School of Natural Sciences Research Strategy 2014/15 – 2016/17

1 VISION

The Stirling School of Natural Sciences is established as a distinctive academic arena where new fundamental understandings of the complex inter-relationships between human behaviours, biological, environmental and aquatic systems and applied technologies are created, explored and tested. We can claim with justification, unique and valuable STEmM research activity in aquaculture; the environmental and conservation sciences; cognition, health and behavioural change and in underpinning applied technologies which computationally investigate complex systems in uncertain and dynamic real world environments. We initiate new programmes of research by integrating academic and market-led approaches, developed through rigorous empirical and multi-disciplinary frameworks given predictive power through computational, mathematics, quantitative modelling and informatics.

Our vision is that our research be world leading in our chosen areas and is recognised by our peers as such. We want our research to have academic, economic and societal impact and to be financially sustainable. We want research users, our staff and research students to work within the School of Natural Sciences because they know they will find the experience intellectually rewarding.

2 CONTEXT

2.1 Internal University Context

The internal context in which the School’s research endeavours operate are bound by the University’s Strategic Plan (2011-2016) which seeks:-

- Upper quartile REF performance in 2014,
- RGC income per academic FTE above average of our peer universities,
- Large scale interdisciplinary research,
- Improved grant application success,
- Increased RPGs per academic FTE,
- RGC income to grow by 12.5% per year (and so double over five years),
- Between 400 and 500 research active staff across the university.

The School embraces all of the above outcomes and targets. The School recognises that the University is currently developing a refreshed strategy and anticipates the revised outcomes and targets will be extensions of those that have gone before. This School Research Strategy assumes these outcomes and targets for the School throughout. In the event that the refreshed University strategy is significantly different to that anticipated then the School will amend this strategy accordingly.

2.2 Internal School Context

The School’s research position is defined by its twelve research groups, its research leadership and its overseeing School research committee (Chair, Professor Brendan McAndrew):-

1. Behaviour & Evolution – based in Psychology – led by Prof Hannah Buchanan-Smith
   Understanding the interaction between evolved capacities and actions in humans and other animals in the changing world of the 21st century.

2. Cognitive Computation – based in CS&M – Led by Prof Bruce Graham
   The development of new computational techniques by studying animal nervous systems and other biological and naturally occurring systems.
3. Cognition in Complex Environments – based in Psychology – led by Prof Peter Hancock
The scientific study of mind and brain in adults and children and has three research areas; cognitive neuroscience, developmental psychology and face research.

4. Computational-Heuristics, Operational Research & Decision-Support (CHORDS) – based in CS&M – led by Prof Edmund Burke
The exploration of computational search methodologies and models that emerge from studying the complexity and uncertainty of real world scheduling, optimisation and decision support problems.

Understanding a broad variety of processes that determine how organisms interact with their environment and how changes in environment can alter the characteristics of organisms over ecological and evolutionary timescales.

6. Environmental Systems, Change & Protection – based in BES – led by Prof Mike Billett
The study of human influence on earth’s landscapes, ecosystems and environments in the past, present and future, and to understand the sustainability of practices and the resilience of ecosystems and society.

7. Aquatic Health & Welfare – based in Aquaculture – led by Prof Randolph Richards
The study of mechanisms that cause disease, the development of improved diagnostic technologies, the development of disease control methods (through vaccines, probiotics, immunostimulants, therapeutics and population based models) and the monitoring of fish welfare.

8. Fish Genetics & Reproduction – based in Aquaculture – led Prof Brendan McAndrew
The management of broodstock and the production of fish as a controllable and sustainable resource. This is achieved through control of maturation and puberty, selective breeding, sex differentiation and control, and basic research on important traits and genes.

9. Fish Nutrition – based in Aquaculture – led by Prof Gordon Bell
The study of fish as food for humans, the development of new species for aquaculture, the welfare of farmed fish, defining the nutritional requirements of emerging species of aquaculture and determining the impact of changing nutrition on the health and welfare of farmed fish.

10. Human Health & Behaviour Change – based in Psychology – led by Prof Ronan O’Carroll
Developing and applying psychological theory and methods to health and social behaviours including health, clinical, and neuro-psychology.

The development of innovative inter-disciplinary computational and mathematical modelling approaches to high impact real world problems.

12. Sustainable Aquaculture – based in Aquaculture – led by Prof Lindsay Ross
Determining how long term resilience and sustainability can be achieved through the study of models, biodiversity and international development.

Cutting across these research groups are the three cross cutting themes of aquatic food security, “big data” and marine biotechnology.

The research groups were submitted to REF 2014 through five units of assessment. The REF5 Environmental Templates submitted are reproduced in the “Strategy Supporting Documents” that accompanies this strategy and are summarised below:-

REF UoA A4 – Psychology. Psychology brings together complementary perspectives from cognitive neuroscience and animal behaviour to address fundamental psychological questions. The Cognition
in Complex Environments Group (9 FTEs submitted in REF) examines the areas of cognition, perception and development while the Behaviour and Evolution Research Group (5 FTEs submitted in REF) considers the areas of comparative cognition, social cognition and cultural transmission. Together the long-term endeavour is to understand mind and behaviour in rich, complex real-world physical and social environments. This is being pursued through the development and deployment of diverse research methods in novel situations, moving rigorous psychological science beyond the laboratory. We note here that Health Psychology was submitted to UoA3.

REF UoA A6 – Aquaculture. The Institute of Aquaculture is a major international centre of excellence for aquaculture research. It uses a range of cross-disciplinary approaches to focus on fundamental questions of fish health and welfare, genetics and reproduction, nutrition and feed supplies and environmental and international development issues relating to the long-term sustainability and security of the global aquaculture industry. Alongside the 28 FTE staff included in the REF submission the Institute has 53 researchers and support/technical staff and trains 80-100 postgraduate research and master students and 30 undergraduates annually making the Institute one of the largest non-governmental aquaculture research and postgraduate training organisations in the world.

REF UoA B7 – Environmental Sciences. The 15 staff submitted were from within the Environment System, Change and Protection and Ecology, Evolution and Conservation groups within Biological & Environmental Sciences. The groups seek to understand the fundamental processes driving the evolution and maintenance of biodiversity from the genetic to the ecosystem level. They then seek to predict and mitigate perturbations of biogeochemical cycles that result from environmental changes, from local to global scales. The ongoing and long-term goal for their research is to ensure a sustainable, healthy future for humanity and the environments on which we depend. From fundamental process-based studies they create and test policy and management solutions to give new approaches to natural resource management.

REF UoA B11 – Computing Science. This research is based in Computing Science & Mathematics and it represents ground breaking innovations which lie at the interface of Computer Science, Operational Research, Management Science, Biology, Aquaculture, Environmental Science and Social Science. The research is centred on three complementary research groups which have the common theme of investigating complex systems in uncertain and dynamic real world environments. The three groups are, Computational Heuristics Operational Research and Decision-support Systems (6 staff submitted to REF), Modelling and Analysis of Complex Systems (7 staff submitted) and Cognitive Computation (3 staff submitted).

REF UoA C17 – Geography, Environmental Studies and Archaeology. Staff for this submission came from Psychology (2 staff submitted), Biological & Environmental Sciences (18 staff) and Aquaculture (3 staff). Their endeavour is to understand environmental relationships in complex society in order to ensure a sustainable healthy future. From fundamental studies they create and test policy and management solutions to give new approaches to natural resource management, mitigate or reverse the impacts of human activities on biodiversity, environmental services and natural resources, and support the sustaining of local communities. Conservation, environment and development agencies recognise the inter-disciplinary nature of their work as unique in the UK and as having global reach.

The research work carried out by these groups is supported by a suite of unique facilities which includes:-

- Controlled Environment Facility, now supporting research funded by NERC, EU Marie Curie, Royal Society, Historic Scotland, Carnegie Trust, Scottish Environment Protection Agency (SEPA), Commercial Activity,
• Environmental Radioactivity Laboratory, now supporting research funded by SEPA, Environment Agency, Sellafield Ltd, DTI–BGS,
• Playgroup equipped to observe children at play (unique in the UK),
• Psychological Imaging Lab equipped with electroencephalography equipment for recording electrical activity along the scalp supporting BBSRC and Sport Scotland funded research,
• Micromorphology, Microscopy and Scanning Electron Microscope Facility, supporting research funded by NERC, EU, Royal Society, Historic Scotland, Carnegie Trust, US–National Science Foundation, UNESCO, Commercial Activity,
• A full range of saltwater and fresh water aquatic research facilities including Home Office approved aquaria (for challenge and genetics/reproduction work) and a model fish farm supporting a range of RCUK, EU and Innovate UK fundamental, commercial and near market research activities.

2.3 External Context
Looking to the future, the Schools major funding sources will be RCUK and Horizon 2020 at the fundamental end of the research spectrum and Innovate UK, innovation centres and end-users of research at the applied end of the spectrum. We continue to work on increasing our understanding of this spectrum as it tells us why different funders support different types of research and why we achieve different financial rates for different types of research. The spectrum is illustrated in the diagram below and is based upon the Technology Readiness Level (TRL) concept. We recognise that science and technology research developed in universities requires a lot of additional work before it becomes a useful product or service for the organisation that funded the research and that if research users influence the course of fundamental research questions being addressed at TRLs one and two then the chances of securing funding later to develop that research at TRLs three and four is greater.

The School is working with the REO to map the various RCUK and Horizon 2020 funding streams that align with the School’s Research Groups. That mapping is shown in the table below. All research councils relevant to the School have recently refreshed or are in the process of refreshing their strategies.

All four themes of NERC’s strategy 'The Business of the Environment' (benefiting from natural resources, resilience to environmental hazards, managing environmental change and discovery science) marry well with the School’s interests. Two of the three themes in BBSRC’s strategy 'The Age of Bioscience' (agriculture and food security, industrial biotechnology and bioenergy and bioscience for health) marry well with the School’s interests. CS&M research groups align well with the EPSRC’s Digital Economy and Healthcare Technologies themes. The mental health and wellbeing and environment and health themes from MRC’s strategy 'Research Changes Lives' also aligns with the School’s interests. Finally much of the School’s research also marries well with the RCUK cross
council themes of Living With Environmental Change (LWEC), Global Uncertainties (GU), Lifelong Health and Well-Being, Global Food Security and Connected Communities.

The Horizon 2020 programme has seven themes of which three:- 1) Health, demographic change and well-being; 2) Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bioeconomy, 3) Climate action, environment, resource efficiency and raw materials, are particularly relevant to the School.

Innovate UK (formerly known as the Technology Strategy Board) has ten themes of which three, 1) Agriculture and food; 2) Health and care, 3) Digital economy, are particularly relevant to the School.

Additionally the Government has developed its portfolio of 'Eight Great Technologies' that are its preferred areas to support. Of these three:-
- Big Data,
- Agri-Science,
- Satellites (and related earth observation technologies)
are particularly relevant to the School.

Finally the Scottish Government has launched its family of eight close-to-market Innovations Centres. Three of these:
- Data Lab,
- Digital Health Institute,
- Scottish Aquaculture Innovation Centre
are particularly relevant to the School. The last of these, the Scottish Aquaculture Innovation Centre (SAIC), is being hosted by the University and is expected to deliver significant research income at close to or above fEC over the next five years. The eight Scottish Innovation Centre are similar to Innovate UK’s eight Catapult centres. Of these two (satellite applications and connected digital economy) are relevant to the School.

Fundamental to the External Context is the funding opportunities open to the School’s research groups. In collaboration with Research & Enterprise Office the School has mapped these opportunities with the results presented in the “Strategy Supporting Documents” that accompanies this strategy. REO and the School will continue to map opportunities as they evolve. This mapping of opportunities is used as the basis of the future research financial model presented in section 9 about Putting the Strategy into Practice.

The School is very conscious of the increasing use by the research councils of 'demand management' whereby the councils are starting to restrict future applications from academics that have submitted too may unsuccessful applications in the past. This gives strong indication of an increased need for appropriate peer review of applications to improve their chances of success.

The School is also conscious of the emerging 'capability analysis' whereby the EPSRC are increasingly concentrating their funding in research groups that they perceive to have particular capability and critical mass. For a small university like Stirling this policy suggests a need to either increase the size of research groups or to form strategic collaborations with similar groups at other universities (so creating a combined group with the necessary critical mass). It is expected that other research councils will follow the EPSRC in implementing capability analysis in the life of this strategy.

2.4 Integrated SWOT Analyses
In generating this strategy we asked the School’s research groups to each assess the external context from their perspective through a series of SWOT analyses. The table below is a SNS generic SWOT analysis many of the points are recurrent issues highlighted by individual research group leaders. These are collated in the “Strategy Supporting Documents” that accompanies this strategy.
## SNS Strengths

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<th>Strengths</th>
<th>Weaknesses</th>
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<tr>
<td>Twelve established research groups with strong academic leadership, publication records, evidence of widespread impact and £1M+ external research awards in all divisions.</td>
<td>Several groups are below perceived critical mass needed for subject – critical mass is becoming increasingly important to funders.</td>
</tr>
<tr>
<td>Almost 100 academic staff returned to REF2014 at externally assessed GPA &gt;2.85 across six different UoAs.</td>
<td>High student staff ratio in BES, Psychology and CS&amp;M reduces opportunities to apply and develop research grant applications and reduces outputs and impact.</td>
</tr>
<tr>
<td>SNS research income represents ≈50% of university total.</td>
<td>Office and lab space at capacity making it difficult to expand staff and RPG numbers to achieve critical mass.</td>
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<tr>
<td>Distinctive research strengths in all divisions, notably aquaculture, developmental psychology, computational heuristics, environmental monitoring and mathematical biology.</td>
<td>Many school facilities, laboratories and equipment are now ageing and will require investment to bring them back to competitive levels.</td>
</tr>
<tr>
<td>Good match of research group interests to national, UK and European research themes evidenced by awards from all UK RCs and EU.</td>
<td>Lack of consistent university strategy on funding PhD studentships reduces number of potential RPGs.</td>
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<tr>
<td>Involved in SFC pooling initiatives (SAGES, MASTS, SINAPSE, SICSA) and SAIC.</td>
<td>University relationships with RCs are not strong.</td>
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<tr>
<td>SNS attracts high quality RPG students</td>
<td>Physical distance separating Cottrell and Pathfoot staff.</td>
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<tr>
<td>Involved in strong collaborations with other HEIs including DTCs.</td>
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## Opportunities

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<th>Opportunities</th>
<th>Threats</th>
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<tr>
<td>New University strategy – double research income – so need to double School income – linear growth from years two to five with year one constrained by lead time to securing contracts.</td>
<td>Increased competition from other HEIs as they respond to demand management, capability analyses and critical mass needs (which in turn creates an opportunity for the School as a collaborator for others).</td>
</tr>
<tr>
<td>New NERC, EPSRC, BBSRC, Innovate UK and EU plans with strategic reviews at RCs due.</td>
<td>REF results and subsequent allocation of REG unknown (also an opportunity).</td>
</tr>
<tr>
<td>UK government emphasis on “eight great technologies”. Scottish Government emphasis on aquaculture.</td>
<td>Potential for key staff to leave.</td>
</tr>
<tr>
<td>SAIC secured, other Innovation Centres (and Innovate UK Catapults) to collaborate with.</td>
<td>Potential ability of University central services to cope with planned expansion of research.</td>
</tr>
<tr>
<td>Potential within DTCs.</td>
<td>RCs increasing concentration on research excellence, critical mass and “capability analysis”.</td>
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## 2.5 Current Financial Performance

Using HESA finance and staff data the School has benchmarked its research earning performance against the University’s twelve peer institutions. To give as much granularity to the results as possible data has been extracted at the academic unit level. This gives robust results for Computing
Science, for Mathematics and for Psychology. The way the University submits its HESA data and how that has changed over time means it is impossible to meaningfully disaggregate Aquaculture and BES and so a combined result for these areas has been taken using the Veterinary Science, Biosciences and Earth, Marine & Environmental Sciences data. Note that these figures include all research active staff including PDRAs.

The graphs below summarise the results (with the full results being available in the “Strategy Supporting Documents” that accompanies this strategy).

Research income per FTE has increased steadily since 2009 while the performance of many peers has been volatile. The School's performance is now almost at the average for the peer group.

After remaining steady until 2011 Computing Science income has recently grown and is now above the peer average. Again, the School's performance is less volatile than many of its peers.
Maths income per FTE has fallen from being the best in the peer group to just below the peer group average.

Psychology’s research income per FTE has risen in recent years such that they are now almost best in class. They are well above the peer group average.

An analysis of School grant applications from 2012/13 Q1 to 2013/14 Q3 inclusive shows 80% of academics made applications. Of these 30% were successful. Consequently 40% secured a grant over the period and between them they secured £7M. Over half of the income secured comes from just eight academics.

The income received by the School is split with 10% to staff recharges, 35% to employing staff on grants (direct staff), 20% to overhead recovery and 35% to other expenses. Within the School Aquaculture and BES tend to recover far less overhead than CS&M and Psychology, while BES tend to recharge more of their staff time. Going forward the School will work with REO and the research groups to try to ensure that far more staff (both academic and technician) and overhead recharges are recovered.

2.6 Publication and Citation Performance
All areas of the School have published well over the last five years and this is evidenced by the very high proportion of staff submitted to REF 2014 after external assessment of their work. Details of publications by research group are provided in the “Strategy Supporting Documents” that accompanies this strategy.
2.7 Research Student Performance

The number of research students (RPGs) in the School has dropped from 176 (120 FTE) in 2010/11 to 136 (103 FTE) in 2014/15. All divisions have shown some volatility in RPG numbers:

- Aquaculture – home/EU numbers have dropped significantly while overseas have risen,
- BES – home/EU numbers have risen,
- CS&M – home/EU numbers have dropped significantly while overseas have risen,
- Psychology – home/EU and overseas numbers have dropped.

The School regards research students as fundamental to a healthy research environment and wishes to grow RPG numbers across all divisions. Where these students work closely with end users of research (such as industry, the public sector or the third sector) then the School believes it can secure a significant contribution from these partners. In the case of Aquaculture, BES and CS&M these contributions should include a cash element. In the case of Psychology the contribution is likely to be entirely in-kind.

3 STRATEGY

3.1 Underpinning Rationale

Our long term underpinning priorities are to:

a) Further enhance the quality, reach and contribution of our intellectual environment through our academic, technical support and administrative staff. This includes new, planned, appointments in key and fast developing research areas including geospatial technologies and developmental psychology and proposed appointments in aquatic physiology & production science, aquatic neuroscience, aquatic economics and health psychology. It also includes replacement of retiring and leaving staff as appropriate.

b) Increasingly aligning ourselves to and influencing the emergence of research council, national government, EU and international research priorities in pursuit of research excellence. We continue to focus on the pressing ‘grand challenges’ that face our global society while aligning our activities to the growth industries identified in the Scottish Government’s Economic Strategy. We recognise the complimentary of these alignments.

c) Enhancing the employability and high-level skills of our research post-graduates. We endeavour to achieve this through new partnerships with industry and other employers and through our new School Employability Officer.

d) Enhancing our field and laboratory based facilities ensuring that they are ‘state of the art’ for research and skills training purposes.

e) Increasingly recognise and continue to proactively drive new and better research configurations across the University; we are active (with specific programmes) with all schools in the University and have recently received funding from all RCUK research councils. Our priority in this area is to deepen our work with the biologists in the School of Sport through the development of Human and Sports Sciences research capabilities.

f) On learning the results of REF 2014 we will:

   a. prioritise support and seek investment for world leading and internationally excellent research activity,
   b. identify internationally recognised research activity and develop this into world-leading activity,
   c. consider how best to support any areas that are performing below internationally recognised levels of excellence.
3.2 Research Active Staff
The School currently has around 110 FTE research active staff of which just under 100 were submitted to REF 2014. This represents around one quarter of the University’s research active staff. If the University cohort were to grow to 600 then this would suggest the School’s research active cohort would grow to 150, an increase of 50%. Research active staff are core School staff that have research as part of their academic role.

3.3 Research Income
We will double our research income from £5M per year to £10M per year by 2020.

We will achieve this by:-

- Increasing the number of research active staff from 100 to 150,
- Increasing RGC income per academic,
- Improving the success rate of grant applications through the appropriate use of peer review (including “early selection” in preference to “late correction”),
- Supporting every member of research active staff towards having funded work in any given year,
- Ensuring RGC salary and overhead recharges are maximised,
- Ensuring more larger grants are submitted,
- Ensuring appropriate technical and administrative support is available.

We share the University’s aim that RGC income per academic FTE is above the average of our peer universities. The benchmarking data given in section 2.5 above on current performance shows that we are already achieving this in Computing Science and Psychology and are just under in Maths and Aquaculture/Biological Sciences. We will strive to improve this position.

Section 2.3 above External Context recognised that the closer research is to market the lower is the risk to the research funder and so the higher the proportion of fEC that can be sought. The School will seek, with REO, to maximise the proportion of fEC that it can recover and will charge more than 100% fEC when this is practical. Where this is the case the School will use the surpluses generated to subsidise unfunded research or research that is still loss-making when any contribution from the Research Excellence Grant has been factored in.

3.4 Research Students
We will increase the number of research students from 1.0 per academic FTE to 1.2 per academic FTE by 2020.

We will achieve this by:-

- Ensuring every member of research active staff is supervising at least one PhD student at any given time,
- Better managing our PhD students to improve our completion rates and so ensure we are eligible for RC studentship funding,
- Working with academic partners in other universities to secure PhD studentships through involvement in doctoral training centres,
- Working with the University to achieve long term security of matched funding for PhD studentships,
- Working with the University to ensure some PhD students contribute to broader School activities through a Research Apprenticeship programme,
- Working with the Students Union to support their “Students as Researchers” initiative.

3.5 Collaborative Research
We will increase the proportion of our research that is collaborative.
We will achieve this by:

- Working more closely with academic partners in other universities to secure critical mass of our research groups,
- Working more closely with academic partners in other disciplines to develop new areas of interdisciplinary research,
- Working more closely with research users such as industrial partners to secure income and to increase the relevance of our work,
- Working more closely with supporters of research users such as Scottish Enterprise, Highlands & Islands Enterprise, Interface and Innovate UK’s Knowledge Transfer Network,
- Working with colleagues in the relevant SFC research pools both for the value they bring as research funding mechanisms and to maintain credibility as a serious research provider.

3.6 Research Excellence
We will strive to improve our REF performance in future exercises.

We will achieve this by:

- Publishing our work in the best journals,
- Incrementally improving papers where this is practical,
- Developing impact strategies for exploiting research (accepting that the weighting of impact is likely to grow in the next REF),
- Better publicising our research successes,
- Better understanding the drivers behind the QS rankings so that we might improve our position.

3.7 Research Group Leadership
Underpinning all of the above we will give greater responsibility to our Research Group Leaders in setting and implementing the strategy for their Research Groups. Group leadership role descriptions have been developed that will result in better communication within and between groups, divisions and the School management so we can identify best practice and respond to particular threats or needs more rapidly. The Research Group Leader role description and individual group SWOT analyses are included in the “Strategy Supporting Documents” that accompanies this strategy.

We have proactively tested our key themes in the past year with our honorary colleagues, External Advisory Groups, Scottish Government Officers, UK Government Officers and RCUK Officers. RCUK cross-cutting themes of Food Security, Living with Environmental Change, Minds in Real Environment driven by curiosity and Analytical, Computational and Modelling Approaches are recognised as nationally and internationally important, distinctive and valued by funders, partners and our academic peers.

3.8 Governance
The School currently has a School Research & Knowledge Exchange Committee which reports to the School Executive and the University Research Committee. The remit of the School Research & Knowledge Exchange Committee is to develop and enhance research and knowledge exchange strategy and practice, to disseminate changes in University policy and to promote linkages between research and teaching. It is called twice a semester and chaired by the School Director of Research & Knowledge Exchange. Other members of the committee are the Head of School, the School Manager, the four divisional directors of R&KE and a representative of the University Research & Enterprise Office. The committee will continue this governance, executive and accountability role in the future. Additionally, in the future the committee will request annual reports from each of the research group leaders.
The School recognises that research generates both academic impact and economic and societal impact (as illustrated below in RCUK impact typology diagram). While academic impact is widely recognised within the University economic and societal impact is less so. However, economic and societal impact is becoming increasingly important to research funders (with pathways to impact statements now being required as part of many RC applications) and to research excellent assessment (with 20% of the REF2014 weighting being attributed to impact).

The School has long delivered economic and societal impact particularly through attracting R&D investment and evidence based policy-making and influencing public policies and evidence of this is provided in the section on REF Impact Case Studies in the “Strategy Supporting Documents” that accompanies this strategy. The School will continue to deliver these impacts. It will also seek to grow awareness of its successes in other impact areas such as environmental protection and sustainability, improving health and well-being and increasing public engagement with research and related societal issues through better engagement with the Marketing office. The School is conscious that its ability to generate impact through commercialisation and exploitation is restricted by the University regulation that vests ownership of IP generated by PhD students with those students. The School encourages the University to follow the path of other research intensive universities and vest ownership with the University. Making this change would suggest a need to protect IP through patenting which in turn would demand a fund to support patenting costs. The School encourages the University to consider how best this should be achieved.

We recognise the emerging view that while we can develop research and ‘incubate’ commercial activity, fully commercial activities are difficult to make financially viable in a University setting and that such activities should be ‘spun out’ to a viable commercial setting at the earliest opportunity. We will work with REO and Finance to establish a viable system for commercialising our research and accept the view that this might be best achieved in collaboration with another university that might have greater experience and capability in this area. We note the typical initial equity split employed by other universities when spinning out ventures of one third to the University, one third to the host school and one third to the lead academic(s) with that equity being diluted should the venture attract equity based investment.
We will also seek to enhance our impact through expanding research student partnership programmes with key stakeholders and propose again to work closely with REO and Finance to identify better systems for funding research studentships in the future.

To encourage greater engagement with the economic and societal impact agenda the School has identified an Impact Champion in each Division. Furthermore, all twelve of our research groups are actively pursuing the development of impact case studies.

The School has recently been successful in attracting the Scottish Aquaculture Innovation Centre to the University. Our view is that the £11M of public money secured for the centre will leverage a further £7M of private money (from aquaculture businesses) and £2M of public money from enterprise agencies. While much of the private money may be “in-kind” rather than cash there should still be £3M per year for each of the next five years available to fund research and development. Our view is that the University should attract up to one third of this money. Business needs associated with the centre are likely to involve reasonably large numbers of small research and consultancy contracts – contracts that cannot wait for staff to be recruited to fulfil them. As such the School will seek additional academic and technical support and the space to house them in Aquaculture to ensure that it can maximise the research benefits offered by the centre. One of the stated aims of Innovation Centres is to ensure academics are credited for the impact that their research has generated. The School will ensure that agreements with businesses allows this and so supports our next REF submission.

5 PARTNERSHIPS AND COLLABORATION

We noted above the distinction between academic impact and economic and societal impact. This distinction is equally valid to our partnerships and collaboration. We will:-

- Improve academic partnership by encouraging more interdisciplinary work between research groups within the School through each of our crossing cutting themes in Food Security, Living with Environmental Change, Minds in Real Environment, and Analytical, Computational and Modelling Approaches.
- Improve academic partnership by encouraging more interdisciplinary work with research groups elsewhere in the University particularly developing stronger links with the biologists in Sports Science and colleagues in Health Sciences,
- Improve academic partnership by encouraging more interdisciplinary work with research groups in other universities and PSREs (including through initiatives such as the SFC pools),
- Improve partnerships that will deliver impact by encouraging more collaboration with key businesses, public sectors organisations and third sector organisation,
- Improve partnerships that will deliver impact by encouraging more collaboration with SAIC and other Innovation Centres.
- Develop further our international and EU collaborative links, with a specific focus on funded collaborations with US, Chinese and south American institutions; we anticipate new collaborations with emerging higher education research markets in sub-Saharan Africa; we anticipate contributing to and working with the University Internationalisation Strategy which is in preparation.

6 INFRASTRUCTURE

To help us deliver on our promises within this strategy the School would value the support of the services. In particular we would value:-
• Development of deep strategic links with relevant parts of RCUK, Innovate UK and Horizon 2020 so that we might be better informed of potential developments and what might drive future success and so that we might better influence their thinking,
• Regular metrics (both pre and post award) detailing our progress against our plan so that we know who is performing well and who might need assistance to perform better,
• Development of match funding sources to support strategic initiatives such as the procurement of equipment or research studentships,
• Clarity over the development of researchers (which both REO and the Graduate School regard as their priority in their most recent service plans),
• Provision of additional space as broadly a doubling of research income suggests a doubling of research students which combined with a doubling of research active staff suggest a need for significantly more space in an already confined environment,
• More coordinated development and maintenance of our unique, large scale infrastructure to maintain our position ahead of our competitors,
• Development of systems that ensure we have a robust position at audit (particularly EU).

7 HR CONSIDERATIONS

7.1 Aligning strategy, leadership and culture
This strategy seeks to consciously give greater responsibility to research group leaders to ensure research group strategies are formed by those closest to their funders, research users and academic peers. In doing this the School believes it will achieve greater buy-in to research group strategies and so increase the likelihood of success. Research group leaders are expected to work closely with Heads of Division, the School Director of Research, divisional directors of research and PIs when developing their strategies and leading their research groups.

7.2 Incentivising and Rewarding Success
We will continue to ensure that we recruit and retain outstanding researchers at all levels, who enhance the research profile of their discipline on an internationally recognised scale. This will require new approaches to recognising academic achievement (such as greater recognition of achieving academic impact in the AAPC process), appreciating the breadth of activities that constitute research success in a variety of disciplines. Staff must be engaged with the aims and targets of their research group and recognise how their intellectual contributions fit within the wider framework of the organisation. Self-reliance and entrepreneurship in research leadership will be encouraged through the innovative use of our resources, including the development and delivery of training opportunities.

8 SCHOOL PRIORITIES

8.1 Prioritised New Investment Requests to Support This Strategy
Elsewhere in this strategy we have identified a need for:-
1. Matched funding for PhD studentships (including research apprentices),
2. Academic and technical support to ensure the benefits offered by SAIC are maximised including the development of academic capability in aquatic physiology & production science, aquatic neuroscience, aquatic economics and environmental micro-engineering & sensing,
3. Investment in new academic research staff and the associated support staff to move the University towards its academic staff target including:
   a. Development of existing research groups to ensure there is an appropriate critical mass and mix of experienced and early career colleagues,
b. Identification of new research arena’s (such as the areas of aquatic physiology & production science, aquatic neuroscience, aquatic economics and environmental micro-engineering & sensing mentioned above) for investment,

4. Support for developing and maintaining large research facilities,
5. Support for planned replacement of old equipment and planned upgrading of older laboratories,
6. Explicit investment in research leadership.

8.2 Outputs and Outcomes

- We will work with REO to better understand the needs of our funders (with the aim of increasing our RGC income),
- We will give greater responsibility to our Research Group Leaders for setting and implementing the strategy for their Research Groups (with the aim of improving all of our KPIs),
- We will strive to support every researcher to have a grant (with the aim of increasing our RGC income),
- We will strive to support every researcher to supervise a PhD student (with the aim of increasing our PhD student to academic staff ratio),
- We will increase the number of peer reviewed larger grants that we submit (with the aim of increasing our RGC income),
- We will work with REO to maximise our staff and overhead recharges (with the aim of improving our financial viability).

8.3 Measuring Progress (Key performance Indicators)

- RGC income per academic,
  - Our current performance is £25k/FTE (from HESA data and including all research active staff including PDRAs),
  - Our target is £40k/FTE by 2020,
- RGC salary and overhead recharges,
  - Our current performance is 31%,
  - Our target is 35% by 2020,
- RPG students per academic,
  - Our current performance is 1.0 FTE,
  - Our target is 1.2 FTE by 2020,
- PhD completion rates,
  - Our current performance is ?,%,
  - Our target is ?% by 2020,
- Research excellence – GPA,
  - Our current (RAE 2008) performance is 2.3,
  - Our target (REF 2014) is 3.0,
- Peer recognition – QS rankings,
  - Our current QS scores are 49.8 in Computing Science, 45.8 in Aquaculture, 30.8 in Biological Sciences, 42.4 in Psychology and 35.5 in Environmental Sciences,
  - Our target is to improve all of these scores year-on-year through to 2020 and beyond.