Sustainable Aquaculture Industry Workshop Report

Thursday 26th March 2015

Carlton Hotel, Edinburgh

Background and aims

BBSRC and NERC, two of the UK's leading public funding agencies for the biological and environmental sciences, are working in partnership to investigate the need for a new pre-competitive research and innovation initiative in sustainable aquaculture. At this industry-focussed workshop we explored how BBSRC and NERC might contribute to delivering new research and innovative approaches to solving industry's challenges.

Aims of the Workshop

- Develop plans for a multi-million pound investment in research and research translation for sustainable aquaculture.
- Engage industry in determining the scope of an industrially relevant pre-competitive funding programme and its strategic direction.
- Introduce options for the proposed programme delivery model and industry contribution.

Structure

The workshop agenda can be found in **Annex 1.** The workshop was split into two parts; the morning session focussed on identifying research and research translation priorities for industry, while the purpose of the afternoon session was to explore the benefits and barriers to collaboration between industry and academia, and suitable delivery mechanisms for research council funding. The breakout sessions are described below. All presentations given can be downloaded here.

Breakout Session 1: Scoping industry challenges for a collaborative research and research translation programme

The aim of this session was for workshop delegates to identify and discuss the key research and research translation needs of the range of businesses operating in the aquaculture sector. In groups, delegates were given the opportunity to reflect on the short, medium and long term challenges facing the industry and consider how research council funding might address these. Delegates were asked to prioritise key challenges and provide a clear justification as to why they need to be tackled. This information will be used by BBSRC and NERC to scope an industry-academic collaborative programme in sustainable aquaculture.

Summary of session:

i. **Introductions** - 5 mins
Each delegate to briefly introduce themselves.

ii. **Post-its** - 15 mins
Delegates put onto post-its the research and translation needs of their business. These should be sorted into short, medium and long term challenges on flipcharts.

iii. **Discussion and Prioritisation** - 20 mins
Groups to reduce the challenges to the top 5 group priorities.

iv. **Justification of prioritised challenges** - 25 mins
Delegates draft a justification for each of the prioritised challenges.

v. **Plenary discussion -** 30 mins
The Chair will open up a plenary session, giving groups the opportunity to present their priorities and discuss their justifications.

Breakout Session 2: Understanding barriers to collaboration and brainstorming possible funding mechanisms

The aim of this session was for workshop delegates to consider the preceding presentations and identify effective means in which industry and academia can work together to tackle pre-competitive research and research translation challenges in aquaculture. In the same groups as in breakout session 1, delegates were asked to consider the following three questions:

- What are the barriers to your business collaborating with academia?
- What are the benefits of your business collaborating with academia?
- Which funding mechanisms could enable your business to work with academia?

Summary of session:

i. **Barriers and benefits** - 20 mins
Groups brainstorm barriers to and benefits of industry-academic collaboration in the aquaculture sector.

ii. **Funding Mechanisms** - 20 mins
Groups to discuss the advantages and disadvantages of the funding mechanisms presented and come up with suggestions of funding mechanisms that could work for the aquaculture industry.

iii. **Feedback -** 20 mins
The Chair will open up the session and give all groups the opportunity to discuss barriers and benefits, and present their suggestions of effective funding mechanisms.

Attendees

The workshop was attended by sixty-four delegates from a range of businesses including breeders, producers, processors, diagnostics and vaccine developers and retailers across the finfish and shellfish sectors. The workshop was advertised to the industrial community by BBSRC and NERC via a community mailing list, by the Knowledge Transfer Network (KTN), Seafish and the Scottish Aquaculture Innovation Centre (SAIC). A small number of hand-picked academics were invited by BBSRC and NERC to represent the scientific research community. Co-funders of the sustainable aquaculture capacity-building research call[1] were also invited, including the Centre for Environment, Fisheries and Aquaculture Science (Cefas), Marine Scotland, Food Standards Agency and the Agri-food and Biosciences Institute (AFBI). The full list of delegates can be found in **Annex 2**.

Key messages

- BBSRC and NERC would like to thank delegates for their valuable contributions and active participation in the Sustainable Aquaculture Industry workshop.
- The main research and research translation challenges for UK aquaculture can be grouped into these broad categories: health and disease, sea lice, fish welfare, breeding including genetics research, product quality, sustainable feedstocks, effects of a changing natural environment, spatial planning and water quality.
- UK Aquaculture is a diverse sector with varying scales of production and types of issues. BBSRC and NERC should ensure that the scope of a future initiative is broad enough to encompass challenges across the sector and not restrict interested companies.
- There is a strong need for a multidisciplinary approach in addressing sustainable aquaculture issues. The incorporation of social and economic sciences and technology transfer from other sectors was considered to be important in finding innovative solutions to the industry's challenges.
- Industry and academia will both benefit from collaboration in the aquaculture sector. A collaborative programme will encourage the exchange of knowledge and facilities, and formation of a network will add value to both academic and industry investment.
- UK Aquaculture is largely dominated by SMEs. Small and medium-sized companies are likely to have limited funds available to invest in collaborative research, highlighting the importance of recognising in-kind contributions. Further, many SMEs rely on income generated from intellectual property, and may be reluctant to invest in research where others will be able to exploit the outcomes.
- A structure that enables individual collaborations between industry and academia, similar to BBSRC/NERC Horticulture and Potato Initiative (HAPI), would be most appropriate for a BBSRC/NERC aquaculture innovation funding mechanism.

[1][Reference/webpage no longer available – Feb 2016]
http://www.bbsrc.ac.uk/funding/opportunities/2014/joint-nerc-fish-health-disease/

Outcomes

Industry challenges

On registering for the workshop, attendees were asked: 'In your opinion, what are three of the biggest challenges facing industry in relation to sustainable aquaculture?' There were 179 responses falling into 14 broad categories (**Chart 1**). The categories are listed in order of the number of times the challenge was mentioned on registration:

1. Health & disease
2. Sustainable feed
3. Sea lice
4. Policy
5. Environmental effects
6. Spatial planning
7. Other
8. Social
9. Breeding/ Genetics
10. Water quality
11. Product quality
12. Welfare
13. New facilities & technologies
14. Knowledge & technology transfer

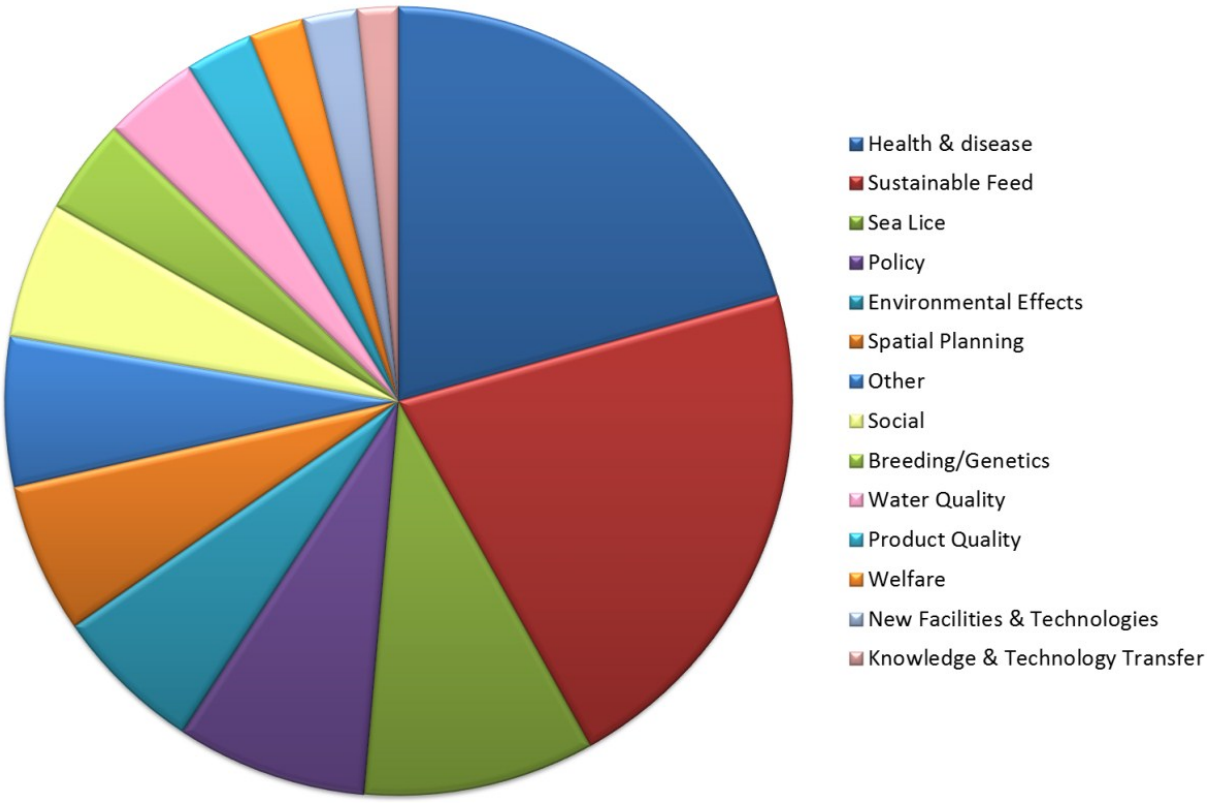

Chart 1: The biggest challenges faced by the aquaculture industry, determined by attendees of the workshop.

The registration survey responses were collated with the points raised during discussions in the first breakout session and plenary discussion. All challenges identified under the headings above can be found in **Annex 3**. Below are some examples of specific issues that were highlighted as challenges in the short, medium and long term.

Short term	Medium term	Long term
Control and treatment of sea lice	Shellfish toxin monitoring	Health and welfare in exposed environments
Risk assessment for emerging diseases	Impact of feedstock on fish health	Multi-factor control of disease, especially where diseases continue to evolve
Development of multispecies shellfish hatcheries	Development of sterile lines for mainstream production of salmon (beyond triploidy)	Enhancing flesh quality
Sustainable feed development with focus on maintaining omega-3 content	Biocontainment/escapes/exotic species	GM feed ingredients
Predictive models for harmful algal blooms (HABs) and jellyfish swarms	Effects of climate change on disease, feed production and planktonic events	Tools to promote and give evidence to social licences for aquaculture
Establishing current carrying capacity of existing sites	Identification of new sites: co-location, off-shore production, ITMA, full-integrated systems	Improving public perception of aquaculture
Appropriate infrastructure and equipment for exposed locations	Technology transfer from terrestrial animals to aquatic species	
Need for cross-disciplinary research		

Funding mechanisms

Delegates gave a broad range of benefits and barriers of businesses collaborating with academia. The full results of the second breakout session and plenary discussion can be found in **Annex 4**.

Some of the key **benefits** were the different skills and facilities academia can provide, in addition to the wider knowledge and expertise that businesses are exposed to when working with academics. Industry representatives put value on the fact that long term relationships can be built as a result of collaboration, leading to further projects and more informal interaction in the future.

The most common **barriers** to industry-academic collaboration were:

- Identifying the right people or departments to talk to within academia.
- Academia and business often have different ways of working; including use of language, timescales and measures of success.

- The grant application process is lengthy, difficult and burdensome for businesses.
- University technology transfer offices can be restrictive around IP and contract terms and conditions.
- Competition between companies restricts the amount of intellectual property businesses are prepared to offer, and project outputs that can be published.
- Many funding calls don't support pilot studies or distinguish between shellfish and finfish sectors.
- Many funding calls require industry to provide high levels of co-funding and don't necessarily take into account the value of in-kind support.

With regard to funding mechanisms that will enable businesses and academics to work together to tackle pre-competitive research and research translation challenges, delegates noted that:

- There are many SMEs in the aquaculture sector, as well as a few large businesses. SMEs are likely to have limited funds available to invest in external research, therefore recognition of in-kind contributions in a research and research translation initiative will be important.
- It is also a diverse sector with varying scales of production and types of issues. BBSRC and NERC should ensure that the scope of the initiative is broad enough to encompass challenges across the sector and not restrict interested companies.
- Knowledge exchange between other academic communities and industry sectors, including engineering, economic and social science in the UK and abroad is important. NERC and BBSRC should explore the possibility of incorporating these sciences and an international element into a future initiative.
- The initiative should engage early career researchers.
- The initiative should be informed by prioritisation exercises previously undertaken by organisations such as Marine Scotland and the Scottish Aquaculture Innovation Centre so as not to duplicate work.

Next steps

Over the coming months BBSRC and NERC will:

- Consider how the industry challenges identified can be best addressed by a pre-competitive research and innovation initiative in sustainable aquaculture.
- Consider research funded under the sustainable aquaculture capacity-building research call and broader UK academic capabilities.
- Consider delivery model options based on information provided by industry at this workshop.
- Undertake further consultations with industry, academia, policymakers and other funding agencies (such as Economic and Social Research Council and Innovate UK) as to how this initiative may fit with their strategic priorities.
- Seek interest from co-funders of the sustainable aquaculture capacity-building research call: Cefas, Marine Scotland, Food Standards Agency and AFBI in co-funding this initiative.

ANNEX 1 Agenda

BBSRC and NERC Sustainable Aquaculture Industry Workshop 26 March 2015 - Carlton Hotel, 19 North Bridge, Edinburgh EH1 1SD	
09.30	Registration, tea and coffee
10.00	**Welcome (Chair)** Anton Edwards
10.10	**Introduction to BBSRC and NERC** Faith Smith and Jodie Clarke, BBSRC & NERC
10.20	**Overview of Sector:** **Industrial Perspective** Lee Cocker, *Domestic Aquaculture Manager, Seafish* John Webster, *Scottish Salmon Producers Organisation* **Academic Perspective** Professor Kenny Black, *PI in Marine Ecology, The Scottish Association for Marine Science (SAMS)* **Q&A**
11.10	Tea and coffee
11.20	**Breakout Session 1: Scoping industry challenges for a collaborative research and research translation programme**
12.55	Lunch
13.40	**Scottish Aquaculture Innovation Centre** Heather Jones, *CE of SAIC*
13.50	**Industry/Academia collaboration in Aquaculture** Louise Buttle, *EWOS*
14.05	**BBSRC/NERC Funding Models** Faith Smith, *BBSRC*
14.15	**Breakout Session 2: Understanding barriers to collaboration and brainstorming possible funding mechanisms**
15.00	Tea and coffee
15.15	**Chair's summary and next steps**
15.30	Meeting close

ANNEX 2 List of Delegates

Name	Organisation	Position
Mr Alex Adrian	The Crown Estate	Aquaculture Operations Manager
Miss Beth Appleyard	Benchmark Animal Health	Project Manager
Ms Angela Ashby	Fish Vet Group	Veterinary Surgeon
Prof Janet Bainbridge	UKT Agri tech organisation	CEO
Mrs Nindy Bhari	Scottish Development International	Senior International Executive
Prof Kenneth Black	SAMS	Principal Investigator
Mr Alan Bourhill	Skretting UK	Marketing Manager
Mr Steve Bracken	Marine Harvest (Scotland) Ltd	Business Support Manager
Mr Stephen Bridges	CP Foods UK Ltd	Company Technical Services Manager
Mr Philip Brown	Aqualife Services Ltd	Technical director
Mr Craig Burton	Seafood Scotland / Sea Fish Industry Authority	Inshore Manager
Dr Louise Buttle	EWOS Innovation	Scientist
Mr Stephen Cameron	Scottish Shellfish Marketing Group	Managing Director
Mr Grant Campbell	Scot-Hatch Limited	Director
Stuart Cannon	Kames Fish Farming	
Mr John Carmichael	BioMar	Sales Support Manager
Miss Jodie Clarke	NERC	Knowledge and Innovation Manager
Lee Cocker	Seafish	
Dr Charis Cook	BBSRC	Innovation Manager
Chris Copping	Ocean Range	
Mr Chris Corden	Scottish Enterprise	Senior Executive
Dr Corinne Critchlow-Watton	Scottish Aquaculture Innovation Centre	Head of Skills and Knowledge Exchange
Mr Alastair Dingwall	Sainsbury's	Aquaculture and Fisheries Manager
Mr Anton Edwards		Rector
Prof Mike Elliott	IECS University of Hull	Director
Prof Carlos Garcia de Leaniz	Swansea University	Director of Fish & Fisheries Research
Dr Alastair Hamilton	Landcatch Natural Selection	Head of Molecular Biology
Mr Callum Harvey	The Knowledge Transfer	Knowledge Transfer Manager -

	Network	Animal Agriculture
Mrs Dale Hill	Lyons Seafoods/Farne Salmon and Trout	Head of Aquaculture
Mr Tom Hind	Tesco	Agriculture Director
Dr Ross Houston	The Roslin Institute, University of Edinburgh	Senior Lecturer
Mr David Hutchens	W & J Knox Ltd	General Manager & Director
Mr Douglas Johnson	Akva Group Scotland Ltd	Director
Dr Huw Jones	The Knowledge Transfer Network	Head of Agriculture
Ms Heather Jones	Scottish Aquaculture Innovation Centre	CEO
Nick Joy	Loch Duart	
Dr Sophie Laurie	Natural Environment Research Council	Head of Innovation and Translation
Prof Lewis Le Vay	Bangor University	Director, Centre for Applied Marine Sciences
Dr Matt Longshaw	Benchmark Animal Health	Product Development Manager
Dr Hazel Macleod	Scottish Environment Protection Agency (SEPA)	Aquaculture Specialist
Mr Thomas Macrae	Akva Group Scotland Ltd	Business Development Manager
Prof Samuel Martin	University of Aberdeen	University Professor
Mr Michael Mason	NeemCo Limited	CEO
Prof Brendan McAndrew	University of Stirling	Professor of Aquaculture Genetics
Mr Ian Michie	Young's Seafood Ltd	Aquaculture Manager
Dr Peter Miller	Plymouth Marine Laboratory	Principal Earth Observation Scientist
Mr Christopher Mitchell	PHARMAQ Ltd	National Sales Manager
Mr Michael Montague	Scottish Environment Protection Agency (SEPA)	Specialist II
Sandy Murray	Marine Scotland Science	
Mr Andy Noble	BBSRC	Strategy and Policy - Agriculture & Food Security / Animal Health & Welfare
Mr Neil Robertson	Elanco Animal Health	European Manager
Professor Chris Secombes	Head, Scottish Fish Immunology Research Centre	Head, Scottish Fish Immunology Research Centre
Mr Richard Slaski	Scottish Aquaculture Research Forum (SARF)	Secretariat
Professor Patrick Smith	Tethys Aquaculture Limited	Manging Director

Mr Andrew Smith	British Trout Association	Executive Officer
Dr Faith Smith	BBSRC	Senior Business Interaction Manager
Dr Vladimir Stoiljkovic	Satellite Applications Catapult	Head of Agri-tech Programme
Mr Iain Sutherland	Highlands and Islands Enterprise	Senior Development Manager, Food and Drink
Mr Kelsey Thompson	Seasalter (Walney) Ltd	MD
Dr Kim Thompson	Moredun Research Institute	Principal Investigator
Dr Alan Tinch	Landcatch	Genetics Director
Dr John Tinsley	BioMar ltd.	Researcher
Miss Sheena Warnock	Scottish Sea Farms Limited	Environment Manager
Dr John Webster	Scottish Salmon Producers' Organisation	Technical Director
Dr Simon Wheeler	UK Trade & Investment	Agritech Specialist
Mr James Wilson	Deepdock Ltd / Bangor Mussel Producers Ltd	Director

ANNEX 3

Research and research translation challenges faced by the UK aquaculture industry

Health & Disease	• Methods for control and eradication of shellfish viruses and diseases e.g. Listeria, norovirus, PRV virus, oyster herpes virus • Shellfish toxin monitoring • Evaluation/ risk assessment and rapid detection methods for emerging diseases in relation to regulations – which do we need to investigate? E.g. Amoebic Gill Disease (AGD), white spot, Saprolegnia. • Gill health: understanding epidemiology and immunology • Understanding pathogen epidemiology, pathogen transmission to salmon, vaccine, reproduction • Understanding dynamics of co-infections • Better genomic information for farmed species and their parasites • Multi-factor control of disease – especially where diseases continue to evolve • Reduction in use of chemotherapy antibiotics and anti-parasiticides • Impact of feedstock on health (e.g. gut microbiome) • Vaccines: Adjuvant development for vaccines; new vaccine delivery methods to replace injection administration • *In vitro* bath release testing for fish vaccines- EU is demanding replacement of *in vivo* testing. • Use of synthetic biology in the control of endo/ecto parasites • Non-genetic (epigenetic) mechanisms for stress resistance and disease
Sea lice	• Eradication of sea lice: physical controls (wrasse, skirts), biological (cleaner fish, feed additives), genetics (breeding resistant fish) and vaccines. • Prevention of sea lice settlement: understanding epidemiology better • Practical 'at the farm' ability to detect/treat/manage sea lice
Welfare	• Cleaner fish: health and welfare • Monitoring welfare of farmed fish (including stress) • Humane, stress-free slaughter process • Welfare in exposed environments
Breeding/ Genetics	• Developing (multi-species) hatcheries for shellfish to support the industry • Assisting hatcheries with triploid production of pacific oysters • Provide a sustainable supply of commercial mussel spat (via hatchery or other) • Selective breeding of shellfish for e.g. increase in production (larger shellfish), lower levels of norovirus etc. • Diversification and domestication in aquaculture – strains and species • Development of sterile lines for mainstream production of salmon (beyond triploidy) • Stock improvement • Genetics to improve disease resistance: selection programmes
Product	• Flesh quality- understanding of processes leading to fillet problems is limited

Quality	• Improving production efficiency whilst maintaining quality
Sustainable Feed	• Sustainable feed development with focus on maintaining omega-3 content (and omega-3 vs. omega-6) ratio • Alternative protein sources (insects, algae, food waste, GM plants) • Basic fish metabolism research to ensure better healthier diets for fish and people • Negative retail consumer perception to use of novel fish feed ingredients • Social responsibility and eliminating issues in the supply chain for fishmeal and fish oils
Environmental Effects	• Better predictive tools of the effects of aquaculture on the natural system and vice versa - predictive tools to determine carrying and assimilative capacity • Resilience to climate change and extreme events • Understanding the impact of rising sea water temperature on diseases and algal growth • Predictive models and warning systems for the formation and movement of harmful algal blooms and jellyfish swarms to allow control and mitigation • Biocontainment/escapees/exotic species in aquaculture • Re-use/recycling fish manure to reduce environmental impact and re-use nutrients lost • Effects of waste (plastic, clinical, packaging) on the environment • Wild cleaner fish impact assessment
Water Quality	• Water quality: understanding the source of problems and developing strategies to deal with them
Spatial Planning	• Economic, social and governance aspects of aquaculture amongst all users/uses: marine spatial planning. • Maximise production with minimal disease spread risk (within and between farms) • Identification of new sites, land-based, co-location, off-shore production, integrated multi-trophic aquaculture, full-integrated systems. • Recirculation systems for peri-urban areas (rural-urban transition zone)
Social	• Improving public perception of aquaculture • Production costs vs. customer price expectations
Knowledge & Technology Transfer	• Need for cross-disciplinary research • Development of realistic integrated management structures that incorporate health, welfare, growth, environment, food safety • Transfer of technology from research to business and between disciplines • Technology transfer from land animals to salmon • Sensors (sound, UV light) to farm management • Communication between agri-tech strategy and aquaculture community • Translation of diagnostic tools to practical application • Tools to promote and give evidence to social licences for aquaculture
New Facilities & Technologies	• Fish and shellfish farm modelling to aid site selection and environmental challenges • Appropriate infrastructure and equipment for exposed locations e.g. mooring systems • Containment of stocks and the use of different materials in net construction • Physical protection from algal blooms • Real time and remote monitoring • Trial/experimental facilities, particularly for disease • Systems support

Policy	• Legislative burden and unpredictable regulations • More efficient regulatory frameworks • Need for underpinning science and data to address restrictive regulations e.g. norovirus load. • Confidence in decision-making • Need for English aquaculture strategy • Understanding the issues that contribute to achieving social licence for aquaculture development • Interactions with conservation legislation in coastal areas • Addressing IUU fishing
Other	• Developing UK knowhow in order to become a leading aquaculture training provider • Why is shellfish production limited and what can we do to increase this?

Annex 4

Understanding barriers to collaboration and suggesting possible funding mechanisms

Question	Answers
What are the **benefits** to your business collaborating with academia?	• Willingness of academia and industry to network/joint collaborative approaches • REF metrics mean that academics are required to think about the economic and social impact of their research, more than they have before – and this is beneficial to business. • There is interest in a holistic integrative approach • Academia provides a different skillset • Academia can provide infrastructure • Benefits of in-kind funding (facilities etc.) gives mutual motivation and ensure KE • Industry gets access to wider academic knowledge and expertise through partnerships • Long-term relationships can be built and contact can become more informal • Pre-competitive projects can benefit whole supply chains • Industry may learn of other funding opportunities through HEIs • Instead of working with SMEs, look at working with industry/levy bodies that have technical understanding that may be lacking in SMEs • Academics/students get real life commercial experience

What are the **barriers** to your business collaborating with academia	• Lack of aquaculture engineers in academia
	• It is difficult to identify the right person/department to talk to in academia
	• Lack of access to academic publications
	• Language – academics need to talk and present their work to industry in plain English.
	• Academics and industry can have a different idea of success – academic papers vs. practical solutions. Some academics have a negative view of applied research.
	• Agreeing working relationships – Universities technology transfer offices can be restrictive around IP and contract terms and conditions, including how to agree what is foreground and background IP
	• Competition between companies
	  ○ Patents
	  ○ Agreements for what is publishable
	  ○ Risks in duplication of work
	• Timing of funding calls – budgets and priorities of industry change. It takes a long time for a project to be funded. And it takes a lot of planning to take part in long-term projects.
	• Paperwork associated with funding applications. Takes a lot of administration time.
	• The application process itself is difficult.
	• Universities administrative and overheads costs bring up the overall project budget which therefore increases the amount of match-funding industry has to find.
	• Difficulty of finding match-funding – many companies don't have an R&D budget and can only provide in-kind resource
	• There is no funding available to pilot scale-up studies
	• Many funding calls don't distinguish between shellfish and finfish sectors

	• Some funding calls can be too specific • Academics often overlook retailers as partners • Retailers may not see themselves as being a help/service for academics
Which funding mechanisms could enable your business to work with academia?	• Club mechanisms are effective but need to be more open and flexible for industry membership • Flexibility is required in monetary requirements from industry, e.g. in-kind • There are lots of SMEs in the aquaculture sector so a club mechanism is not appropriate • In-kind contributions should be recognised: staff time, data, facilities, platforms, supply chains • The valuation of in-kind contributions needs to be clear to industry • Leeway in terms of themes and priorities so as to not restrict interested companies • This is a diverse sector with varying scales of production and different issues • Appropriate outreach, so that companies are aware when there is a funding mechanism to engage them • Is there an opportunity to bring in expertise from outside of the UK? • KE between other academic sectors and industry, including engineering and social science • Engagement of early career researchers • Research Councils should use/complement SAIC and Marine Scotland priorities and coordinate with other funders/ use established networks • Funding should be UK-wide supporting small industries as well as large