

SRPe Response to the: Independent Review of SFC's Research Pooling Initiative

Background to the Scottish Research Partnership in Engineering (SRPe)

The SFC established research Pooling in Scotland in 2006 with the overall objective of enhancing research competitiveness, achieving sustainable critical mass in the Scottish research base, improving the quality of research and providing a more attractive research environment. University research Pooling in engineering has had a major impact in strengthening Scotland's economy and research standing.

During the Initial Phase of research Pooling from 2006/07 to 2012/13, three individually funded regional engineering research Pools were established. Strategic cohesion and coordination was provided by an overarching Scottish Research Partnership in Engineering (SRPe) Board comprised of the SRPe Chair and the three regional Pool Directors:

- *ERPem: Edinburgh Research Partnership in Engineering and Mathematics (comprising: Edinburgh; Heriot-Watt; Edinburgh Napier)*
- *GRPe: Glasgow Research Partnership in Engineering (comprising: Glasgow; Strathclyde; Glasgow Caledonian; West of Scotland)*
- *NRPe: Northern Research Partnership in Engineering (comprising: Dundee; Aberdeen; Robert Gordon)*

Over this period, the three engineering Pools successfully delivered across all of their key objectives significantly strengthening research excellence and its impact in driving the socio-economic prosperity of Scotland.

At the end of the Initial Phase the decision was made by the SRPe Board to consolidate the three regional Pools to a single pan-Scotland SRPe Pool of ten universities. This provided increased critical mass and strategic alignment to take the Pool to its next level of impact. This also provided the platform for increased strategic-level engagement with Government / public sector agencies and industry, and supported Scotland to compete more effectively for UK and International research funding.

Within the Continuation Phase SFC has provided SRPe with funding of £612.5K over 5 years (matched by partner universities). Strategic themes have been established in key areas of challenge/opportunity for Scotland which match the Pool research strengths: Advanced Manufacturing; Robotics and Autonomous Systems; Infrastructure and Environment; and Engineering at the Life Sciences Interface. SRPe's Energy theme has evolved over the past 10 years and is now delivered by our sister-Pool the Energy Technology Partnership (ETP); a separate Pool.

The strategic themes are strongly horizontally integrated providing the robust cross-disciplinary research-driven solutions required to address the complex challenges of the 21st century. Under the overall strategic governance of the SRPe Board, each theme is led by a Thematic Leadership Group comprised of a nominated Chair and leading academic experts from across the Pool, representing a national research resource for provision of expertise and strategic guidance to Government, industry and the wider international research community.

Pooling continues to contribute to the growth of engineering research activities across Scotland's universities with the total annual engineering research income increasing from ~£43M in 2006/07 to ~£108M in 2017/18. Our broad estimate for the current year is that engineering and associated thematic research funding across the Pool is in excess of £500M.

Given the complex technical challenges and significant strategic opportunities ahead and the increasing complexity and competitiveness of the national and international funding environments (including the potential impact of Brexit) Pooling of Scotland's engineering research resources is increasingly critical to Scotland's future success as a nation.

SECTION 1: INITIAL RESEARCH POOLING INITIATIVE

Q1a. WHAT HAS BEEN THE IMPACT OF THE INITIAL RESEARCH POOLING INITIATIVE?

You may wish to consider the following in your response:

- Has the Pooling initiative met its objectives: to enable Scotland to compete effectively for funding, research staff and doctoral students both nationally and internationally; and provide a more attractive research environment? How can that be evidenced?
- Examples of the ways that Pooling has impacted on the relations between Pooling partners and on how individual partners work with other external bodies.
- Evidence that the partnerships associated with Pooling have had broader impacts on Scottish HEIs.
- Examples of other outcomes of research Pooling, and how they have impacted on the Scottish research landscape.
- Have Pools made an impact on Scotland's reputation? What are the national (Scotland/UK) and international perceptions of Pools?
- What aspects of Pooling have attracted most interest from outwith Scotland/ academia and have they impacted on developments elsewhere? Can you give examples of this?
- What has happened that would not have happened without research Pooling? Please give examples.
- What has been the impact of Pooling outside of the academic sector, on policy and industry? Can you provide examples of this?
- Have there been missed opportunities, where Pooling could have had an impact but didn't?

The Pooling initiative has been highly successful in maximising the **overall impact and research excellence** of the Scottish universities. The improvements in RAE/REF performance across the three engineering Pools over the Initial Phase of research Pooling are provided in Table 1. Over this period the total numbers of academic staff / researchers and the intensity and quality of research increased significantly across Scotland.

	RAE 2008			REF 2014		
	FTE	Power	GPA	FTE	Power	GPA
ERPem	221	570	2.58	225	716	3.18
GRPe	215	518	2.41	272	821	3.02
NRPe	94	234	2.49	87	264	3.03
Total/SRPe	530	1325	2.50	584	1799	3.08

Table 1: Improved Intensity and Quality of Engineering Research over the Period 2008 to 2014

Substantial **research portfolio growth** has been driven by Pooling e.g. from 2006/07 to 2012/13 the research income within GRPe increased to a combined £120M+. Within NRPe the total funding obtained from Joint projects and NRPe funded staff was £100M over the same period. Between 2008-2013 ERPem was awarded £106M of research income from UKRCs, EU, TSB and industry. The total annual engineering research income across the Pool has continued to grow increasing from ~£43M in 2006/07 to ~£108M in 2017/18. Our broad estimate for the current year is that engineering and associated thematic research funding across the Pool is in excess of £500M.

The **international competitiveness** of Scotland in research programmes such as H2020 has been significantly increased by Pooling e.g. under SRPe's Pool Engagement in European Research (PEER) programme the University of Glasgow has been part of the successful £7.5M HERMES H2020 collaborative bid securing £600K of research income for Glasgow.

Pooling has significantly enhanced the overall profile of Scottish university research **attracting a number of high calibre academics and researchers** e.g. from 2006/07 to 2012/13 the GRPe Pooling investment directly established 32 new

academic appointments with the FTE increasing by 37% from 541 to 742 and with the postgraduate research student FTE increasing by 149% from 394 to 982. Staff were attracted from the US & Canada (e.g. Princeton), England (e.g. Cambridge, Imperial College), Northern Ireland (Queens Belfast) and continental Europe (Torino). Senior staff were also recruited from industry (e.g. IBM, Owens Corning). The ERPem Pooling investment directly established 12 new key academic appointments plus 10 fellowships. SRPe has continued to flourish and grow and today boasts a community of over 1,000 academics, 5,500 postgraduate students and 13,500 undergraduate students.

Pooling has played a critical role in **engineering skills development** to meet the needs of the industrial and the academic research sectors. During the Initial Phase a joint Graduate School was formed across the regional Pools adding value across the individual Graduate Schools within the member Universities. 82 PhD students were directly funded galvanising collaborative research programmes and bringing additional external and industrially-relevant research problems into the university research portfolios. A number of EPSRC/NERC funded Centres for Doctoral Training (CDTs) were established across the regions e.g. ERPem established the EPSRC CDT in Robotics and Autonomous Systems in collaboration with SICSA (Heriot-Watt, Edinburgh); the EPSRC CDT in Photonics in collaboration with SUPA, GRPe (Glasgow, Strathclyde), NRPe (Dundee) and St Andrews; the NERC CDT in Oil and Gas in collaboration with NRPe (Aberdeen).

During the Initial Phase a number of **new multi-disciplinary Joint Research Institutes (JRIs)** were established delivering several strategically important UK initiatives e.g. within ERPem the UK Carbon Capture and Storage Research Centre (UKCCSRC) (£10M); the UK Centre for Marine Energy Research (UKCMER) including the UK All-Waters combined wave and current test facility and the IDCORE-Industrial Doctorate Centre in Offshore Renewable Energy (£11M); the EPSRC Centre for Innovative Manufacturing in Laser-Based Production Processes (£5.1M); the UK University Defence Research Centre with academic partners, Defence Science and Technology Laboratory (DSTL) and industry partners (including Selex-ES, BAE Systems, Thales UK (£4.3M); the IMPACT programme for implantable, smart sensors enabling targeting of radio and chemo-therapies for cancer treatment (£5M); and the Integrated Research Centre (IRC) in Healthcare Sensing (£11.2M).

Significant investment was made across the regions in **shared equipment and facilities** enriching Scotland's capacity and capability in addressing engineering challenges and opportunities and providing investment efficiencies e.g. new joint laboratories for rehabilitation engineering research at Glasgow Caledonian embedded in the Queen Elizabeth Spinal Injuries Unit at the Southern General Hospital; new equipment such as the "shaking table" on the Dundee Geotechnical Centrifuge provided an attractive facility for the international and national research communities.

Over the lifetime of Pooling a number of **high profile and socio-economically important strategic initiatives** have been launched with Government, public sector and private sector collaborators securing substantial additional investment, developing new collaborations, knowledge exchange and joint bids targeting funding opportunities to address critical skills gaps and support the growth of the Scottish economy e.g. in robotics and autonomous systems, signal/image analysis (Edinburgh, Heriot-Watt) with recent awards including the £36M ORCA Robotics Hub (EPSRC/Industry), plus £35M funding from the Edinburgh City Deal for the National Robotarium.

SRPe is also a **key delivery partner in the ~£126M Scottish Government, Agency and Local Authority funded National Manufacturing Institute Scotland (NMIS)** with Strathclyde University established as the anchor institution. This has provided the pathway for the Scottish universities to collaborate on skills provision and delivery of solutions to industry challenges in advanced / digital manufacturing. Within the NMIS programme SRPe has secured £1.5M of additional investment from the Scottish Government / SFC as part of SRPe's Advanced Manufacturing Theme for skills provision to meet critical industry skills gaps. Within this SRPe is delivering 30 industry doctorates (**NMIS-Industry Doctorate Programme in Advanced Manufacturing (NMIS-IDP)**) and a **CPD programme in Advanced Manufacturing Technology and Leadership** for Scottish industry / SMEs to support their journey towards Industry 4.0 / digital manufacturing. This investment will leverage a further £1.8M of external investment, at least ~£1.5M of which will come from industry.

Along with the **SRPe-Industry Doctorate Programme (SRPe-IDP)** launching in 2019, which will establish a further 12 industry doctorates (across Robotics and Autonomous Systems, Infrastructure and Environment and Engineering at the Life Sciences Interface), this will fully establish the pan-Scotland **SRPe Graduate School in Engineering**.

SRPe has a programme underway targeting the **NMIS Advanced Manufacturing Challenge Fund (NMIS-AMCF) (European Regional Development Funding (ERDF) of £18M)** and we are working towards securing up to ~£5M for delivery of technology demonstrators, outreach and impact acceleration projects taking technologies from early stage research to higher levels of technology readiness for industrial application.

A MoU between SRPe and NMIS has been established as a **pathway for strategic collaborations** to be established between universities, NMIS and other national research programmes e.g. with the National Subsea Centre (Aberdeen City Deal/OGTC) led by Robert Gordon University as part of SRPe's programme development towards the NMIS-AMCF.

Additional SFC strategic investment (£50K) has been secured under SRPe's Robotics and Autonomous Systems theme to deliver the industrial impact initiative establishing academic-industry collaborations targeting up to £15M of the **Industrial Strategy Challenge Fund (ISCF)**.

SRPe continue to deliver workshops and events to develop collaborative relationships across the **wider innovation network, the Innovation Centres, other research Pools and industry** e.g. 2018 SRPe workshop with OGIC/CENSIS/industry partner to address the oil & gas sector challenge of Conductor Remediation and Life Extension; 2017 SRPe Industry Conference: Demystifying Digital Manufacturing for SMEs in collaboration with the Advanced Forming Research Centre (AFRC) (including presentations from e.g. Siemens, Microsoft and Laing O'Rourke). The relationships between university partners, with other research Pools (e.g. ETP, MASTS, SICSA, SUPA) and with other external bodies continue to flourish. SRPe has established strategic level relationships with government, public sector agencies (such as SE, SDS, SDI) e.g. supporting SDI on industry visits to attract foreign direct investment to Scotland. Pooled skills provision and research by the Scottish universities is highly attractive to international industry investors who are looking to grow or establish new technology-driven businesses in Scotland. The regional engineering Pools provided start-up funding for the Directorate of the Energy Technology Partnership for delivery of the Energy theme. ETP has evolved over the last 10 years and is now a separate sister-Pool. An active role was played by SRPe research leaders in the establishment of the Innovation Centres e.g. CSIC, SAIC, CENSIS (with SICSA and SUPA), OGIC, DHIC (with SICSA).

Pooling has underpinned the launch of **spinout companies** e.g. GRPe: Mode Diagnostics (bowel health monitoring); Clyde Biosciences (toxicity testing) + others.

SRPe work in close collaboration with the **Scottish Government, Scottish Enterprise (SE), Scottish Development International (SDI) and Skills Development Scotland (SDS)** and we continue to have a significant impact in **influencing the research agenda and policy in Scotland**. In addition to the key supporting role SRPe played in establishing the ~£126M Scottish Government, Agency and Local Authority funded National Manufacturing Institute Scotland (NMIS), with Strathclyde University established as the anchor institution, other examples would be: NRPe with ETP played a key role in delivery of the business case for the TSB-funded Offshore Renewable Energy (ORE) Catapult (£47M); the Offshore Renewables Institute (ORI) established and funded jointly by NRPe is an example of a legacy project incorporating industrial demand with academic expertise within the research sectors served by the Energy & Clean Technologies / Civil Engineering JRI's; GRPe influenced innovation policy through Scottish Enterprise (Enabling Technologies and Smart Materials), Government (contributions on fracking to the Scottish Government, and through the Royal Academy of Engineering: consultation with the HMG Committee of Radioactive Waste Management and the professional institutions e.g. IMechE report on energy).

The SRPe Chair and Board Members continue to hold a range of **senior appointments at a strategic level in Scotland**. The SRPe Chair, Prof Sir Jim McDonald, is on a number of influential Boards and Committees which shape policy e.g.

Co-Chair of the Scottish Energy Advisory Board with the First Minister and Chair of the Glasgow Economic Leadership Board. The SRPe Executive Director, Dr Caroline Cantley, has recently become a Member of the Scottish Science Advisory Council of the Scottish Government.

*SRPe strongly support delivery of **equality and diversity** initiatives across Scotland e.g. SRPe supported 4 successful bids led by Glasgow, Edinburgh, Heriot-Watt, Strathclyde (~£2M) within the EPSRC Inclusion Matters programme. SRPe will deliver an Inclusion Matters pan-Scotland workshop in 2019 to maximise project integration and impact.*

*In terms of missed opportunities, it has been recognised that Scotland has yet to take full advantage of the opportunities within the **Industrial Strategy Challenge Fund (ISCF)**. SRPe are addressing this by targeting the ISCF via our SFC funded RAS & AI Industrial Impact Acceleration Initiative within our Robotics and Autonomous Systems Theme.*

Q1b. WHAT LESSONS CAN BE LEARNT FROM THE RESEARCH POOLING INITIATIVE?

We are interested to hear what lessons can be learnt from the initiative both to identify and share good practice, to understand better collaborative relationships and to inform development and management of future SFC investments. You may wish to comment on:

- **What lessons can be learnt about making collaborations work effectively?**
- **Have particular Pooling models been shown to work well/badly, in all cases / in specific contexts?**
- **Were particular elements of Pooling more effective than others?**
- **From your perspective what evidence can you give regarding what worked well, or didn't? Why? You may wish to consider: academic posts; improved facilities and equipment; graduate schools and studentships.**
- **Are there lessons to learn from the range of Pools supported?**
- **Were the disciplines covered by Pools the right ones? Some Pools were focussed on discrete discipline areas while others were broader / interdisciplinary – are there lessons to be learned from the different models?**
- **Were there missed opportunities in other areas? What happened in those areas?**
- **Are you aware of examples of location impacting on or limiting institutions' involvement in research Pooling and/or of examples that overcame any limitation?**
- **What lessons can SFC learn from the initiative on how we design/ implement/ manage projects?**

During the Initial Phase from 2006/07 to 2012/13 the three regional engineering Pools delivered high profile staff appointments, investment in postgraduate studentships and strategic-level investment in key equipment and facilities significantly enhancing Scotland's research capabilities, capacity and competitiveness on the UK and international stage. Building upon this success SRPe has continued to go from strength to strength working in close collaboration with key partners across government, public sector agencies and industry at a strategic level.

Recognising the relatively modest level of funding during the Continuation Phase SRPe's focus has been on strategic elevation of the Pool and on supporting the government, public and private sectors on delivery of major pan-Scotland strategic initiatives. This has reaped significant external investment within a short timescale which will be further capitalised to continue to grow the impact of university-led engineering research in Scotland.

The future of engineering in Scotland critically depends on continued commitment to and investment in research Pooling. Enhanced Pool funding for strategic level pump-priming activities and engagement would deliver further increased value to the Scottish economy. Increased provision of funding for sponsored industry-doctorates (PhDs) would be highly effective in further strengthening the collaboration between industry and academia, paving the way for longer term strategic relationships and programmes to be developed. Skills development programmes such as the SRPe PECRE scheme have provided important support for Early Career Researchers and the SRPe PEER scheme has been highly successful in securing European funding e.g. H2020 collaborative HERMES Project (£7.5M) with £600K of research income secured by Glasgow. Continuing investment in both schemes would continue to add significant value.

The provision of additional strategic funding for targeted initiatives, e.g. the RAS & AI Industrial Impact Accelerator Initiative, has enabled the SRPe community to better prepare for the next wave of opportunities within ISCF.

There is a current mismatch between the level of public investment, which is relatively modest, and the breadth of impact expected. A better balance of expectations would be desirable.

Currently there is significant investment in Innovation Centres and a better balance of investments with research Pools would be more effective in delivering solutions to industry and in ensuring that the longer term strategic outcomes are delivered to drive economic growth.

Most of the SFC funded research Pools are disciplinary, rather than thematic sector-focused. Challenge / opportunity-led research Pools are highly effective for strengthening the triple-helix collaborative approach between industry, academia and government / public sector driving socio-economic impact. Consideration should be given to the merits of establishing thematic sector-focused Pools versus disciplinary Pools.

The level of impact achieved across the existing suite of Pools is variable and largely depends on the leadership strategy, culture and the disciplinary / focus area. It is important that specific key performance metrics be carefully tailored to drive performance and validate the investments.

Consideration should be given to making the case for Pooling on a competitive investment case basis, demonstrating value added/investment leveraging opportunities, as opposed to a grant/funding case applications for research activities. SRPe as a disciplinary Pool focuses on strategic thematic sectors aligning the research strengths and capabilities of Scottish university-led engineering research with the key areas of opportunity. This strategic approach to investment to yield maximum impact makes a compelling case for investment to future-proof economic growth and enhance the research excellence and its impact in Scotland.

SECTION 2: POOLING NOW AND IN THE FUTURE

As the initial Pooling investments came to an end, SFC provided limited continuation funding (matched by institutions), to allow successful Pools to maintain a central resource, for 5 years.

The research landscape has changed since the inception of Pooling and continues to change substantially. This includes changes to funding and funding structures, a greater interdisciplinary and challenge-led research focus, increased prominence of innovation, industry engagement and the economic impact of research, BREXIT and international competition.

Q2a. IN THE CURRENT RESEARCH LANDSCAPE, WHAT IS THE PERCEPTION OF, AND ROLE FOR, THE POOLS?

- **Has the changing landscape and funding environment affected evolution of the research Pools?**
- **Do institutions remain committed to individual Pools and the concept of Pooling more widely?**
- **How does Pooling fit with the current focus on interdisciplinarity and challenge led research?**
- **What is the current role of Pools and how has that changed since the initial phase? Is the current model right?**
- **How do Pools interact with other SFC investments such as Innovation Centres?**

The research funding landscape is increasingly competitive and for the Scottish universities to compete effectively going forward research Pooling is critical. The implications of Brexit have made this more acute.

Our university partners remain highly committed to research Pooling and in continuing to provide matched investment. The engineering research Pool is recognised by the university partner institutions as a key mechanism for driving the growth of the Scottish research portfolio and economy. The Pool is also the central strategic resource for government,

public sector organisations and industry to access to the Scottish university research community and is the central strategic body for the institutions to collaborate effectively to address priority skills gaps and research challenges at a national strategic level. It is an effective forum for networking and establishing peer relationships and for increasing the overall impact of university research.

The fit between Pooling and the current focus on interdisciplinarity and challenge led research is extremely strong in SRPe as we have structured our strategy and activities around challenge / opportunity-led thematic areas. This is particularly important given the extensive nature of engineering which is comprised of a wide range of sub-disciplines with a diverse range of cross-sectoral applications.

The current Pooling model is effective but increased and more targeted investment is required to accelerate economic impact. Hence consideration should be given to tuning the investments to the Pools with highest potential for impact.

Currently there seems to be a focus on delivery of short term project solutions to industry via Innovation Centres. More balanced investment and strengthened collaborative integration at an SFC and senior strategic level between the Research Pools and Innovation Centres would be highly beneficial.

Q2b. SHOULD RESEARCH POOLS HAVE A CONTINUING ROLE IN THE SCOTTISH RESEARCH BASE?

- **Will the concept of research Pooling remain relevant in the developing research landscape? How can/should the model evolve to fit that landscape?**
- **What happens when the five years' continuation funding comes to an end?**

Given the current and developing research landscape research Pooling in engineering becomes increasingly critical for the future success of Scotland as a research and technology-led nation and to ensure that Scotland fully capitalises on the significant areas of economic opportunity ahead. Pan-Scotland coordination of collaborative research effort at a challenge-led and strategic level with the critical mass delivered by research Pooling is vital for Scotland and the UK's future economic prosperity. There is increasing competition within the UK and internationally for research funding and this is acutely heightened by the potential impacts of Brexit.

Given the significant and demonstrable impact of research Pooling since its launch in 2006 and given the increasingly complex and challenging research landscape it is anticipated that investment in Pooling continues. It is recommended that increased investment is made in Pools where there is the highest potential for socio-economic impact in alignment with government and industry strategic needs.

Without continuation of support from the Government / public sector (to maintain the triple-helix approach to collaboration between universities / public sector and industry) the Pools would be unlikely to be sustainable in the longer term.

SECTION 3: ANYTHING ELSE

Q3.1. ANY FURTHER PERSPECTIVES ON THE INTRODUCTION, IMPLEMENTATION AND IMPACT OF RESEARCH POOLING ARE WELCOME.

Alternative membership models around university member subscription (rather than matched investment between the SFC and the universities) would drive very short term project-level deliverables as opposed to longer term strategic outcomes of critical national priority, and would be unlikely to be sustainable.