Institution: Robert Gordon University

Unit of Assessment: 15 General Engineering

a. Context

RGU's research vision is *'to be internationally recognised for excellence in applied research in key thematic areas and to demonstrate tangible success in applying that research for the benefit of the wider community'*. Consequently the focus is on translational research and its resultant impact.

The research in this unit has impact locally, nationally and internationally through solving problems and transferring new technologies and innovative practical solutions to industry. The main user groups of our applied research are the Oil & Gas industry, companies involved in Renewable/Sustainable Energy, Environmental Agencies, and technology companies developing environmental solutions.

Economic impacts come from technologies that improve the performance of businesses through improved processes and spinout of novel technologies. The Energy Group's modelling research has resulted in improved sand management in offshore drilling, reduced corrosion in pipelines, and a new spin-out company offering specialist real-time flow assurance solutions.

Environmental impacts result from new technologies and processes to monitor and mitigate pollution. The Environmental Technologies Group has developed robust and reliable monitoring regimes that have been adopted as legislation internationally for marine environments. The impact of these improved regimes is that Oil & Gas exploration and production becomes more vigilant about oily pollutants, with resulting improvements in marine environments. The group's research on cyanobacteria has resulted in more reliable detection of cyanotoxins, reduction in aquatic pollution, with impact on aquaculture and availability of potable water.

b. Approach to impact

The impact of our research comes from the development of original ideas through to applications, with particular emphasis on implementation of technologies that impact on wealth creation (Energy Sector) and life quality improvement (Environmental Technologies). Our holistic approach to impact aids the transfer of relevant new technology to industry, through initial dialogue, one to one engagement with non-academic users, full interaction during project development, and post-interaction follow-through.

Engagement with Key Users

Industrial engagement has always been a key aspect of research within the IDEAS Research Institute, and in particular exploiting the expertise and facilities to solve industrial problems, extend capabilities and introduce novel technologies.

Initial dialogue occurs from dissemination of expertise through publication, personal contacts, website and press, and networking at events, workshops and conferences. Industry conferences and journals (e.g. those managed by the Society of Petroleum Engineers SPE) are an important mechanism to showcase research outcomes and expertise to the Energy sector, but also to understand industry needs, problems and challenges. Industry exhibitions and conferences also gather key industry players in the field, and RGU is always very well represented at leading energy events such as All Energy, Subsea UK and SPE Offshore Europe. This unit plays a very important role presenting its leading-edge technologies and networking with potential industry collaborators.

This unit is also well connected through academic industry networks. The National Subsea Research Institute (NSRI) is a partnership with the Universities of Aberdeen, Dundee and Newcastle, Subsea UK, and 20+ subscribing industry members. NSRI's STAG (Subsea Technology Advisory Group) events provide a forum to highlight subsea priorities. The Sand Management Network contains 20 Oil & Gas operating and service provider companies, and is a forum to share issues and technologies related to sand management for oil production. The Scottish Sensors Systems Centre (S3C) is a Scotland wide network of universities and companies, and its events showcase technologies and facilities; e.g. an S3C event in Aberdeen took the form of a subsea technology open day at RGU and Aberdeen University. This unit also has an established network of users of Environmental Technologies; e.g. James Hutton Institute for food

and water security, and Marine Scotland Science for marine environments.

The Interface scheme, Scotland's knowledge connection for business to universities, is an efficient pipeline for SME enquiries. Short feasibility studies are an effective way to initiate engagement with users for both Energy and Environmental Technologies themes. Short student projects or Innovation Voucher engagements explore the application and proposed technology solution. Follow-on projects such as KTP or jointly funded PhDs prove to be a good way to develop an idea into an implemented "proof of prototype" to solve an industry problem and to embed the technology into the sponsoring company.

We have taken advantage of Scottish Enterprise funding through its Proof of Concept programme to commercialise technologies developed through research. We also benefitted from an RSE Business Enterprise Fellowship that provides training, mentoring and experience of entrepreneurship and commercialisation, designed to establish skills in marketing the technology to potential users/funders. RSE enabled the spinout of technology as Intelligent Flow Solutions Ltd.

Nature of Interactions and Follow-Through to Identify Impacts

The KTP programme is an important and effective route to **economic** impact in the **Oil & Gas** industry. In the period this unit has had 10 KTPs and their successful translation to impact is evidenced by technologies and KTP associates successfully embedded in the companies and further joint projects between RGU and the company (e.g. Opus Plus, Cabot, Sureclean and Gas2). One example for the **Energy** group is the KTP project with Opus Plus that developed Mare's Tail® to increase the removal of oil from produced water. This novel technology is now embedded in the company and its impact continues to be monitored through the KTP follow-up processes. A further KTP with **Lawton** exploited ecotoxicity assays for determination of **Environmental** impact of chemicals destined for use in the petrochemical industry.

Economic impact from **Environmental Technologies** research in the **Oil & Gas** industry typically comes from joint projects with companies in its supply chain. The relationship between Cabot Speciality Fluids and RGU is a typical example of word of mouth and personal contact interaction. An Interface project funded by Shell used drilling fluids provided by Cabot Speciality Fluids. Whilst Cabot oversaw the handling of these fluids, discussions with **Pollard** led to a KTP between RGU and Cabot. The KTP developed and enhanced an environmentally friendly well construction fluid. Impact from RGU's technology is shared with a wider pool of Oil & Gas companies, including ConocoPhillips, Mi SWACO/Schlumberger and Intertek.

Environmental impact from **Environmental Technologies** research is normally through technology companies. An Interface enquiry from SME Nanoparticulate Surface Adhesion Ltd. solved a problem to assist in assessing the quality of one of their products, photospheres, which is used in water treatment, and led to the development of new products for the company. A follow-on collaborative project develops a system for in-situ quality water measurement, and its potential for the detection of multiple pollutants is currently being explored.

Impact from **Environmental Technologies** research in the **Biotechnologies** industry is built from a long-standing collaboration between RGU and Enzo Life Sciences. **Lawton** and **Edwards** produce the world's largest portfolio of high quality toxins and related bioactive compounds, facilitating enhanced vital research in this area. The impact is reflected on a global scale with at least 10% product utilisation in relevant publications.

The **Energy** group also generates **economic** impact through **spinout**. IP from novel membrane technologies was protected by two families of patents (Syngas and Fisher Tropsch), and then the technologies were made available through the spinout of Gas2 Ltd. Gas2 attracted inward capital investment of over £18 million during 2008-2013 to finance the commercialization of this technology. Flow assurance technology was the basis for an RSE Business Enterprise Fellowship. Following the one year fellowship secondment, the Intelligent Flow Solutions spinout was formed in 2010. RGU researchers remain as directors on the board of both spinouts.

Agile Approach to Opportunities

External interactions can be initiated through personal contacts, from RGUs reputation for industry engagement and applied research, or via Interface. In addition, the Oil & Gas sector has a variety of specialised routes for engagement with innovation providers, including ITF the Industry

Technology Facilitator for Energy industries.

New industry/Interface enquiries and ITF calls come in to our Business Development Services department where they are channelled by a business development manager to the appropriate Research Institute (**Hossain**), School (**Steel**) and/or a specific research group leader (**Hossain, Steel, Pollard, Lawton, Robertson**). Calls for proposals from S3C and the new CENSIS Innovation Centre are channelled through RGU's PI **Pollard**. Research groups contain a mix of experience from research leaders through to PhD students. This variety of experience and available time ensures that following-up opportunities and implementing projects is done efficiently.

Support to Achieve Impact
RGU's emphasis on translational research means that "research" is synonymous with applications, impact and knowledge exchange. Annual research reviews with a senior mentor allow staff to review their research achievements in the previous year and identify objectives for the coming year. Significant funded interaction is recognised in the membership level for the IDEAS research institute, and this directly relates to research allowances in workload planning.

Overheads from funded interactions are shared with the PIs, enabling them to invest strategically in their own research activities; to grow new areas, to shape their interactions with industry and other research users and beneficiaries. Reward contracts allow staff to share the benefits of net income received by the university as a result of commercial licensing of intellectual property.

Use of Institutional Facilities
The University's Research Enterprise and Business Development Services provide supporting services such as engaging with business and industry, drafting non-disclosure agreements, protecting intellectual property, negotiating bespoke contracts with industry, and good contact relationship management. The North of Scotland KTP Centre supports engagement with potential KTP partners, assists generation of proposals, and manages successful joint projects. The effectiveness of this approach is demonstrated by RGU's success in winning KTP projects; currently second in Scotland for KTPs. RGU has a partnership with Frontier IIP, a subsidiary of Sigma Capital Group plc. Together with Frontier, the University has established the RGU Ventures Investment Fund to provide seed capital for spinout and joint venture companies to achieve sustainable economic impact.

c. Strategy and plans

Our aim is to achieve economic and environmental impact through interactions with industry, building on a track record of applied research that adds value. Our strategy is to foster a research team of diverse, complementary skills with a strong ethos for industrial applications. Showcase events like the launch of the IDEAS Research Institute exploits individual links and a full contacts list, and offers networking opportunities to engage local, national and international industry.

The focus will continue to be novel technologies for Oil & Gas, including environmental technologies that monitor and mitigate pollution, but there is also opportunity for renewables and sustainability. The extensive engineering facilities in the new Riverside East building will be exploited to build industry engagement. RGU is the only university to boast a DART®, a state-of-the-art multimedia facility that simulates at full-scale a real offshore platform or land rig.

The proposed Oil & Gas Innovation Centre (OGIC) to be based in Aberdeen will be industry-driven and is designed to act as an innovation catalyst for industry. This unit is well placed to take advantage of this and related Innovation Centres (ICs): the proposed Data Lab and its Oil & Gas hub to be located at RGU; and the existing CENSIS IC with its opportunities for sensors in Energy.

d. Relationship to case studies

The **Membrane Technologies** case study exemplifies our approach to commercialisation: protecting IP through patents, then exploiting through spinout. Gas2's success highlighted the need for more initial investment and led to the establishment of RGU Ventures Investment Fund.

Environmental Monitoring Regime case study demonstrates the effectiveness of our links with user bodies outside the Oil & Gas industry. Dissemination of the monitoring methods through Environmental Agencies led to their adoption as the standard regime in the North Sea and beyond.