Research into the Scottish Food and Drink Innovation Landscape

Scottish Enterprise

optimat
strategies for success

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Executive Summary

This study was commissioned in April 2017 to review the innovation landscape in Scotland to establish if there are any gaps in innovation infrastructure provision. It builds on evidence provided in a previous piece of research carried out for Scottish Enterprise by Campden BRI in 2014 (Food & Drink Sector: Innovation Infrastructure and facilities in Scotland summary report of industry demand, existing innovation support and options to address any identified gaps). Desk research was undertaken to review the current innovation infrastructure provision to food and drink companies in Scotland. Stakeholder consultations were carried out with 26 organisations across Scotland, including trade and sector bodies, innovation centres, research centres and economic development bodies, to gain their perspectives on the barriers, challenges and opportunities for innovation in Scotland as well as any perceived gaps in the current support provision from the public sector, academia or other sources accessible to companies. Following the research, a gap analysis was carried out and a number of options for collaboration and outline observations elaborated. It should be noted that direct engagement with companies and academia was not part of this study and so it serves as a discussion document for the wider food and drink partnership to use as part of its strategic planning and development activities. The outputs of the research may require further analysis to refine the way forward.

The research carried out within this study is not exact or exhaustive as it provides a snapshot in time of the innovation landscape in Scotland and how it is perceived by key stakeholders and is, therefore, subjective in nature. A detailed programme of research to identify each piece of equipment and physical asset relevant for food and drink companies was not the remit for the work.

The dynamics of the innovation space in Scotland's food and drink sector have changed since the Campden BRI report was written and there have been developments in public sector support programmes for innovation as well as the establishment of both the Scottish Funding Council (SFC) and Innovate UK funded innovation centres. The SFC Innovation Centres programme committed £120 million in core funding for eight innovation centres for the period 2013-2018. The innovation centre most specifically aligned to the food and drink sector is the Scottish Aquaculture Innovation Centre but the Centre for Sensors and Imaging Systems (CENSIS) and the Industrial Biotechnology Innovation Centre (IBioIC) also offer demand-led innovation to the agri food chain from a range of cross-sectoral perspectives. There are also four Agri-Tech Centres - centres for agricultural innovation – funded by Innovate UK, that have been created to encourage closer working between industry and academia, with three of these having partner organisations based in Scotland demonstrating the demand for the near to market application of technologies and solutions to support companies' growth ambitions.

More recently, SEFARI (Scottish Environment, Food and Agriculture Research Institutes) was launched in March 2017 and is a collective working across six of Scotland's research institutes[1] to improve the availability of information on, and connections between, areas such as the environment, land, food, agriculture and rural communities. It is delivering a Centre for Knowledge Exchange and Impact and will support delivery of the Scottish Government's Strategic Research Programme that will deliver £250 million of funding over five years.

Furthermore, the Scotland Food & Drink Partnership launched the new Make Innovation Happen service in May 2017 to drive innovation across the whole food and drink sector offering flexible, dedicated support to companies through a joined up approach that connects them to right type of support to meet their innovation needs. This was based on a vast amount of research and consultation undertaken across the partnership to ensure the delivery of a service that meets the needs of the industry.

Another element to be considered as part of the emerging food and drink innovation landscape is that of the City Deals and the number of proposed developments that will directly (and indirectly) support the food and drink sector in Scotland. Funding for some key (and innovative) facilities are being proposed that could have a significant impact on Scotland's research potential and innovation support infrastructure. It would, therefore, be prudent to explore the option of industry and the food and drink partnership working together to agree food and drink related opportunities in a collective and cohesive manner to avoid displacement or duplication in terms of the world class provision of expertise already in place within Scotland and to focus investment in alignment with strategic opportunities and industry demand.

The innovation landscape is vast and often fragmented but there is a real desire to bring the players together in a way that best supports the needs and demands of the industry.

In the past few years there has been significant uptake of innovation support among food and drink businesses as can be seen in the success of programmes and wider partnership initiatives such as the Food and Health Innovation Service (FHIS), Think Local (and the recently launched Connect Local), Market Driven Supply Chains (MDSC) as well as other support provision via Business Gateway, ESpark, the Wider Innovation Team and others. In addition, over the period from 2013 to 2017, Interface (administering the programme on behalf of the Scottish Funding Council) awarded 168 innovation vouchers to companies in the area of food and drink (including agriculture and aquaculture) with a value of more than £870,000. The demand for innovation support can also be seen in the number of grant funded collaborative research projects that have been carried out by Scottish universities, research institutes and companies. A snapshot of such funding amounted to more than £100 million of public sector funding (from research councils, Innovate UK, Scottish Enterprise, Highlands and Islands Enterprise and Scottish Government) being awarded to Scottish organisations for research, innovation and development projects, over a three year period, demonstrating an

[1] Moredun Research Institute, Scotland's Rural College, The James Hutton Institute, Royal Botanic Garden Edinburgh, Biomathematics and Statistics Scotland and The Rowett Institute, University of Aberdeen

unwavering appetite and uptake of collaborative research and knowledge transfer opportunities.

Stakeholder consultations also indicate that there is ambition and desire among companies to innovate and grow and there are many examples of companies doing this successfully, often in collaboration with academia or indeed through collaboration with other companies in the sector e.g. through Common Interest Groups. Some of the key innovation opportunities that arose from the consultation were related to models of innovation and collaboration to drive the process as well as adding value at all points in the supply chain. For example, a significant opportunity highlighted was the need for the better use (and understanding) of sophisticated data to support decision making, which is particularly relevant in agri supply chains and could provide transformational change in the harvesting of crops or rearing of animals.

There are, however, challenges that business face in driving innovation further in their operations. These include the need for more commercial focus in collaborative projects, overcoming traditional mind sets in farming operations, limited capacity for innovation in SMEs and access to facilities to scale up the manufacturing process. Many of the challenges identified, however, could be overcome by the teams delivering support programmes in terms of how they market to and engage with the sector.

It is interesting to note that the barriers to innovation are largely perceived at a company level but the academic / innovation centres have also experienced these barriers in trying to drive forward innovation. The culture and internal dynamics of organisations seem to be very important when trying to drive innovation within an organisation. It is believed that innovation is often seen as a 'add on' to someone's day job and so is not championed from within, making the process difficult and lacking in leadership. Internal skills, knowledge and capabilities are considered as barriers to innovation but these could be addressed at a sector or trade body levels, to some extent, to facilitate and change in company mind set. Likewise, close engagement with delivery partners can break down the barriers as companies feel that their individual needs are understood and priorities in any project or interaction.

Based on the research and feedback from industry stakeholders on the current and future needs of food and drink companies, there are some perceived gaps in Scotland at this time. The first perceived gap relates specifically to that highlighted in the Campden BRI report and that is the lack of provision of pilot scale facilities and equipment to support company innovation in the technical development stage of the product and process development cycle. It should be noted that stakeholders were generally of the opinion that there was no specific need for new large scale facilities in Scotland, but some suggestions were raised for consideration in terms of other facilities that could support the scaling up of production for the sector. Research may be required, therefore, to test the feasibility of such suggestions that include:

- Scale up / demonstration production site – based within a supply chain company premises to consolidate an industry focussed approach. If the facility could also allow access to equipment manufacturers then there may be options to provide wider supply chain solutions at a sub-sectoral level
- Demonstration sites for new technologies and applications (to increase awareness, knowledge and practical application of new technologies), taking cognisance of synergies with HEI's and Innovation Centres (see breakdown of facility provision, Table 5)

It will be important to understand if these are absolute gaps in the support infrastructure in Scotland or if there are other ways in which companies are addressing their needs in these areas. If these gaps have not been addressed since the initial Campden BRI report was written in 2014, why is this? Do they hinder competitiveness and innovation within the sector?

The second perceived gap is a capacity gap in terms of SMEs ability to take advantage of the available infrastructure currently available. As described, internal business and resource constraints are one of the most significant barriers to innovation and this indicates the logistical/transactional nature of the barriers rather than a lack of ambition or desire within businesses to take advantage of what's available in the innovation ecosystem.

There is a widespread belief that collaboration is one of the most strategic ways in which to address the challenges raised and to drive growth, productivity and business efficiency through innovation. There were a number of key areas of collaboration that stakeholders highlighted as important in addressing key innovation challenges for Scottish businesses, including collaboration across the innovation actors, common interest groups and communities of practice. These provide options to address the weaknesses highlighted and enhance the innovation ecosystem that companies are operating within. Communities of practice, in particular, offer a relatively innovative way in which to approach collaboration and are deemed to be an option that could offer real potential to effect change, although it is a process that requires commitment and time.

To address the weaknesses in the current landscape a number of other options are put forward and are focussed on supporting innovation uptake in companies. The options include leveraging the value of grant funding to amplify the potential benefits to companies and the wider industry, using mentors from like-minded businesses to support innovation thinking and learning journeys, and enhancing early stage support to companies by linking technical and non-technical experts within incubator facilities.

Finally, a number of observations were highlighted for consideration and discussion by the Scotland Food and Drink Partnership to stimulate and increase the uptake of innovation and enhance the landscape in which food and drink companies operate. This recognises the strength of the academic and research infrastructure that already exists within Scotland and seeks only to address areas highlighted in the discussions with stakeholders as options for future development. It is also important to stress that any suggestions related to new physical

infrastructure will require further investigation to ensure they would be sustainable and viable and tested against a defined industry need.

The relative importance and prioritisation of the observations shown below will change over time, and will depend on the strategic direction of any given organisation within the Partnership, but offer specific suggestions for consideration and further investigation:

- Support for the development of sub-sector (potentially integrated) innovation strategies that also look at understanding the current and emerging physical infrastructure needs of companies (at the sub-sector level)
- Address the low awareness of support that already exists and the opportunities that industry can harness by using and linking with, for example, innovation centres, Interface, academia, etc.[2]
- Investigate the possibility of technology demonstrator sites to support increased uptake of innovative solutions within the food and drink sector
- Further investigate the perceived gap in pilot scale activities and how this can be addressed – be it through increased awareness of existing / planned facilities and availability of access via innovation centre connections, for example, or to identify specific industry needs going forward
- Research to investigate the demand and potential uptake of enhanced/supported incubator facilities to verify the perception of demand by stakeholders, recognising the challenges of creating profitable and sustainable facilities
- Understand how Communities of Practice (as a novel way to effect action) might be used to drive change and stimulate innovation at sector level or to address specific common challenges
- Further research or an impact assessment exercise to :
    - understand the impact of collaborative research undertaken and how the benefits and knowledge from the public funded research has cascaded into industry – this could be at a societal, company, industry and behavioural level
    - support public sector bodies in future policy decisions related to investment in innovation and research
- Understand the potential for enhanced collaboration between (and among) innovation centres, research centres and industry players to address food and drink sector opportunities and challenges. Facilitation by the food and drink partnership could work to create a more cohesive response to industry needs that might strengthen Scotland's competitive position
- Initiate discussions to address the perceived disconnect between academia and industry and understand if any action needs to be taken to overcome any misconceptions or challenges that may hinder the wider uptake of innovation activities

[2] Make Innovation Happen was in development at time of report consultation. This should be considered as a suitable vehicle for delivery (see p6-7)

- Seek a view on the potential to leverage the value of grant funding by creating a mechanism to offer additional public sector innovation support that will enhance the outputs of funded projects, facilitate real change and stimulate further growth and development of Scottish businesses[2]
- Consider a mechanism to feed innovation related information such as case studies, developments, support programmes, event, etc. to trade bodies for dissemination to their members to stimulate innovative thinking at a sub sectoral level[2]
- Initiate further discussion on how the sector can make better use of data (at all levels) to support decision making. Understand how the food and drink partnership can drive this discussion and support knowledge transfer across the sector

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1. Introduction

Scottish Enterprise commissioned Optimat, in April 2017, to review the innovation landscape in Scotland to establish if there are any gaps in innovation infrastructure provision.

1.1 Approach and Methodology

This study builds on evidence provided in a previous piece of research carried out for Scottish Enterprise by Campden BRI in 2014 (Food & Drink Sector: Innovation Infrastructure and facilities in Scotland summary report of industry demand, existing innovation support and options to address any identified gaps). There have been a number of new elements added to the innovation infrastructure in Scotland since that report was written and so this study will seek to both update details of the facilities available within the dedicated food and drink research centres as well as provide a broader overview of the expert technical knowledge that can be found within the Scottish innovation landscape.

The following areas were considered specifically as part of this review:

- Academic assets infrastructure – physical facilities, research being carried out, academic excellence, research and innovation funding
- Current and potential future demand – for innovation support amongst food and drink companies in Scotland
- Options for collaboration to address sectoral challenges or market opportunities

The approach used to complete this study was a mix of desk research and stakeholder interviews. Desk research provided background information on the breadth and depth of facilities and support available in Scotland that can be accessed by innovative food and drink businesses. It also supported a review of the demand for innovation support and access to technical research partners by looking at the grants awarded for collaborative research and innovation projects to companies, research institutes and universities across Scotland.

Telephone consultations were also carried out during April and May 2017 with 26 stakeholders in Scotland's food and drink innovation landscape to provide insight into how the different elements of the innovation system fit together to support companies to grow, innovate and become more competitive. A list of the stakeholders involved in the consultation programme is provided in Appendix A and our sincere thanks goes out to everyone that took the time to provide their valuable and insightful input to this study.

It should be noted that direct engagement with companies and academia was not part of the remit of the study and so it serves as a discussion document for the wider food and drink partnership to use as part of its strategic planning and development activities. The outputs of the research may require further analysis to refine the way forward.

1.1.1 Scope of the research

This study, while looking at the innovation infrastructure and facilities in Scotland today, takes a more subjective approach than that undertaken by Campden BRI in 2014. As mentioned, the remit for this work does not extend to direct consultations with businesses in the food and drink sector. A number of recent surveys and consultations have taken place with companies and so it was deemed inappropriate to ask them to take part in another innovation related study in a short space of time. Instead, the views and insights from trade bodies, sector associations, innovation centres, research centres and economic development organisations were sought to understand the issues and opportunities around innovation from a wider sector/sub sector perspective. Furthermore, the remit of the study was not to speak to each individual academic and research organisation to determine the facilities and equipment they have available to support company innovation. The study, instead, addresses new facilities, organisations and programmes that have been established since 2014 and how this has changed the innovation landscape within which companies can access the support and advice they need. Stakeholder consultations also sought to understand the perceived gaps in the innovation ecosystem and what opportunities could be harnessed to stimulate and drive the uptake of innovation across the food and drink sector in Scotland.

1.2 Background

Scotland's food and drink sector is characterised by a high number of SMEs. In March 2016 there were 17,320 business registered as operating within the food and drink sector in Scotland, with 98.8% of these being small (0-49 employees). These small businesses accounted for 52.4% of all employment in the sector[3].

This characteristic contributes to the issue that, despite a world class research base, Scotland (and the UK) currently lags behind other areas of Europe in terms of innovation. SMEs in particular are less likely to engage in collaborative innovation. This is reflected most strikingly in the sectors spend on R&D (as measured by Business Enterprise Research and Development, BERD), which was £18 million in 2015, a decrease of 5.3% since 2014. Spending on R&D in this sector represents only 2.1% of the total BERD spend in Scotland[3].

Innovation can be described as anything that delivers new or improved products and services that customers, consumers and market categories want, as society, trading climate and trends change over time. Innovation enables food and drink companies to be competitive in local, national and international markets. An innovation system is defined by UK government[4] as complex, involving interactions between businesses, knowledge institutions, academics, funders, business support organisations and the innovation infrastructure bodies. In addition, there are important innovation sub-systems oriented around technologies or demands

[3] Growth Sector Briefing – Food and Drink, Scottish Government, February 2017
[4] Innovation Report 2014, The Department of Business, Innovation and Skills, March 2014

Innovation takes many forms. Some modes of innovation are science-based and rest on R&D, while others rest primarily on other skills such as design or the ability to absorb information from external sources. Some forms of innovation create entirely new goods and services, while others upgrade what already exists. So learning and development happens through an interactive process with other enterprises and the scientific, information and technology infrastructure[4]. It is the potential to create value and accelerate growth that is important. Examples of non-technology based innovations include:

- New business models, including employee ownership, co-operatives and social enterprises
- Design, design-thinking and creativity are part of an innovative approach
- Increasing collaboration within and beyond Scotland
- Novel approaches to procurement
- Open innovation portals to encourage solutions from SMEs in other sectors

Innovation entails problem-solving, and this frequently involves problems that are outside the existing capabilities of businesses. It is also recognised that innovation can mean many different things to many different people and it can involve product, people, processes, markets and the workplace and it can be challenging to achieve.

The provision of support for innovation has developed in recent years as can be seen from the significant investment in Scotland and the wider UK in research and innovation centres. The Scottish Funding Council (SFC) Innovation Centres programme was established in 2012 and committed £120 million in core funding for eight innovation centres for the period 2013-2018 and in partnership with Scottish Enterprise (SE) and Highlands and Islands Enterprise (HIE) aims to support transformational collaboration between universities and businesses to enhance innovation and entrepreneurship and to support business growth, particularly, but not exclusively, in Scotland's priority sectors[5]. At this time, the innovation centre most specifically aligned to the food and drink sector is the Scottish Aquaculture Innovation Centre. There is also the Centre for Sensors and Imaging Systems (CENSIS) and the Industrial Biotechnology Innovation Centre (IBioIC) that offer demand-led innovation to the agri food chain from a range of cross-sectoral perspectives.

Over and above these, there are four Agri-Tech Centres - centres for agricultural innovation – funded by Innovate UK, that have been created to encourage closer working between industry and academia. Three of these centres have partner organisations based in Scotland that are able to extend their reach through collaborative working relationships across the UK. The development and continued success of these research and innovation centres demonstrates the demand for the near to market application of technologies and solutions to support companies' growth ambitions.

[5] Business Engagement an Economic Impact Evaluation of the Innovation Centres Programme, EKOS, 2016

Furthermore, in March 2017, the Scotland Food & Drink Partnership launched 'Ambition 2030', the industry's new strategy. This bold strategy establishes a vision to cement food and drink as Scotland's most valuable industry and outlines the goal to double turnover in the sector to £30 billion by 2030. Innovation is one of the three areas on which the strategy focusses, recognising the need to develop new products and processes to support growth of the sector.

In line with this, a new service was launched in May 2017 - Make Innovation Happen. This service is being delivered through a coalition of key public sector and industry bodies working together collaboratively to drive innovation, with £1.1m of critical funding coming from Scottish Enterprise and Highlands and Islands Enterprise. This new service will be open to all businesses across the whole food and drink sector in Scotland and seeks to offer flexible but dedicated support to companies by offering a joined up approach that connects them to the right type and level of support for their specific innovation needs.

There has clearly been a significant amount of work carried out in recent years to develop a more joined up approach to supporting food and drink businesses with their innovation needs. The innovation landscape is vast and often fragmented but there is definitely a desire (and investment to back it up) to bring the players together in a way that can best support the needs and demands of industry.

2. Current and Potential Future Demand for Innovation Support

Since publishing the report referenced earlier on which this study builds (Food & Drink Sector: Innovation Infrastructure & Facilities in Scotland Summary Report of industry demand, existing innovation support and options to address any identified gaps, Campden BRI, 2014), there has been significant progress made to engage the sector in the prioritisation of support to meet industry needs and to address barriers to innovation. This has included disseminating the Campden BRI Report amongst the Scotland Food & Drink Innovation Group and directing HEIs, Innovation Centres, local authorities and developers of new facilities to the availability of the Report on the platform 'Evaluations Online'. This has provided research that key institutions with existing facilities can consider when seeking to build on their strengths (individually or on a collaborative basis) and offers new entrants evidence of supply and demand for physical assets and facilities when developing their own propositions.

The dynamics of the innovation space in Scotland's food and drink sector have changed since this report was written and there have been developments in public sector support programmes for innovation as well as the establishment of both the SFC and Innovate UK funded innovation centres. The continued need for and development of innovation support, however, is unwavering among businesses, public sector and policy makers seeking to ensure that Scotland's food and drink industry continues to thrive.

This section of the report summarises a very recent, but key development within the food and drink landscape in Scotland (Make Innovation Happen service) and the work that was done in developing this innovation response. It also seeks to discuss the overall dynamics of the current innovation landscape, the uptake in support by companies and the current and potential future demand for innovation support based on both stakeholder consultations and recent company demand studies commissioned by Scottish Enterprise.

2.1 Make Innovation Happen

Led by the Scotland Food & Drink Partnership, extensive consultations were undertaken between 2014 and 2016, with industry leaders and businesses in the food & drink sector to consider the future approach to innovation. The approach taken was three-fold:

1. Understand business innovation activity and how well it was supported by current provision
2. Map existing products and services across public, private and academic providers and understand its impact on business
3. Review good practice and assess future trends for innovation globally

Through this work, it became apparent that there needed to be a focus on improving the connectivity of innovation support, developing an 'innovation journey' and maximising the impacts for businesses.

During this period, the Scotland Food & Drink Innovation Group worked to streamline existing provision, to de-clutter the landscape and to align services more effectively across providers as well as creating a unified food and drink innovation identity that established a single access route of businesses looking for information and support to help them innovate.

As a result of this work, the public sector, working with Scotland's food and drink industry, launched the 'Make Innovation Happen' service on 10th May 2017. This service includes support for both incremental and disruptive innovation and is open to all businesses across the supply chain from farm to fork.

Figure 1 provides a representation of the types of services available to companies throughout their innovation journey and indicates the more joined up nature of the service, in response to an identified business need.

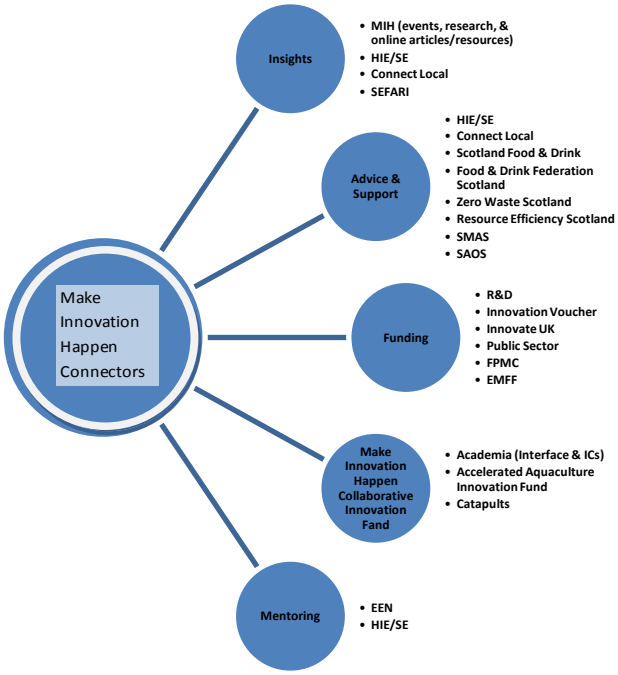

Figure 1: Make Innovation Happen - How it works

Access to these services is available to businesses at any stage of business development and growth, whether this involves developing a proposition or concept or understanding how to launch a new product to market.

It should be noted that the Make Innovation Happen service launched during the short period of time in which this study was taking place and so at the time of writing this report and during the industry consultation phase, the service was very new and had yet to gain traction. Much of the feedback highlighted in section 2, with regards to barriers challenges and opportunities for innovation, demonstrates that the issues highlighted during the Make Innovation Happen consultations (and which the service seeks to address) remain a concern for Scotland's food

and drink companies and something that key industry stakeholders believe need to be overcome. Clearly Make Innovation Happen is designed with the aim of addressing many of these issues and it is hoped that it will achieve success in doing so. The impacts, however, are unknown at this stage and so it is important to demonstrate the actual perceived industry needs and concerns at this point in time.

2.2 The Dynamics of Innovation Support Uptake

Availability of Innovation Support

Over the last decade there has been a wide range of innovation support delivery projects directed at food and drink manufacturers, funded through Scottish Enterprise, including the recently launched Make Innovation Happen service. These support programmes have included innovation support around (i) specific market opportunities (such as health) (ii) improving processing and products and (iii) strengthening supply chains from farm to fork. Programmes have delivered both bespoke 1:1 support as well as using collaborative models, including common interest groups. Together with programmes funded by Scottish Government and Scottish Funding Council (that encourage co-operation within the supply chain and collaboration with academics, respectively), the agri food sector (from primary producer to food manufacturer) has been able to access a range of opportunities that can both stimulate and underpin innovative thinking as well as assist in creating channels to markets. The recently launched Connect Local project also targets the sector to facilitate growth of enterprises and strengthen local supply chains as well as encouraging collaborative working to address common challenges. A range of different intermediaries have delivered these programmes and those that have been completed were all successful in terms of engagement with the industry and meeting target outputs.

The innovation voucher programme is funded by Scottish Funding Council and administered by Interface. Over the period from 2013 to 2017, 168 innovation vouchers were provided to companies in the area of food and drink (including agriculture and aquaculture) with a value of more than £870,000. Interface is an important part of the innovation landscape for food and drink businesses (as well as SMEs across a range of other sectors) as it provides a central point of access to the world class knowledge, expertise, technologies and facilities available in Scotland's Universities, Research Institutes & Further Education Colleges. In addition to this, Interface also carries out key innovation support activities such as and providing advice on innovation related funding streams, bespoke translation and brokerage to match business requirements and academic expertise, facilitating collaborative projects between businesses and universities as well as supporting access to specialist facilities with assistance, training and knowledge from in-house trained experts.

During the period 2013-2016, Interface food and drink also funded eight winning innovation competitions, each between £25,000 and £50,000, and funded four PhD's, one MSc Project and 35 Proof of Principle and feasibility studies.

In addition, the Scottish Government, through its Food Processing, Marketing and Cooperation (FPMC) grant, has invested several million pounds in capital projects to enable both primary producers and processors to improve performance to increase their sustainability, competitiveness and new market opportunities, including exports.

Fundamental to innovation support is the range of SE and HIE products that can deliver advice and grants that will deliver business improvement, manufacturing efficiency, prepare businesses for export as well as funding for R&D projects. These products span across the innovation continuum from market opportunity, product proposition, viability, market engagement and market launch and dovetail into the development cycle of innovative products and services. Whilst a degree of the SE products are aimed at companies that are relationship managed by Account Managers and/or the Wider Innovation Team, it also engages with early stage enterprises that are actively seeking innovation support and can, on merit, access innovation support by way of the By Design and Make it To Market grants. Through Business Gateway early stage enterprises can receive business planning advice and signposting to relevant SE products for which they meet eligibility criteria. In terms of innovation support, Business Gateway advisers refer companies to the Wider Innovation Team to access innovation relevant support and knowledge. This business support chain based on stage and potential for growth ensures that enterprises in the vertical or horizontal food and drink supply chain can access the business and innovation support that is necessary to improve the performance and sustainability of the sector. Furthermore, the SE SMART and R&D grants enable single companies to undertake technical feasibility studies and research and development (R&D) that have commercial endpoints and support the wider strengthening of the sector in Scotland.

SE, HIE and Innovate UK research and development (R&D) funding has been awarded over the years to Scottish companies and consortia that include Scottish food and drink businesses and this recognises and demonstrates that Scottish based enterprises are active in high risk, game changing projects that seek to future proof their market performance.

There is also a new European service that has been set up to support rural innovation – it is called European Innovation Partnerships and will be launched during the summer of 2017. Innovation in the agricultural sector is a real challenge and so the EU has put in place this provision to support collaboration. It is funded by the Scottish Rural Development Programme (SRDP), with part funding from the European Union, and will provide an innovation brokerage service to stimulate partnerships that will move agri businesses into the space they need to be to achieve a specific innovation outcome. This is a new type of innovation support within the current landscape as it is very proactive in its approach. It will also actively seek funding support opportunities for successful partnerships and collaborative activities (e.g. from the Knowledge Transfer Programme, FPMC, SRDP, etc.) to help them to take forward the project idea. This demonstrates the need for collaboration as a tool to support innovation in the more traditional sectors where resources and the culture can be significant barriers to the innovation process.

Another new support for innovation in the sector was implemented during 2017 - SEFARI (Scottish Environment, Food and Agriculture Research Institutes). It was launched on 29 March 2017 and is a collective working across six of Scotland's research institutes to improve the availability of information on, and connections between, areas such as the environment, land, food, agriculture and rural communities[6]. SEFARI makes the links between researchers and information users through innovative events, conferences and key conversations to promote and utilise research findings. It will receive £0.8 million from the Scottish Government during the period 2017-18 to deliver a centre for knowledge exchange and impact. SEFARI will also support delivery of the Scottish Government's Strategic Research Programme that will deliver £250 million of funding over five years to tackle issues including animal and plant disease, agricultural practices, crop research, community resilience, climate change, soil stability, water resources, nutrition, and food.

Uptake and Examples of Innovation Support

SE's commitment to Open Innovation has attracted one Scottish based global organisation that is a committed supplier to the food manufacturing sector to be a participant in its platform. For example, Devro plc has committed a full time innovation co-ordinator to further its need and commitment to innovation within its business, as demonstrated in its strategic report that highlights the importance of collaborating with external partners to help solve issues where it doesn't have the expertise within the company[7]. Devro is also a partner in an Innovate UK R&D project, demonstrating the leverage that can be gained from really committing to the innovation process.

A whole range of innovation support and funding is already in place to encourage and enable companies to take advantage of current and future market opportunities that will contribute to the sustainability and performance of the sector.

Previous innovation support programmes have all met with success and their evolution has been in line with market need, trends and demand. There are many examples of commercial successes and collaborations across a range of sub sectors as a result of the varied programmes where innovation has been a key driver. The demand for, and outcomes from these programmes demonstrate the dynamics of innovation support uptake, even although outcomes – and impacts - may arise and extend beyond the lifecycle of the public sector support project.

An example was the Food & Health Innovation Service (FHIS), a five year programme that delivered support to 265 companies across Scotland between 2010 and 2015. Nearly 40 companies re-engaged with FHIS during the 5 year period and one company grew from

[6] Moredun Research Institute, Scotland's Rural College, The James Hutton Institute, Royal Botanic Garden Edinburgh, Biomathematics and Statistics Scotland and The Rowett Institute, University of Aberdeen
[7] http://www.devro.com/investors/annualreport2016/download-centre/

concept stage to SE Account Management status within that period. There was a good spread of companies producing products across 14 categories with prepared foods, bakery and non-alcoholic drinks being highest participating subsectors; this was not surprising, however, given that these products lend themselves to improvements in nutritional profile. Perhaps vitally there was connectivity between FHIS and other support projects that were delivered by the consortium partners committed to connectivity, as attempts were made to facilitate innovation journeys for companies across the whole innovation ecosystem. The connectivity principle is now a core commitment of the Scotland Food & Drink Partnership delivery of the Make Innovation Happen service.

70% of enterprises engaging with FHIS were recruited through direct marketing and over 77% of companies receiving support were micro or small enterprises that often lacked internal resource and reverted to support programmes to realise their innovation ambitions. Large enterprises that had the resource and capabilities to capture and implement innovative product development in-house also benefited from bespoke FHIS support, although the market opportunity tended to be in niche and artisan markets. The vast majority of the FHIS engagements were around innovative product development rather than processing innovations.

This example would suggest that innovation demand from public sector programmes will continue to be, in part, driven by either early stage entrepreneurial companies or those in the early growth phase, where innovative product development is likely to be constrained by the size and capabilities of the manufacturing environment.

Programmes that stimulate innovation, offer knowledge and resources to test new approaches and embed supply chain co-operation working models can effectively contribute to the growth and sustainability of enterprises.

Collaboration is often at the heart of innovation and there are flagship case studies to demonstrate this across key subsectors and in areas such as process, NPD and business model innovation. Collaboration with either academics or supply chain partners has been instrumental to forging new relationships, ongoing interactions and addressing a whole host of challenges facing business in both well-established and traditional sectors.

For example, within the fisheries sector, The University of Aberdeen, Abertay University and the University of Stirling have collaborated on projects with companies such as *Dawnfresh*, the *Scottish Salmon Company* and trade associations such as *Seafish* on fundamental issues from looking to the future through the analysis of consumer preferences to the processing of wastewaters into biofuels and valuable chemicals[8].

Lightbody, in the bakery sector, also embarked on a collaborative project with Strathclyde University to use hyper spectral imaging to understand the role of moisture in limiting the shelf

[8] http://www.interface-online.org.uk/news/interface-food-drink-competition-winning-tail

life of its celebration cakes – an example of the use of sophisticated technology to improve the shelf life of a bakery product.

Another example with a focus on waste and efficiency in primary production is that of Agrico, a specialist developer and supplier of high grade seed potatoes that embarked on a multidisciplinary and collaborative commercial feasibility project to make use out of their reject potatoes. This example (see below) demonstrates the importance, and success, of multidisciplinary projects and the wider impacts that can be achieved from collaboration.

All of the food industry is concerned with waste and possibly no sector is under more pressure than primary production. These businesses need to be as lean as possible to maintain their slim margins, but with waste becoming ever more costly to deal with, they need to become more imaginative. *Agrico* sought to address this issue through its involvement in an innovation and multi-disciplinary collaborative project on waste potatoes. The project's aims were to make use of reject potatoes and waste from the distillery sector in Scotland for the production of high value commodity chemicals and biofuels, without impacting on food supply, and providing a disposal route for the rejected potatoes. This was funded by a collaborative innovation competition through Interface (food & drink). The project had both environmental and business merits – it provided a source of income for potato producers / users and distillers from the sale of the chemicals and biofuels; it achieved energy savings through the use of the biofuels for power and heating; and led to the production of a potential animal feed. The collaboration brought together the expertise of Edinburgh Napier University and Celtic Renewables (a spin-out company from the Biofuel Research Centre (BfRC) at Edinburgh Napier University) to work with the food and drink industry to turn their waste potatoes into acetone, butanol, ethanol, hydrogen gas (all high value chemicals or biofuels) as well as a potential animal feed[9].

The common interest groups and the many company projects developed in collaboration with academia, resulting from the Interface Food and Drink programme, also reinforces the observation that collaborative working is important for Scottish food and drink companies. Indeed during the period from 2013 to 2016, Interface Food and Drink had a focus on multiparty collaboration and created, facilitated or were involved in 16 common interest Groups and funded 26 projects as a result. The Scottish Rapeseed Oil common interest group is an excellent example of how a group of companies, trading the same product, benefited collectively by enhancing the reputation of a raw material in Scotland whilst maintaining their own USP for new commercial opportunities. Other common interest groups involving craft brewers and distillers are recognising that from a traditional industry, a new generation of innovative businesses are emerging and these are often taking disruptive approaches to innovation that address the demands from consumers.

[9] http://biofuels-scotland.co.uk/bioenergy-potential-waste-potatoes-project

Although official data from other food and drink support projects were not known to the project team (and it is difficult to compare and contrast very different types of programmes), the delivery organisations involved, both in the past (Think Local) and ongoing (Market Driven Supply Chains) confirmed that the outputs from these exceeded expectation on the metrics used.

The Market Driven Supply Chain Project (MDSC), through a transformational and collaborative approach, supports and encourages the development of effective supply chains that work to deliver what the market wants and adding value throughout the supply chain. It has, for example, worked with a Perthshire based food processing and packing company, to respond to the need of its customers in the premium meat, vegetable and fish sectors. The work resulted in the development of its capability to manufacture and supply fresh, added-value, high care products based on premium Scottish provenance. This example of processors turning to their ingredient suppliers to support the development of innovative solutions is also something that was highlighted in the stakeholder consultations as an important way of adding value throughout the supply chain and pulling innovation through to the company in a way that could not be done by them alone.

Stakeholder interviews confirmed the importance of collaborative models of innovation, with one trade body noting that 'these models are particularly productive for strengthening value and supply chains', whilst 'common interest groups are seen as particularly relevant for horizontal and vertical supply chain participation'. Another interview highlighted that 'more collaboration and co-operation are essential' and a global technology and advisory organisation emphasised that 'supply chain collaboration is critical for driving innovation'.

It is clear, therefore, that more collaboration and cooperation across the supply chain and with other actors in the innovation space, is seen as a key way in which to stimulate and drive innovation within Scotland's food and drink sector.

Demand for Market Focussed Innovation Support

The strategic priority for the Scotland Food & Drink Partnership is to accelerate market focussed innovation to support and improve the competitiveness of the sector and increase business investment in innovation and R&D. Industry engagement was undertaken in 2015, led by the Scotland Food & Drink partnership to develop and articulate an 'Innovation Response' that would meet the needs and ambition of the sector. This led directly to the development of Make Innovation Happen and in particular identified that access to business connectors that provide a joined up approach through the innovation ecosystem was critical. From an industry perspective the quality and industry knowledge of these connectors will be crucial to the success of the programme. Additionally, having access to a mentor with innovation experience to accelerate the journey of products into the market was seen as being vital. These two identified needs (and which Make Innovation Happen seeks to address) illustrates how important it is to ensure that the support mechanism is dynamic to the current

and emerging needs of the sector. Interestingly, access to labelling and regulatory advice was also seen as critical to the innovation process and this has relevance in the provision of support to early stage companies who find themselves either in start-up incubators or independently working independently.

Recently there have been a number of entrepreneurial food and drink start-ups in various incubators / accelerators around Scotland. The current incubator infrastructure is not food and drink specific but house a wide range of entrepreneurs. Many of these concept stage companies do not have Business Gateway advisers and lack understanding of the food manufacturing sector, including its legislation, and do not have an appreciation of safe and compliant food processing procedures, beyond kitchen scale. These incubators can often bring in sector expertise through their mentors. An example of this is a cohort of nine such enterprises that have recently been mentored through ESpark in Glasgow by an ESpark mentor with a food and drink innovation background. Several of these start-ups had the potential to deliver a unique product concept but the majority were in embryonic stage of understanding their respective supply chains and market opportunity. A positive highlight was that two entrepreneurs from that group have gone on to secure funding based on a co-operation model and a robust business plan to develop new premises that will offer space for other entrepreneurs developing drinks products – this, in itself, is an innovative approach to supporting other small businesses and create new opportunities.

It is believed that existing (and potential new) incubators offer an opportunity to capture concept and early stage enterprises that require food specific and robust business planning, market and supply chain awareness and the fundamentals of branding as part of a critical foundation prior to investing in product development. Unless there is a mechanism to access food and drink specific business and commercial knowledge there is the possibility that these early stage entrepreneurs could have mismatched expectations. The Wider Innovation Team at SE has relationships with the ESpark centres to support this. Additionally, bespoke business support to food and drink start-ups has been implemented in the North East of Scotland and is committed to aiding the sector within the region. Companies receiving such support are likely to venture into the innovation ecosystem over time and the wider consultation process highlighted that, while incubators are not necessarily innovative themselves, they are a necessary part of the landscape to support the potential for innovation and should be considered as part of this work. **It is recognised, however, that challenges exist for investors in both the implementation and operation of incubator facilities that meet the perceived requirement for having local access that will offer a sustainable and profitable operational model.**

The innovation ecosystem, by its nature, has to be complex but there is a need for transparency and support to navigate the landscape. It seems logical that there should be a need for companies to demonstrate strategic business planning in order to receive support from innovation programmes to facilitate successful implementation of the projects. Business advisers should also be made aware of the support given so that outputs can be embedded to

improve the financial and competitive performance of the company. An ability to share the detail of support given between partners in the food and drink innovation landscape would be beneficial to both the company and the innovation support organisations.

2.3 Stakeholder Consultation Insights

Twenty six stakeholder interviews were undertaken between April and June 2017. While companies were not contacted directly, the recent consultative work undertaken by the Scotland Food & Drink partnership in the development of the Make Innovation Happen service contributed to the insights gained into the barriers, challenges and needs of food and drink businesses in Scotland today. The consultation programme carried out in this study was with key stakeholders in Scotland, which included innovation and research centres, trade bodies, innovation intermediaries and the public sector. This adds to the body of work carried out in 2015 and allows us to make a judgement call on the potential future demand for innovation support based on level of knowledge and interaction these stakeholders have with companies on a regular basis. The consultations sought to understand the key drivers of innovation as well as the hurdles and challenges (current and emerging) facing companies (and at a sector level).

From the stakeholder interviews conducted it was clear that trade bodes dealing directly with companies on a daily basis believe that innovation is vital in their sectors; although it was interesting to note that none of these organisations had a sector specific innovation delivery role to their members. As a result of this research, however, there were positive indications from trade associations / sector specific bodies of a desire to become more proactive in the innovation space. For example, recognition from Scottish Bakers that it would publish, via its marketing channels, any relevant innovation support available to its members (it already has examples of innovative working with members to stimulate new practices). Indeed this same body believes that its members will revert to it as the first point of contact for innovation signposting and so this is an important element in stimulating innovation within the sub sector. Seafood Scotland also reported that it will actively share innovative ideas with its associations and that it is open to being more proactive on a direct company basis. The Scottish Dairy Hub is equally ideally placed to drive innovation in the sector given its knowledge of, and access to, the sector. The Scotch Whisky Association tends to be held up as an example of an organisation that has excellent links to and communication with its members and this sub sector has been particularly active in the innovation space for a long time.

Direct communication with companies at a sub sector level may be a relatively simple way in which to disseminate information, case studies, knowledge and opportunities to stimulate and support innovation, both incremental and more transformative. There does, however, need to be a clear and consistent way in which the trade bodies can access the relevant information that can be translated to address the needs of their members. Perhaps the Make Innovation Happen Insights programme is a means to address this issue going forward.

It is interesting to note that the connectivity between trade bodies and innovation centres was not as joined up or formalised as had been thought. Through this work the interviewers were able to signpost and make introductions to facilitate interaction and dialogue between a number of organisations. This suggests that there is some disconnect among the actors in the innovation space, which should be addressed to facilitate the joined up and seamless innovation journey that companies and the public sector are working towards.

On the innovation supply side, the innovation centres (CENSIS, CEIL, Agrimetrics, IBioIC, SAIC and Agri EPI centre) present Scotland with a new dimension, in addition to the breadth and depth of academic knowledge that exists across the HEI / FEI / research institutes. The Scottish Funding Council Innovation Centre programme (in partnership with Scottish Enterprise and Highlands and Islands Enterprise) had the remit to support transformational collaboration between universities and businesses. The Centres aim to enhance innovation and entrepreneurship across Scotland's key economic sectors, create jobs and grow the economy. The Innovate UK funded centres for agricultural innovation are a new collaborative model between the agri-tech sector and UK government. The centres will help the UK to (i) turn agricultural innovation into commercial opportunities for UK businesses, (ii) encourage inward investment and (iii) improve farming practice. The centres will improve the economic performance of UK farming through the development and uptake of technologies, knowledge, and practices, resolve challenges that no one part of the sector can address alone and open up opportunities for transformational change in the sector, not possible in current structures. In terms of innovation, these centres are hives of opportunity at either a specific sector level or from an enabling technology perspective along supply chains (from pre-farm to post-farm gate) enabling processors to have the quality and specification of raw materials they require. Their position in the Scottish agri food and drink innovation ecosystem not only widens the opportunity for cross sectorial innovation but also deepens access to UK wide knowledge and expertise that can be embedded within Scottish food and drink supply chain.

As a result of the consultation with CENSIS, for example, there is a desire to ramp up its engagement with the sector through the trade associations to stimulate innovation using appropriate sensors that would enable smart technology to be made viable in rural settings. It now has an event theme planned as a result of this research. IBioIC has been working with some large players in the food and drink sector on projects related to food waste and is interested in working more with companies in the sector in relation to the valorisation of waste streams.

The Innovate UK funded innovation centres, Agri-EPI, CIEL and Agrimetrics, will enable Scottish industry to expand its reach to innovation providers beyond those available in Scotland due to their links and close collaboration with other partners within the innovation centres that support the delivery of innovation projects and research. This supply and reach of knowledge and facilities, which is often not available to the same extent by the HEIs, expands the horizon that Scottish food and drink businesses can draw from and, hopefully, drive further demand from the industry. The innovation centres should also provide more commercially

driven responses as they are working closer to market and tend to be industry led. There are already examples of dialogue and interactions taking place between the innovation centres but more could be done across the sector to enhance the opportunities for collaborative projects going forward.

From the perspective of all of the interviewees, there is a wealth of knowledge across the industry sectors and they understand what challenges companies are facing and what market led innovation is required to ensure sustainability of the industry. The intermediaries were exceptionally well versed in the delivery of support and the innovation centres provide a new dimension that has great potential for exploitation of truly novel technical innovations that will add to both sustainability and food security.

A summary of the responses provided by stakeholders to key aspects of the questionnaire is shown below to provide stimulus and indicate the overall impressions of the sector.

2.3.1 Innovation opportunities

Stakeholders were asked what they regarded as the main innovation opportunities for the sector and/or subsectors and some of the key responses are shown below to illustrate the key opportunities identified during the consultation phase.

At a more generic level, some of the innovation opportunities highlighted include:

- More use of open innovation models
- The (better) use of data to make more informed choices
- Prototype centres to demonstrate / de risk technology
- Innovation skills development – talent drives innovation…
- More joined up supply chain working from farm to retailer
- More use of Common Interest Groups

Perhaps one of the most powerful opportunities highlighted, that can be addressed through the Scottish landscape of knowledge and facilities, is the demand for better use (and more understanding) of sophisticated data to support decision making. This has particular relevance in agri supply chains and could be transformational in the way crops are harvested or animals reared to meet specification of the processors and retailers. There are a number of projects ongoing throughout Scotland and the UK looking at the use of data and there are centres, such as the Data Lab and CENSIS, which could support more work in this area. This identified need will become increasingly important as technology further drives innovation and change.

The theme of collaborative innovation models was also expressed here relating to both vertical and horizontal supply chains as a means to enhance R&D capacity and outputs.

Some key responses to this question also addressed specific product and process innovation related opportunities, including:

- Moving companies from being primary processing to adding value
- Using legislation and regulatory drivers to stimulate new products

- Support around raw material supply- sustainability and wider societal challenges
- Initiatives around technical innovation – water, energy, regulations
- Support for food safety accreditation in small companies
- Automation and robotics across the supply chain from planting to packaging

As expected, a strong message in the responses relates to adding value at all points in the supply chain.

In terms of moving companies from early stage to growth businesses, it was highlighted within the consultations that access to industry level technical support within incubators / small scale flexible production units could be a significant opportunity to create the right conditions for innovation, as mentioned previously. Stakeholders believe that this would address the key technical areas around safe food production and compliance systems required for accreditation (such as SALSA) but also around compliance with labelling and shelf life considerations. While these issues are more around compliance and are perhaps regarded as barrier to innovation, it is believed that supporting companies to address these more mundane issues will allow them to move into the space where they are able to think more laterally about innovation. Access to commercial, fit for purpose knowledge and support in these areas could be delivered by considering innovative approaches, for example, creating opportunities to access the technical teams of established Scottish manufacturers or developing an alliance with a commercial provider of technical services that understands the product development cycle and the needs of start-up companies. Indeed some trade bodies can facilitate access to expertise in some key areas, such as labelling, but there may be additional opportunities that could be explored. If companies are encouraged to think about innovation from the very beginning and in all aspects of the product, process and workplace development spectrum then it could stimulate projects that can effect real change.

Automation, even at a simple level, either in agricultural systems or processing lines is going to be both a significant opportunity and a necessary path to follow for companies. Given the resources and programmes within the innovation landscape, Scotland could be well placed to drive this with fit-for-purpose demonstration facilities. Perhaps by harnessing the technical SME base in Scotland, it could create potential opportunities with sustained demand for equipment and technology integrators that can provide commercialisation routes into global markets.

Some specific innovation opportunities also emerged in relation to the pre-farm gate stage of the value chain, many of which relate to automation and using technologies to carry out task that have long been undertaken manually. These included:

- Monitoring systems of animal health and productivity in real time
- Use of drones in arable production
- Sensors that communicate with mobile technology
- Improved disease control in aquaculture

- Rapid methods of disease detection

It could be said that the innovation centres are well placed to drive these opportunities and also provide a platform for engagement with equipment and integrator SMEs, both in Scotland and the wider UK. Indeed, some innovation centres are already involved in projects that are dealing with these issues, such as Agri-EPI in its projects related to the use of drones for arable production and sensors for monitoring the characteristics of live animals.

These drivers of innovation also align well with R&D support from SE, HIE and Innovate UK as well as demonstrating opportunities to build collaborations across sectors.

2.3.2 Innovation challenges

Stakeholders were asked to comment on their thoughts around the innovation challenges for the sector in Scotland, with comment being both of a generic nature and having technical considerations. A summary of some of the key innovation challenges that came through from the consultations is shown here:

- Market insight has to be the driver – commercial focus is key
- Post BREXIT impact on supply chains and R&D capacity
- Cross sector working
- Traditional mind sets in farming enterprises (culture)
- There are few large players and so little perceived clustering effect that can be used within the sector
- Need to pull technical knowledge and expertise through to companies
- Scale / capacity for innovation – smaller companies already undercapitalised for innovation
- Integration of smart technologies into supply chain
- Tension point between automation and labour
- Access to pilot plant or toll facilities
- Scaling up to manufacture

The innovation challenges were, in the main, a reiteration of commonly held beliefs and should be considered in how an innovation ecosystem is viewed by the players within it. Indeed, one stakeholder commented that "how the offer is made is so important – how businesses view the support and take advantage of it is as important as the programmes and facilities themselves", suggesting that consideration needs to be given to the messages that companies are receiving. Does the ecosystem make the most of what it has to offer? Again, the Make Innovation Happen service will go some way to addressing this issue as much of the (non-technical) challenges highlighted above could be addressed by the individuals / teams that are delivering programmes of support in terms of how they market and engage with the sector.

2.3.3 Barriers to innovation

The responses, when asked about the barriers to innovation were not surprising and are generally widespread. Figure 2 allows us to view the perceived barriers in a way that demonstrates whether they are internal, company specific barriers or are have an impact at the wider industry level. It also plots the relative scale of the barriers in terms of their impact on the innovation process.

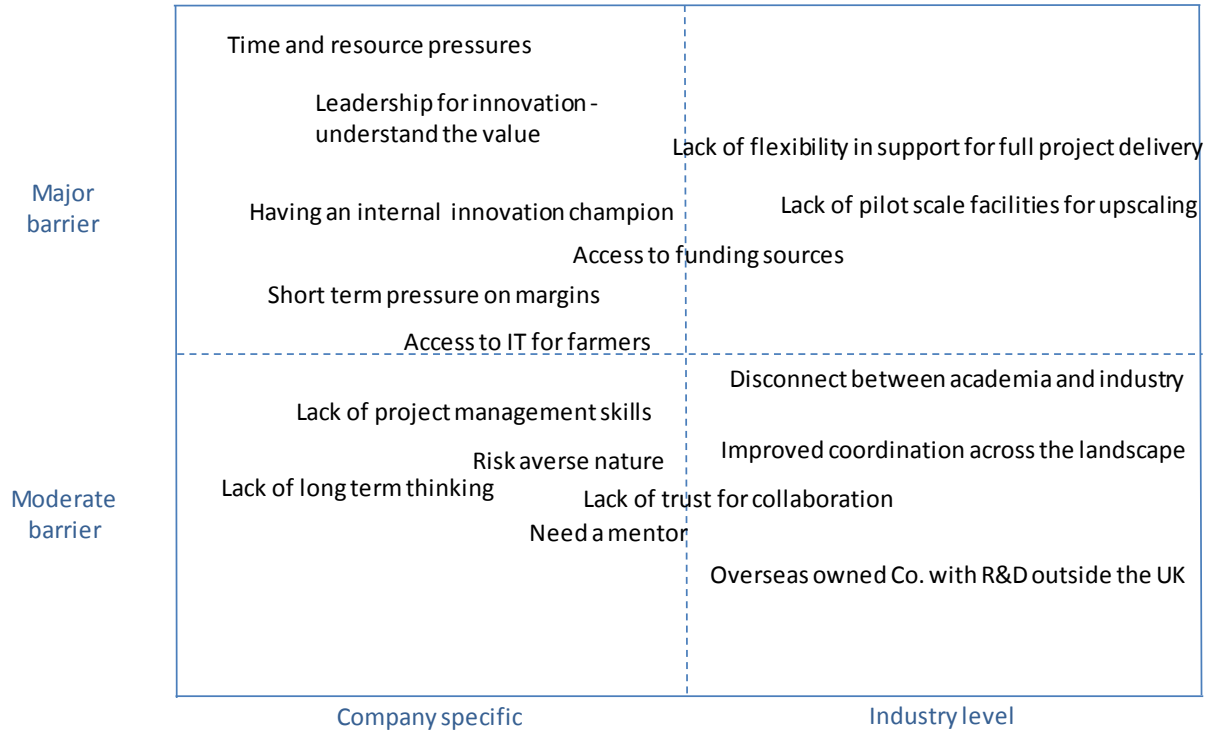

Figure 2: Perceived Barriers to Innovation (from consultation programme)

Barriers to innovation are largely perceived at a company level but the academic / innovation centres have also experienced these barriers in trying to drive forward innovation. It should be noted that the Make Innovation Happen service should provide a means of addressing some of the barriers identified by the research, such as access to a mentor and improved coordination across the landscape.

The apparent disconnect between academia and industry was highlighted by a number of respondents in terms of the different priorities and aspirations each party may have and the different timescales to which they work. Much of this, however, will be related to the culture and scale of both organisations and understanding how to best address these differences. Stakeholders indicated that the research needs to be responsive to market trends and company needs and suggests this may not always align with academic project ambitions. There is recognition, however, that this is not always the case and that Universities are working to address such misconceptions. The strength and success of collaborative projects

being undertaken between academia and industry in Scotland is testament to the demand for such interactions and the results that can be achieved when these are undertaken effectively.

Some barriers, it appears, could be addressed at trade and sector body level to facilitate a change in company mind sets and longer term thinking as well as providing opportunities to make the change. Likewise, the ways in which delivery partners engage with sectors and businesses should be considered – often the barriers can be broken down through direct relationships and an understanding of company needs. For instance a stage gate approach to nurturing companies and mentoring support (regardless of company size) can in many cases build a relationship that is beneficial to both parties. Indeed, any project should be approached with a clear understanding of what the practical need is that is being addressed and what each party wants to get out of the project.

It was clearly noted in the consultations that it is not the lack of ambition that hinders innovation in companies but the transactional/logistical barriers.

2.3.4 Importance of collaborative innovation

Collaboration type models were highly praised by stakeholders, all of which supported collaborative models for innovation. Key to success, however, is having a partner that can take the solutions to market and so the underlying research infrastructure needs to support the wider supply chain. Without a doubt supply chain collaboration, alongside the research and science base, is very important for the sector and people are the key to innovation – they drive it. There is, however, a compelling need to make the collaboration completely relevant to the businesses involved and to see the opportunity and route to market, otherwise it can be difficult to get buy in and commitment. The stakeholder interviews also supported cross sectoral collaboration as a must going forward – a need to think outside the box and not just a sectoral focus.

Both the landscape for innovation support (in the broadest sense) and the breadth of businesses that have benefited from it, means that the stage of maturity of the innovation ecosystem has now reached a point where there is a clear opportunity to better integrate the offerings for the benefit of the companies. The development of bespoke innovation support that is aligned to business strategy (and stage of company growth), together with the knowledge resources across academia and the facilities for testing and product development, means that the rich ecosystem has the potential to offer significant opportunities for collaborative projects and activities that could result in a step change within the sector, both in outputs and mind sets.

The stakeholder consultation programme has provided valuable insight into a number of issues and challenges that the innovation landscape could work to address. It has also demonstrated a real willingness and desire to collaborate across the sector, vertically and horizontally, to create a more joined up offering and to harness the power of what already exists.

2.4 Innovation Project Funding

Demand for innovation in Scotland can also be seen in the type and number of grant funded research projects being carried out by Universities, research institutes and companies, with a significant number of these being collaborative in nature. A review of the specific food and drink sector related projects that have been funded within the last three years (all those started or already running from in 2014 to May 2017) has been carried out. The list of projects is not exhaustive and represents a snapshot in time of food and drink related collaborative research projects funded by the UK research centres. Data was sourced from the RCUK Gateway to Research[10] as well as from data related to other public funding for innovative research/projects such as SE's SMART and R&D grants and the Scottish Government Food Processing, Marketing and Cooperation (FPMC) grant (for feasibility studies or capex that are based on an element of innovation for the company and its product or process).

An overview of the identified funding awarded to Universities, research centres and companies, for innovation projects started or running during the period 2014-2017, is shown in Table 1. As indicated, this summary is not exact or exhaustive but is used as an indicator of the demand for innovation support and funding within Scotland in recent years and demonstrates the appetite and uptake of collaborative research and knowledge transfer.

[10] http://gtr.rcuk.ac.uk/

	BBSRC	Innovate UK	NERC	EPSRC	Other	Total Project Grant Funding
Universities						
Heriot-Watt University	£1,013,141	£669,747		£189,964		£1,872,852
Napier University					£10,000	£10,000
Robert Gordon University		£87,221				£87,221
Scotland's Rural College (SRUC)	£3,974,945	£2,636,066	£202,100	£110,440		£6,923,551
University of Aberdeen	£4,144,984	£483,711	£457,802			£5,086,497
University of Abertay		£316,962			£5,000	£321,962
University of Edinburgh	£23,797,600	£422,371	£31,052	£42,362	£7,592	£24,300,977
University of Glasgow	£10,276,959	£433,936		£249,766		£10,960,661
University of Highlands and Islands	£241,276	£77,604			£290,000	£608,880
University of St Andrews	£1,771,436	£20,001				£1,791,437
University of Stirling	£2,749,332	£1,694,450				£4,443,782
University of Strathclyde	£371,175	£280,220		£295,661		£947,056
University of the West of Scotland	£55,159	£102,700				£157,859
Research Institutes						
James Hutton Institute	£2,053,899	£3,226,525				£5,280,424
Moredun	£784,455	£605,911				£1,390,366
Science and Advice for Scottish Agriculture (SASA)		£157,900				£157,900
Scotch Whisky Research Institute		£361,457				£361,457
Scottish Association For Marine Science	£249,709	£75,093	£427,085			£751,887
Companies						
All Companies	£0	£8,722,081	£0	£0	£34,999,804	£43,721,885
Total	**£53,453,052**	**£20,373,956**	**£1,118,039**	**£888,193**	**£35,312,396**	**£111,145,636**

BBSRC - Biotechnology and Biological Sciences Research Council

NERC - Natural Environment Research Council

EPSRC - Engineering and Physical Sciences Research Council

Table 1: Innovation funding for food and drink related projects started or ongoing since 2014, from data available on RCUK Gateway to Research and SE/Scottish Government innovation and research grants

In addition, it should be noted that significant funding has been provided by Scottish Funding Council, via Interface, to companies, research institutes and HEIs. As mentioned previously, more than £870,000 in innovation voucher funding was awarded between 2013 and 2017 and

around £730,000 was awarded by Interface Food and Drink for feasibility studies, proof of principle and innovation competitions between 2013 and 2016. This demonstrates the level of business engagement being facilitated at a purely Scottish level.

The level of funding for innovation projects, as shown in table 1, is clearly significant, with BBSRC and Innovate UK having invested more than £70 million during the review period to organisations in Scotland. It should be noted that this does not include grants that may have been sought from other sources such as the European Union or grants that these organisations have received in other sectors or technology areas.

The significant 'other' company funding relates to a great deal of capex investment (e.g. from the Scottish Government FPMC grant and other feasibility studies) but there remains a significant level of funding for companies involved in collaborative R&D and knowledge transfer projects. These collaborative projects involving Scottish companies are primarily related to bench scale work in the technical development stage, with the capex grant often related to the need to scale up facilities within the business to achieve growth and increased capacity.

Based on this review it is clear that The University of Edinburgh is a significant player in collaborative food and drink related research projects and the Roslin Institute is one of the institutes within the University that is most active. The University of Glasgow, SRUC and the James Hutton Institute are also very active players in the innovation landscape in Scotland. While some Universities may be absent from this list, i.e. Queen Margaret University, this is because no food and drink related, grant funded research projects were identified during the review period from the sources used.

In addition to these collaborative funding opportunities that Scottish companies, universities and research institutes have been able to take advantage of, Scottish Enterprise offer significant opportunities for innovation support through its grants, specialist support and signposting services. In January 2014, Scottish Enterprise launched a new strategy that aims to encourage 7000 new innovators and to add £1.2 - £1.5 billion GVA to Scotland's economy as a consequence of more companies innovating and increasing their turnover from exploitation of innovative ideas through 4 strands:

- Customer-led innovation, which will drive more new products and services across the Scottish supply chain by leveraging demand for key international corporates and public agencies
- Deeper company innovation engagement that will increase the international sales of current innovators by increasing capacity to better exploit investments
- Sector innovation approach to increase the central role of innovation as a driver for competitiveness
- Wider innovation approach to significantly increase the number of Scottish companies improving their competitiveness through new and improved products and services in international markets

An additional strand of innovation support around people and workplace innovation has also been added to its priorities that bring together an organisation's people, processes and business relationships to develop new ways of working that benefit everyone and increased productivity. In addition, specialist support includes 1-2-1 support from a variety of specialists that cover innovation, ICT, sustainability, intellectual assets as well as services such as SMAS.

In the last full year of delivery (2016/17), specialist support was provided to 221 F&D companies and 186 first time food and drink innovators. 182 innovation projects were supported by SE during this period, with £6.7 million contributed to F&D projects (valued at a total of £28.6 million).

Given the amount of public funding committed to innovation and R&D in recent years and with recognition of the evaluation and monitoring already in place around this, it is suggested that further research, or an impact assessment, may be useful to help support future policy decisions related to investment in innovation and research in Scotland. This would allow for a greater understanding of the impact of this investment and whether the benefits and knowledge has cascaded further into industry to support growth and development of the wider food and drink sector.

3. Research and Innovation in Scotland (Academia)

The brief for the research sought to understand where there are world class institutes and/or academics in Scotland to support food and drink sector innovation. To do this, the Research Excellence Framework (REF) was consulted. This is the UK-wide system for assessing the quality of the research carried out in the UK's publicly-funded universities and replaces the Research Assessment Exercise (RAE), last conducted in 2008.

Within the Scotland, the Scottish Funding Council uses results of the REF to:

- Inform the selective allocation of research funding to HEIs
- Provide benchmarking information and establish the reputation of institutions in research
- Provide accountability for public investment in research and demonstrate its benefits

How is the REF assessed?

Panels of experts in individual academic subject areas carry out the REF assessment under three broad headings.

- Outputs: the main focus of the REF is to identify excellent research of all kinds. This is assessed through expert review. In subjects where robust data is available, expert review may be informed by additional citation information
- Impact: recognition is given where researchers build on excellent research to deliver demonstrable benefits to society, public policy, culture, quality of life and the economy
- Environment: the REF takes account of the quality of the research environment in supporting a continuing flow of excellent research and its effective dissemination and application[11]

The three elements of the assessment are scored and combined to produce an overall quality profile for each submission.

Each academic institute is responsible for its own submission. The assessment is carried out by Unit of Assessment (UOA) and the one relevant for this study is UOA 6: Agriculture, Veterinary and Food Science. The overall quality profile for Scottish institution submissions is shown in Table 2 and indicates the proportion of the submission deemed to meet the starred level shown.

[11] http://www.sfc.ac.uk/Priorities/Research/ResearchExcellenceFramework.aspx

For context, the definitions of the starred categories are:

- 4* - quality that is world leading in terms of originality, significance and rigour
- 3* - quality that is internationally excellent in terms of originality, significance and rigour but which falls short of the highest standard of excellence
- 2* - quality that is recognised internationally in terms of originality, significance and rigour
- 1* - quality that is recognised nationally in terms of originality, significance and rigour

HEI	# FTE staff submitted	Overall Quality Profile % of the standard meeting submission for:			
		4*	3*	2*	1*
University of Aberdeen	20.40	56	36	8	0
University of Edinburgh (joint submission with SRUC)	122.62	42	32	23	3
University of Glasgow	38.80	46	45	9	0
Heriot-Watt University	9.50	23	42	34	1
Scotland's Rural College (SRUC) (joint submission with University of Edinburgh)	57.37	42	32	23	3
University of Stirling	28.00	40	48	11	1

Table 2: REF Overall Quality Profile for Scottish HEIs in UOA 6: Agriculture, Veterinary and Food Science

With regards to the number of full time staff submitted, this relates to the staff selected to be included in the submission that undertake 'research only' or 'teaching and research'. The relevance of the staff and their knowledge base in Scotland's Rural College (SRUC) and in the University of Edinburgh within this category is clearly significant, with around 160 FTE academics put forward in their joint submission.

It is clear that Scotland has some world-leading and internationally excellent institutions and academics in this field, with the University of Aberdeen leading the way in terms of research excellence.

The four UK higher education funding bodies use the REF results to inform the selective allocation of their research funding to HEIs. Table 3 demonstrates how this impacted on the research and innovation grant funding[12] awarded to each HEI in the current academic year

[12] Comprising Research Excellence Grant, Research Postgraduate Grant and University Innovation Fund

(2016-17)[13]. Note that the figures in table 3 do not include any teaching or general grants allocated to the HEIs by the Scottish Finding Council. They also relate to the wider assessment of research activities beyond agriculture, veterinary and food science and are not specific to the food and drink sector.

It does, however, indicate the importance of academic excellence and work towards the REF submissions to support other research and innovation within the Universities. The REF has taken place every five to seven years since 1986, and is the basis on which nearly £2 billion of annual research funding is handed out and so it has huge reach across the UK university system, which is a key part of the innovation landscape in Scotland and wider UK.

University or Research Centre	Research and Innovation grant (SFC) 2016/17
Glasgow Caledonian University	3,533,000
Heriot-Watt University	14,160,000
Napier University	2,694,000
Queen Margaret University	1,291,000
Robert Gordon	2,250,000
Scotland's Rural College (SRUC)	3,467,000
University of Aberdeen	24,410,000
University of Abertay	1,198,000
University of Dundee	22,767,000
University of Edinburgh	88,440,000
University of Glasgow	54,151,000
University of Highlands and Islands	3,033,000
University of St Andrews	20,359,000
University of Stirling	8,220,000
University of Strathclyde	23,306,000

Table 3: SFC research and innovation grant funding for Scottish HEIs in 2016/17

[13] Only the Research Excellence Grant element of this is based on REF results and accounts for 84% of the overall funding allocated to institutions during this period

There is some criticism of the REF in terms of how it assesses the impact of research and a recent independent review[14] of the REF proposes 'widening and deepening the notion of research "impact" to include influence on public engagement, culture and on teaching, avoiding distortions of research choices and careers'. It is suggested that this would perhaps encourage more innovation and longer term research projects (with relatively high research risk) that strive for excellence as well as interdisciplinary research. The next REF assessment is due to take place in 2021.

It should also be noted that the Scottish Government provides additional funding to HEIs and research institutes for strategic research projects but the breakdown by organisation is not known at this time.

Another area of interest in understanding the impact, reach and success of the research carried out within Scottish Universities relates to the companies spinning out from them. From secondary research, a number of spin-out organisations have been identified within the food and drink space – these are shown in table 4. The list is not exhaustive and the organisations have had varying degrees of success. Silent Herdsman, for example, a developer of a neck-collar monitoring system used to detect estrus and health problems in dairy cows was acquired by Afimilk, a global provider of dairy farm management solutions, in 2016. Afimilk has also been involved in several collaborative, publically funded innovation projects in recent years and so the potential benefits of pursuing innovative research partners and project support is noted.

[14] Research Excellence Framework review, Lord Nicholas Stern, 2016

Organisation	Name	Status	Date Incorporated	Exit Date (if appropriate)
University of Edinburgh	R2 Biotech	Active	06/03/2008	N/A
University of Glasgow	Pulsetta	Active	06/10/2011	N/A
University of Strathclyde	Eat Balanced	Active	21/09/2010	N/A
University of Strathclyde	Cormacks		11/11/2008	14/07/2010
University of Strathclyde	Cambio	Active	25/11/1985	N/A
University of Strathclyde	Angelic Gluten Free	Active	26/05/2011	N/A
University of Strathclyde	Eat Super	Active	15/01/2007	N/A
University of Strathclyde	Great British Sausage Company	Active	07/05/2008	N/A
University of Strathclyde	The Hidden Lane Café	Active	01/09/2014	N/A
University of Strathclyde	FoodAdo	Active	21/10/2009	N/A
University of Edinburgh	Advanced Pest Solutiions	Active	27/11/2003	N/A
University of Glasgow	Anacail	Active	03/11/2010	N/A
University of Glasgow	Greenways Consulting	Active	24/04/2009	N/A
University of Glasgow	Optoswim	Active	28/06/2007	N/A
University of Glasgow	Reactiv Lab		02/08/2007	03/03/2010
University of Stirling	Aquatic Diagnostics	Active	15/08/2001	N/A
University of Strathclyde	3F Bio	Active	30/01/2015	N/A
University of Strathclyde	Fixed Phage	Active	23/02/2010	N/A
University of Strathclyde	Insignia Technologies	Active	02/07/2008	N/A
University of Strathclyde	Silent Herdsman		06/11/2007	15/02/2016
University of Strathclyde	Solus Scientific Solutions	Active	23/06/2009	N/A
University of Highlands and Islands	Shetland Seafood Quality Control	Active	12/05/2000	N/A
Queen Margaret University	Bactokil		20/07/1998	02/06/2009
Heriot Watt University	DiverSense	Active	17/11/2014	N/A
Heriot Watt University	Horizon Proteins	Active	19/11/2014	N/A
Heriot Watt University	Nandi Proteins	Active	01/12/2000	N/A
Glasgow Caledonian University	Temp-Tell	Active	01/01/1999	N/A
Heriot Watt University	Microsense	Active	25/01/2017	N/A
Edinburgh Napier University	Celtic Renewables	Active	25/01/2012	N/A

Table 4: Examples of Food and Drink Related University Spin-Out Companies

In terms of academic research excellence and reach, therefore, it is clear to see that Scotland's food and drink sector has the potential to tap into a wealth of technical knowledge and expertise. This relatively short piece of research tells us that:

- Scotland has six academic institutions that are classed as world leading within the field of Agriculture, Veterinary and Food Science
- World leading and internationally renowned researchers are working within Scotland's academic institutions, notably with a significant number engaged in research at SRUC that tends to have a high level of engagement with the industry
- There are a significant number of food and drink related companies spinning out of Universities, some with highly successful outcomes – and many of which are/have been engaged in collaborative grant funded research to meet their innovation needs
- Some institutions that are heavily involved in innovation research and collaboration are missing from the list of academic excellence but this seems to indicate the difference between pure research and industry facing (close to market) innovation support for businesses e.g. Abertay and QMU are very visible at an industry facing level in terms of academic support to food and drink companies

4. Innovation Support Infrastructure in Scotland

Within Scotland, there is a wide range of support available to companies seeking to innovate. The range of support is summarised in this section in relation to public sector support, technical knowledge and expertise available with Universities and relevant research centres and institutes and the availability of equipment and facilities within Scotland's dedicated food and drink research centres (some of which are located within Universities).

4.1 Public Sector

This report does not intend to replicate work already undertaken elsewhere. As mentioned in section 2.1, Scottish Enterprise, and the wider Scotland Food and Drink Partnership, has recently completed a broad internal exercise in developing the Make Innovation Happen and part of this was to map the availability and sources of public sector innovation support across Scotland. This support is particularly related to innovation within the food and drink sector and encompasses elements in the innovation system available from Scottish Enterprise, Highlands and Islands Enterprise, Scottish Government, Interface, Scotland Food and Drink, Food and Drink Federation Scotland and Zero Waste Scotland.

The mapping exercise identified more than 100 'products' available, delivered by a number of different organisations, and these range from grant funding and leadership events to specialist expertise. The somewhat cluttered landscape of public sector support has been addressed with the development of 'Make Innovation Happen', which has defined new principles of the 'innovation journey' that companies go through. As highlighted previously, it connects businesses to the right support to meet their individual project needs at all stages of the innovation journey from opportunity identification to product launch and tailors the type of support to the company's individual requirements.

This innovation support map will be used by the Make Innovation Happen 'connectors' and is available to the wider Scotland Food and Drink Partnership. This report, therefore, does not make an attempt to replicate or re-frame this aspect of the public sector innovation support to Scottish companies.

4.2 Technical Expertise

As is widely recognised, Scotland has a wealth of technical expertise in food and drink research and development and this is located (and often embedded) in institutions throughout the country. A summary matrix has been developed to demonstrate the breadth of technical knowledge, expertise and capability available within Scottish Universities, research centres, innovation centres and colleges to support innovation activities and business growth. This is shown in Table 5. **This matrix presents a snapshot in time of where food and drink expertise lies across Scotland's institutions and may not capture areas of expertise that *could* be applied to food and drink but is not specifically related to the sector. Best endeavours have been taken to capture all sector relevant areas of expertise.**

Organisation	Key Disciplines								
	Animal breeding	Plant breeding	Animal welfare	Aquaculture / Mariculture	Nutrition & Dietetics	Brewing & distilling	Health research / Physical performance	Agricultural engineering	Data handling & modelling / informatics
UNIVERSITY									
University of Aberdeen		x	x	x	x		x		
University of Edinburgh	x	x	x				x		
University of Glasgow	x	x	x	x	x		x	x	
Heriot-Watt University				x		x			
University of Stirling	x		x	x			x		
University of the Highlands and Islands	x	x	x	x			x		
Strathclyde University									
University of West of Scotland					x		x		
Robert Gordon University					x		x	x	
University of Abertay				x		x	x		
University of Dundee		x			x		x		
Napier University				x			x	x	
Glasgow Caledonian University					x		x		
Queen Margaret University					x		x		
University of St Andrews	x		x	x			x		
RESEARCH CENTRE									
Scotland's Rural College (SRUC)	x	x	x	x				x	
James Hutton Institute		x					x		
Moredun Research Institute	x		x						
Rowett Institute for Nutrition & Health					x		x		
Biomathematics & Statistics Scotland (BIOSS)									x
Royal Botanic Garden Edinburgh		x							
Scotch Whisky Research Institute						x			
Roslin Institute	x		x						
INNOVATION CENTRE									
IBioIC									
CENSIS									
SAIC				x					
Agrimetrics									x
CIEL	x		x						x
Agri - EPI	x	x		x				x	
FEI									
New Lanarkshire College									
City of Glasgow College									
Glasgow Clyde College									
South Lanarkshire College									
	10	9	10	11	8	3	15	5	3

	Product Development to Market Launch / Value Chain									
Organisation	NPD	Raw materials & ingredients	Functional ingredients	Food safety	Shelf life	Traceability	HACCP	Sensory and consumer analysis	Packaging	Supply chain logistics
UNIVERSITY										
University of Aberdeen	x	x	x	x	x	x				
University of Edinburgh		x		x				x	x	x
University of Glasgow		x	x							
Heriot-Watt University	x	x	x	x	x			x		x
University of Stirling				x						
University of the Highlands and Islands		x		x						
Strathclyde University	x	x	x	x	x			x	x	x
University of West of Scotland						x			x	x
Robert Gordon University		x		x			x			
University of Abertay	x	x	x		x	x		x	x	
University of Dundee			x							
Napier University		x		x					x	x
Glasgow Caledonian University			x	x	x		x	x		
Queen Margaret University	x	x	x		x			x		
University of St Andrews		x				x		x		
RESEARCH CENTRE										
Scotland's Rural College (SRUC)	x			x		x				
James Hutton Institute		x	x		x	x		x	x	
Moredun Research Institute				x						
Rowett Institute for Nutrition & Health	x	x	x							
Biomathematics & Statistics Scotland (BIOSS)										
Royal Botanic Garden Edinburgh										
Scotch Whisky Research Institute		x						x	x	
Roslin Institute				x						
INNOVATION CENTRE										
IBioIC										
CENSIS										
SAIC				x						
Agrimetrics										
CIEL		x								
Agri - EPI										
FEI										
New Lanarkshire College	x									
City of Glasgow College	x									
Glasgow Clyde College	x									
South Lanarkshire College	x									
	11	15	10	13	7	6	2	8	7	5

	Enabling Technologies								
Organisation	Novel processing	Automation & robotics	Rapid prototyping	Sensors / imaging	Nanotechnology	Thermal processing	Dry/low water technologies	Remote Communication technologies	Food waste technologies
UNIVERSITY									
University of Aberdeen									x
University of Edinburgh	x	x		x	x			x	x
University of Glasgow		x			x				x
Heriot-Watt University		x	x		x	x			x
University of Stirling									
University of the Highlands and Islands				x					x
Strathclyde University	x	x	x	x	x	x	x	x	x
University of West of Scotland	x	x	x	x				x	
Robert Gordon University			x	x					x
University of Abertay	x				x		x		x
University of Dundee				x				x	
Napier University		x		x				x	x
Glasgow Caledonian University			x						x
Queen Margaret University	x								x
University of St Andrews				x					
RESEARCH CENTRE									
Scotland's Rural College (SRUC)				x				x	
James Hutton Institute	x								x
Moredun Research Institute									
Rowett Institute for Nutrition & Health									
Biomathematics & Statistics Scotland (BIOSS)									
Royal Botanic Garden Edinburgh									
Scotch Whisky Research Institute									
Roslin Institute									
INNOVATION CENTRE									
IBioIC									x
CENSIS				x				x	
SAIC									
Agrimetrics									
CIEL		x		x				x	
Agri - EPI		x							
FEI									
New Lanarkshire College									
City of Glasgow College									
Glasgow Clyde College									
South Lanarkshire College									
	6	8	5	12	5	2	2	8	13

Table 5: Overview of food and drink related technical knowledge and expertise

It is recognised that some of the research centres highlighted in table 5 are located within/part of Scottish Universities but given their dedicated resource for near to market food and drink research and knowledge transfer, they have been analysed separately to demonstrate the depth of innovation support available. Some of these centres, as noted earlier, have had significant collaborative research funding in recent years and play a key role in supporting innovation in the sector.

The SFC and Innovate UK funded innovation centres that are relevant for food and drink innovation activities have also been included in this research. The centre for Crop Health and Protection (CHAP) is missing from the overview as it is the only one of the Innovate UK funded innovation centres that does not have delivery partners based in Scotland. These centres have a clear remit for agricultural innovation in line with the UK government's Agricultural Technologies (Agri-Tech) Strategy to makes sure the knowledge and insight from the UK's world-leading science base is translated into benefits for society and the economy. These centres did not exist when the previous Campden BRI study was carried out and so these are new to Scotland's innovation landscape. Indeed the partnerships with Scottish institutions have resulted in new capital equipment being secured and located in some of Scotland's research centres (see section 4.3) and these collaborative relationships are extending the reach of innovation opportunities for both the centres and Scottish companies.

The table clearly shows a number of key strengths across the different actors in the innovation landscape. For example, health research, aquaculture and animal breeding/welfare are key disciplines where Scotland has core strengths and a varied group of institutions involved in research, development and education in these areas.

Similarly, there is a wealth of technical knowledge around raw materials and ingredients, as would be expected in a country where provenance, quality and premium are essential to branding, marketing and reputation.

As can be seen in the table, a number of colleges have also been included in the overview in response to the stakeholder consultations during which their relevance was highlighted. Colleges have a very important role to play in the overall innovation landscape as they are able to offer support and facilities for companies developing new products, processes and formulations. Development kitchens are a key resource that small food companies can access as well as the expertise from food technologists and chefs to help with, for example, reformulation, product development and design. Colleges tend to have an excellent reach into the SME sector and their graduate placements could be key to workplace innovation and cascading innovation thinking into businesses.

A college innovation agenda is being developed via the Scottish Funding Council and a review of college estates and infrastructure is ongoing. Indeed the Reid report on innovation

centres[15] stated that "The success of the college sector in Scotland can be through innovation of business products, but is more often about delivering skills, and through those enhanced skills, improved productivity and efficiency". It suggests having the colleges working more closely with the innovation centres and universities to strengthen the performance of the innovation centres and so their inclusion in the innovation landscape is logical. No metrics or national overview of their reach or impact on innovation is currently available but work is ongoing in this area, independent of this research.

4.3 Dedicated Food and Drink Research Facilities

As indicated, there are some dedicated research centres that have significant facilities and equipment to support food and drink innovation. Some of the capital equipment is new in the last few years and some has been made available through alliances and partnerships with the Innovation Centres. For example, the Roslin Institute houses CIEL's Large Animal Research and Imaging Facility (LARIF) and also a freshwater aquaculture system funded by Agri-EPI. This demonstrates the benefits that can be achieved through collaborative relationships, which it is hoped will, in turn, generate new expertise and opportunities for research and innovation throughout the supply chain.

Table 6 provides an overview of the selected dedicated food and drink research facilities available in Scotland to highlight the types of capital equipment available to support research and innovation in the sector. Note that the stakeholder consultations did not highlight any specific gaps in equipment provision or availability at an industry or sub-sector level, other than a more general lack of facilities to support the scale up of manufacturing.

It is also noted that there are other centres and university departments with facilities and equipment available to support commercial and collaborative research in the wider areas of food and drink, agriculture, veterinary science and enabling technologies, but for the purposes of this study we have focused on research centres with a critical mass of dedicated facilities for food and drink innovation activities and which are more industry facing. If a company is interested in understanding the equipment and facilities available in Scottish academic institutions in relation to a specific innovation need then it should seek guidance from Interface[16] to ensure that it is directed to the right type of specialist support. Interface has carried out a significant piece of work recently to create a platform of specialist facilities available through Scotland's HEIs and FE Colleges. This includes assets held across Scotland and across all sectors.

Other dedicated food and drink centres were identified by stakeholders but these have not been included as they do not offer physical assets. For example, the Centre for Aquatic Food Security, based at the University of Stirling is a virtual centre and the Scottish Joint Food

[15] Independent Review of the Innovation Centres Programme, Chaired by Professor Graeme Reid, September 2016
[16] http://www.interface-online.org.uk/how-we-can-help/specialist-facilities

Security Alliance, which is a collaboration between the James Hutton Institute, the University of Dundee and the University of Aberdeen) has no facilities its own.

Organisation	Institute / Centre	Facilities Available
Heriot Watt University	International Centre for Brewing and Distilling	For brewing the facilities available are: a 2 hl experimental plant includes a mash tun, cereal cooker, lautertun/infusion mash tun, and a mash filter. These feed in to three brewing vessels which can be used for the production of ale or lager wort, and malt or grain distillers' wash, from a variety of raw materials. The fermentation and conditioning tanks are designed for beer or spirit production. Green beer can be cask matured, and there are also facilities for filtration together with a bright beer tank and equipment for bottling and kegging. Within the School of Life Sciences there are also confocal microscope and new proteomics facilities. For distilling: a pilot distillery consists of a 25-litre wash still and an 18-litre spirit still. A micromaltings allow the production of sufficient raw materials for up to a 200 litre brew-length. The facility includes maltings, mash-baths, milling machines and analytical equipment.
James Hutton Institute		The James Hutton Institute and its commercial arm The James Hutton Limited offer scientific research services and products to clients in agriculture, food and drink, extractive industries including (marine and oil/gas), environmental and ecological science, aquaculture, nutraceuticals and vetinary medicine . The Institute boasts extensive laboratory capabilities and a range of specialist equipment carrying out the full range of inorganic and organic analysis. It operates several environmentally controlled rooms to support its analytical and research work, including 29 research polytunnels for advanced crop breeding and research purposes at farms in Angus, Aberdeenshire and Lanarkshire covering 1000h. Cold rooms, freezers, and constant temperature and growth rooms. It has significant glasshouse facilities (1ha) in Dundee and controlled environment plant facilities with walk-in plant growth rooms and reach-in plant growth cabinets. There are also specific services available includes: X-Ray diffraction, Lipid analysis, Molecular Diagnostics , Isotope analysis, Inorganic analysis, Soil analysis, Scanning Electron Microscopy, Fourier Transform Infrared Spectroscopy and Organic analysis as well as other consultancy and research services in plant breeding, crop trialling and efficacy testing, new product development, agri tech, crop modelling, Drone technology, Bio controls and Bio stimulants, mycorrhiza, genetic marker identification, DNA finger printing, germplasm screening, Genotyping, PCN identification and contract research.
Moredun Research Institute		The clinial facilities includes purpose built farm animal accommodation and a post mortem suite, with incineration facilities. An extensive high containment facility is also available that provides optimal controlled environmental conditions for large and small animal species and facilitates research on specified pathogens The laboratory facility includes a number of adaptable laboratory areas, a fully validated cell culture laboratory and all relevant auxiliary areas including hot and cold rooms, storage areas and wash rooms. Biosafety testing services are supported by a sterility suite comprising two class D rooms each with a class A isolator. One room is used for test articles, the other for positive controls. Incubators are housed in a separate room. The Moreden Proteomics Facility (MPF) provides the facilities and expertise for the investigation of infectious diseases both from pathogen and host perspectives. The Pathology Unit provides general support for all of Moredun's research by supplying digital image capture and analysis of cell preparations and tissues
Queen Margaret University	Scottish Centre for Food Development and Innovation	Dedicated microbiology laboratory; fully-equipped sensory suite; dedicated chemistry laboratory and analystical facilities and a technology/white room for industry to test new technology, development kitchen
Scotch Whisky Research Institute		Key facilities are segmented into five science areas: - A cereals laboratory, including micromaltings, to support the development of new varieties of wheat and barley. It also carries out distilling quality analysis. - A pilot plant allows it to produce spirit at a bench-top scale for sensory and compositional analysis and a Flow Cytometer is a rapid, high-throughput screening tool used in the research to understand yeast and fermentation performance. - A controlled environment maturation store allows it to artificially manipulate maturation conditions. - Compositional analysis of spirit underpins its fundamental research and product protection work. It has a suite of chromatographic instruments and has a Gas Chromatography-Olfactometer which helps understand the link between whisky composition and flavour. - It has a dedicated sensory laboratory, with data collected and analysed using specialised sensory software.

Organisation	Institute / Centre	Facilities Available
Scotland's Rural College (SRUC)		Key resources at SRUC include: Experimental farms including main livestock and crop species, Plot-scale agronomy trial capability, Nitrous oxide emission measurement equipment, Individual food intake measurement facilities for dairy and beef cattle, Methane measurement facilities for livestock Suite of techniques for monitoring animal behaviour, CT and ultrasound scanning and Animal and crop science laboratory facilities. Within animal and veterinary science, specific facilities include Edinburgh Genetic Evaluation Services (providing database services), a CT Scaning facility (including the UK's only mbile CV scanner devoted to farm animal studies), a biomarkers laboratory and specific research farms. Its Poultry Unit has government-approved modern and flexible research facilities that encompass the key areas of Breeding, Laying, Hatching, Growing and Processing. Within crop and soil systems research there are field trial sites throughout Scotland as well as laboratory and glasshouse testing facilities. It also has facilities such as a methane chamber to measure methane gas emissions from cattle, facilities for recording feed efficiency at Easter Howgate Beef Research Centre and spectral measurement techniques such as visible and near infrared spectroscopy (Vis-NIR) and hyperspectral imaging (HI).
The Royal Botanic Garden Edinburgh		The Scientific and Technical team manage the laboratory research facilities tha include: a molecular laboratory (for population genetics, molecular phylogenetics and evo-devo work), microscopy (light and electron microscopy and image processing) and general laboratory facilities (ultra pure water, autoclaves, centrifuges and refrigeration)
University of Aberdeen	The Rowett Institute	The new Human Nutrition Unit was opened in 2017 and is a unique human trials facility for the food sector. It houses the UK's only residential facility. The institute has a metabolic research facility (which has a development kitchen), clinical investigation unit (assess the effectiveness of dietary interventions), body composition suite (gather physiological data). Analytical facilities are also available and include analytical chemistry (strict quality control regimes), gas chromatography mass spectrometry (metabolic studies), gas isotope ratio mass spectrometry (metabolic studies) and liquid chromatography mass spectrometry (support understanding of the balance between diet and human health)
University of Abertay	Food Innovation and Abertay	Facilities available include: New Product Development Kitchens, Photographic & Food Styling Studio/Kitchen, Consumer Panels / Sensory Analysis, Eye Tracking, Human Interaction Virtual Environment, Lecture Theatre for Food Demonstrations. Specific equipment includes: Atomic Force Microscopy, X-ray Computerised Tomography Scanner, Stable Microsystems Texture Analyser, Vaccum / Modified Atmospheric Packaging, Freeze Drying (small scale), Various High Shear Mixers, GCMS + HPLC, Ultrasonics (pasteurisation), Atomic Absorption Spectrometry (heavy metal analysis), Microbiology Laboratories, Laboratory Scale Brewing & Distillery, Ultrafiltration Sous Vide, Smoker (external pilot plant)
University of Edinburgh	The Roslin Institute	State of the art faciliies include: laboratories, bio-imaging facilities, and genome sequencing facilities through Edinburgh Genomics. It also has access to outstanding veterinary hospital facilities, and farm facilities. It is currently building the new Easter Bush Innovation Centre, an incubator space for animal bioscience work and is also developing The Centre of Comparative Pathology (integrating diagnostic, training and imaging resources for human, experimental animals, livestock and companion animals), comprising of CIEL's Large Animal Research and Imaging Facility (LARIF), and a Equine Diagnostic, Surgical and Critical Care Unit. The LARIF facility includes specialised suites and computed tomography (CT) and magnetic resonance imaging (MRI) as well as controlled environment rooms for poultry and large animals that can be used for highly monitored wefare and behaviour studies. Roslin also hosts a freshwater aquaculture system (funded through Agri EPI) and is designed to undertake disease challenge trials
University of Stirling	Institute of Aquaculture	Analytical laboratories in Genomic, molecular and bioinformatics, Microbiology and Immunology, Imaging facilities, Nutritional analytical services, Water quality services, It has freshwater sites in Central Scotland, tropical and temperate freshwater recirculation systems in Stirling and marine facilities in the West of Scotland.

Table 6: Selected dedicated research facilities for food and drink innovation support (data taken from secondary data sources and supplemented via stakeholder consultations)

It is not surprising to see that the distilling and brewing sector is very well served in Scotland with highly relevant facilities and pilot scale plant available. The research in these facilities is also very much industry led, focusing on addressing sector level challenges that all organisations face as well as carrying out company specific research on a more competitive

basis. The agricultural and primary processing sector can also draw on significant facilities, equipment and analytical testing to support animal and plant breeding, welfare and product development. Health and nutrition also feature well in terms of facilities available to support innovation and company growth and development. All of this aligns well with the Scottish Government and the Scotland Food and Drink Partnership's priorities of provenance, premium and health. Facilities dedicated to addressing the Scottish Government priority related to environmental sustainability, however, does not come through as clear in these dedicated facilities. They will, however, by their very nature not be found in food related centres and departments but there are many examples of relevant facilities for environmental sustainability in other departments within Scottish research institutions. Stakeholder consultations continually raised the need for collaborative and cross-sectoral approaches to energy, transport, water and efficiency in order to address this wider, societal issue effectively as an industry.

As discussed in the previous report by Campden BRI, Scotland is well served by support for bench-scale product and process development and much of the research carried out by the organisations noted above (as well as those highlighted in Table 6) will be at this level of technical development. **This current study did not include a detailed analysis of customer demand for technical facilities but is based on the technical needs identified in the Campden BRI report and those highlighted in section 2 from stakeholder interviews, Scotland's industrial needs for innovation at the bench scale level for new product development are well served by existing facilities and competences within the universities and research centres.**

With regards to pilot scale facilities, the report by Campden BRI identified that there was a gap in pilot scale infrastructure in Scotland. As mentioned, the brewing and distilling sector is one that does have strong capabilities for pilot scale processing facilities, as seen in the Heriot-Watt University International Centre for Brewing and Distilling and the Scotch Whisky Research Association. These are true centres of excellence that have significant industry and trade body support and are very much industry-led in terms of research.

From stakeholder discussions, and direction from Interface, there are also new pilot scale facilities that have been set up in recent years (since the Campden BRI report was completed) that have added to the innovation landscape and capabilities within Scotland. These are:

- The Rowett Institute's new state-of-the-art Human Nutrition Unit (HNU) – new building opened in January 2017
- University of Abertay's new science facility that will host a lab dedicated to the sensory analysis of food
- Queen Margaret University's Scottish Centre for Food Development and Innovation, opened in December 2014

These facilities demonstrate the developments that have taken place in Scotland in recent years to support innovation and development of food and drink businesses and are addressing gaps in the provision of support at this scale.

The feedback, however, indicates that there remains a perceived gap in the provision of pilot scale facilities to support company innovation in the technical development of products and processes. Scaling up was one of the biggest challenges identified by stakeholders in relation to innovation for business growth.

It is worth noting, however, that stakeholder consultations and published information also highlighted facilities that are being developed or considered across Scotland to support innovation that may come on stream in the coming years. There are a number of City Deals, some of which are active and some that are in progress, which have opportunities for food and drink companies across Scotland and potential implications for the wider supply chain. These initiatives represent an ongoing process and emerging landscape that is likely to change over time and so it is assumed that the themes and opportunities coming from them will be picked up and reviewed to ensure that they are working together for Scotland in the wider context of the evolving innovation landscape.

A number of the options under development are shown here to demonstrate the breadth of planned and emerging initiatives:

- International Barley Hub[17] (purpose built centre to be located in the James Hutton Institute – a collaborative development – funding sought via the Tayside City Deal)
- Seafood Centre of Excellence (feasibility study currently being carried out by SRUC)
- Northern Innovation Hub (Inverness/Highlands City Deal – to be delivered by HIE in partnership with The Highland Council. It will deliver a range of targeted initiatives over a 7 year period principally across the food and drink, life sciences, creative industry and tourism sectors)
- Advanced Plant Growth Centre[17] (James Hutton Institute – futuristic vertical farming facility near Dundee with funding sought from the Tayside City Deal)
- Agri-Food and Nutrition Hub for Innovation (funded from the Aberdeen City Deal- aims to stimulate higher levels of innovation for both existing companies and new starts/spinouts across the wider food supply chain)
- Food and Drink incubator and accelerator facilities (a number of proposed developments across Scotland as part of wider regeneration and growth activities)

These developments demonstrate the demand for continued research and innovation support for food and drink businesses in Scotland and the ambition to continue to develop world leading research facilities as well as practical support and development opportunities for SMEs.

[17] http://www.hutton.ac.uk/news/tay-cities-deal-submission-launched

Example of Scotland's Emerging World Leading Expertise

Vertical farming in a controlled environment is on the increase as farm land becomes more scarce and the benefits of reduced transportation, reduced labour costs and the sustainable use of scarce natural resources are demonstrated.

Intelligent Growth Solutions[18] is an organisation that is working in conjunction with the James Hutton Institute and demonstrates the pioneering work being done to automate the growing of fruit and vegetables. The yet-to-be-constructed advanced plant growth centre will grow crops in a large building, which technically could be situated anywhere, and will produce a consistent, year-round supply of food. It will be controlled by artificial intelligence and will use novel lighting technologies and sensors within the £2.5M facility. While there are other examples of vertical farming across the UK and beyond, this is different in that it will use robotics and sensors to automate the process. The project owners say that total automation is technically feasible and presents benefits such as the small footprint of the facility, reduced food miles and more energy efficient production processes. This type of facility is one that could be seen as a new type of farm in the future and the ability to be fully automated may present real opportunities on a global scale.

[18] https://www.intelligentgrowthsolutions.com/demonstrator/

5. Gap Analysis

Based on the review of the current innovation infrastructure landscape and feedback from industry stakeholders on the current and future needs of food and drink companies, there are a number of perceived gaps in Scotland at this time. It is important, however, to consider the sustainability of company needs and how any potential new facilities can support them. While there are perceived gaps in infrastructure, there is a need to consider the scale of absolute demand to fill these gaps.

The first perceived gap related specifically to that highlighted in the Campden BRI report and that is the lack of provision of pilot scale facilities and equipment to support company innovation in the technical development stage of the product and process development cycle. As highlighted previously, the brewing and distilling sector is well served at this level of innovation and there has been significant capital investment in other new food and drink centres of excellence that is starting to address this need. Scaling up to manufacturing, however, remains a challenge for Scottish businesses and stakeholders believe that there is an infrastructure gap to meet future demand.

The results of the gap analysis provided in the Campden BRI report will remain valid in that the new centres that have been set up since that study was carried out do not have a specific focus on pilot scale trials for the defined sub-sectors (the Campden BRI report focussed on the bakery, meat processing, fish and seafood and dairy sectors). The stakeholder consultations carried out for this study generally concur with this. For the bakery sector, companies currently go out with Scotland for specific technical expertise and they often use their ingredient providers' technical centres to drive innovation in the sector. Within aquaculture, there is a feasibility study and consultations underway in relation to a proposed technical centre of excellence to support innovation in Scotland, highlighting an identified gap in current provision. The dairy sector, however, does not necessarily see the need for any large scale facilities in Scotland as it is currently well served from other UK centres; so while there is a gap there is not necessarily a demand to fill this gap, as with the bakery sector.

Overall, stakeholders consulted during this study were generally of the opinion that there was no specific sector need for new large scale facilities in Scotland, although some suggestions were raised for consideration, in terms of potential new facilities that could support the scaling up of production for the sector. These included:

- Scale up / demonstration production site – based within a supply chain company premises to consolidate an industry focussed approach. If the facility could also allow access to equipment manufacturers then there may be options to provide wider supply chain solutions at a sub-sectoral level
- Demonstration sites for new technologies and applications (to increase awareness, knowledge and practical application of new technologies), taking cognisance of synergies with HEI's and Innovation Centres (see breakdown of facility provision, Table 5)

It is recognised that some support exists in the form of the Scottish Manufacturing Advisory Service (SMAS) and the Market Driven Supply Chains (MDSC) project but these do not offer access to facilities and equipment.

As mentioned, it will be important to understand if these are absolute gaps in the support infrastructure in Scotland or if there are other ways in which companies are successfully addressing their needs in these areas. It may be that existing infrastructure can be positioned differently to address perceived gaps and this may need further investigation if new propositions are brought forward. If these gaps have not been addressed since the initial Campden BRI report was written in 2014, why is this? Do these perceived gaps hinder competitiveness and innovation within the sector? Any proposition for new facilities within the sector needs to be able to address these questions and they should be considered carefully to ensure that no displacement or duplication occurs in terms of the world class provision of expertise already in place within Scotland. It is also important to ensure that any new developments are sustainable and viable in the longer term and are tested against industry need.

The second perceived gap relates to a capacity gap in terms of SMEs ability to take advantage of the available infrastructure currently available. A number of barriers to innovation were highlighted in section 2 of the report and these can be categorised as issues related to the capacity of organisations to undertake innovation in their business. For example, time and resource barriers were repeated throughout the consultations but also issues related to the lack of skills at the management levels and dedicated innovation 'champions' to drive and manage innovation within the workplace. These demonstrate a capacity gap that needs to be addressed rather than demonstrating a lack of ambition or desire within businesses to take advantage of what's available in the innovation ecosystem.

In relation to this, the consultations highlighted the importance of incubator facilities and how access to these can be hugely important in stimulating innovation in SMEs. There are already incubators and accelerator facilities available across Scotland but small businesses are unlikely to travel out with their local area and so a widespread regional requirement exists to support early stage businesses to get access to the right facilities and sector knowledge. Added value support such as the availability of food technologists and other innovation experts within these spaces was also suggested to inspire innovation and development to address capacity issues that exist for companies in accessing and taking up innovation support that is available to them. In addition, the provision of agri food mentors would go some way to support the early growth of these enterprises.

5.1 Strengths and weaknesses of the innovation landscape

This study has demonstrated the breadth and depth of the current innovation infrastructure landscape in Scotland. It is useful then to summarise the key strength and weaknesses of this landscape to identify potential options that can be considered to address the weaknesses.

The strengths of the current food and drink innovation infrastructure landscape are:

- World class and internationally renowned academic institutions and researchers
- State of the art facilities for research and innovation support
- Collaborative innovation and research centres that have a reach out with Scotland with access to additional facilities and innovation opportunities
- Food and drink strategy with innovation and collaborative partnership at its core
- An understanding of the need to have a joined up process to support companies in terms of signposting and access to support systems
- Wide ranging support and access to numerous products, funding and advisor expertise within the public sector
- Wealth of student placement programmes that cascade innovation thinking into companies and create additional capacity for innovation
- Investment in collaborative research projects at a national and international level
- Supportive trade bodies, working for their subsector and the wider sector to support innovation
- Desire for more collaboration to address sector wide (and cross-sectoral) issues and challenged for manufacturing businesses

These highlight some of the key findings of the research, demonstrating the proactive nature of the sector and the quality of infrastructure already in place to support companies.

A number of weaknesses were highlighted throughout the study, however, and the key ones that relate to the study are shown here:

- Perceived limited infrastructure to support companies in scaling up their operations
- Lack of awareness by companies of what support is out there and how to access it
- Addressing the resource, skills and leadership constraints in companies to undertake innovation
- Limited collaboration across supply chains and across the different actors in the innovation space
- Lack of a critical mass of innovation activities (at a sector or technology level) to stimulate disruptive change
- Limited cross fertilisation of innovation support to harness opportunities and add value to leverage the effects of grant funding for innovation and/or capex

Again, it is noted that the new Make Innovation Happen service is designed to address some of these issues and that this is at an early stage of roll out. It is, therefore, not yet known to what extent it has/will create efficiencies and simplify the landscape for companies seeking innovation support.

6. Options for Collaboration and Outline Observations

6.1 Options for Collaboration

In seeking to address the weaknesses highlighted in the previous section to strengthen the innovation infrastructure landscape in Scotland a number of options have been developed to enhance the potential for collaboration. These are based on both desk research related to the landscape and the feedback received from the twenty six stakeholders consulted as part of this work. The stakeholders, as mentioned previously, were from across the full innovation support landscape and so their input has been extremely valuable in understanding the desire and ambition to enhance the current offering in terms of infrastructure and collaboration.

There is a widespread belief that collaboration is one of the most strategic ways in which to drive growth, productivity and business efficiency through innovation. There were a number of key areas of collaboration that stakeholders highlighted as important in addressing key innovation challenges for Scottish businesses. These provide options to address the weaknesses highlighted previously and enhance the innovation ecosystem that companies are operating within. These are:

- Collaboration across the innovation actors
- Common interest groups and clusters
- Communities of Practice

Collaboration across the innovation actors

The research indicates that there needs to be more collaboration and cooperation among the research institutions and organisations providing support within the innovation landscape. During the course of this study, we were asked to make introductions to other stakeholders within the food and drink space as there was a recognition that they should (but are not) already be talking with each other. This was surprising given the relatively small space in which sector operates in Scotland. This suggests, therefore, that there is a need to ensure that, within these 'innovation actors', the right people are connected to each other and that there is a means to facilitate regular dialogue in relation to how they are all addressing both specific issues and wider societal/sector challenges.

The interactions could take a number of forms, one of which could be in developing communities of practice, which are described below.

It is recognised that the Make Innovation Happen Collaboration Fund (launched in June 2017) is now available to support collaborative actions. This is an additional resource that can be tapped into within the emerging landscape and demonstrates the continuing demand for such activities.

Common interest groups and clusters

Common interest groups have worked well in recent years, as evidenced in the success of those developed by Interface Food and Drink. Interface Food and Drink set up 16 common

interest groups, including the Resource Efficiency Industry Advisory Group and the Scottish Rapeseed Oil group, which have proved to be highly successful. Developing more of these, where needed, or extending the work carried out to date, provides a means to help companies translate the needs of their business into practical actions. Importantly, it brings together multi-disciplinary teams, with a breadth of knowledge and expertise, that can work together to address common challenges in conjunction with companies. Stakeholder consultations, as mentioned, previously, were clear about the need to look at the common needs of the sector and to address these collaboratively as many concerns have a wider societal impact that will impact the whole supply chain.

Facilitating cluster development is also suggested as a means to stimulate more disruptive innovation with the sector in Scotland. Clusters would be based around similar projects and challenges for industry groups, but facilitated by an independent party to drive the process. Unlike individual projects that tend to create incremental change, stimulating multi-party projects and creating critical mass of innovation activities and projects is likely to have disruptive change that will foster more innovation and further growth. Feeding the result of these initiates back into the industry will create a tumble down effect and the impact on innovation and change will be greater.

Communities of Practice

Communities of Practice was highlighted as an opportunity for the food and drink sector to create a 'buzz' in companies around innovation and driving change either at a sector level or in response to a specific common challenge.

The definition of Communities of Practice are "groups of people who share a concern, a set of problems or passion about a topic and who deepen their knowledge and expertise in this area by interacting on an ongoing basis.....Over time, they develop a unique perspective on their topic as well as a body of common knowledge, practices and approaches. They also develop personal relationships and established ways of interacting. They may even develop a common sense of identity. They become a community of practice."[19]

Figure 2 represents the characteristics of a community of practice in which the sector can come together to work as a 'community' to understand how it can best effect change by harnessing the individual skills, resources and knowledge held in the group. The communities can, of course, interact online as well as in a physical setting.

[19] Wenger, E., McDermott, R. and Snyder, W. M. (2002): Cultivating Communities of Practice, Boston, MASS, Harvard Business School Press

Figure 3: Community of Practice[20]

The three key characteristics highlighted in figure 3 are[20]:

- Domain – the community of practice has an identity defined by a shared domain of interest (e.g. food and drink). Membership, therefore, implies a commitment to the domain and a shared competence that distinguishes members from other people
- Community – In pursuing their interest in their domain, members engage in joint activities and discussions, help each other and share information. They build relationships that enable them to learn from each other; they care about their standing with each other
- Practice – Members of a community of practice are practitioners. They develop a shared repertoire of resources: experiences, stories, tools and ways of addressing recurring problems— in short, a shared practice. This takes time and sustained interaction

A Community of Practice will also need a leader or coordination team to drive the initiative and coordinate those involved in the community. It could be used to support workplace innovation, supply chain innovation, drive sector strategies, address common/societal challenges, etc. Working together in this way allows a significant level of learning and sharing among those involved in the process. Solutions do not always come from obvious places and this is one option to stimulate and drive innovative solutions in an innovative way.

This type of initiative is also a potential way to address the resource and capacity constraints within companies that want to take advantage of innovation support. There are obviously

[20] Adapted - Wenger, E. (1998): Communities of Practice: learning, meaning and identity, Cambridge, Cambridge University Press

resources that need to be put into the 'community' but the benefits that can be harnessed could be significant.

Supporting Innovation Uptake in Companies

Over and above these strategic collaboration options, some additional suggestions are proposed to enhance the innovation infrastructure landscape and uptake by companies. These are:

- In order to leverage the value of grant funding, consideration could be given to the proactive targeting of companies receiving capex grants to have other innovative support directed to them as a consequence of their grant allocation
  - For example, FPMC grant recipients often present projects that could really benefit from additional support from research organisations or innovation specialists to enhance their offering and facilitate real change, whether a capex or cooperation type project
- The use of mentors from other likeminded businesses to support innovation thinking and learning journeys
  - The success of SEs open innovation programme is a testament to how important it can be to look outside the box and to challenge the status quo – both in large companies and SMEs
- Research to understand how the development and support of incubator facilities can provide enhanced services and support to take companies on the innovation journey by linking with technical and non-technical experts to achieve clarity on the product development cycle (these should not simply be an empty building with no support)
  - As mentioned previously, however, there is recognition that challenges exist for investors in both the implementation and operation of incubator facilities that meet the perceived requirement for having local access that will offer a sustainable and profitable operational model

Scotland's food and drink innovation landscape is wide and varied and has excellent support at all levels of industry and public sector. Its crowded nature can be confusing for companies and industry bodies alike but there is a clear willingness to work together to enhance competitiveness and growth in companies as well as an appetite to achieve the sector wide ambitions for Scotland.

6.2 Outline Observations

To stimulate and increase the uptake of innovation and enhance the landscape in which food and drink companies operate, the observations shown below are suggestions that could be considered for further discussion by the Scotland Food and Drink Partnership. This recognises the strength of the academic and research infrastructure that already exists in Scotland and seeks only to address areas highlighted in the discussions with stakeholders as options for future development. Furthermore, it takes account of the fact that, while a number of issues exist around ease of access to support, joining up provision and help to take full commercial

advantage of innovation investments, Make Innovation Happen has recently been established to address these issues.

It should be noted, when reviewing the observations below, that the landscape, in terms of existing support provision, is relatively busy and dynamic and organisations need be mindful of this when considering any new facilities or support within the sector (e.g. City Deal propositions). Indeed, consideration needs to be given to how new propositions will fit into and enhance the evolving landscape of innovation support for companies in Scotland.

Again, it is important to stress that any suggestions related to new physical infrastructure will require further investigation to ensure they would be sustainable and viable and tested against a defined industry need.

Based on the weaknesses highlighted in the study and collaboration options developed, the opportunities for further discussion that could be considered are:

- Support for the development of sub-sector (potentially integrated) innovation strategies that also look at understanding the current and emerging physical infrastructure needs of companies (at the sub-sector level)
- Address the low awareness of support that already exists in Scotland and the opportunities that industry can harness by using and linking with, for example, innovation centres, Interface, academia, etc.
- Investigate the possibility of technology demonstrator sites to support increased uptake of innovative solutions within the food and drink sector
- Further investigate the perceived gap in pilot scale activities and how this can be addressed – be it through increased awareness of existing / planned facilities and availability of access via innovation centre connections, for example, or to identify specific industry needs going forward
- Research to investigate the demand and potential uptake of enhanced/supported incubator facilities to verify the perception of demand by stakeholders, recognising the challenges of creating profitable and sustainable facilities
- Understand how Communities of Practice (as a novel way to effect action) might be used to drive change and stimulate innovation at sector level or to address specific common challenges
- Further research or an impact assessment exercise to :
  - understand the impact of collaborative research undertaken and how the benefits and knowledge from the public funded research has cascaded into industry – this could be at a societal, company, industry and behavioural level
  - support public sector bodies in future policy decisions related to investment in innovation and research
- Understand the potential for enhanced collaboration between (and among) innovation centres, research centres and industry players to address food and drink sector opportunities and challenges. Facilitation by the food and drink partnership could work to create a more cohesive response to industry needs that might strengthen Scotland's competitive position

- Initiate discussions to address the perceived disconnect between academia and industry and understand if any action needs to be taken to overcome any misconceptions or challenges that may hinder the wider uptake of innovation activities
- Seek a view on the potential to leverage the value of grant funding by creating a mechanism to offer additional public sector innovation support that will enhance the outputs of funded projects, facilitate real change and stimulate further growth and development of Scottish businesses
- Consider a mechanism to feed innovation related information such as case studies, developments, support programmes, event, etc. to trade bodies for dissemination to their members to stimulate innovative thinking at a sub sectoral level
- Initiate further discussion on how the sector can make better use of data (at all levels) to support decision making. Understand how the food and drink partnership can drive this discussion and support knowledge transfer across the sector

Note that the prioritisation of these observations is likely to change depending on the strategic views of the Partnership (or individual organisations within it) at any given time.

Appendix A – Stakeholder Organisations Consulted

Agri-EPI Centre
Campden BRI
CENSIS
CIEL
Dairy UK
Elmwood Campus, SRUC
Food and Drink Federation Scotland
Food Innovation Network KTN
Highlands and Islands Enterprise
IBioIC
Innovate UK
Interface
NFUS
SAOS
Scotch Whisky Association
Scotch Whisky Research Institute
Scotland Food and Drink
Scottish Aquaculture Innovation Centre (SAIC)
Scottish Bakers
Scottish Enterprise
Scottish Funding Council
Scottish Government
Seafood Scotland
SEFARI
SRUC/SAC
The Rowett Institute
Universities Scotland

business growth | economic development | technology commercialisation

Head Office

Optimat Ltd.

Torus Building, Rankine Avenue

Scottish Enterprise Technology Park

East Kilbride G75 0QF

tel: +44 (0)**1355 272 800**

fax: +44 (0)**1355 272 556**

web: **www.optimat.co.uk**

optimat