore unable to identify employment or Gross Value Added outcomes to PMS-IC's work.

Whilst there are clear mitigating factors it is hard to conclude that PMS-IC is on track in relation to targets. In considering on-going public funding for the Centre, it is important to consider that PMS-IC is likely to be delivering economic benefits, but they will take longer to emerge than Centres engaged in activities that have a clearer route to market.

To what extent does PMS-IC build engagement with the innovation ecosystem?

PMS-IC is Scotland's national centre for accelerating the advancement and adoption of precision medicine, and therefore has a reasonably tight sectoral focus unlike some of the other ICs which focus on enabling technologies across a wide range of sectors. Data from the client survey illustrates that the majority of respondents operate either in the health and social work sector (33% of respondents) or the professional, scientific and technical sector (25% of respondents).

The stakeholder interviews revealed that individuals that had engaged with PMS-IC were positive about the collaborative work undertaken, but there was not a strong sense that PMS-IC is highly visible in the sector or helping build the ecosystem. Instead, stakeholders typically identified a lack of capacity within PMS-IC with comments including 'they need more resource, more staff, more hands on deck.

They are under resourced [53] and ‘PMS-IC are great to work with, they are very collaborative, but are thin on the ground and people don’t know who they are and what they do’ [58].

Stakeholders did not identify any examples of PMS-IC providing strategic leadership and acting as a catalyst via development of a sector or technology area strategy. However, several stakeholders highlighted the work PMS-IC has completed in creating Data Commons as a significant step in addressing a major barrier to research into precision medicine.

However, results from the client survey are more positive in this respect with:

- 44% of respondents stating that PMS-IC was raising the profile of the sector/technology area within Scotland.
- 38% of respondents stating that PMS-IC was promoting investment and leverage of resources into the sector/ technology area from outside Scotland.
- 31% of respondents stating that PMS-IC was acting as a strategy partner; and fostering synergies and networking within the sector or technology.

It should be noted that the sample size is small with only 13 respondents completing this question. Furthermore 31% of respondents stated that PMS-IC was not delivering any benefits for the wider innovation ecosystem.

The evidence is mixed but the general sense is that PMS-IC is lacking sufficient capacity to take a full and pro-active role in promoting and building the ecosystem.

What wider benefits has PMS-IC delivered?

As highlighted above, given the lack of robust evidence on direct routes to economic benefits it is important to consider wider societal and environmental benefits. In considering the wider benefits of PMS-IC support, clients were asked which, if any, of the UN Sustainable Development Goals (SDGs) had their establishment made a significant contribution to, as a result of working with the Innovation Centre and:

- 38% of respondents identified industry, innovation and infrastructure;
- 25% of respondents identified good health and well-being;
- 19% of respondents identified decent work and economic growth;
- 13% of respondents identified reduced inequalities; and,
- 13% of respondents identified quality education.

In addition, each of the case study interviewees highlighted the wider societal benefits that their collaborative projects could potentially deliver.

The evaluation concludes that PMS-IC is supporting the delivery of wider benefits, this includes influencing work. Several stakeholders highlighted in the interviews that that PMS-IC has influenced Government policy. A Board member stated that ‘the Centre has put Precision Medicine on map of Scotland. Nicola Sturgeon has talked about the importance of Precision Medicine at major conferences. There have been a number of pan-Scotland meetings focussed on Precision Medicine’ [52].

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 range of sectors. Respondents were most commonly located in Edinburgh and Glasgow (76% of all respondents). None of the respondents were located in the Highlands and Islands.

However, it is noted that PMS health projects require clinical academic input which is typically only possible through large teaching hospitals and that some five of the IC's recent projects are pan-Scotland involving Aberdeen, Dundee, Edinburgh and Glasgow⁴. Further, PMS are actively addressing. Engagement with Highland Islands Health Board has commenced, and the IC are exploring potential collaborations.

What lessons can be learned from PMS-IC's operation?

PMS-IC is working to overcome a number of significant challenges. This includes adopting a new governance structure to address a condition of the Phase 2 funding awarded by Scottish Funding Council and Scottish Enterprise. The governance model adopted at the Centre's launch has proved problematic with stakeholders highlighting concerns around perceived neutrality and delays in obtaining permission from PMS-IC's Board to commence collaborative projects. The model has also led to concerns amongst the core funding agencies about the level of influence that private sector partners have over the utilisation of public funding. A major lesson has to be to pay careful attention to the potential for governance arrangements to influence stakeholder's perceptions of neutrality and funders' confidence to invest.

As documented throughout this report, PMS-IC has been disproportionately impacted by COVID-19 with disruption still on-going at the point this report was finalised. PMS-IC gave up their laboratory for use as a Lighthouse Lab, and this remains the case until March 2023. PM had to identify and commission a new laboratory. The new lab is at the same venue, but it is on a different floor to the offices, is smaller and isn't laid out as effectively as the previous laboratory.

Senior staff and Board members highlighted on-going challenges recruiting skilled staff for the Centre. The Centre lost around half of its staff team at the end of Phase 1 due to the uncertainty over funding for Phase 2, and the delays in receiving confirmation of this funding. When the current Chief Executive joined in January 2019 PMS-IC had only eight staff. PMS-IC has to operate with the University of Glasgow's salary bands and report challenges competing with the private sector. The cost-of-living crisis has made it more of a risk for prospective employees to take a pay cut to join PMS-IC.

There are some areas for reflection for the core funding agencies. PMS-IC operates in a sector with a relatively sparse SME base dominated by multi-national pharmaceutical firms. This makes it very difficult for the Centre to achieve the equity objectives outlined earlier. PMS-IC is clearly engaged in work with significant long-term potential, but the authors are uncertain as to whether the Centre's current model is in keeping with the Innovation Centre concept.

⁴ PMS correspondence March 2023.