Coast to Capital: Strategic Economic Plan
Developing Networks of Innovation
Space to be Creative

Report for

Coast to Capital Local Enterprise Partnership

Version 1

by

Dr Dave Cooper
University of Chichester

October 2013

The following paper outlines the need for a top-down strategy review to complement the bottom-up analysis and consultation approach being taken to develop a Strategic Economic Plan for Coast to Capital. It provides a discussion on the need for a sector based vision and an approach for creating that vision. The strategy attempts to provide answers to three broad questions:

1. What is the Coast to Capital area to be known for?
2. How will we need to respond to developments in technology and other forms of innovation?
3. Where are we genuinely at the leading edge of innovation – what are our research and innovation strengths and where do they lead us?

Acknowledgements

The following individuals have supported the preparation of this work:

- **Dr Emma McKinley, University of Chichester**
- **Jamie Watson, Coast to Capital**
- **Lindsey Simpson, Coast to Capital**
- **Ian Parkes, SOA**
- **Mike Barrow, Department of Economics, University of Sussex**
- **Chris Baker, University of Brighton**
- **Mike Herd, Sussex Innovation Centre**
- **Phil Jones, Wired Sussex**
- **Rob Berry, Kent Surrey Sussex Academic Health Science Network**
- **Steve Welch, Electronics Sensors and Photonics Knowledge Transfer Network (Technology Strategy Board)**
- **Chris Thompson, Connected Digital Economy Catapult (TSB)**

Executive Summary

The development of the Coast to Capital Strategic Economic Plan is an opportunity to create a strategic vision for the region, which is effectively balanced; grounded in current priorities but also builds on existing strengths to develop a national and international profile. This vision has the potential to provide the platform to attract developers and businesses with associated significant investment in; jobs, infrastructure, commercial property and housing. It is likely that an ambitious and thematic approach will be more attractive for both Government and EU funding. It also has the potential to inspire a more innovative and enterprising culture in the population.

This top down approach has focused on the establishment of Regional Innovation Systems (RIS) underpinned by two core components Smart Specialisation and the creation of innovation friendly business environments for SMEs. It is based on a wider view of innovation that is not just technology based but recognises creativity in general and the value of open innovation systems, centred on collaborative networks and communities. The

outcome was the result primarily of desk based analysis of regional research strengths matched to UK technology priorities and a high level analysis of business profiles. It was further informed by regional priorities and the presence of existing networks and clusters of activity. The following sectors have been identified to form the basis of a RIS strategy:

- **Connected Digital Economy including, creative digital media, software development, Big Data**
- **Bioscience including Medical Technologies (Life Sciences)**
- **Electronics potentially further focused on vehicle electronics and sensors**
- **Environmental/Renewable Technologies**

Horticulture, Food Production and Agri-Science was also considered. It is an important sector for the region but has a limited regional HE research base and does not appear to have the jobs and GVA growth potential that Coast to Capital is looking to deliver. Although, it has not been recommended for inclusion in the RIS, it is suggested that specific sector initiatives are supported on a project by project basis.

The work has also developed a SWOT profile for the region related to characteristics that underpin subsequent RIS development.

Strengths	**Weaknesses**
• Strong Area Assets (FDI Report);Location, Lifestyle, Skills, Connections • Presence of a number of global companies across a range of sectors, some with their own research capability • A few strong sectors in enabling and growth technologies; digital, electronics, medical • 3 technologically research intensive universities • A number of strong independent research organisations • Leading centre for innovation and productisation (SINC)	• Few absolute sector strengths • Limited business clusters (exception is digital media) • Businesses tend to operate in isolation • HE is insufficiently connected to the local economy • Regional HEs have a limited global profile • Pockets of deprivation • Infrastructure disconnects (road ,rail, broadband) • Strong anti-development lobby • Levels of Innovation and business support are inconsistent
Opportunities	**Threats**
• Smart Specialisation focussed on key sectors • Utilising existing networks to develop regional initiatives; Kent Surrey Sussex Academic Health Science Network, Electronics Sensors and Photonics KTN, Connected Digital Economy Catapult • Development of focused micro-clusters and associated supply chains • Connecting HE into regional businesses possibly through the establishment of science parks • Exploiting ERDF and other EU funding streams e.g. Horizon 2020, Interreg V • Enterprise start-up and support framework • High growth product innovation support	• Initiatives will require significant long-term commitment, planning, leadership and investment in resources • HE does not buy-in to the need for regional collaboration and open-innovation • Sub-regional politics and the failure to agree on sector prioritisation, place based initiatives and overall need for a vision • Failure to engage with business around the vision • Selecting the wrong industries/sectors and not being allowed to make mistakes

Using Benneworth and Dassen's[1] profiling model for Strengthening Global-Local Connectivity in RIS (fig. 12), Coast to Capital regional analysis exhibits characteristics relating to both the need to build clusters and to strengthen global connections. They suggest that appropriate RIS support initiatives would include:

- Cluster-building programmes, bringing companies together and stimulating collective action, at least partly aiming to create a collective cluster identity.
- Increasing proximity between actors by encouraging routine encounters such as seminars, workshops, match-making, and collective bidding.
- Developing shared research infrastructure that brings businesses to solving business problems.
- Helping SMEs to fit into large firm supply networks, develop more local linkages and stimulate local innovation.
- Business support focused on networking activities, ensuring that these networks stimulate innovation rather than routine market activities.
- Support for innovation resources, assisting with finance, intellectual property (IP), skills, management training.

A range of potential sector specific initiatives have been proposed each revolving around establishing a network of innovation. The Coast to Capital LEP role would be to act as catalyst or convener for the innovation networks, to provide leadership where necessary, to draw in the required partners for each chosen network, and to support the network to self-sufficiency.

The other dimension for a successful RIS is the creation of innovation friendly business environments for SMEs. Previous work in this area researched the nature of support available to businesses and the organisations providing that support. The findings emphasise local business needs for face to face continual support and guidance for new and established businesses. They also raise the issues of finance for start-up businesses and the obstacle this plays in encouraging business formation. Coast to Capital is in a position to take a lead in supporting the creation and development of research and innovation intensive businesses.

Recommendations

A number of specific recommendations are made with a view to progressing this work.

1) Coast to Capital should work with potential stakeholders to explore and facilitate the development of Networks of Innovation in each of the proposed core sectors:

- **Connected Digital Economy including, creative digital media, software development, Big Data**
- **Bioscience including Medical Technologies (Life Sciences)**
- **Electronics potentially further focused on vehicle electronics and sensors**
- **Environmental/Renewable Technologies**

[1] [1] Benneworth, P. & Dassen, A. (2011) Strengthening Global-Local Connectivity in Regional Innovation Strategies, OECD

This will require bringing together stakeholders from business, research, local authorities and other areas as appropriate. It may be undertaken in association with other networks for example the Kent Sussex and Surrey Academic Health and Science Network in Life Sciences. The objective of these groups will be to explore; the viability of a network, identify common areas of interest, develop a potential purpose/focus for the network and a framework in which it can operate. It will be essential to begin to build trust amongst the stakeholders.

Building on the recommendations arising from Sir Andrew Witty's report[2], Coast to Capital should consider asking the Universities to chair these embryo innovation networks but ensure that both large and small businesses are adequately represented. They should seek to identify projects for development, potentially preparing for Witty's so called 'Arrow Head' project proposals.

It is specifically recommended that the Life Sciences Network explores the issue of an aging population as the basis for its activity.

It is also recommended that a summit is organised for the regional universities to explore the practicalities of developing a collaborative approach to environmental technology research and innovation. Each of the universities in the region has its own area of interest in relation to environmental technology and the low carbon agenda. This is mostly uncoordinated and may involve duplication. It is suggested that a coordinated and collaborative approach, involving all related initiatives that have the potential to reduce carbon emissions, would have real significance and facilitate the development of a national and international profile in this still fledgling sector.

Within this context Coast to Capital should undertake more in depth analysis into research, development and manufacturing capability in target sectors. Current analysis has been limited to desk based activity. It is necessary to contact businesses and research organisations to find out more specifically what they do at each site and their propensity to engage in regional activity.

2) Coast to Capital should work with the universities and key industries to investigate the development of at least one landmark regional centre of excellence/technopole associated with an innovation network sector to act as a focus for research and inward investment.

Such centres or science parks can act as a real stimulus to cluster building and networking.

3) Coast to Capital should take a lead in the creation of innovation friendly business environments for SMEs through the development and implementation of a coordinated and holistic strategy.

This should recognise and promote the principles of the Small Business Act for Europe**.**

[2] Encouraging a British Invention Revolution: Sir Andrew Witty's Review of Universities and Growth, Final Report and Recommendations, Oct 2013

- Create an environment in which entrepreneurs and family businesses can thrive and entrepreneurship is rewarded
- Ensure that honest entrepreneurs who have faced bankruptcy quickly get a second chance
- Design rules according to the "Think Small First" principle
- Make public administrations responsive to SMEs' needs
- Adapt public policy tools to SME needs: facilitate SMEs' participation in public procurement and better use State Aid possibilities for SMEs
- Facilitate SMEs' access to finance and develop a legal and business environment supportive to timely payments in commercial transactions
- Help SMEs to benefit more from the opportunities offered by the Single Market
- Promote the upgrading of skills in SMEs and all forms of innovation
- Enable SMEs to turn environmental challenges into opportunities
- Encourage and support SMEs to benefit from the growth of markets

The strategy should recognise the need to work with partners to establish region-wide initiatives to provide established and start-up businesses with structured, coordinated and sustainable support to promote growth, innovation and enterprise. This builds on the work undertaken to develop the Business Navigator portal and the successful RGF 4 bid and proposed Wave2 bid. Within this context, the universities should be encouraged to explore the potential to establish a similar consortium to the SETsquared partnership between the universities of Bath, Bristol, Exeter, Southampton and Surrey and focused on accelerating the development of technology based ventures[3]

Coast to Capital should further continue to develop and promote the export potential of small businesses within the region.

Coast to Capital should evaluate the potential implementation of a business charter across the region. The purpose of this informal charter, modelled on the Developer's Charter implemented by Arun District Council, would be to promote, for example, local supply chains, training and education, sustainable practice and equitable terms.

Coast to Capital should consider working with area partnerships and universities or colleges to evaluate and coordinate the development of a number of Innovation Centres / Enterprise Hubs. These might be themed e.g. electronic, engineering, creative, prototype production (Fablab, media production, e.g. Hethel Engineering Centre). It may be possible to work with the High Value Manufacturing Catapult to develop a local small business prototyping centre.

4) Coast to Capital should ensure that its skills strategy aligns with the sector specific aims of this strategy and supports the development of a knowledge base that will underpin the needs of the core sectors identified.

It should specifically take action to ensure that all schools and colleges have visibility of the Handbook for Enterprise Education[4] and are actively engaged in developing enterprising

[3] http://www.setsquared.co.uk/support-early-stage-companies
[4] Batchelor, L (2013), A Handbook for Enterprise Education, Coast to Capital

mind-sets. It should also work with schools, colleges, universities and industry to promote the development of effective digital skills at all levels.

Contents

1.0 Introduction

Following the response to the Heseltine report on local growth[5], the Government is asking LEPs to develop new strategic multi-year plans for local growth. Funding for local areas from the newly created Single Local Growth Fund will reflect the quality of strategic proposals put forward by LEPs.

The Single Local Growth Fund will be allocated through a process of negotiation of a Local Growth Deal and using competitive tension to strengthen incentives on LEPs and their partners to generate growth. The size of the potential fund will be announced as part of Spending Round for 2015-16. There is a commitment to include elements of skills, transport and housing funding.

EU structural funds will also be aligned and strategic plans will need to consider both aspects. EU priorities are innovation and R&D, support for SMEs, skills, low carbon, employment and social inclusion.

LEPs will also have to create new skills strategies, fully integrated with the strategy for local growth.

A project has been established to create a Strategic Economic Plan for Coast to Capital, which adds value to existing plans and policies and which enjoys the endorsement of all key stakeholders. A key component of the project is to take a bottom-up approach based on an analysis of existing regional socio-economic plans and consultation. Whilst this is critical, this type of approach tends to produce outcomes which focus on today's issues. This was evidenced in the results from the Open Space Forum run by Coast to Capital in March 2013.

[5] Lord Heseltine, (Oct 2012), No Stone Unturned In Pursuit of Growth

The development of the Strategic Economic Plan is an opportunity to create a strategic vision for the region, which is effectively balanced; grounded in current priorities but also builds on existing strengths to develop a national and international profile. This vision has the potential to provide the platform to attract developers and businesses with associated significant investment in; jobs, infrastructure, commercial property and housing. It is likely that an ambitious and thematic approach will be more attractive for both Government and EU funding. It also has the potential to inspire a more innovative and enterprising culture in the population.

To facilitate this debate, it has been suggested that the bottom-up approach should be complemented by a top-down strategic development initiative. The following paper is a development of these ideas. The approach draws on work undertaken by the EU on Regional Policy for Smart Growth in Europe 2020 (May 2011) and the work undertaken on Smart Specialisation presented The Guide to Research and Innovation Strategies for Smart Specialisations – RIS 3 (May 2012). The underpinning objectives are focused on smart, sustainable and inclusive growth. It is a strategy for the long term.

2.0 Context

There is a growing body of evidence to support highly focused regional development

2.1 Smart Growth

The EU has become an increasing advocate for regional innovation systems (RIS) based around the idea of Smart Growth[6]. "Increasingly, there is strong agreement that innovation is the key factor in promoting competitiveness in a globalizing knowledge economy."[7] However, the direct link between growth and innovation is more complex although "it has been long understood that the generation, exploitation and diffusion of knowledge are fundamental to economic growth, development and the well-being of nations"[8]. The concept of Smart Growth is focused on developing the innovation potential of regions, recognising that the capacity to innovate is dependent on local factors; business culture, skills, education, research capacity, investment and finance and creative potential to name a few. It recognises that innovation is increasingly diverse, complex and can involve many stakeholders and no single region is the same. It is underpinned by two core components Smart Specialisation and the creation of innovation friendly business environments for SMEs. It is based on a wider view of innovation that is not just technology based but recognises creativity in general and the value of open innovation systems, centred on collaborative networks and communities.

Sir Andrew Witty's Review of Universities and Growth (Oct 2013)[9] states that "The strongest basis for regional economic growth is activity rooted in a sound understanding of a locality's comparative economic advantage. This means that the task of Local Enterprise Partnerships (LEPs) and other bodies seeking local growth is to understand where comparative economic advantage lies, and to focus on how best to land the benefits of associated economic activity for their locality."

This broad concept of innovation has its roots in the work of Joseph Schumpeter[10] who reasoned that economic development and growth is driven by a clear process in which new technologies replace outmoded ones. He identified two types of change, radical and incremental and within this, proposed a list of 5 types of innovation:

i) Introduction of new products
ii) Introduction of new methods of production
iii) Opening of new markets
iv) Development of new sources of supply for raw materials or other inputs
v) Creation of new market structures in an industry

---

[6] Commission Communication – Europe 2020: a strategy for smart, sustainable and inclusive growth. COM(2010)2020, 3 March 2010
[7] Asheim et al (July 2011), Constructing Regional Advantage: Towards State-of-the-Art Regional System Innovation Policies in Europe? European Planning Policies, Vol 19, No 7, Routledge
[8] Oslo Manual (2005), Guidelines for collecting and interpretating innovation data, 3rd ed. OECD
[9] Encouraging a British Invention Revolution: Sir Andrew Witty's Review of Universities and Growth, Final Report and Recommendations, Oct 2013
[10] Schumpeter, J. (1934), The Theory of Economic Development

The OECD has refined these into four types of innovation[11]:

Product innovation is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics.

Process innovation is the implementation of a new or significantly improved production or delivery method. This includes substantial changes in techniques, equipment and/or software.

Marketing innovation involves significant changes in product design or packaging, placement, promotion or pricing. (Design refers to product form and appearance; those changes that do not alter the product's functional or user characteristics).

Organisational innovation has to do with a firm's business practices, workplace organisation or external relations. For example, new practices could improve learning and knowledge sharing within the firm (establishing databases of best practices, lessons and other knowledge; introduction of management systems for general production or supply operations, such as supply chain management, business re-engineering, lean production and quality management).

A literature review on the development of innovation models and the relationship with business clusters is explored in Appendix 1. This is an unpublished piece of work that was undertaken at the University of Chichester as part of the CAMIS project.

2.2 Smart Specialisation

"Smart Specialisation is an important policy rationale and concept for regional innovation policy. It promotes efficient, effective and synergistic use of public investments and supports regions in diversifying and upgrading existing industries and in strengthening their innovation capacity."[12] Smart Specialisation strategies build on existing strengths and capabilities in a thematic way. They help to concentrate resources and finances on a few key priorities rather than spreading investments thinly across areas and business sectors. Smart Specialisation has the potential to; stimulate private investment, ensure that research and innovation resources reach a critical mass, promote local business cluster activity and supply chains and provide a focus for inward investment and export. It is about identifying those areas that a region can be known for, which is currently not clear for Coast to Capital. This has many consequences for example there have been no recent significant funding awards made for research centre developments aligned to technological developments in the region.

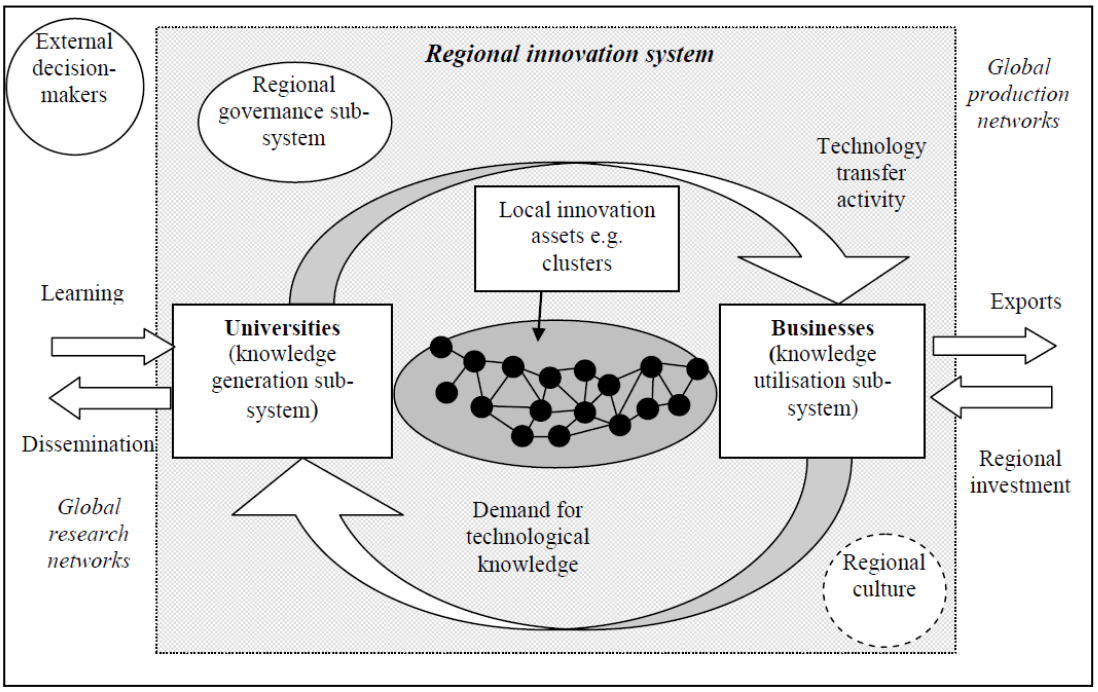
[11] High Growth Enterprises; What Governments can do to Make a Difference? – © OECD 2010
[12] Regional Policy for Smart Growth in Europe 2020, EU, May 2011

Concepts of Smart Specialisation are a development of Regional Innovation Systems (RIS)and were introduced in 1994. The innovation model of a Regional Innovation System (RIS) is one of the most modern approaches for supporting innovation and assessing the effects of innovation on specific regions. It is an innovation policy that promotes regional science, technology and innovation with the participation of regional stakeholders (Zabala-Iturriagagoitia, Jimenez-Saez et al. 2008)[13]. Business clustering is intertwined with the model of RIS as the latter provides necessary conditions for the formation of clusters. It is associated with knowledge spill-overs and encourages innovative activities through R&D and investments in technology. The main goals were to:

- Promote more open processes to help the development of regions.
- Create an innovation culture.
- Identify the needs of regional firms in terms of innovation support services.
- Help Small and Medium Sized Enterprises (SMEs) grow.
- Coordinate existing innovation support strategies.
- Promote inter-firm and public-private networking and collaboration.
- Encourage horizontal clustering.
- Identify new pilot innovation projects and themes.
- Integrate interregional cooperation and policies within Europe.

RIS is further explored in Appendix 1. One critical point about RIS is the complex network of stakeholders working in an open environment operating within the region but effectively networked both nationally and internationally. The complexity is illustrated in Fig. 1.

13 Zabala-Iturriagagoitia, L., L. Jimenez-Saez, et al. (2008). "Evaluating European Regional Innovation Strategies." European Planning Studies 16(8): 1145 - 1160.



Source: Authors' own design after Cooke, P (2005), "Regionally Asymmetric Knowledge Capabilities and Open Innovation: Exploring 'Globalisation 2' – A New Model of Industry Organisation", *Research Policy*, 34, pp. 1128-1149.

Figure 1, Regional Innovation System Network[14]

To be effective Smart Specialisation requires; a vision; clear governance and policy; effective collaboration between businesses, universities and research centres; business clusters linked to regional supply chains; high quality transport and communication infrastructures; matched skills and education; innovative and entrepreneurial SMEs.

This emphasis on a sector focus is widely recognised,

"Sectoral strengths and clusters are a sound starting point for creating regional growth, and this implies collaboration between LEPs and universities across the country." Independent Review of Universities and Growth: Preliminary Findings, Sir Andrew Witty, July 2013

"Coast to Capital is advised to focus on a manageable number of viable interventions for supporting sectors and latent clusters with growth potential – The aim should be to take a long term commitment to support worthwhile initiatives." Exploration of High Impact Business Growth Models for Coast to Capital, Economic Growth management Ltd, July 2013

It is however recognised that many issues with promoting industrial policies in the past have been attributed to attempts to 'pick winners'. This was the focus of a debate in February 2011[15] and directly addressed by John Kay, Visiting Professor at the London School of Economics: "Industrial policy is, to my mind, all about picking winners. Of course, picking

[14] Ref. Benneworth, P. & Dassen, A. (2011) Strengthening Global-Local Connectivity in Regional Innovation Strategies, OECD

[15] © 2011 The Authors. Public Policy Research © 2011 ippr public_policy_research_–_December–February_2011 183

winners has a terrible reputation, but that is because in the past governments didn't really pick winners – instead they picked industries they knew nothing about but which they thought would be very nice to have, like various kinds of advanced technologies. Or worse, they picked losers. 'Picking winners' was just a banner under which governments gave large subsidies to failing firms, which as a result failed slightly more slowly than they would otherwise have done. But in the UK we have a range of sectors in which we have competitive advantage."

Developing a Smart Specialisation Strategy is dependent on developing strategic intelligence about the region and identifying those sectors in which Coast to Capital has a strategic advantage. This work followed an approach as outlined in Fig 2 on the next page.

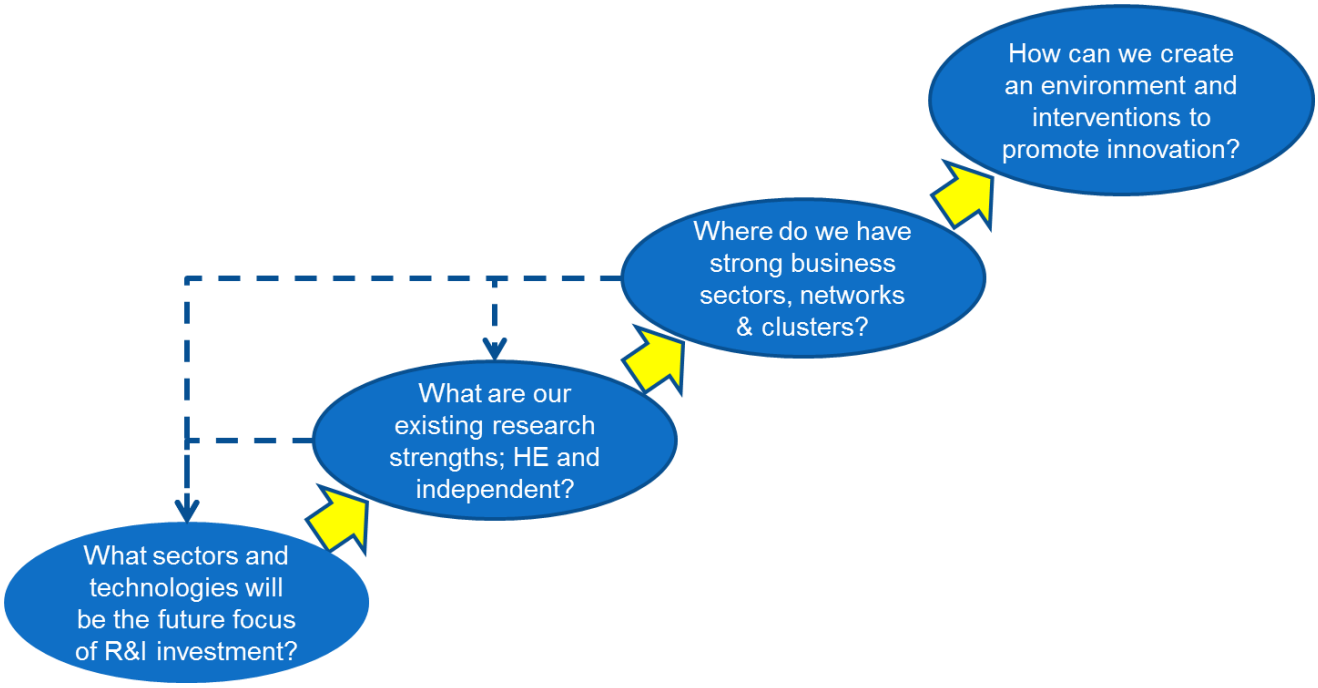


Figure 2, Identifying Regional Strategic Advantage

3.0 Technological Alignment

There is widespread agreement about the broad focus for technology research over the next decade

The starting point for the work is an evaluation of those technologies/sectors which are likely to be the focus of research and development activity over the coming decade. The UK government has decided to concentrate its resources on a specific sub-set; the 'Eight Great Technologies'[16]. Described in an article by David Willets, Minister of State for Universities and Science, they have subsequently been backed by the Chancellor of the Exchequer. These technologies can be aligned with Coast to Capital sectors as follows:

Technologies	C to C sector alignment
The big data revolution and energy-efficient computing	Creative, digital and IT
Satellites and commercial applications of space	
Robotics and autonomous systems	Advanced engineering
Life sciences, genomics and synthetic biology	Health and life science
Regenerative medicine	Health and life science
Agri-science	
Advanced materials and nano-technology	Advanced Engineering
Energy and its storage	Environmental Technologies

In selecting these technologies, the government is fully aware of previous failures when attempting to pick winners. Essentially it has identified "…big general purpose technologies. Each one has implications potentially so significant that they stretch way beyond any one particular industrial sector – just as Information Technology has transformed retailing in recent years, so satellite services could deliver precision agriculture in the future." Technologies on the list have been selected based on three criteria; scientific relevance and potential, a distinctive UK strength and at a stage of development where new technologies are emerging with identifiable commercial opportunities. The emphasis is on value capture not just on value creation.

The work presented as the Eight Great technologies draws on previous UK 'Foresight' studies undertaken[17]. More recently Mckinsey have identified 12 economically disruptive technologies[18]:

[16] Willets' D. (2013), The Eight Great Technologies, Policy Exchange
[17] Technology and Innovation Futures: UK Growth Opportunities for the 2020's, 2012 Refresh, Government Office for Science, Foresight Report.

- Mobile internet
- Automation of knowledge work
- Internet of things
- Cloud technology
- Advanced robotics
- Autonomous vehicles
- Next generation genomics
- Energy storage
- 3D printing
- Advanced materials
- Advanced oil and gas exploration
- Renewable energy

These have similarity to the eight great technologies and can in part be subsumed into this categorisation. The Top Ten Strategic Technology Trends for 2014 from Gartner[19] also reinforces and extends the IT components of this work:

The technology focus within the UK appears to be reasonably stable and is being used to inform government policy and investment. As an example the Technology Strategy Board (TSB) is creating seven catapult centres each targeting an area that has been identified as strategically important for the UK and which, has a large global market potential:

- **High value manufacturing** - Driving manufacturing innovation to commercial reality.
- **Cell therapy** - Growing a UK cell therapy industry that delivers health and wealth.
- **Offshore renewable energy** - Applying innovative solutions for economic growth in offshore wind, wave and tidal generation.
- **Satellite applications** - Applying satellite solutions for economic growth.
- **Connected digital economy** - Accelerating growth through the Digital Economy.

---

[18] McKinsey Global Institute (May 2013), Disruptive Technologies: Advances that will transform life, business and the global economy

[19] http://www.gartner.com/technology/research/top-10-technology-trends/ October 2013

- **Future cities** - Creating integrated systems delivering products and services that meet the future needs of the world's cities.
- **Transport systems** - Driving economic growth though the efficient and cost-effective movement of people and goods.

Within the context of this section, it is also worth noting the key priorities of the EU structural funding (ESF) allocation for 2014-2020. These will inevitably influence research priorities for ESF, Horizon 2020 and Interreg V for example. Although not as focused as the Eight Great Technologies, they do provide a number of cross-cutting themes, especially in relation to focusing support on SMEs and innovation.

Top priorities

- Research, technological development and innovation – especially commercialisation
- Raising SME competitiveness – especially re exports
- Shift to low-carbon economy – especially energy efficiency & renewable technologies
- Employment & skills (including social inclusion)

Other objectives

- Climate change adaptation, risk prevention & management
- Environmental protection & resource efficiency
- Sustainable transport and removing network bottlenecks
- Access to & use of ICT

It is critical that any Coast to Capital innovation strategy recognises that these technologies will be the basis of funding opportunities well into the future.

4.0 Coast to Capital Research Strengths

All of the reports on developing regional innovation models recognise the importance of building on regional strengths both in terms of existing business capability but equally importantly, emphasise the importance of Higher Education. The Wilson Report into Business and University collaboration[20] recognises that, "Universities are an integral part of the skills and innovation supply chain to business." It also states that universities have a key role to play in Local Enterprise Partnerships and should, "support their local economy through proactive engagement, both through increased collaboration with SMEs and through partnerships with major corporates."

Of further significance to this piece of work, the report highlights the relationship between universities and enterprise zones. These could benefit from the strength and reputation of local universities in promotion, and from their capacity for research, innovation and high-level skills provision, to attract business. It was noted that some local authorities are acquiring the powers to create enterprise zone conditions within existing and prospective university science parks. "This is an opportunity that has the potential to achieve significant economic growth—in some ways emulating the US business clusters that exist around their research-intensive universities, but exploiting the complementary nature of excellence within the UK university sector."

To establish the capability of universities within the region, an analysis has been undertaken based on a desk based review of research capability that has been tested through conversation where possible. Sources included the universities' own websites and publications together with both versions of the Witty Review[2122]. Universities included from within the region are: Brighton, Sussex, Chichester and University of the Creative Arts. Although, outside the region, Surrey was included due to its proximity and potential influence, for example, in the Gatwick Diamond. The work has been guided by Coast to Capital sectors of interest, the Eight Great Technologies and McKinsey's 12 disruptive technologies to provide a framework. As such it has not considered research beyond technical activities. On this basis, the potential levels of contribution from Chichester and the Creative Arts are limited. Although both Sussex and Brighton Universities are involved in effective research, it is clear that they do not have the international profile in this area that Surrey, for example, has. Capabilities are summarised in the following sections:-

4.1 The University of Brighton

Summary

The University of Brighton is one of the larger HE institutions in the Coast to Capital region. It actively participates in a wide range of research, and exhibits substantial expertise that can link to the various priority areas identified by Coast to Capital. The research, conducted

[20] Wilson, T. (Feb 2012), A Review of Business- University Collaboration
[21] Witty, A. (July 2013), Independent Review of Universities and Growth: Preliminary Findings
[22] Encouraging a British Invention Revolution: Sir Andrew Witty's Review of Universities and Growth, Final Report and Recommendations, Oct 2013

across the University's departments, includes: business development, social informatics, artificial intelligence, medicine and pharmaceuticals, tourism and services management, and environmental technologies and management. The University was identified as a Rising Research Star in the national Research Assessment Exercise of 2008.

Link to Eight Great Technologies

Life Sciences
Regenerative medicine
Advanced materials
Environmental technologies
Synthetic biology

Relevant Research

Research in the Faculty of Science and Engineering seeks to actively contribute to the sustainable future agenda, addressing global issues including water and energy supply, waste management and the development of technological solutions to sustainability concerns.

The School of Pharmacy and Biomedical Science supports over 100 staff members and works alongside the Brighton and Sussex Medical School developing regenerative medicine treatments, with recent success in achieving a £200K research grant. It has specific expertise in disease processes, biomedical materials and nanoscience/nanotechnology. (Head: Prof John Smart)

The Brighton and Sussex Medical School is a collaborative venture which supports a range of research, including the development of advanced biomaterials for use in regenerative medicine, and is involved in the production of innovative treatments and furthering pharmacological understanding of drug interactions. (Dean: Prof John Cohen)

The Vetronics Research Centre is the only academic centre of excellence in the UK focusing on vehicle electronics, with the ultimate goal of increased safety. The strength of the Centre is built on state-of-the-art facilities, sophisticated modelling and simulation, practical experimentation and key partnerships with industry. (Head: Prof Elias Stipidis)

Sir Harry Ricardo Laboratories have over 30 researchers who work on areas such as increasing fuel and energy efficiency, fostering strong links between the University and Ricardo UK, and encouraging collaborations with over 40 academic institutions worldwide. (Head Prof Morgan Heikel)

The School of Computing, Engineering and Mathematics has research groups working on interactive technologies, informatics and, more specifically, grouped network data. Postgraduate Digital Media Arts and Digital Media Production programmes have been developed in collaboration with the city's industry and there is an internship programme that links talented graduates with local businesses.

The University's research related to the creative industries includes product design, focusing on the application of techniques in problem diagnosis and the subsequent development of

innovative solutions using advanced engineering technologies, and sustainable design – the ways in which goods can be designed to extend product life. Interdisciplinary investigation across the creative and performing arts, architecture and design, media, languages and literature is encouraged.

As part of the City Deal Project Brighton has proposed to develop a central research lab on the Preston Barracks site that will focus on establishing clusters covering; Big Data, Regenerative Medicine, Automotive, Musculoskeletal /degenerative disease, Smart Materials and the Green Growth Platform . The funds to develop the Green Growth Platform have just been awarded by Hefce.

4.2 The University of Sussex

Summary

The University of Sussex is the second largest University in the Coast to Capital region. The University has developed strong links with the local community and with other HE institutions within the region. Research and innovation in the university is delivered across a number of sectors including: Biochemistry and molecular biology, engine efficiency, health informatics, biomedical diagnostics, data management, informatics and data systems, and communications. Within the Witty report, it is noted that Sussex has received research funds mapped to the 8 great technologies in relation to Robotics and Big Data. It is also features in the QS world rankings for Physics and Psychology.

Link to Eight Great Technologies

Life Sciences
Regenerative medicine
Big data and energy efficient computing
Robotics and autonomous systems
Synthetic biology
Advanced Materials

Relevant Research
The Atack Lab (linked to Biomedical and Molecular biology) which is developing new drugs for cancer treatment. The school has also established the Sussex Genome Damage and Stability Centre, with strong links to the Brighton and Sussex Medical School. (Head: Prof John Atack)

The Brighton and Sussex Medical School engages research in the areas of regenerative medicine, alternative treatments for cancer, Alzheimer's, dementia and addiction. This collaborative venture between the Universities of Brighton and Sussex supports over 50 academic researchers active in a range of areas. (Dean: Prof John Cohen)

The School of Engineering and Design focus their research on vehicle efficiency, looking at energy efficiency for engines and drag reduction. (Head: Professor Diane Mynors)

The university also actively researches in the areas of informatics and data systems, management of data systems and biomedical diagnostics, development of video analytic software and robotics.

SPRU- Science and Technology Research examines issues raised by scientific and technological change. They pursue ways to achieve excellence, efficiency and competitiveness in the use of science and technology by firms engaged in knowledge exchange and innovation management; by industries and regional authorities seeking to understand technological trajectories and the clustering of companies; and governments seeking to nurture competences and capabilities.

Recent projects in SPRU have focused on developing more effective 'open' innovation systems; intellectual property rules; uses for expertise in governance and links between research, higher education and industry.

The Sussex Energy Group focuses on community led sustainable energy projects.

4.3 The University of Creative Arts

Summary

The UCA is a specialist university focusing their teaching and research in art, architecture, fashion, media and communications at different campuses across the South East and the Coast to Capital region. Although there is evidence of a range of high quality research, this is not taking place in the areas directly related to the technology focus. The UCA also supports enterprise through the EDGE consultancy network which is a bank of creative expertise and technical specialists who could be involved in the supporting businesses in terms of communications, creative digital media and promotional activity. Its work is highlighted in the Witty Review, “The University of the Creative Arts delivers a range of support for SMEs, including the first dedicated support in its region for low carbon innovation in SMEs. As well as supporting businesses to develop sustainable solutions, the University also supports companies' strategic development.”

Link to Eight Great Technologies

No direct link

Relevant Research

UCA has an international reputation for producing high quality research in the areas of craft and design, fashion, communications and media.

While it does not link to any of the priority growth areas identified for the Coast to Capital region, UCA could have a supporting role in encouraging economic and innovative growth for the region.

4.4 University of Chichester

Summary

One of the smaller universities in the region, Chichester is engaged in research including sports science, sports psychology, business and management, enterprise and innovation, and around the arts. While there is considerable research activity, there are only limited links to the proposed strategic growth areas for the Coast to Capital region. These would fit into work associated with diet, diabetes and support for small business enterprise.

Link to Eight Great Technologies

Life Sciences

Relevant Research

The University of Chichester is an active research institute with over 150 researchers covering a range of topics across the university's various departments. It undertakes research into innovation, business growth and development, internationally respected sport science, diet and psychology.

Through involvement with the Rampion Wind Energy and Kent Wind Energy Projects, the School of Enterprise Management and Leadership have developed significant understanding and specialist knowledge around supply chain development for the wind energy sector.

The University is developing an increasing reputation for the provision of effective business support and facilities to small and start-up businesses through contracts such as 'Be the Business' for WSCC.

4.5 University Of Surrey

Summary

The University of Surrey does not lie within the boundaries of the Coast to Capital region. However, the region has significant links with the institution and it was decided it was appropriate to consider the role the University could play in strengthening the surrounding area. It is a large university with a significant research capability of national and international standing.

Within the Witty report, it is noted that Surrey has received research funds mapped to the Eight Great Technologies in relation to Energy Storage, Robotics and Satellites. It is also the only regional university that features in the QS world rankings for Electronics, Environmental Science and Materials Science.

Link to Eight Great Technologies

Regenerative medicine

Synthetic biology
Pharmaceuticals
Advanced materials
Space and Satellites

Relevant Research

Development of the Advanced Technology Institute which also facilitates the Ion Beam Centre, a national centre for research and expertise for the impact of radiation on living cells. Development of the IBC was supported by £1.5million grant, and is a collaborative venture between a number of HE institutions. (Director: Professor Roger Webb)

The Surrey Materials Institute supports 50 academics who conduct research into the properties of structural materials and has had successes in digital technology, creating one of the components now integral to CD, DVD, and Blu-ray technologies, with recent funding success of £3.5million to relocate the SMI.

The Centre of Communication Systems Research supports over 150 researchers covering a range of topics. Additionally, it houses the world's first 5G research centre, which will focus on developing the next generation of mobile internet technologies. (Head: Prof Rahim Tafazolli)

The Department of Health and Medical Sciences is affiliated with various research centres specialising in a number of areas, including: diabetes treatment, the Centre for Toxicology, Surrey Sleep research Centre, and the Surrey Materials Institute, and have developed new cancer detection tests. (Research Officer: Dr Rosalyn Casey)

Links to the Surrey Research Park which supports a range of companies which are active in the fields of communications, mobile phone technology and biomedicine.

4.6 Independent Research Organisations

There are a number of independent research organisations in the area; Leatherhead Food Research (food production), Campden BRI (brewing), The Blond McIndoe Research Foundation (wound healing). A brief summary of their respective capabilities follows:-

Leatherhead Food Research

The organisation is funded by its 1500 members in the global food and beverage market - ranging from large multi-nationals to SMEs, and including ingredient suppliers, manufacturers, retailers and foodservice businesses. 50% of its membership are based in the UK and Europe and 50% in the rest of the world. It is successful and operates profitably with a turnover of £9m pa. Its services include market intelligence, food research and analysis, food legislation, business and technical information and training. It does not focus regionally and does not have any particular insights on local food production activity. It has undertaken work with regional universities including Reading, Sussex and Surrey. The Sussex work was in the area of nutrition. They would be interested in working with Coast to

capital and could see potential activity associated with for example; nutrition, diabetes and obesity.

Specific services include:

- Regulatory Services
- Food Innovation: Focusing on food ingredients and product formulation
- Sensory & Consumer: Sensory evaluation and consumer insight research to the food and drink industry.
- Nutrition: Research on nutrition and human health.
- Food Safety

Campden BRI

Campden BRI is also a membership focused organisation operating across two sites. The Head Office is at Chipping Campden in Gloucestershire and the Brewing Division at Nutfield in Surrey. They have some 1400 members and employ 300 staff turning over £20m pa. They provide practical scientific, technical, legislative and information support to the food, drink and allied industries. Specific strengths include:

- Manufacturing technologies - food processing (heating, chilling, freezing), aseptic technology, microwave heating, malting and brewing, milling, baking and extrusion, process control and instrumentation, and packaging technology
- Safety assurance - including hygiene and sanitation, microbiology and preservation, processing technologies, analysis and testing (microbiological, chemical), and quality and safety management systems
- Product development, product quality, consumer studies, market insights, sensory science, authenticity testing, shelf-life evaluation, labelling and legislation
- Agri-food production, ingredients and raw material technologies
- Training courses and events delivered by world-class experts
- Leading industry guidance on best practice and legislation

The Blond McIndoe Research Organisation

Located on the site of the Queen Victoria NHS Trust Hospital at East Grinstead in West Sussex, the Blond McIndoe Research Foundation (BMRF) is a research charity that works to improve wound healing, repair and regeneration to assist medical professionals treat burns survivors, and patients with soft tissue injuries. Their aim is to develop new procedures and technologies that will simplify treatments, reduce healing time and reduce scarring left by their injuries.

They work closely with the hospital and other centres including the University of Brighton, Brighton and Sussex Medical School, Imperial College London and University College London. Their research covers:

- Skin regeneration – reconstructing skin after trauma to restore appearance and function

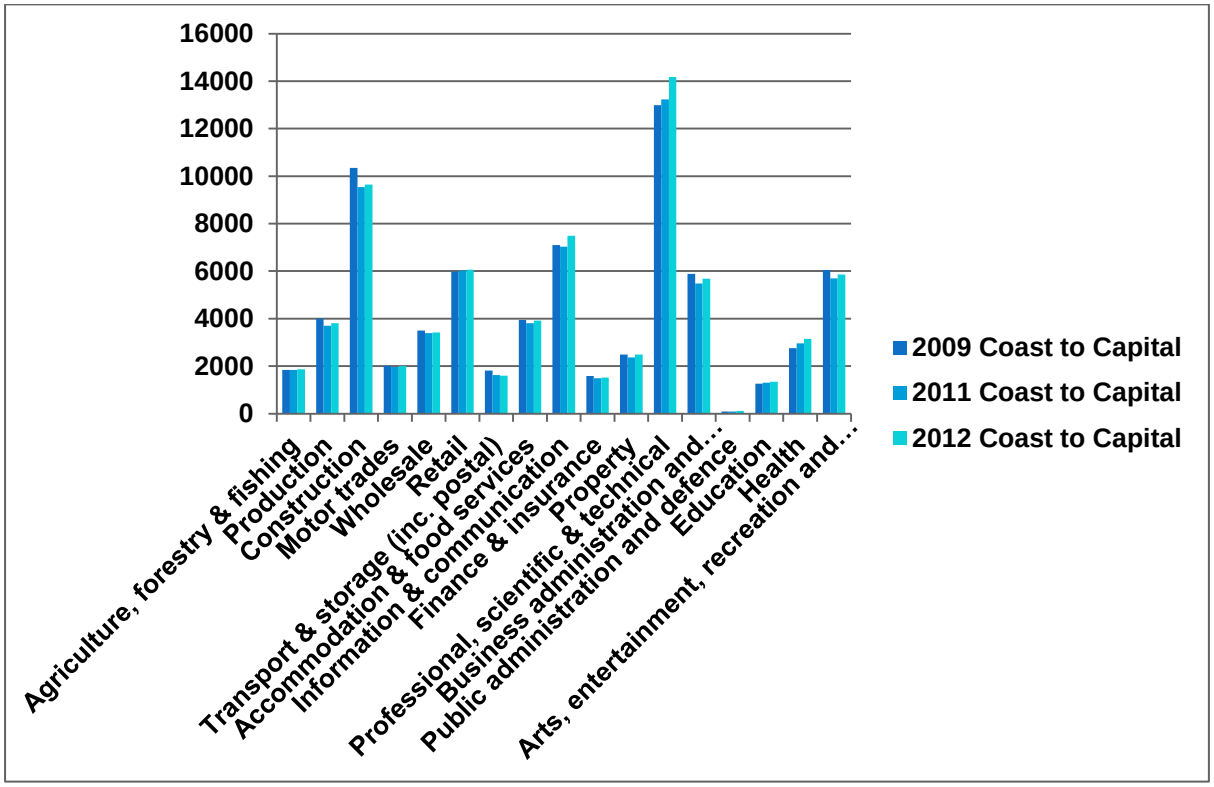
- Nano-structured materials – controlling the behaviour of wound repairing cells
- Wound assessment tools – positive detection of wound infection to reduce healing complications
- Soft tissue reconstruction
- Melanoma – The role of miRNAs in disease progression of malignant melanoma

5.0 Coast to Capital Business Sector Strengths

The RIS 3 Guide[23] emphasises the importance of building on existing economic strengths and avoiding duplication of activity between proximate regions. Initial work undertaken on behalf of Coast to Capital[24] identified regional sector strengths;

- Health and Life Sciences
- Creative, Digital and IT
- Advanced Engineering
- Financial and Business Services
- Environmental Technologies

This was reinforced by an initial SIC based analysis under this project:



However, this approach does lack some of the focus required for smart specialisation. Although significant sectors, it was decided not to develop work in the area of financial and business services. This is because they tend to be supported by cross sector technology innovation and are not specifically linked to HE research in the region or government investment. The research undertaken was desk based and used a variety of data sources. The principle database was the Bureau Van-Dyke (BV-D) database held by Coast to Capital. This is based on SIC Codes but does identify specific businesses. Other sources such as the Witty Interim Review and Growth Intelligence were also used to compliment the analysis.

[23] Foray, D. et al (May 2012), Guide to Research and Innovation Strategies for Smart Specialisation (RIS 3), EU
[24] Nairne, B. and Marshall, S. (May 2012), Foreign Direct Investment Report for the Coast to Capital Local Enterprise Partnership Board

The research undertaken identified the following business sector strengths for further consideration:

- **Bioscience including Medical Technologies (Life Sciences)**
- **Electronics with a potential focus on sensors and vehicle electronics**
- **Connected Digital Economy including, creative digital media, software development, Big Data**

This outcome was based on analysis of regional research strengths matched to UK technology priorities and a high level analysis of business profiles. It is further informed by the presence of existing networks and clusters of activity. It also recognises the existence of proximate clusters covering for example, Aerospace (Farnborough) and Marine (Solent).

The research considered two other sectors, **Environmental Technologies** and **Horticulture, Food Production and Agri-science**. Neither of these sectors appears to operate at the same level in terms of contribution to GVA and jobs as the other three within the region but both have significance. Environmental Technologies are a key focus of the Brighton City Deal and arguably at the beginnings of significant growth due to the potential demand for low-carbon initiatives. Horticulture is almost of strategic importance given the proportion of national market share for some produce grown in the region. The following sections discuss the merits of each of these sectors in turn.

This work was undertaken before the production of the Final Report and Recommendations of the Witty Review[25]. This reinforces the sector focus taken. It identifies sectors in which Coast to Capital specifically has higher employment location quotients as:

Life Sciences (Position has dropped between 2008 and 2012 (Closure of GSK?)
Information Economy
Education
Professional Services
Nuclear
Construction

The work utilises early information from a piece of research being undertaken for the Department of Business Innovation and Skills by the Enterprise Research Centre. This uses as its base the 11 Sectors identified in the UK Industrial Strategy for Growth. These are:

<u>Advanced Manufacturing</u>

Aerospace
Automotive
Life Sciences
Agri-tech

[25] Encouraging a British Invention Revolution: Sir Andrew Witty's Review of Universities and Growth, Final Report and Recommendations, Oct 2013

Knowledge Services

Education
Information economy
Professional and business services

Enabling sectors

Nuclear
Oil and gas
Offshore wind
Construction

It is appropriate to recognise these sector classifications as using they are the focus of individual sector strategies[26]. Focusing Coast to Capital strategic attention in associated sector areas is more likely to enhance the opportunities for initiative funding and success.

5.1 Bioscience Including Medical Technologies (Life Sciences)

The life sciences sector includes pharmaceuticals, medical technologies, diagnostics and medical biotechnologies. In SIC 2007 terms it is here defined as:

- Manufacture of basic pharmaceutical products and pharmaceutical preparations
- Manufacture of irradiation, electro-medical and electrotherapeutic equipment
- Manufacture of medical and dental instruments and supplies
- Research and experimental development on biotechnology

The Department of Business innovation and Skills Employment Location Quotient map for the UK Fig. 3 does indicate that Coast to Capital has a higher than average figure. The BV-D analysis Fig. 4 and 5 also demonstrates the presence of some significant businesses in the area.

There is a significant network developing, the Kent, Sussex and Surry Academic, Science and Health Network that has the potential to provide a focus for linked, research, business and health activity.

[26] https://www.gov.uk/government/collections/industrial-strategy-government-and-industry-in-partnership

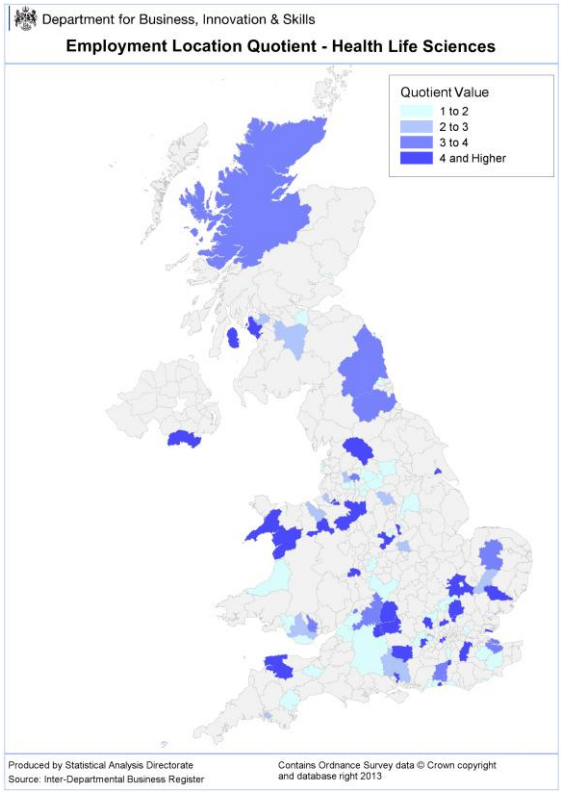
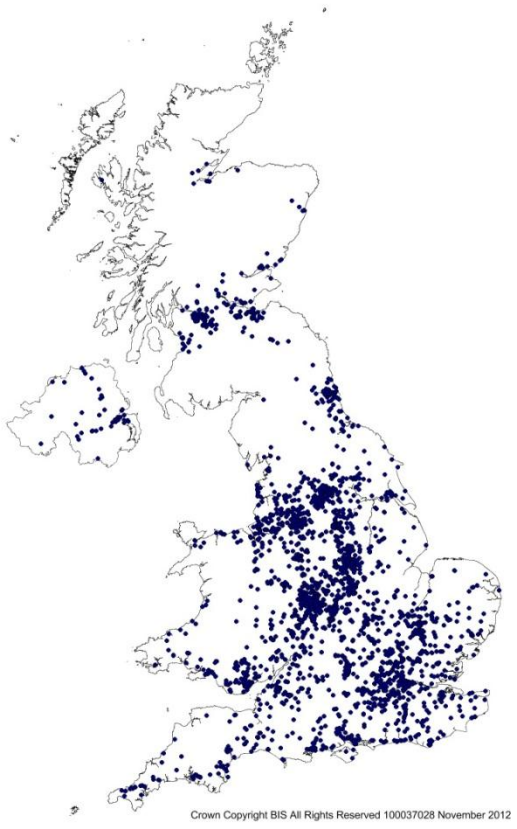


Figure 3

Companies with turnover larger than £500K



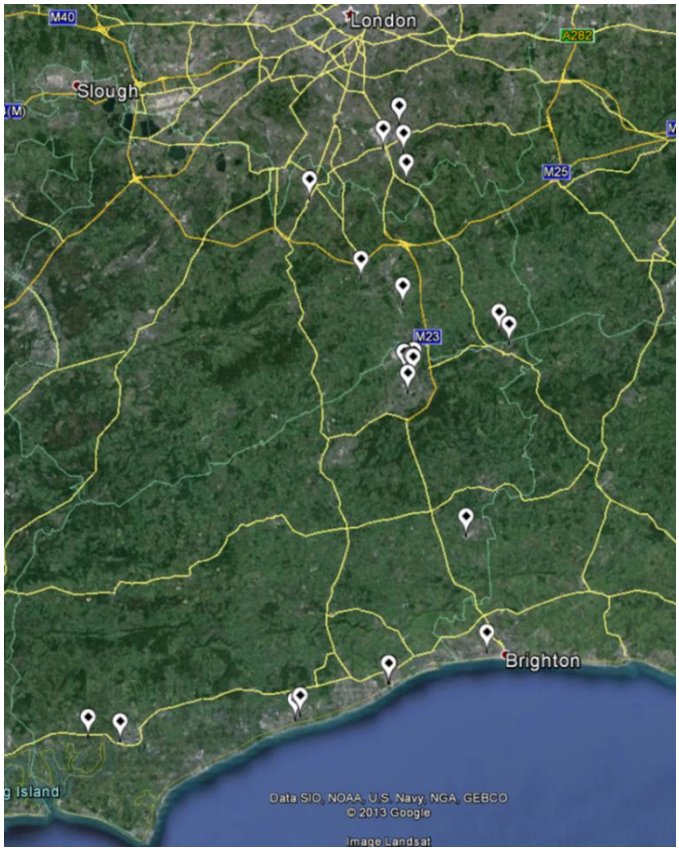
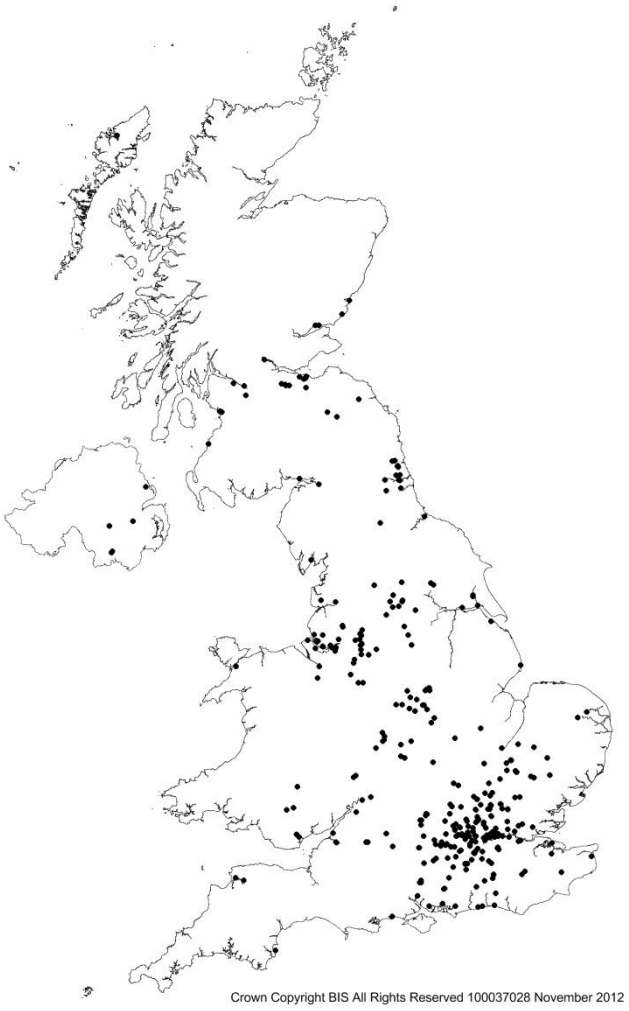
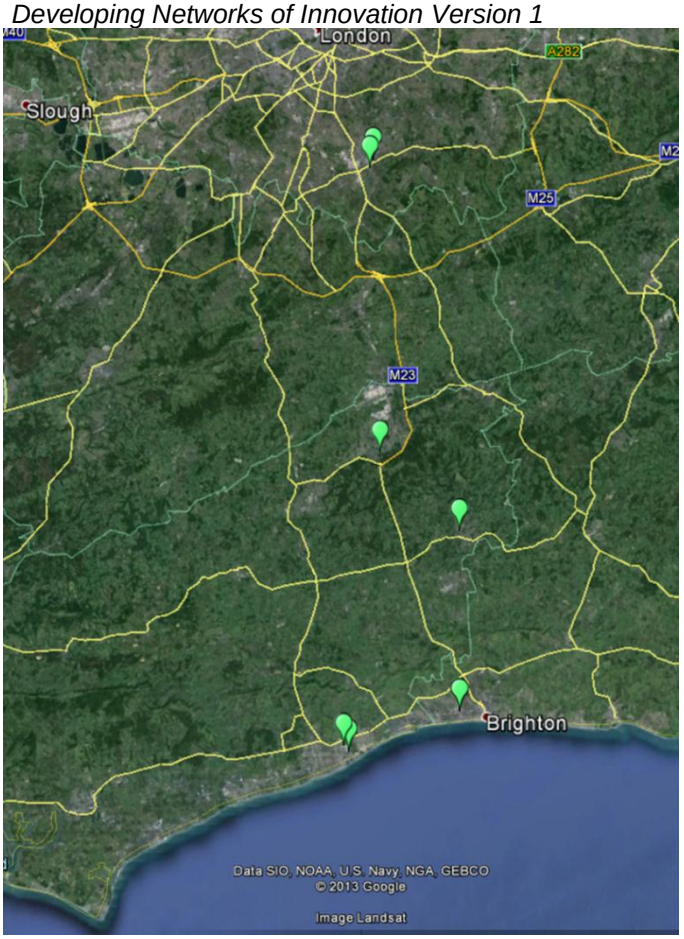


Figure 4, Distribution of Medical Technology Companies





Companies with turnover larger than £500K

Figure 5, Distribution of Pharmaceutical Companies

There are some significant businesses in the area, each with their own research capability, for example:

Example Pharmaceutical Businesses

Novo Nordisk UK - The company employs 360 people at its Crawley site. It has been operating within the UK for more than 25 years. Diabetes care accounts for 85% of business in the UK. Haemostasis management represents around 6% of business and Growth Hormone Therapy and Hormone replacement therapy account for approximately 6% and 3% respectively.

Allergy Therapeutics - Based in Worthing where most of its manufacturing and product development takes place. The company employs 350 staff. The company provides general information for the allergy sufferer and healthcare professionals about the prevention, diagnosis and treatment of the allergic condition with a special focus on allergy vaccination (also known as specific immunotherapy or desensitisation therapy). AT's current portfolio of competitive products includes products containing allergoids, (modified allergens) tyrosine depot and MPL® adjuvant.

Example Medical Technology Companies

Eleckta – Swedish owned, it employs some 800 staff on its Crawley site and produces some 400 X-Ray linear accelerators (linacs) for use in treating cancer every year. The large majority of these are exported worldwide. It is currently working with Phillips and the University Medical Centre Utrecht to develop the next generation of machines combining MRI with linacs.

Varian –Varian Medical Systems' European manufacturing headquarters is located in the heart of the Gatwick Diamond business region and employs more than 230 people. Its products are used in the treatment of cancer. Specifically, Exact™ couches for ultra-precise patient positioning are manufactured here, as well as VariSource™ HDR (high dose rate) afterloaders for brachytherapy treatment and the Acuity™ radiotherapy treatment planning, simulation and verification system.

Roche Diagnostics - headquartered in Burgess Hill, West Sussex, employs approximately 500 individuals. It provides a broad range of diagnostics and monitoring products and services, spanning all sectors of the market: from small hand held devices used directly by patients or healthcare professionals, to large diagnostic instruments found in hospital laboratories.

In particular, Roche has developed innovative systems for people with diabetes and those receiving anticoagulation therapy. In hospitals, their products support laboratory services by providing accurate diagnosis of patient samples and enabling the rapid diagnosis of medical conditions in Accident & Emergency, intensive care or in the operating theatre.

Roche pioneered the application of Polymerase Chain Reaction (PCR) technology and products enable clinicians to monitor the progression of diseases and their patients' response to treatment. They are also one of the world's leading manufacturers of research reagents and systems for determining the causes of, or people's predisposition to, disease.

Eschmann – is located in Lancing and employ over 200 people in the manufacture and supply of medical products and devices to hospitals, GP surgeries, and dental practices in both the private sector and public sectors. Eschmann design and manufacture a range of market leading products, including: powered operating tables, operating table accessories, specialist operating tables, operating theatre lighting systems, surgical suction units, benchtop autoclaves, electrosurgery units and accessories such as smoke evacuation units, monopolar and bipolar forceps, scissors and electrodes.

5.2 Connected Digital Economy (CDE)

In SIC 2007 terms the information economy sector is here defined as:

- Software publishing
- Telecommunications
- Computer programming, consultancy and related activities
- Information service activities

This produces an employment location quotient that demonstrates the South East is marginally better than average compared to the rest of the UK. However Growth Intelligence takes a much broader view of the sector than that offered by a SIC Code analysis alone. The resulting paper[27] suggests that "The digital economy is highly concentrated in a few locations. In terms of raw firm counts, London dominates but Manchester, Birmingham, **Brighton** and locations in the Greater South East (such as Reading and **Crawley**) also feature in the top 10, Fig 6. The report also suggests that companies in the digital economy exhibit higher than average rates of growth and tend to have higher rates of employment.

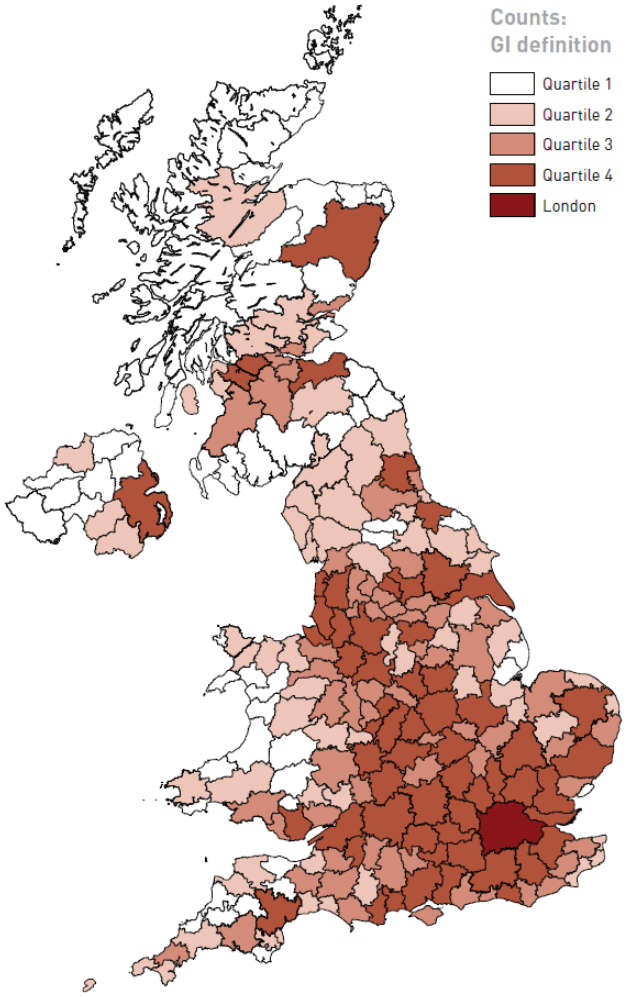
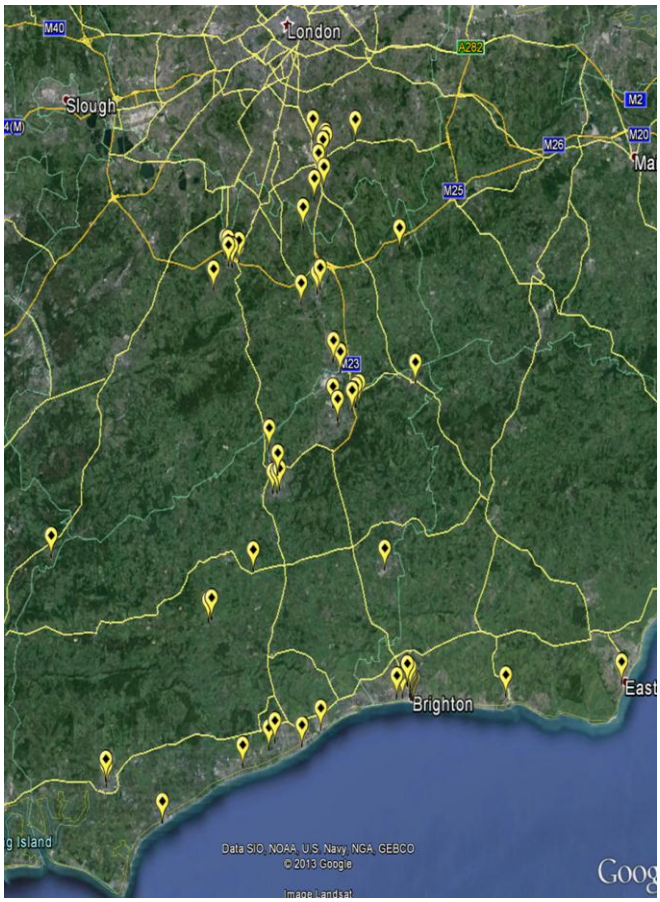


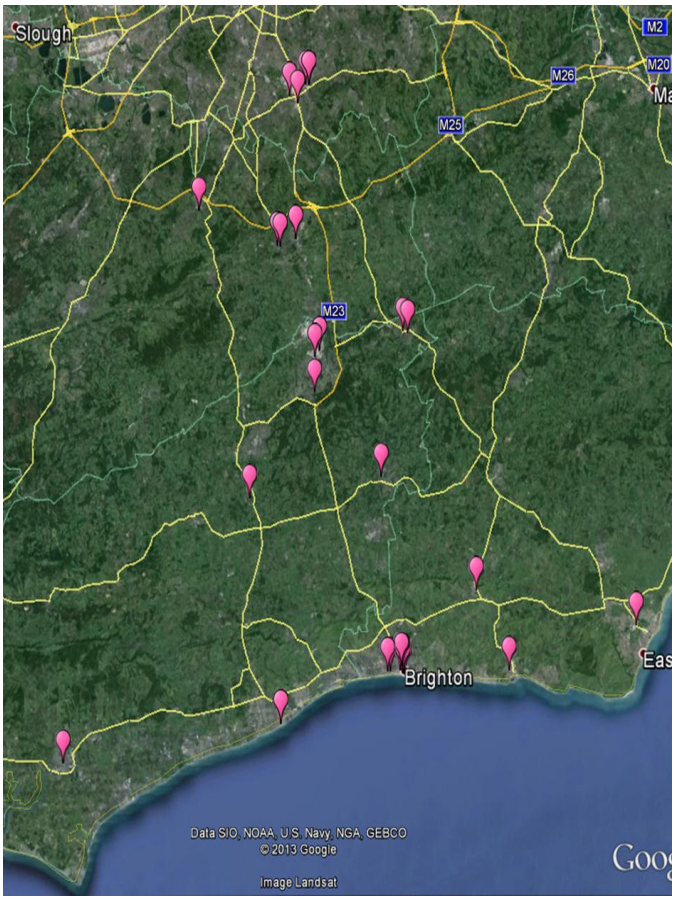
Figure 6, Growth Intelligence Employment Location Quotient for the Digital Economy

[27] Nathan, M. et al (2013) Growth Intelligence, Measuring the UK's Digital Economy with Big Data, NIESR

The B V-D analysis, Fig. 7 shows the presence of some significant companies in the area although it may be appropriate to reduce the turnover cut-off for digital media.



Software companies with turnover larger than £500K



Digital Media companies with turnover larger than £500K

Figure 7, Distribution of Connected Digital Economy Companies

The Connected Digital Economy is arguably the strongest and clearest sector in the region. The sub-sector covering Creative Digital IT in Brighton is particularly strong and through its membership network, Wired Sussex, it has a national reputation. Wired Sussex operates a model of network engagement, which may represent a prototype for the broader CDE in the region. Research into the cluster presented as the Brighton Fuse Project[28] has highlighted some remarkable results both in support of the Creative Digital Media sector but also in support of cluster activity. The cluster employs some 6500 people in the City with an average of 7 people employed per company. These contribute some £700 m to the local economy and at 14% exhibit growth well in excess of other local business sectors. Within the cluster, there is clear demarcation between those businesses that are innovative, integrated and network widely in terms of demonstrating higher growth rates.

[28] The Brighton Fuse, (Oct 2013), Final Report, www.thebrightonfuse.com

The Technical Strategy Board has established a Catapult Centre covering the Connected Digital Economy. Unlike other catapults, which are focused on science parks and research centres, this Catapult is more focused on enabling projects at this time. Current proposed programme areas include:

- Creative media and content
- Digital health
- Digitally enabled cities

They are also focused on building capabilities in; next generation connectivity, digital marketplaces, the integration of datasets and the internet of things. It is likely that over time they will begin to explore the establishment of physical centres and this may present an opportunity for Coast to Capital.

Example CDE Companies

The following are a few examples of businesses operating principally within the area. There are many examples of global organisations that have key activities within the region but it is difficult to identify specific activities and scale from a web based analysis.

Bond International Software is a worldwide provider of software solutions in the field of Human Capital Management. It is a world leader in staffing and talent management software for recruitment consultancies and corporations of all sizes, and provides HR, e-recruitment and payroll solutions to the public, education and publishing sectors. Many of its staff are based on of its site at Worthing.

Aquilaheywood employs over 200 people, mostly out of its offices in Redhill. It is a supplier of life and pensions administration software solutions in Europe; as our markets continue to grow, we keep on going from strength to strength. It has a client base of over 200 major organisations who use their systems to administer the pensions of 9 million people. Revenues have grown at a rate of 23% annually over the last 8 years and we have been consistently profitable.

Creative Assembly – based in Horsham, employs some 300 people not all based on site. It is a computer games business and made its name in 2000 with the PC strategy game Shogun: Total War. It has one of the largest studio owned motion capture facilities in Europe.

Jelly Fish – is a global digital marketing company with its headquarters in Reigate. It employs some 80 people and has a turnover in excess of £25 m.

Cap Gemini Aspire – Operating out of HMRC offices in Worthing, this division provides back office systems development and support for HMRC.

Intuitive – based in Croydon, employs some 50 people and develops software for the travel industry

5.3 Electronics with a Potential Focus on Sensors and Vehicle Electronics

It is more difficult to identify specific engineering sectors using SIC coding due to the wide variety of business types. It is also arguable that some businesses in other sectors, for example Medical Technologies also fit here. The main SIC codes are the manufacture of electrical components (26110) and the manufacture of measuring equipment (26511). The Blue tags in fig. 8 are SME electronic companies in the C2C region. The red pins represent Electronic companies with a turnover in excess of 500k. Some very clear geographic clusters emerge around Croydon, Crawley, Brighton and Worthing.

It is possible that some companies may be picked up by SIC 71122, which is Engineering related scientific and technical consulting activities. Apart from the 'other engineering' category this is the most prolific in the C2C region. There is an increase in companies towards the capital but limited evidence of clustering in the C2C LEP region.

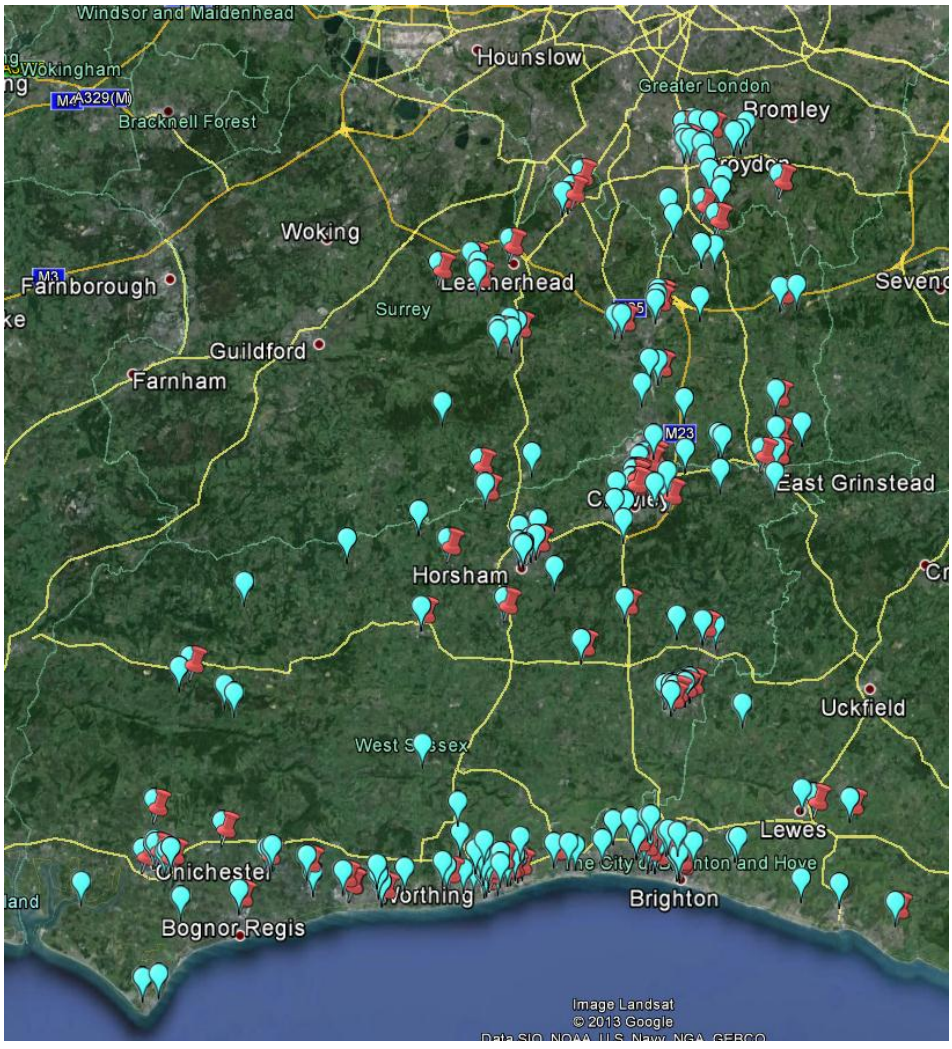


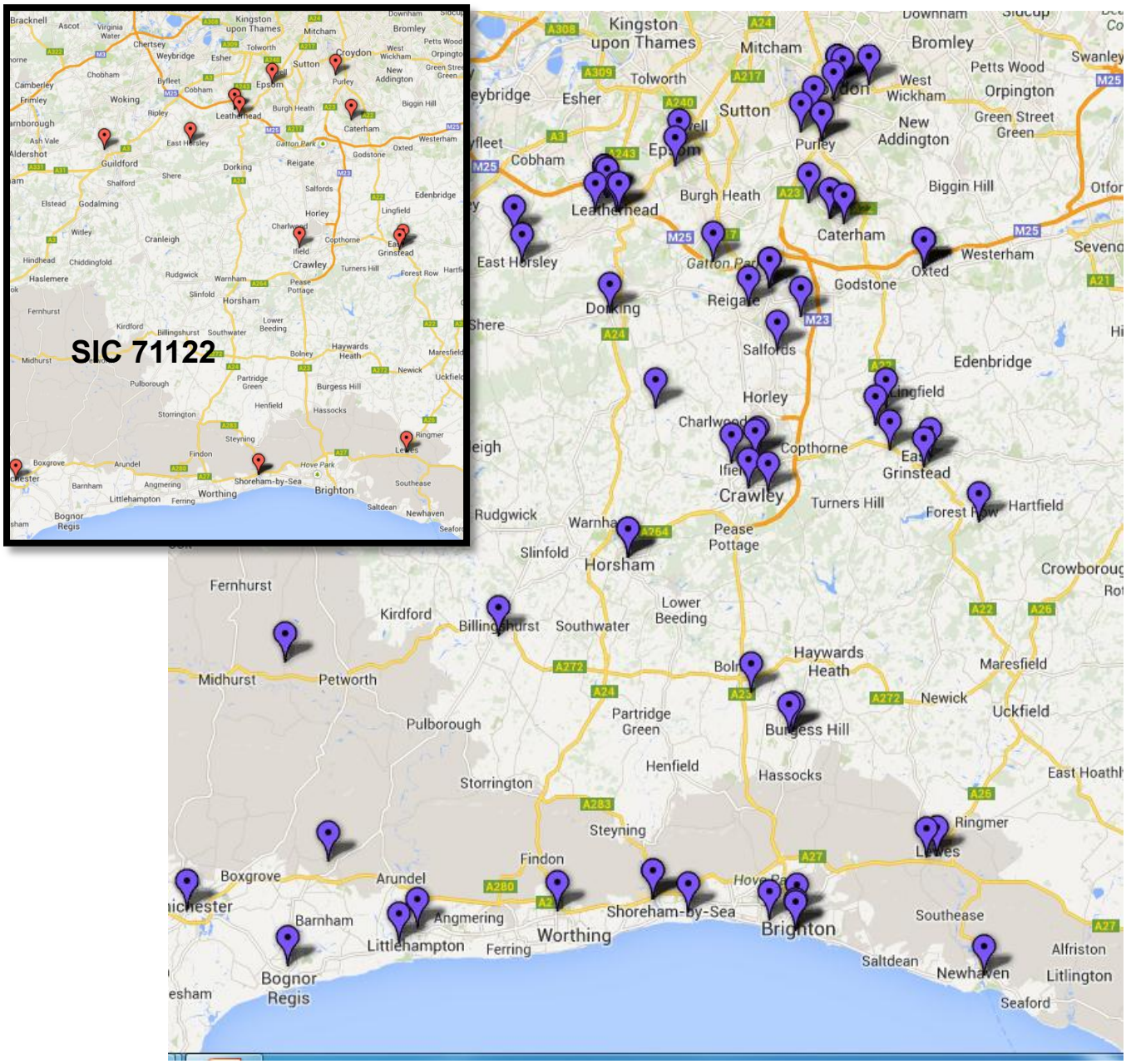
Figure 8 Electronic businesses

Interestingly the companies with a larger turnover, are all in different SIC Codes and apart from Ricardo's in Shoreham are all clustered around Gatwick. The TSB's Electronics Sensors and Photonics Knowledge Transfer Network has its headquarters in Horsham.

Although this is perhaps incidental, it may represent an opportunity for further activity. There is evidence at the individual business level of strengths in sensors of metrology and sensors.

The distribution of engineering companies is illustrated in Fig. 9. SIC 71122 is Engineering related scientific and technical consulting activities. Apart from the 'other engineering' category this is the most prolific in the C2C region. There is an increase in companies towards the capital but limited evidence of specific geographic clusters in the region. There are a number of major consulting Business HQs.

Figure 9, The distribution of engineering companies



Example Electronics Companies

Ricardo – is an engineering consulting and technology development company with its head offices based out of its Shoreham Technical Centre. Some 600 people work on the site. Key areas of expertise include low-carbon gasoline, diesel, hybrid and fuel cell powertrain technologies; the latest driveline and transmission systems; control electronics and software development; vehicle systems integration, and the engineering of the latest concepts in wind energy and tidal power systems.

Thales UK – Has a significant operation based in Crawley. It focuses on providing defence related communication systems and simulators.

Bowers and Wilkins designs and produces music speakers at its headquarters in Worthing for both domestic and commercial use. Export makes up over 85% of the companies $85mllion turnover. Today Bowers and Wilkins employs over 350 people in various factories, and offices all over the world, the main factory, a purpose built 140,000 square foot building, sits a few yards away from the original site at Dale Rd Worthing. The company has a separate R&D Facility, now based in the former SME factory at Steyning. This facility employs over 25 full time engineers, working on new projects and developments.

Vega Controls in Burgess Hill manufactures specialist level measurement instruments and controls, mainly for tank gauging, level indication for the quantity or level detection for many products and processes in manufacturing, storage and service industries. It is a world leader in process radar level measurement and radar transmitters and many other technologies.

Centronic is a leading manufacturer of radiation detectors based in Croydon. They manufacture gas-filled radiation detectors, silicon photodiodes, Geiger-Muller tubes, radiation tolerant cameras, coil wound components and UV instrumentation. It is supplying an Ultra High Vacuum electrical feed-through assembly for interfacing of the diagnostics related to the ITER-like Wall project, an EFDA/JET enhancement programme.

Technoflex based in Chichester is one of the UK's largest providers of flexible and flex-rigid multilayer circuits and assemblies. They undertake in-house design, assembly and testing

Liquid Level Systems Limited based in Rustington specialises in providing instrumentation for continuous liquid level measurement and control for shipyards and land based industries world-wide. The Company design products that meet the high standards of performance and reliability demanded by the marine industry in the hostile environments experienced at sea. It in the development of liquid level measurement technology employing pressure sensing techniques.

.

5.4 Environmental/Renewable Technologies

Environmental or Renewable Technologies (Cleantech) include a wide variety of different sub-sectors, fig. 10. Partly as a consequence, it is a difficult sector to analyse using SIC codes. The analysis undertaken illustrates the lack of significant activity in the region, Fig. 11, perhaps due to its relatively early development. Larger companies with turnover in excess of £500k tend to have mixed activities and 50% include environmental activity as part of their output. The inclusion of smaller firms such as consultants would probably see an increase in the number and diversity of industry – many are registered under a particular SIC Code but have evolved into the environmental field. With the exception of energy production and recycling, environmental activity tends to be a theme for businesses within other sectors.

Figure 10, Renewable Technology Sectors

Source, http://www.cleantech.com/about-cleantech-group/what-is-cleantech/

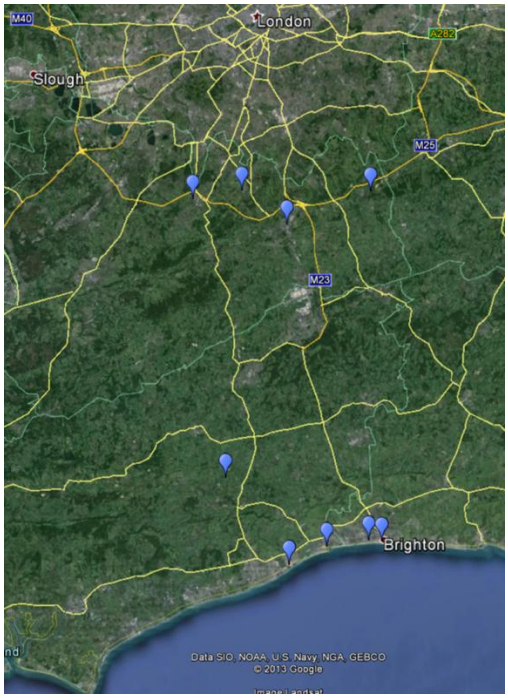


Figure 11, Distribution of Environmental Technology Businesses with a turnover in excess of £500K

However, it is clear that the sector cannot be ignored especially given the focus of the Brighton and Hove City Deal, the award of substantial funds to the University of Brighton for the development of the Green Growth Platform and the Green Deal contracts to be awarded by WSCC.

Example Renewable Technology Companies

Within the database developed, the only environmental businesses identified are subsidiaries of larger global businesses or sectors within a large engineering consultancy for example, Kellog Brown and Root.

Aerotrope – a small team of engineers and consultants based in Brighton that provide design solutions to the wind and low carbon vehicle sectors.

5.5 Horticulture, Food Production and Agri-Science

This is not currently a sector supported by Coast to Capital as it is comparatively small in terms of jobs and GVA. This perhaps fails to recognise its strategic importance in the rural economy. Regional horticulture has a national profile with the production of significant percentages of glasshouse vegetables, herbs and houseplants. According to Defra Statistics, West Sussex has the largest area for vegetables grown under glass in the country and the third largest area given over to vegetable production in general. Although local HE is not active in Agri-science related activities, the colleges of Brinsbury and Plumpton are prominent educators. The East Malling Research Centre is on the borders of the region and is very active in horticulture and land based research.

There are also major independent research organisations; Leatherhead Food Research and Campden BRI are globally recognised for food processing and brewing research. There is

also the UK HQ for Nestle. Overall though, the level of food production is focused around a large number of small independent manufacturers and suppliers.

DEFRA and BIS have recently produced the UK Agricultural Technologies Strategy (22nd July 2013). Within this, they are proposing to fund up to five centres for agricultural innovation. It should however be recognised that other areas are currently better placed to take advantage of this and other related opportunities.

Whilst networking groups such the West Sussex Growers Association provide a vehicle for progressing initiatives, they would need to become more engaged, both commercially and with a broader set of potential stakeholders.

5.6 Summarising the Coast to Capital Profile

Whilst it is always difficult to create a profile of a region and effectively create a stereotype, there are some significant themes, which can be captured within the context of a SWOT matrix.

Strengths	**Weaknesses**
• Strong Area Assets (FDI Report);Location, Lifestyle, Skills, Connections • Presence of a number of global companies across a range of sectors, some with their own research capability • A few strong sectors in enabling and growth technologies; digital, electronics, medical • 3 technologically research intensive universities • A number of strong independent research organisations • Leading centre for innovation and productisation (SINC)	• Few absolute sector strengths • Limited business clusters (exception is digital media) • Businesses tend to operate in isolation • HE is insufficiently connected to the local economy • Regional HEs have a limited global profile • Pockets of deprivation • Infrastructure disconnects (road ,rail, broadband) • Strong anti-development lobby • Levels of Innovation and business support are inconsistent
Opportunities	**Threats**
• Smart Specialisation focussed on key sectors • Utilising existing networks to develop regional initiatives; Kent Surrey Sussex Academic Health Science Network, Electronics Sensors and Photonics KTN, Connected Digital Economy Catapult • Development of focused micro-clusters and associated supply chains • Connecting HE into regional businesses possibly through the establishment of science parks • Exploiting ERDF and other EU funding streams e.g. Horizon 2020, Interreg V • Enterprise start-up and support framework • High growth product innovation support	• Initiatives will require significant long-term commitment, planning, leadership and investment in resources • HE does not buy-in to the need for regional collaboration and open-innovation • Sub-regional politics and the failure to agree on sector prioritisation, place based initiatives and overall need for a vision • Failure to engage with business around the vision • Selecting the wrong industries/sectors and not being allowed to make mistakes

In their work for the OECD on strengthening Global-Local Connectivity, Benneworth and Dassen[29] have profiled different policy orientations and innovation dynamics. These are summarised in fig. 12.

	Connecting globally	Sustaining momentum	Cluster-building	Deepening pipelines
Archetype for region	Peripheral regions lacking strong research strengths and international connections	Regions with strong local cluster organisations well networked with policy actors	Small groupings of competitive businesses with limited local connectivity	Region dependent on limited number of global production networks/ value chains
Key weakness	Absence of connection to external actors – no external stimulus for innovation	Risk of hollowing out and being left behind by GPNs – maintaining global lead	Regional firms tend to look outwards – contagious local undervaluing of partners	Dominance by a single firm or chain that exploits not supports regional actors
Existing strengths	Latent innovative actors with potential to grow quickly and deliver change	Highly innovative, well networked clusters playing leading role globally	Industrial districts with competitive advantages and global profile	Industrial ecosystem supporting value chains with diversification opportunities
Key challenge	Building a global pipeline: finding connection point from region to key global actors	Building up new regional hinges connected to regional firms – building critical mass.	Improving local networking connecting more local actors to growing regional network	Extending hinge connectivity & networks around hub
Optimal solutions	Helping regional actors take the first steps in international co-operation (collectively?)	Bringing outside actors in, and helping to collectively shape future trends	Channelling innovation support to stimulate growth through regional clusters	Helping second-tier innovators became market leading and shaping
Example regions	Madeira, Portugal Tallinn, Tartu Estonia Attica, Greece Sardinia, Italy	Ile-de-France, France Baden-Württemburg, Germany Flanders, Belgium Toronto, Canada	Skåne, Sweden Navarra, Spain Auckland, New Zealand Zuid-Holland, Netherlands Nord-Pas-de-Calais, France	Eindhoven, Netherlands Piemonte, Italy Limburg, Belgium Seattle, USA North East of England, UK

Source: Benneworth, P. & A. Dassen (2010), "Strengthening Global-Local Connectivity in Regional Innovation Strategies – A Theoretical and Policy Reflection", *Project Working Paper for OECD Regional Innovation Strategies Project*, CHEPS, University of Twente, Enschede, Netherlands.

Figure 12, RIS Profiles

Coast to Capital regional analysis exhibits characteristics relating to both the need to build clusters and to strengthen global connections although it most closely matches the Cluster-Building category. There are clearly some businesses and organisations that have effective global connections; Leatherhead Food Research, Sussex University, Electa, Thales and Ricardo to name but a few. But there is little evidence that these connections are translated into local supply chain opportunities. In many respects both of these areas are closely linked as effective clusters need to have strong connections both internally and externally.

[29] Benneworth, P. & Dassen, A. (2011) Strengthening Global-Local Connectivity in Regional Innovation Strategies, OECD

6.0 Policy Intervention

Whilst it is possible to build a profile of the region based on the relative sector strengths and match this to technological futures, the challenge is to identify policy interventions that have the potential to make a difference and are able to be facilitated by Coast to Capital. Benneworth and Dassen have made the connection between the regional characteristics and suitable interventions. These are summarised in Table 1.

	Cluster Building	**Connecting globally**
1) Improve Innovation governance and strategic intelligence for policy-making	• Identifying regional pockets of excellence • Identifying opportunities for spill-over effects	• Identifying regional strengths in Sectors • Identifying potential local lead partners • Bringing the outside in – conferences etc.
2) Foster an Innovation friendly environment	• Encouraging local co-operation to build mutual trust • Practical innovative activities encouraging relationship building • Seminars from lead stakeholders to disseminate knowledge and expertise	• Building connectors to attract potential future investors • Support for match-making • Mentoring and building up local links • Highly skilled gatekeepers and brokers with outside knowledge
3) Higer Education / human capital development	• Universities leading micro-clusters as honest brokers • Supporting market research, technology analysis of cluster shared needs • Creating entrepreneurial labour market with business experience, technology hubs etc.	• Establishing global research profile • Attracting talent and technology to the region • Bringing new innovation partners to stimulate growth
4) Development of research culture	• Shared R&D facilities • Use of university / technology centre as broker • Stimulating informal knowledge exchange • Small tenders and awards for shared working	• High profile sites visible for potential outside partners • Places for the global and local to meet within the region, e.g. Science Park
5a) Strengthen	• Signposting services to	• Providing resources

Innovation in the SME sector	reduce effort necessary for SMEs to access innovation resources • Career services, innovation advice, finance, MBAs, training	to allow local firms to directly access knowledge in the innovation process • Courses and training in innovation processes for SMEs and strategy makers
5b) Industrial policy and strategic technology policy	• Helping local businesses to fit into supply-chains • ISO9001, industry standards • Promote new products into existing markets • Supporting innovation projects • Proving collaborative concepts	• Signalling long-term commitment to the area to encourage private matched investment • Attracting outside investors and partners (Singapore model) • Creating a flagship as anchor to fill in sparse innovation system
6) Encourage enterprise tech transfer, develop innovation poles and clusters	• Brokerage: match-making introductions, signposting, creating regional knowledge database • Industrial knowledge circles – technology clubs with lead actors involved	• Supporting lead cluster actors as anchor for regional innovation activity • Designating an innovation pole to highlight local competency and long-term future orientation
7) Promote and sustain creation and growth of innovative	• Creating supportive spaces for new high-technology businesses • Support in accessing external knowledge sources • Ready provision of high-tech entrepreneurship resources (finance, skills, IP)	• Attracting and embedding R&D services via FDI • Supporting co-operation with local businesses and universities • Shared research and innovation seed-corn • Small scale but intensive

Table 1, The relationship between global orientations and the use of the innovation policy toolbox[30]

[30] . Benneworth, P. & Dassen, A. (2011) Strengthening Global-Local Connectivity in Regional Innovation Strategies, OECD

Building a regional cluster is about providing support to developing businesses, research centres and collective activities that have the potential to draw in other businesses that may not be active in innovation into the sector. The authors document two case examples of regions that have promoted cluster building activity that have some relevance to Coast to Capital. In each case, they have ensured connections that are both local and global.

Regio Skåne: Building an innovative food cluster

The Skåne region in the south of Sweden is one of the country‟s traditional agricultural areas, but since accession to the European Union in 1995, and increasing globalisation in the food sector, agriculture has come under considerable pressure to develop higher-value products, and to compete through innovation. From 2000, the Regional Council encouraged its food companies to work together more closely, and in 2003, they bid for and won national funding through the VINNOVA programme for ten years of support for the food innovation system in Skåne. This region is closely linked across the Öresund Bridge with the Danish Jutland Innovation System, which includes a number of firms, research institutions and venture capital firms which add to regional critical mass, and the Skåne Food Innovation Network is also active in the Öresund Food Network, which specifically seeks to stimulate and expand interaction between firms, research organisations, and business support services, on both sides of the Öresund Strait. The focus of the Food Innovation Network has, and continues to be, on densifying the local RIS, supporting innovative collaborative projects between partners often active in their own global networks, but with limited experience of local collaborations. To extend international co-operation and interaction, the Food Innovation Network has played a leading role in the development of the Baltic Sea Region food cluster („Baltfood‟).

Brainport Eindhoven & the High-Technology Campus

The region of North Brabant in the Netherlands prospered in the post-war period as the light-bulb company Philips transformed itself into a consumer electronics, health and hygiene business, investing heavily in the *Natuurkundig Laboratorium* (Physics Laboratory or NatLab). Although the region‟s development appeared to stall in the 1990s with increasing overseas competition affecting Philips‟ success, this trend has recently been reversed following the embrace by the Philips NatLab of the Open Innovation concept and its transformation into the High-Technology Campus. NatLab had previously been a highly secretive development centre for Philips, but in 2000, the Laboratory formally opened its doors to outside companies to establish themselves in the park, and access Philips facilities, including clean rooms, materials testing and electronic prototyping. A shared laboratory space, Miplaza, was also established, and currently more than 90 companies employ more than 8 000 researchers. This has helped in particular to bring local companies more closely into Philips‟ network and develop their own relationships with the large companies with which Philips is itself working. This is illustrated by one project within the High-Technology Campus, the Holst Centre, established as a “Open Innovation Centre for Wireless Autonomous Microsystems and Systems-in-Foil”. This has been founded by IMEC, the Flemish Centre for Micro-Electronics and TNO, the Dutch Applied Research organisation as a means of creating a coherent research programme and assembling research teams to bring the ideas close to market. The Holst Centre co-ordinates research involving market leaders globally, as well as local SMEs, and helps to integrate new local businesses effectively into this wider value chain.

7.0 Sector Focused Initiatives

The report into the Brighton Fuse research into creative digital IT clusters[31] noted that "It is very difficult to create artificial clusters from nothing, but policy can be helpful later on." The report goes on to state that, "The Brighton creative and digital cluster wasn't created by Government policy but once up and running, the experiences of Brighton suggest government policy can have a positive effect. ……Firms in the cluster benefit from a 'thicker' market for talent, which creates knowledge 'spill overs' and a multiplier effect – with knowledge developed in one project being reused in others - in ways not possible in an area without the concentration of firms, the diversity of activity or the co-ordination provided by aggregator organisations. In these sorts of situations, policy works particularly well if 'aggregator organisations' articulate bottom-up concerns and work with policy makers to address them."

The following section considers each of the sectors identified in turn and considers how each might be developed within a Regional Innovation System. It draws on those ideas articulated in the previous sections but should not be regarded as either a menu or definitive.

Each is based on enabling a network of innovation which builds on a combination of regional research strengths and capacity, businesses, sectors, and, importantly, people and organisations prepared to collaborate and lead. The innovation networks would:

- Focus development on existing strengths and capabilities
- Concentrate resources and finances on a very few key priorities
- Ensure that research and innovation resources reach a critical mass and facilitate local business cluster activity and supply chain development
- Build a reputation for the area which would begin to attract national and international attention and which would support inward investment and further business clustering – leading to future jobs creation

The Coast to Capital LEP role would be to act as catalyst or convener for the innovation networks, to provide leadership where necessary, to draw in the required partners for each chosen network, and to support the network to self-sufficiency.

7.1 Connected Digital Economy

The work undertaken indicates that this has the strongest potential of the regional sectors and includes the specific CDIT cluster in Brighton & Hove. The nature of the industry does not clearly support the idea of a traditional science park although there are benefits from both virtual and physical clustering. In this industry, the network is the supply chain and flexibility and speed are essential. Potential initiatives would include:

[31] The Brighton Fuse, (Oct 2013), Final Report, www.thebrightonfuse.com

- Creating a regional network for the Connected Digital Economy and integrated with the TSB Catapult. This could take its lead from the development of the Wired Sussex Network with a broader portfolio of activity and a broader community of interest.
- Promoting the development of HE research led centres of excellence and projects in strategic areas connected to active micro-clusters, e.g. Big Data, Internet of Things, Digital Health.
- Supporting the development of regional innovator communities and workspaces for small businesses e.g. The Skiff or Software City in Sunderland. This might consider the potential for rolling out the Wired Sussex/ Brighton Fuse project to other towns.
- Providing specific support for example in relation to IP and Copyright
- Positioning region to become one of the 'spoke' centres for the intended longer term development of the CDE Catapult.
- Supporting the creation of clear links with education to ensure that schools are developing curricula that address the IT needs of businesses (both providers and users of the technologies).

7.2 Electronics with a Potential Focus on Sensors and Vehicle Electronics

Although one of the larger sectors in the region and providing a range of manufacturing jobs, this is a harder sector to segment with certainty, given the wide range of activities covered by both the research centres and businesses in the area. There are, however, some emergent themes that have potential. As an example sensor technologies are cross cutting enablers in many sectors and critical componentry to the growth of the 'internet of things'.

It is recognised that the further development of this cluster may be difficult and involve investment but in the long term, may prove to be fruitful in terms of linking research to OEMs to supply chains with a manufacturing capability and the associated jobs impact for a range of skill levels. Potential initiatives would include:

- Creating an innovation network for electronics and sensors and integrated with the EPS Knowledge Transfer Network but also linked to regional professional engineering bodies.
- Develop a regional Science Park/Technopole linked to established capability and the Industrial Strategy for Growth focused on the automotive sector, e.g. Vehicle electronics and engine performance (Ricardo link).
- Promote strong collaboration between Sussex, Brighton and Surrey HE to build a globally credible research capability focused on sensor technologies required to underpin the internet of things.
- Provide focus for research and development funding bids.
- Identify and promote local supply chains.

7.3 Bioscience and Medical Technologies

The strength of this sector in the region is reliant on the research credibility of the region's universities. Although a number of major pharmaceutical businesses are present in the region, there is little manufacturing undertaken. There are larger numbers of medical

technology businesses covering a wide range of applications, many overlapping into the electronics sector.

Taking this sector forward will require further segmentation and this would have to be undertaken with expert input. Examples that currently have regional significance might include; regenerative medicine, wound care, biomedical diagnostics, dementia treatments, diabetes care and management. The danger of focusing down to this level is that it opens up the risks associated with trying to pick winners.

Potential initiatives would include:

- Work with Kent, Surrey & Sussex Academic, Health & Science Network to develop a strong network of interest across the region effectively connecting industry with researchers and the NHS to promote areas of shared interest and bid effectively for funds to support innovative research and development activity. KSSAHSN are keen to explore the potential of joint initiatives.
- Develop a regional Science Park/Technopole linked to established capability, e.g. regenerative medicine, wound care (Blond McIndoe Research Centre), biomedical diagnostics, dementia treatments, medical technologies.
- Identify and promote local supply chains.
- Consider an issue based approach that focuses for example, on the aging population (active health, welfare, nutrition, dementia) or diabetes management.

7.4 Environmental/Renewable Technologies

This sector is still in the early stages of development, it is very diverse and it is not clear that there are any established clusters or active networks focused in these areas. However, the promotion of low carbon economies is an increasing priority for governments and is attracting significant focus, matched by funding. There is evidence that it is a growth sector with established demand. At this time the sector does not have a significant profile in terms of jobs and GVA but it does have future potential. This is recognised in its prominence within the Brighton City Deal proposals.

As identified in Fig. 10, the sector is very diverse and the key will be to focus in on a number of different areas that have broad potential. Selecting these will require expert input and not be influenced by politics and or fashionable statements. As an example, there has been a good deal of discussion given to the potential of wind farm related activity given the impending approval and development of the Rampion wind farm. However, the bulk of manufacture will take place outside of the region and the number of long-term jobs created will be small. It might be better to focus attention on technologies that make long term business sense in addition to being environmentally acceptable. Examples would include the recovery of usable resources from waste and recycling and sustainability of manufacture.

- There is an opportunity for Coast to Capital to stimulate involvement in the sector through the establishment of cluster activity potentially building on the University of Brighton's Green Growth platform.

- Sponsor research to identify potential opportunities for research and innovation leading to the establishment of centres of excellence.
- Promote and invest in a number of high profile projects and work with partners to support specific initiatives. Examples would be the combined horticultural and energy hub proposed by West Sussex Growers Association and the Clean-Tech hub proposed at Newhaven. These would have the benefit of developing expertise and local supply chains.
- Work with education providers on targeted skills development.
- Bring together the three universities of Brighton, Sussex and Chichester to create a single renewable technologies network and research capability.

7.5 Horticulture, Food Production and Agri-Science

At this time the strength of economic evidence for Coast to Capital to develop a network of innovation in this broad and diverse sector is insufficient at this time. The relative importance of the sector is recognised but there is no clear HE research strength in the region and this would need to be built from scratch. It is no surprise that recent DEFRA funding awards for agricultural and horticultural technology centres were all outside of the region to facilities demonstrating existing strengths. The independent regional research centres focus on food production and are not specifically focused on regional activity or strongly linked to other regional stakeholders.

The Horticulture business sector is well developed and making use of advanced technologies developed elsewhere. Many of the businesses either undertake their own research to growing or buy in research from established centres outside of the region. The sector needs protection as it is important and key to the rural economy but it does not appear to be a source of jobs and GVA growth that Coast to Capital is looking for. However, the application of renewable technologies associated with energy production and sustainable operations is still undeveloped and may provide opportunity for regional engagement and specialisation under the Renewable Technologies headline.

Given Coast to capital's limited resources, it is suggested that it only engages in a limited project focused strategy of intervention in this sector linked to other initiatives.

8.0 Creating an innovation friendly business environment for SMEs

In order to capitalise on the potential benefits of Smart Specialisation and the resultant supply chain opportunities, it is essential to have a thriving SME sector for growth, jobs and innovation. This is a cross cutting initiative that in many respects is sector independent. It recognises that intervention can have a significant impact in supporting the start-up, development and growth of innovative businesses. This is articulated for example in the Brighton Fuse Project and the OECD's study on what governments can do to support high growth businesses[32].

The University of Chichester undertook some self-funded work investigating the levels of support available to businesses in the region.[33]

This work researched the nature of support available to businesses and the organisations providing that support. The output of the work is illustrated in Fig. 13 and demonstrates that the majority of support services are available for established businesses. The research found that there is no organisation in Coastal West Sussex or beyond that offers one-stop support over the life of a growing business, i.e. from raising start-up aspirations to established business. There are support services for the majority of needs of a business available in the area or from an online source, but business owners need to know where to look, and in many cases, to actively seek out the support. This is being compounded by the rapid increase in a wide range of similar but disconnected grants and support funds available to SMEs. The range of services available is identified in Fig. 14.

32 OECD (2010), *High-Growth Enterprises: What Governments Can Do to Make a Difference*, OECD Studies on SMEs and Entrepreneurship, OECD Publishing

33 Andrews, L. & Cooper, D. (May 2012), Coastal West Sussex Enterprise Network, Supporting Coastal West Sussex Enterprise

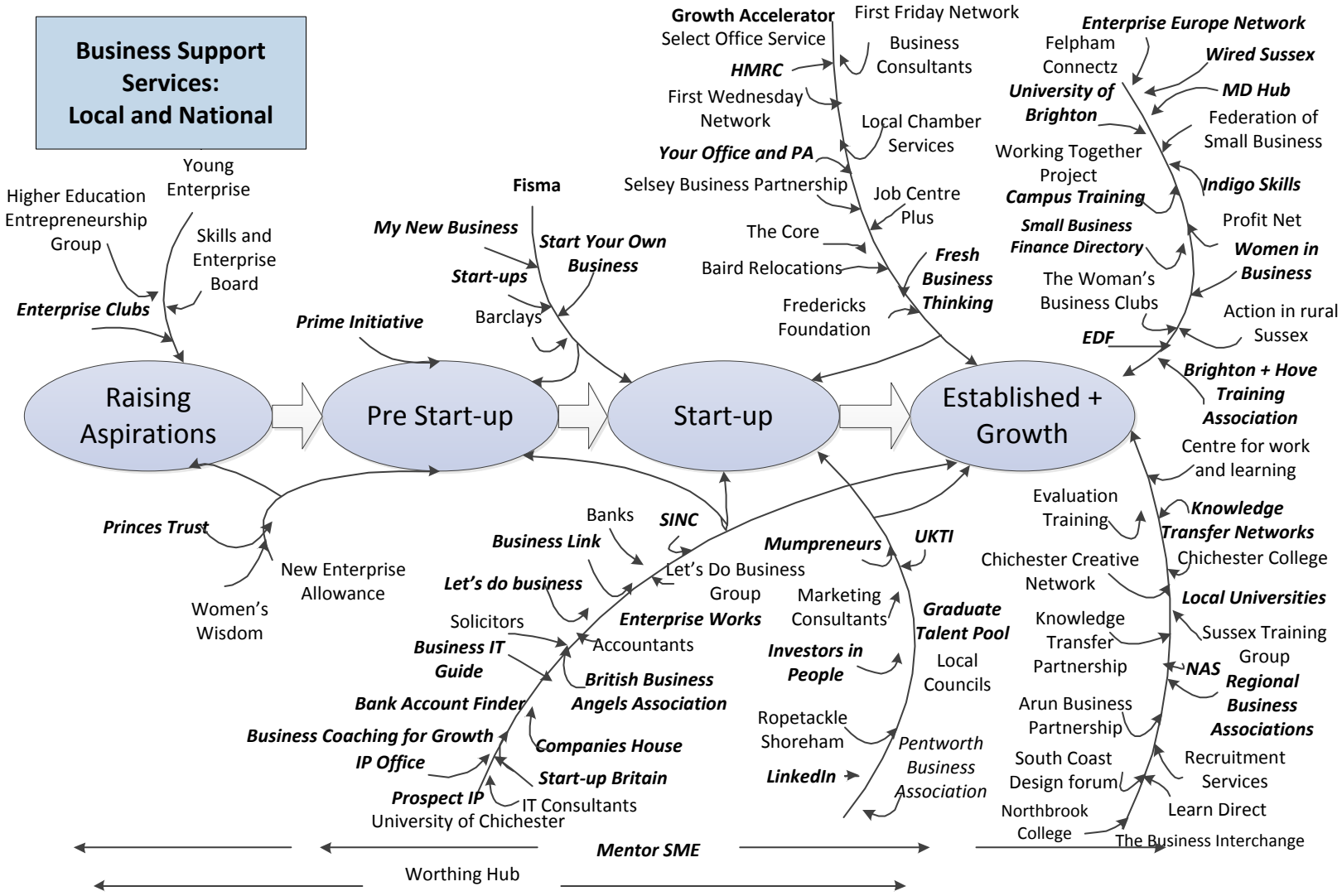


Figure 13, Support Organisations: National, Coast to Capital region and Coastal West Sussex

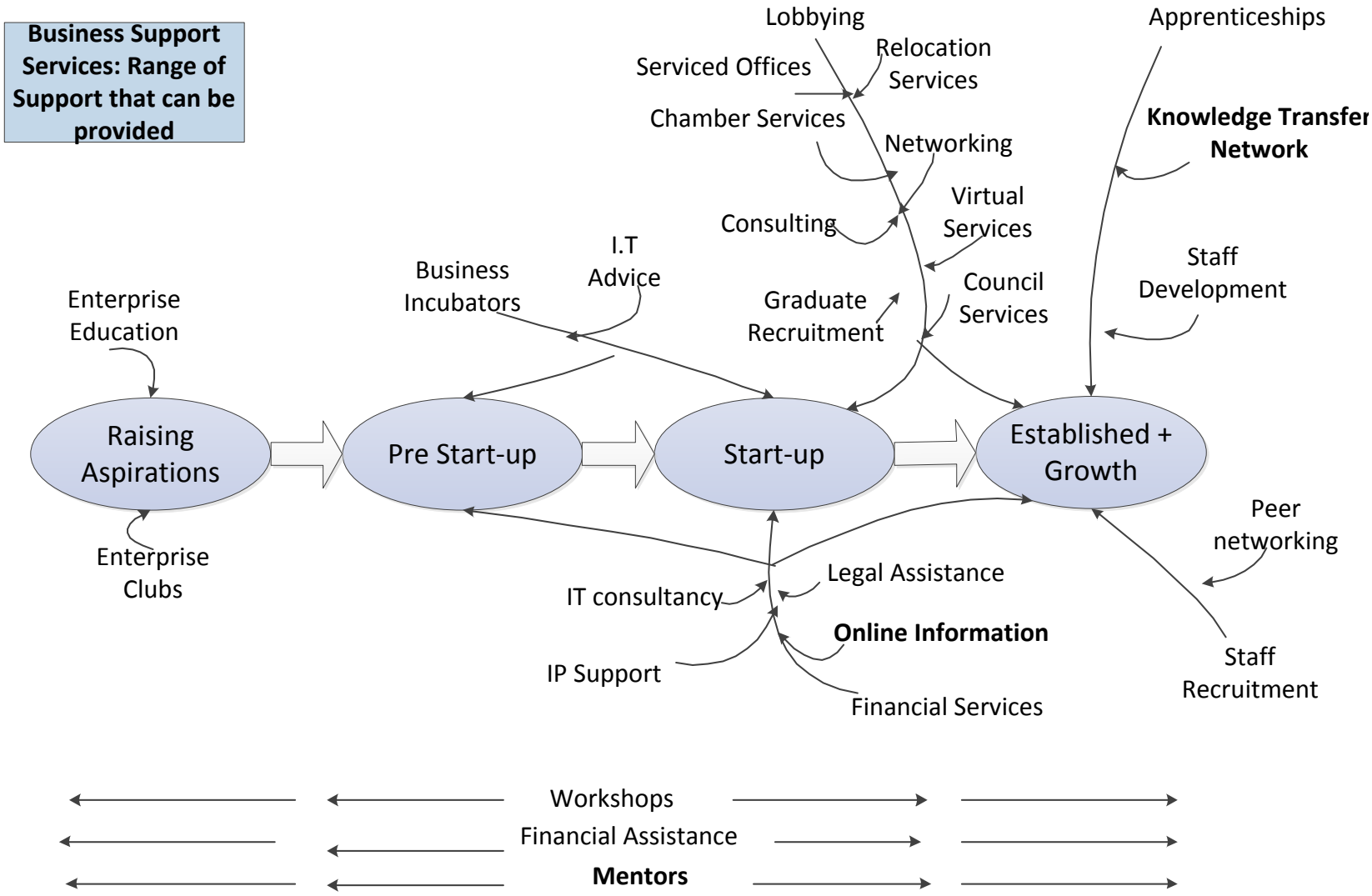


Figure 14, Range of support: Coastal West Sussex, Coast to Capital and National

A Coast to Capital commissioned survey[34] investigated groups with low enterprise performance in the Coast to Capital region. Key findings from this report were:

- For most start-up and young businesses, finance is the main obstacle faced. Cash flow is identified as the main obstacle or difficulty in starting up a business but availability and cost of suitable premises, the economy and obtaining finance were also mentioned a significant issues.

- Many businesses bemoan the loss of Business Link and believe that face to face business support is critical to their on-going sustainability. Many businesses had used the services of Business Link and had attended workshops, free courses and had received mentoring. Many businesses thought the closure of Business Link was to the detriment of new business start-ups and for themselves as their businesses developed.

- The value of mentoring was discussed by many recent start-ups and by more established businesses.

- Local support received from business organisations or Chambers of Commerce was rated highly. However, as business support tends to be transactional rather than continual, it was recommended that support needs to be on-going and more focused.

- Some businesses made the point that often the information they sought was not easily accessible or understandable.

- Targeted start-up advice was considered useful as was more one- to-one support rather than just signposting.

These findings emphasise local business needs for face to face continual support and guidance for new and established businesses. It also raises the issues of finance for start-up businesses and the obstacle this plays in encouraging business formation.

Coast to Capital is in a position to take a lead in supporting the creation and development of R&I intensive businesses;

- Provide a focus for skills development matched to regional priorities
- Encourage schools, FE and HE to inspire enterprising mind-sets
- Promote a culture of open innovation and support for local supply chains through effective networking
- Adopt and promote the principles of the Small Business Act for Europe
- Facilitate the provision of sustained business support, especially focused on product innovation, marketing and export
- Coordinate the development of a region wide network of Innovation Centres / Enterprise Hubs possibly themed e.g. electronic, engineering, creative, prototype production (Fablab plus 3D printing, media production, e.g. Hethel Engineering

[34] Tullet, S. et al (April 2012), Enterprise and Entrepreneurship Development; Understanding Groups and Areas With Low Enterprise and Entrepreneurship

Centre) – Has the potential to engage with the High Value Manufacturing Catapult Centre

- Ensure straightforward access to finance
- Focus on outcomes not just outputs[35]

Fab Lab Manchester

Fab Labs – digital fabrication laboratories – were set up to inspire people and entrepreneurs to turn their ideas into new products and prototypes by giving them access to a range of advanced digital manufacturing technology.

The UK's first Fab Lab opened in Manchester in March 2010. It is owned by The Manufacturing Institute, managed by its technically-skilled staff and based in the iconic Chips building in New Islington, Manchester. At the heart of Fab Lab Manchester is digital manufacturing technology, combining 2D and 3D design with the latest fabrication technology. Embracing a broad spectrum of methods ranging from CNC machining to 3D printing, it can produce a single unique product from a digital design in a matter of minutes and at a very low cost in comparison to traditional tooling methods.

To date, 3,000 small manufacturers, inventors, schools and community groups have used Fab Lab Manchester with a wide range of products having been conceived, developed and prototyped there.

http://www.fablabmanchester.org

[35] Sources; Regional Policy for Smart Growth in Europe 2020, EU, May 2011; Exploration of High Impact Business Growth Models for Coast to Capital, Economic Growth management Ltd, July 2013; Small Business Act, EU 2008

9.0 Conclusions and Recommendations

The report set out to try and answer a number of key questions:

.

1. What is the Coast to Capital area to be known for?
2. How will we need to respond to developments in technology and other forms of innovation?
3. Where are we genuinely at the leading edge of innovation – what are our research and innovation strengths and where do they lead us?

The research focused on the establishment of Regional Innovation Systems underpinned by two core components Smart Specialisation and the creation of innovation friendly business environments for SMEs. It is based on a wider view of innovation that is not just technology based but recognises creativity in general and the value of open innovation systems, centred on collaborative networks and communities. This outcome was based on analysis of regional research strengths matched to UK technology priorities and a high level analysis of business profiles. It was further informed by regional priorities and the presence of existing networks and clusters of activity. It also recognises the existence of proximate clusters covering for example, Aerospace (Farnborough) and Marine (Solent). The following sectors have been identified to form the basis of a RIS strategy:

- **Connected Digital Economy including, creative digital media, software development, Big Data**
- **Bioscience including Medical Technologies (Life Sciences)**
- **Electronics potentially further focused on vehicle electronics and sensors**
- **Environmental/Renewable Technologies**

Horticulture, Food Production and Agri-Science was also considered. It is an important sector for the region but has no regional HE research base and does not appear to have the jobs and GVA growth potential that Coast to Capital is looking to deliver. Although, therefore, it has not been recommended for inclusion in the RIS, it is suggested that specific sector initiatives are supported on a project by project basis.

The work has also developed a SWOT profile for the region related to characteristics that might underpin subsequent RIS development. Whilst there are some key strengths, there are weaknesses:

- Few absolute sector strengths
- Limited business clusters (exception is digital media)
- Businesses tend to operate in isolation
- HE is insufficiently connected to the local economy
- Regional HEs have a limited global profile
- Pockets of deprivation
- Infrastructure disconnects (road ,rail, broadband)
- Strong anti-development lobby
- Levels of Innovation and business support are inconsistent

Using Benneworth and Dassen's[36] profiling model for Strengthening Global-Local Connectivity in RIS (fig. 12), Coast to Capital regional analysis exhibits characteristics relating to both the need to build clusters and to strengthen global connections. It most closely matches the Cluster-Building category. They suggest that appropriate RIS support initiatives would include:

- Cluster-building programmes, bringing companies together and stimulating collective action, at least partly aiming to create a collective cluster identity.
- Increasing proximity between actors by encouraging routine encounters such as seminars, workshops, match-making, and collective bidding.
- Developing shared research infrastructure that brings businesses to solving business problems.
- Helping SMEs to fit into large firm supply networks, develop more local linkages and stimulate local innovation.
- Business support focused on networking activities, ensuring that these networks stimulate innovation rather than routine market activities.
- Support for innovation resources, assisting with finance, intellectual property (IP), skills, management training.

A range of potential sector specific initiatives have been proposed each revolving around establishing a network of innovation. The innovation networks would:

- Focus development on existing strengths and capabilities
- Concentrate resources and finances on a very few key priorities
- Ensure that research and innovation resources reach a critical mass and facilitate local business cluster activity and supply chain development
- Build a reputation for the area which would begin to attract national and international attention and which would support inward investment and further business clustering – leading to future jobs creation

The Coast to Capital LEP role would be to act as catalyst or convener for the innovation networks, to provide leadership where necessary, to draw in the required partners for each chosen network, and to support the network to self-sufficiency.

The other dimension for a successful RIS is the creation of innovation friendly business environments for SMEs. Previous work in this area researched the nature of support available to businesses and the organisations providing that support. It demonstrates that the majority of support services are available for established businesses rather than new or newly created businesses. The research found that there is no organisation in Coastal West Sussex or beyond that offers one-stop support over the life of a growing business, i.e. from raising start-up aspirations to established business. There are support services for the majority of business needs available in the area or from an online source, but business owners need to know where to look, and in many cases, to actively seek out the support. This complexity is being compounded by the rapid increase in a wide range of similar but disconnected grants and support funds available to SMEs.

[36] [36] Benneworth, P. & Dassen, A. (2011) Strengthening Global-Local Connectivity in Regional Innovation Strategies, OECD

The findings also emphasise local business needs for face to face continual support and guidance for new and established businesses. They also raise the issues of finance for start-up businesses and the obstacle this plays in encouraging business formation.

Coast to Capital is in a position to take a lead in supporting the creation and development of research and innovation intensive businesses. This may include for example;

- Providing a focus for skills development matched to regional priorities
- Encouraging schools, FE and HE to inspire enterprising mind-sets
- Promoting a culture of open innovation and support for local supply chains through effective networking
- Adopting and promoting the principles of the Small Business Act for Europe[37]
- Facilitating the provision of sustained business support, especially focused on product innovation, marketing and export
- Coordinating the development of a region wide network of Innovation Centres / Enterprise Hubs possibly themed e.g. electronic, engineering, creative, prototype production (Fablab plus 3D printing, media production, e.g. Hethel Engineering Centre)
- Ensuring straightforward access to finance
- Focusing on outcomes not just outputs

9.1 Recommendations

1) Coast to Capital should work with potential stakeholders to explore and facilitate the development of Networks of Innovation in each of the proposed core sectors:

- **Connected Digital Economy including, creative digital media, software development, Big Data**
- **Bioscience including Medical Technologies (Life Sciences)**
- **Electronics potentially further focused on vehicle electronics and sensors**
- **Environmental/Renewable Technologies**

In each of the four core sectors Coast to Capital should seek to establish an initial interest group to explore the creation of a network of innovation. and identify common areas of activity and potential purpose/ focus for the network. This will require bringing together stakeholders from business, research, local authorities and other areas as appropriate. It may be undertaken in association with other networks for example the Kent Sussex and Surrey Academic Health and Science Network in Life Sciences. The objective of these groups will be to explore; the viability of a network, identify common areas of interest, develop a potential purpose/focus for the network and a framework in which it can operate. It will be essential to begin to build trust amongst the stakeholders. This draws on three essential tenets for effective clusters[38]:

1. Trust

2. Leadership

[37] EU (June 2008), Think Small First; A Small Business Act for Europe
[38] Robins, D. (September 2011), Clustering in the Marine Industry, Report for CAMIS Interreg IV project

3. Purpose

"For clusters to remain sustainable each of these elements must exist in some form or another. The purpose can change – new direction, innovation, challenge or threat – and leadership can change as the project or direction changes, but if trust disappears then the cluster will doubtless fail to survive. It is the trust that appears to be the hardest to achieve, sustain and build on. Developing trust takes a long time, sometimes years and the strength of the cluster relies on the level of trust that is maintained."

Building on the recommendations arising from Sir Andrew Witty's report, Coast to Capital should consider asking the Universities to chair these embryo innovation networks but ensure that both large and small businesses are adequately represented. They should seek to identify projects for development, potentially preparing for Witty's so called 'Arrow Head' project proposals. This entails building the capabilities and resources that will develop supply chains in the UK, driving forward globally competitive technological ideas into real businesses. Witty sees it as a multi-faceted challenge, embracing among other things skills, support for small and medium enterprises (SMEs), access to finance, appropriate available facilities and transport infrastructure.

It is specifically recommended that the Life Sciences Network explores the issue of an aging population as the basis for its activity. This has the potential to build on a wide range of associated activities that the region has strengths in; active health, welfare, nutrition, dementia. It also recognises the aging regional demographic and the strength of the care sector in general.

It is also recommended that a summit is organised for the regional universities to explore the practicalities of developing a collaborative approach to environmental technology research and innovation. Each of the universities in the region has its own area of interest in relation to environmental technology and the low carbon agenda. This is mostly uncoordinated and may involve duplication. It is suggested that a coordinated and collaborative approach, involving all related initiatives that have the potential to reduce carbon emissions, would have real significance and facilitate the development of a national and international profile in this still fledgling sector.

Within this context Coast to Capital should undertake more in depth analysis into research, development and manufacturing capability in target sectors. Current analysis has been limited to desk based activity. It would be necessary to contact businesses and research organisations to find out more specifically what they do at each site and their propensity to engage in regional activity.

2) Coast to Capital should work with the universities and key industries to investigate the development of at least one landmark regional centre of excellence/technopole associated with an innovation network sector to act as a focus for research and inward investment.

Such centres or science parks can act as a real stimulus to cluster building and networking.

Sanz[39] differentiates a number of roles which science and technology parks can play in practice:

- Privileged links to governments
- Direct co-operation with universities
- Hosting mature business communities
- Focus on business incubation/creation
- Strong international dimension

3) Coast to Capital should take a lead in the creation of innovation friendly business environments for SMEs through the development and implementation of a coordinated and holistic strategy.

This should recognise and promote the principles of the Small Business Act for Europe**.**

- Create an environment in which entrepreneurs and family businesses can thrive and entrepreneurship is rewarded
- Ensure that honest entrepreneurs who have faced bankruptcy quickly get a second chance
- Design rules according to the "Think Small First" principle
- Make public administrations responsive to SMEs' needs
- Adapt public policy tools to SME needs: facilitate SMEs' participation in public procurement and better use State Aid possibilities for SMEs
- Facilitate SMEs' access to finance and develop a legal and business environment supportive to timely payments in commercial transactions
- Help SMEs to benefit more from the opportunities offered by the Single Market
- Promote the upgrading of skills in SMEs and all forms of innovation
- Enable SMEs to turn environmental challenges into opportunities
- Encourage and support SMEs to benefit from the growth of markets

The strategy should recognise the need to work with partners to establish region-wide initiatives to provide established and start-up businesses with structured, coordinated and sustainable support to promote growth, innovation and enterprise. This builds on the work undertaken to develop the Business Navigator portal and the successful RGF 4 bid and proposed Wave2 bid. Within this context, the universities should be encouraged to explore the potential to establish a similar consortium to the SETsquared partnership between the universities of Bath, Bristol, Exeter, Southampton and Surrey and focused on accelerating the development of technology based ventures[40]

It should further continue to develop and promote the export potential of small businesses within the region. Whilst it would appear from the survey that many small businesses plan to export their goods and services, many do not and most suggest a 2 year horizon to enter the export market. This would suggest that exporting is not a priority. The work of Coast to Capital should be accelerated in this area to convert this aspiration into a

---

[39] Sanz, L. (2009) ―Innovation and entrepreneurship: what science parks can do, paper presented to *NewChallenge, New World: How Science Parks can help in times of crisis, 2009 ASPA-IASP Joint Conference*, Hsinchu, Taiwan, 25th-27th November 2009, *www.2009aspaiasp.org.tw/doc/1_Sanz.pdf.*

[40] http://www.setsquared.co.uk/support-early-stage-companies

reality. One possible idea ventured was the establishment of a network of export clubs at a local level.

Coast to Capital should evaluate the potential implementation of a business charter across the region. The purpose of this informal charter, modelled on the Developer's Charter implemented by Arun District Council, would be to promote, for example, local supply chains, training and education, sustainable practice and equitable terms. Promoted by Coast to Capital and implemented at a local level, it would improve a number of issues identified by the analysis such as skills and cash flow whilst promoting the region in terms of quality and service.

Coast to Capital should consider working with area partnerships and universities or colleges to evaluate and coordinate the development of a number of Innovation Centres / Enterprise Hubs. These might be themed e.g. electronic, engineering, creative, prototype production (Fablab, media production, e.g. Hethel Engineering Centre). The number, location and focus of these centres will be critical. The experience of SINC would suggest that there is only demand/scope for a few centres focused on high growth product development innovation for example. It may be possible to work with the High Value Manufacturing Catapult to develop a local small business prototyping centre.

4) Coast to Capital should ensure that its skills strategy aligns with the sector specific aims of this strategy and supports the development of a knowledge base that will underpin the needs of the core sectors identified.

It should specifically take action to ensure that all schools and colleges have visibility of the Handbook for Enterprise Education[41] and are actively engaged in developing enterprising mind-sets.

It should also work with schools, colleges, universities and industry to promote the development of effective digital skills at all levels.

9.2 Threats

As part of the recommendations, it is important to recognise that there are a number of threats that have the potential to thwart the ambitions of Coast to Capital in achieving its objectives:

- The Initiatives proposed will require significant long-term commitment, planning, leadership and investment in resources.
- Universities and key faculties and researchers have a significant role to play. If they do not recognise the benefits of regional collaboration and open-innovation but pursue their own individual interests, it will be very difficult to establish effective networks and build the major programmes envisaged.
- The dynamics of a smart specialisation strategy will only work at a regional level and requires cooperation at that level. Sub-regional politics and the failure to agree on

[41] Batchelor, L (2013), A Handbook for Enterprise Education, Coast to Capital

sector prioritisation, place based initiatives and the overall need for a vision will stifle effective activity.

- Failure to engage with business around the vision will also impede development and restrict the necessary component of value capture from the research undertaken.
- Although broad sector based initiatives have been proposed at some stage it will be necessary to select and pursue more focused initiatives. Some of these may not deliver the anticipated benefits. It is important that the causes of mistakes are learned but that the programme moves forwards rather than being hindered by them.

Appendix A

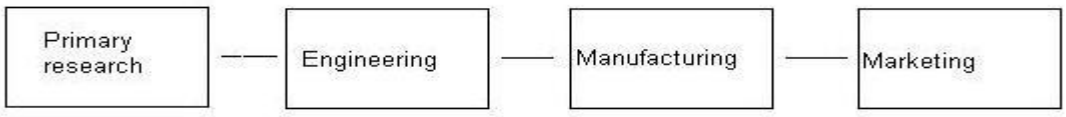
Innovation models an extract from an unpublished report by Dr Kostas Giannoutakis, Research Assistant – SEMAL, University of Chichester in 2010 as part of the EU Funded Interreg Project- CAMIS

A commonly accepted definition of innovation is the successful introduction of a new or improved product, process or service to the marketplace (Hobday 2005). Joseph Schumpeter characterised innovation as a "creative destruction" (Tidd 2006). Innovation is about developing new ideas and marketing them for a financial benefit to the firm. The money making aspect is what distinguishes innovation from invention in a university laboratory or research centre (Freeman and Engel 2007). Innovation has captured the business research interest and constitutes an inseparable part of business research in the last 35 years. It is estimated that businesses will excel in the future mainly if they are innovative, and thus innovation becomes a target and part of the decision making process and business functioning for many business models nowadays. Firm-level innovation has been one of the key growth factors for industrially advanced countries and is believed to be the driving force to development for developing countries as well (Hobday 2005) .

Through the years several models of innovation have emerged and were utilised by firms. The most widely accepted classification of innovation models is the one described by Prof Roy Rothwell, researcher of innovation management of the University of Sussex (Rothwell 1994), who identified five generations of innovation models. Rothwell's models of innovation start from the 1950s and span to nowadays. Each model is an update to the previous one, without mutual exclusion of each other. That is to say, businesses since the second half of the 20th century up to nowadays may adopt several different models at the same time. Also, the transition from one model to the next is often regarded as a change in the perception of what the best practice should be, rather than as a real progress (Hobday 2005). Rothwell's five generations of innovation models are as follows:

1. First generation: "Technology Push" (1950s – Mid 1960s): Linear models of innovation which attempt to describe innovation as a linear process starting with primary research and ending with marketing of the final product. According to these models, innovation starts with primary research in universities, or even accidentally. This triggers more research in a firm level, usually inside some company's engineering department, which leads to manufacturing and mass production of the business idea in a formed product. Finally, there is the need for right promotion of the product to the consumer, and this is where marketing comes into the process. A schematic representation of a characteristic first generation models (often called, "the linear model") is given in Figure 1.

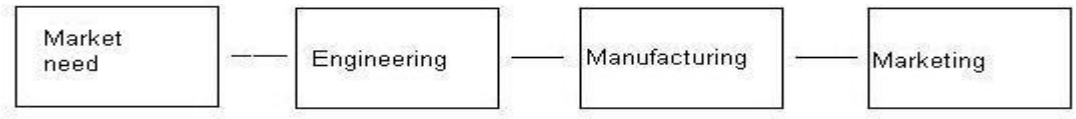
Figure 1: 1st generation - Technology Push model (Hobday 2005)



This model highlights the importance of technology, hence its name, as driving force for the innovation. Although there are studies advocating that first generation or the linear model of innovation is still in use (Godin 2005), the linear model is broadly considered inadequate to explain innovation to a certain extent, due to its simplistic linear nature.

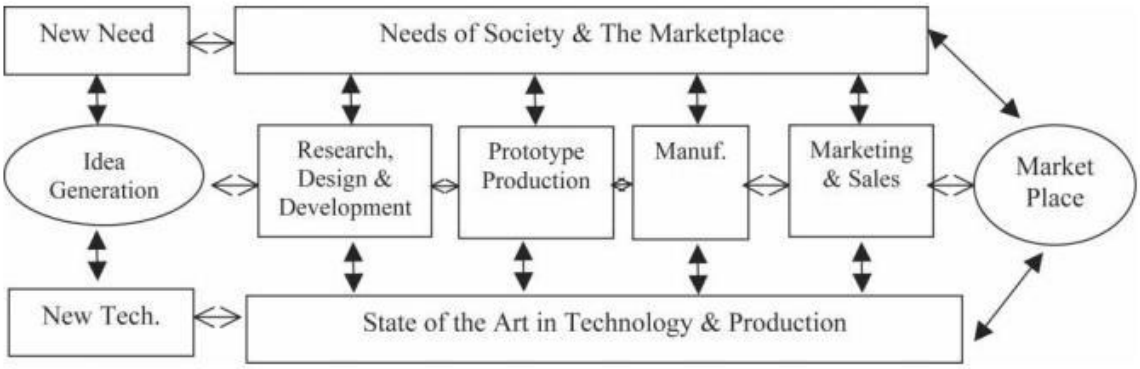
2. Second generation: "Demand Pull" (Mid 1960s – 1970s): The rise of the "market need" theories in the 1960s led to the 2nd generation of models, which emphasize the role of the market in the production and propagation of the innovation. Again, they were linear models, similar to the 1st generation models with the focus on the proactive market and the reactive R&D. Figure 2 represents a typical 2nd generation model.

Figure 2: 2nd generation – Demand Pull. Note the difference from Figure 1 on the driving force (Market need instead of primary research) (Hobday 2005)



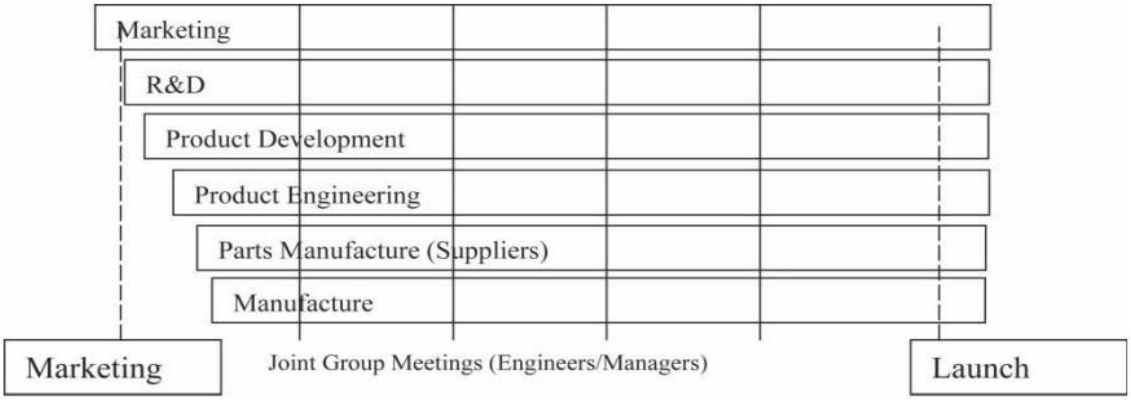
3. Third generation: "Coupling or Interactive models" (1970s): The great handicap of the first two generations models was their linearity, which was not enough to explain the innovation process and its complex interactions. This inefficiency gave birth to the third generation of innovation models, which depict interactions of science & technology and the marketplace. As shown in figure 3, a typical 3rd generation model still includes the main core of the past two generations, but now there are feedback loops between science & technology and the marketplace from the later stages to the earlier. Also R&D and marketing are more balanced and they equally contribute to the innovation process, rather than have a more proactive or a more reactive role.

Figure 3: 3rd generation – Coupling or Interactive (1970s) (Hobday 2005)



4. Fourth generation: "Integrated models" (1980s): Although more balanced between R&D and marketplace, 3rd generation models were still linear in nature. The 4th generation models, inspired by the Japanese automobile industry, included overlapping or integrated areas between the various departments of the firms, like shown in Figure 4. These models are not characterised by sequential processes and consider interactions with external partners as well, such as suppliers, universities and public organisations, as well as customers.

Figure 4: 4th generation – Integrated models (1980s) (Hobday 2005)



5. Fifth generation: "Systems Integration and Networking models" (Post 1990s): The last generation of innovation models, widely used by firms nowadays, are an extension of the 4th generation. They focus on networking of the firm with suppliers and customers, make extensive use of IT facilities, R&D, simulations and CAD systems for product design, they aim at total vertical integration with all levels of the supply chain and stress the importance of total quality management and other non-price factors. Fifth generation differs from the fourth on the use of advanced computing and high-tech and in the words of Prof Roy Rothwell, "5th generation represents the *electronification* of innovation" (Hobday 2005).

Classifying innovation in a series of generations has been a masterpiece of academic work, however, the list cannot be exhaustive and like any model it is based on assumptions and simplifications. It is impossible to draw a "normal" frame of innovation and we should bear in mind that innovation might also be discontinuous, or its diffusion might not follow any of the models described above and be S-shaped instead (Tidd 2006). S-shaped (or logistic) means that the rate of adoption is low at the beginning and only the "innovators" adopt the new idea. Next the "early adopters" follow, and the "late majority" adopt as the idea matures. Finally, the curve straightens and gets the S shape as the "laggards" are the last to adopt.

Several other classifications of innovation models exist. One of the most popular is the distinction between open and closed innovation. Some of the models in the Rothwell's five generations could be open or closed innovation models. A firm is said to follow a closed innovation policy when it undertakes on its own all the stages of the production process, from the conception of the idea to the marketing of the product. It is a model dominated by secrecy from the firm and total internal control. Open innovation on the other hand, is a

model with several external partners involved in the production process, collaborations and ventures, but with different vested interests as well, which can slow down and undermine the production. According to Munsch (Munsch 2009), the open model approach can provide three clear benefits to the firm:

1. New ideas considered from different perspectives.
2. Mitigation of business and financial risk by the participation of many different parties.
3. Speed to market when good coordination exists and all parties make valuable contributions.

Open and closed innovation models have also been examined from a mathematical point of view, with the development and testing of simulation models (Almirall and Casadesus-Masanell 2010), showing that open innovation sometimes might be restrictive for a firm to adopt a particular technological procedure for a product.

Other studies on innovation, such as (Makri and Lane 2007) emphasize the importance and pivotal role of scientific knowledge and technological advancements in innovation, similar to the case of innovation in terms of the fourth and fifth generation models. Freeman and Engel (Freeman and Engel 2007) discuss about some other distinction of innovation models, the corporate and the entrepreneurial models. According to the corporate model, an invention passes through technology development, testing and market launch, in a long time process where more and more people are added in the business team that conceived the original idea (e.g. engineers, business analysts, marketers etc). As a result, ownership of the innovation moves from the original innovators to the corporation. An incremental innovation, i.e. an extension or improvement of an existing product is easier to survive than is a new product sold to the market. The entrepreneurial model on the other hand, is more focused on the role of venture capitalists and the innovation process is centred on the business itself from the beginning to the end. Freeman and Engel also stress the importance of mobile resources and aligned incentives for successful innovation. Mobility of resources is important for the versatility and adaptability of the firm, back there is always the danger of temporary inefficiencies during the transition of resources from one location to another. Well aligned incentives ensure that resource providers direct their resources to the right innovators and to the right projects.

Innovation and clustering

It is believed that clustering promotes innovative firms and innovation policy is (or should be) in the governments' policy agenda. The theory of business clustering was developed in early 1990s by Michael Porter (Porter 1990) and it has gained popularity among business theorists and academics. According to Porter's theory of business clusters, clusters are believed to increase productivity and make companies more competitive nationally and globally. They exist to create a competitive advantage for the collective and the individual firms also (Arikan 2009). Geography is a major characteristic of business clusters and research finding demonstrate that the frequency of interactions between cluster firms and knowledge exchange increases with geographic proximity (Arikan 2009). Despite the fact that there is as yet not much evidence to conclude how clusters behave in different locations

and circumstances (Simmie 2004), Porter's theory might be globally applicable. A great part of literature on business clusters emphasizes innovation and knowledge developed in them. Michael Porter (Porter 1990) refers to three mechanisms within a business cluster that may increase a firm's competitiveness:

1. Shared best practices, training resources and available labour force in the cluster, which increase the firm's productivity.
2. Encouragement and fostering of innovation, which also causes increases in productivity.
3. Speeding of the production process and enables new business models in the cluster to form and develop.

Porter also provided six hypotheses why business clustering promotes innovation, as they are described and challenged by (Simmie 2004):

1. Rapid perception of new buyer needs.
2. Concentrates knowledge and information.
3. Knowledge-based economies are more successful when knowledge is localised.
4. Facilitates on-going relationships with other institutions, including universities.
5. Allows the rapid assimilation of new technological possibilities.
6. Provides richer insights into new management practices.

Close cooperation with suppliers, contractors, customers and support institutions will encourage interactive learning and will create innovative environment (Asheim 2007). An optimal breadth and depth of business clustering is not generally accepted with some studies advocating high clustering and reach (Schilling and Phelps 2007) and some others supporting that the location does not make a difference in respect to innovation performance (Doloreux, Amara et al. 2008). An important aspect for the formation of clusters seems to be the cluster identity (Romanelli and Khessina 2005), i.e. the type of firms that consist the cluster. Even clusters located in areas with inferior resources but with strong identity can thrive. Clusters might also consist of companies of the same sectors and still be characterised by significant differences, as the evidence from the British financial services in London, Edinburgh/Glasgow and Bristol have shown (Pandit and Cook 2003).

There are numerous papers on regional studies in business clusters, spanning several sectors and geographic regions. Principal Component Analysis (PCA)[42] for innovation clusters in EU-15 (Tokumasu and Watanabe 2008) reveals the existence of three clusters (Cluster 1: Belgium, Germany, France, Ireland, Luxembourg, Netherlands, Austria, UK,

[42] Principal Component Analysis is a method that transforms a set of possibly correlated variables to a set of uncorrelated variables, called principal components. The method is derived from the linear regression model and is defined as an orthogonal linear transformation that transforms the data into a new coordinates system. Every principal component accounts for a percentage of variance to the regression model, with usually the first 2 or 3 components to account for over 90% of the total variance. Principal components with insignificant variance can be discarded from the model. In case of two principal components, the first principal component is the line of best fit of the regression model and the second principal component is a line vertical and perpendicular to the line of best fit. Therefore, the axes system of the linear regression is rotated to a new coordinates system whether the two principal components are now the new axes. This way, the cloud of data in the scatter plot is regressed more accurately around the line of best fit.

Cluster 2: Sweden, Finland, Denmark, Cluster 3: Greece, Spain, Italy, Portugal), with the northern countries at much stronger position in terms of inputs and innovation resources and with IT-focused institutions that lead IT-based economy growth. Studies of innovation cluster in Europe (Moreno, Paci et al. 2006) also examine how much specialisation or diversity and other local factors (e.g. home market effect, agglomeration phenomena etc) affect innovation in a local industry. They show that clustering is highly affected by institutional and geographical proximity, although technological proximity did not appear to be a strong factor. Examples frequently mentioned in business literature are the Silicon Valley in California (Osama and Popper 2006), the "Third-Italy" (Asheim 2007) and the Silicon Fen in Cambridge (Garnsey and Heffernan 2005). The last demonstrates a unique case of how technology companies around a science centre can transform the local economy and how collective firms solve problems hard to be solved by individual enterprises (Garnsey and Heffernan 2005). Similar clustering phenomena have been observed in Oslo, Norway, where companies find it useful to interact with consulting companies and important customers (Isaksen 2004). A study of Flanders, Belgium (Cabus and Vanhaverbeke 2006) reveals that business clusters are highly associated with external economies, which are taking over internal economies. Networking cannot be explained in terms of urban networks, but in terms of relationships between firms located in territories with dynamic industrial communities. Innovation systems with similarities have been observed in Wales, Scotland, East Anglia, Stockholm and East Gothia (Sweden) as being underdeveloped due to deep reliance on public support (De-Laurentis 2006). It is supported that a combination of public and private governance at a regional level to promote innovation can be more efficient (De-Laurentis 2006). Another study for 13 clusters in Sweden illustrates four distinct models of cluster approaches: a) industry-led initiatives, top-down public policy exercises in brand-building, c) projects to produce an industry cluster from thin-air and small scale, geographically dispersed clusters that link to deep global rather than national systems, sources of innovation and competitive advantage (Lundequist and Power 2002). For the case of Germany a strong tendency towards clustering of industries or of strengthening existing clusters is observed (Brenner 2005), in contrary to the Randstad region of The Netherlands where studies on high-tech SMEs showed that regional clusters hardly exist (Wener and Stam 1999).

By examining the innovativeness and importance of local cooperation, it is statistically shown that highly innovative firms are more likely to cluster. Furthermore, clustering seems not to be restricted to high-tech companies and companies with clustering dynamics tend to cooperate well with suppliers and universities (Brenner 2005). Finally, with regards to overseas companies, research findings are similar and it is shown that clustering can be positively correlated with regional development, as is the case of Australia (Roberts and Enright 2004), or, it increases the innovation, knowledge depth and interaction of high-tech personnel, like it happens in Taiwanese science parks (Hu 2008).

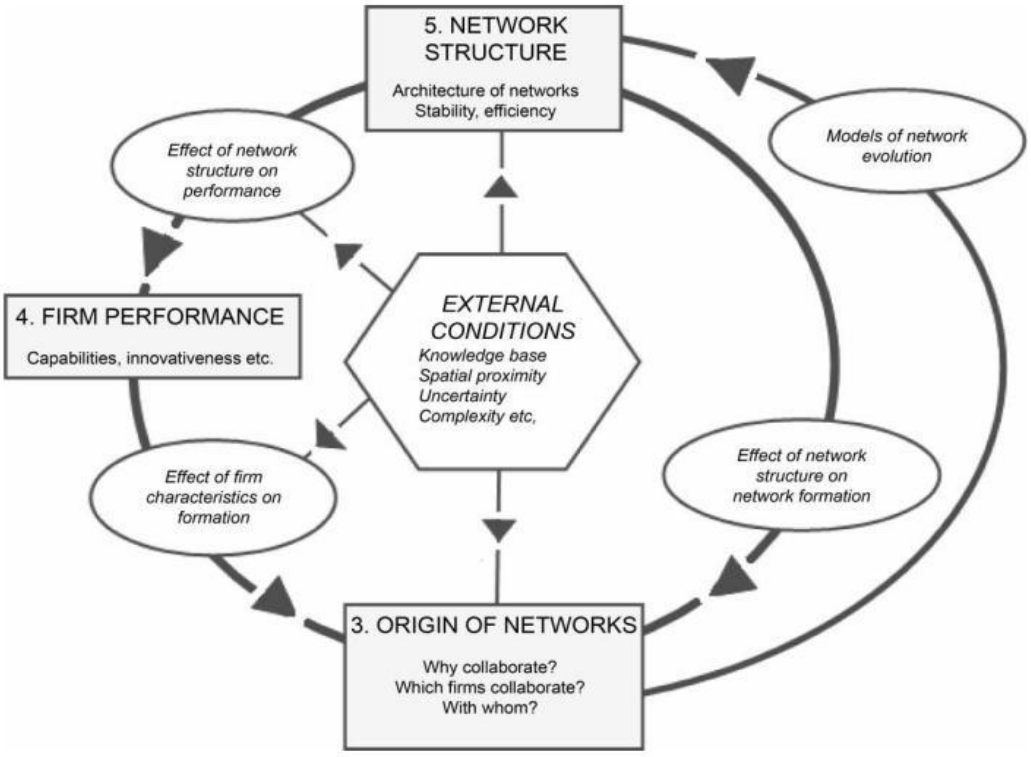
Innovation and Knowledge Spillovers

According to (Arikan 2009), the reason a cluster exists is to create a competitive advantage for the collective and for individual firms by knowledge creation. Knowledge creation and spillovers are believed to be major characteristics of business clusters and totally intertwined

with innovation. Arikan studies inter-firm knowledge exchange in business clusters and defines it as formal or informal interactions between firms that involve either voluntary or involuntary forms of knowledge exchanges. In his study to find evidence of such inter-firm knowledge in clusters, he makes and tests eleven propositions concerning knowledge, lead time, modularity in product technology, level of technological dynamism, exploration-based search strategies, number of industries that use the same technology, the lead firm's level of cooperation, tacit knowledge, information channels and knowledge brokers, knowledge overlap between cluster firms, knowledge exchanges between cluster firms and outside entities and dissolve of knowledge relationships that no more enhance knowledge creation. He studies what relationship all these factors above have with creation of knowledge and exchange of knowledge in the cluster. He also tries to explain why some clusters may perform better than others. Knowledge intensity, presence of strong firms, interfirm knowledge exchanges and institutional environment for cooperative relationships seem to be some of the main success factors.

However, most of the research on interfirm knowledge and clusters is not generic like (Arikan 2009), but focused on different business sectors and this makes more difficult to draw universally acceptable conclusions (Ozman 2009). According to (Ozman 2009), the most common studies on interfirm networks can be represented in a flow diagram, like the one in Figure 5.

Figure 5: Circular flow diagram of network research (Ozman 2009)



Three are the main parts of this diagram: a) origins of networks, b) firm performance and c) network structure. Studies on origins of networks try to find out why firms collaborate, with who they collaborate, what the effect of collaboration is etc. Firm performance studies

answer the question how the structure of the network or the environment influences the firm performance. Network structure studies looks at the overall structure shaped and how the external conditions affect the network. The diagram above shows the commonalities among the three different approaches and how the change is focus transfers from one study to another, e.g. by focusing on effect of network structure on performance we move from “network structure” study to a “ firm performance study” etc.

From a mathematical point of view, there have been models of business clustering that investigate the potential and the effects of knowledge exchange. (Cowan, Jonard et al. 2006) developed a model in which pairs of firms come together and join their knowledge in order to innovate. The success of this collaboration is dependent on whether the two firms had collaborated successfully in the past. The model is agent-based, consisting of firms motivated only by knowledge creation, and it shows that firms tend to form pairs with firms that offer complementary knowledge. It seems that there is also an optimal degree of similarity, companies that are too similar will not collaborate successfully as they have too little to exchange. On the other hand, companies too diverse have little in common and communication is too difficult in order to establish a knowledge exchange portal. In an update model, (Cowan, Jonard et al. 2007) the collaboration is determined by cognitive, relational and structural embeddedness and successful collaboration of the past dynamically increases the probability for collaboration in the future. Also the opinions of one firm’s partners matter in this updated model: If my partners had a good experience working with A, then probably firm A will be a good partner for me. Some interesting findings indicate that when information about third parties comes indirectly from former partners, firms tend to form triangles that lead to clustering. When innovation sharing and the importance of structural embeddedness form a star-like cluster, companies at the centre of the star perform better than the other firms. Similar results are observed even when the model is extended from static to an iterative game of network formation (Baum, Cowan et al. 2008; Cowan and Jonard 2009)

Although it is widely believed that clustering is correlated with interfirm knowledge and innovation, certain studies fail to provide any such evidence at a regional level (Fleming, III et al. 2007).

Regional Innovation Systems

The innovation model of a Regional Innovation System (RIS) is one of the most modern approaches on supporting innovation and assessing the effects of innovation on specific regions and its contribution to economic development. It is an innovation policy that promotes regional science, technology and innovation with the participation of regional stakeholders (Zabala-Iturriagagoitia, Jimenez-Saez et al. 2008). Business clustering is intertwined with the model of RIS as the latter provides necessary conditions for the formation of clusters, it is associated with knowledge spillovers and encourages innovative activities through R&D and investments in technology.

RIS initiative was introduced in 1994 and its main goals were (Zabala-Iturriagagoitia, Jimenez-Saez et al. 2008):

- Promote more open processes to help the development of regions.
- Create an innovation culture.
- Identify the needs of regional firms in terms of innovation support services.
- Help Small and Medium Sized Enterprises (SMEs) grow.
- Coordinate existing innovation support strategies.
- Promote interfirm and public-private networking and collaboration.
- Encourage horizontal clustering.
- Identify new pilot innovation projects and themes.
- Integrate interregional cooperation and policies within Europe.

Each RIS has also three main phases: a) Consensus building and awareness phase (contacts and discussions among key regional actors), b) analysis phase (identification of firms' innovation needs, analysis of the innovation capital of the region etc) and c) elaboration of the RIS (identification of pilot projects, designing and implementation of evaluation systems etc). In terms of methodology, there is no global method of implementing RIS, each region and policy need its own special plan. However, it is commonly accepted that a successful RIS strategy requires an effective combination of quantitative and qualitative methods in order to understand the economic and social impact of the policies.

The European Research Area (ERA), an initiative launched in 2000 as part of the Lisbon Strategy (Bruijn and Lagendijk 2005), aims to integrate research programmes and structural funds to improve the European competitiveness in the "knowledge society" (Heraud 2003). The ERA is implemented through the RIS. A RIS can bring together regional development organisations, universities, local authorities, stakeholders and sponsors. Its main characteristic is its regional nature. Nevertheless, the network of organisations and people involved might exceed the geographical borders of a specific region. RIS is focused on science and technology and although it is related to the contemporary innovation models, its basis can be found in the linear models of innovation, the first generation model (Heraud 2003): Any increase in research inputs (R&D, facilities, infrastructure etc) will statistically lead to increased output of technological creation and industrial innovation. RIS's relation to more recent innovation models can be found in its emphasis on scientific knowledge and general education at every stage of the process leading to innovation (Heraud 2003). Also the local socio-economic conditions are considered to play an important role for the creation of successful RIS (Rodriguez-Pose and Crescenzi 2008). Although the realisation of the Lisbon Strategy has not been to the full aspiration of the policy makers and more than R&D and technological advancements are needed (Bruijn and Lagendijk 2005), it is agreed that RIS has been an important catalyst to increase innovation in Europe.

Studies about RIS have attacked the relationships developed between technological SMEs in terms of competition and co-opetition (Gnyawali and Park 2009), as well as the issue of SMEs versus Transnational Corporations (TNCs) (Christopherson and Clark 2007). It is believed that when SMEs coexist with TNCs in the same region, SMEs have more opportunities to innovation and be easier established in the global markets. (Christopherson and Clark 2007) investigate three factors that explain why in practice this does not really happen, namely political power, existence of research centres and the regional labour market. TNCs dominate all three factors, they have enough political power to influence

regulatory policy, they own or have control of major research centres and attract the most educated and talented workforce from the labour market. But if so, why SMEs still exist and some of them are great innovators? (Christopherson and Clark 2007) say the answer is in the RIS structure: TNCs have a limited role in RIS, they are not region-oriented. They target the global markets and try to establish networks in other countries. Another explanation may be found in the perception of networks as hierarchies of companies. TNCs are interested in networks only if they are going to be high in the hierarchy and only if this is going to increase their profitability internationally. Finally, exclusivity is another deterrent for TNCs to work in regional networks, meaning that they find no incentive to belong in a network if there is not strict control of who is in and who should definitely stay out. For all these reasons, SMEs can keep a distance from TNCs, form networks and prosper in the boundaries of RIS.

There are also articles that model and assess RIS mathematically. In one of these (Crescenzi 2005), the author investigates the regional innovative activity of EU-25 and shows how the geographical accessibility and human capital accumulation interact with local innovation and how this leads to economic growth. In another paper (Zabala-Iturriagagoitia, Voigt et al. 2007) the authors apply Data Envelopment Analysis (DEA) to evaluate regional innovation based on data provided by the European Innovation Scoreboard for 2002 and 2003. DEA is a non-parametric technique that looks for the so call “efficient frontier” in a convex solution space. It is an extreme-point optimisation method that compares possible solutions by combining various “decision making units” and assesses them on the same set of inputs and outputs. In this study the percentage of people in higher education, percentage of people in lifelong learning, employment in manufacturing high-tech employment in services, public R&D expenditure and high-tech patent applications to the European Patent Office are considered as inputs. On the other hand, the number of awarded patents is considered as output. It is found that the technological level of the region is positively correlated to the need for system coordination, enforcing this way the role of RIS.

Although in principle RIS sounds like an effective strategy to boost innovation, the reality of tackling innovation disparities across regions is more complicated. There is a vicious circle effect in attacking innovation disparities as explained by (Heraud 2003): the richest countries in Europe can spend more funds on innovation policies. Hence, in the long run the poorer countries will still be behind in innovation capacities and will be less successful in bridging the gap between themselves and the leading innovation countries. As an indication, support per person working in manufacturing is 200 Euros in France, Denmark and Finland, 50 in Spain and less than 10 in Greece. Despite the fact that the EU has not made the full potential of RIS, it is generally accepted that they have the capacity to contribute to the economic development of regions. (Iammarino 2005) argues that effective RIS should have both top-down and bottom-up characteristics and examines the case of Italy. Top-down or Macro-to-Micro is the shift from national scale to regional scale and according to (Iammarino 2005) it is necessary to integrate with it bottom-up (micro-to-meso) perspectives. This way the RIS framework works provides enough base to determine whether a region is an innovation system, despite some difficulties in this analysis, such as insufficient information. There are more authors that recognise the importance of RIS in shifting innovation from a national to a regional level (Nuur, Gustavsson et al. 2009), but they also emphasize some risks involved in this process. Most important of them, the risk that RIS might lose its strength as a tool dealing with the structural problems connected to innovation and globalisation. They perform a case study of a Swedish policy programme, Vinnvaxt, to

highlight the challenges that emerge when RIS approach is used in a small open economy and in industrial sectors with global reach. As a conclusion of their study, they suggest that RIS could be reinforced by being applied to transregional and transnational policy programmes, become more knowledge intensive, handle the complexity of industrial dynamics better than the linear model, put in place mechanisms to avoid regional lock-ins, arising from local financing and enforcing the administrative rather than the desired functional regions, and develop policies that contain both regional and technological focus. In the following, I am describing some more empirical studies of RIS across Europe.

In Finland, a country with small population and few resources, RIS has placed the country among the top innovators in several international rankings (Jauhiainen 2008). With an organised innovation policy since the early 1990s and Porter's theory applied, Finland climbed up the rankings of innovation. It also systematically reviewed the innovation concepts and models and paid special attention on regional clusters. Although Finland is leading innovation as a country overall, there are disparities among regions with some of them to demonstrate remarkable performance, such as the Lahti region (Pekkarinen and Harmaakorpi 2006; Aula and Harmaakorpi 2008) and some others to lag behind (Jauhiainen 2008). In another study (Koch and Stahlecker 2006) examined three German metropolitan regions, Bremen, Munich and Stuttgart emphasizing on Knowledge Intensive Business Services (KIBS). KIBS were introduced in the early 1990s and operate like providers, purchasers or partners in the context of innovation. They usually provide specialised expert knowledge, R&D and problem solving for local businesses. The study tries to identify how the regional techno-economic and institutional structures in the RIS affect the development of KIBS. The authors support that the differences in the structure of innovation systems across regions is due to different knowledge dissemination and endowment with incubator organisations which provide this knowledge, human capital and opportunities for development for KIBS. In Italy, the Lombardy region, one of the most industrialised and innovative regions in Europe, is highly based on local SMEs and the firms are very networked and clustered (Muscio 2006). Lombardy accounts for the biggest part of Italy's R&D (26% of the total national expenditure in R&D and 21.5% of the total national employment in R&D). The RIS in place allows local firms to access help from various public and private institutions, while lots of attention has been put on the technological development of the region (Bosco 2007). In Spain, the 'Mondragon Cooperative Experience' (Lopez, Lopez et al. 2009) is one of the oldest (since 1956) examples of industrial cooperatives in the world. It is formed by a group of 106 cooperative firms, 136 subsidiaries and 18 entities promoting the same business values, such as cooperation, participation, social responsibility and innovation. Especially about the last one, innovation is the central target of the cooperative. The aim is to enhance innovation, not only for the creation of new products, but also for new business and management models. In Belgium the food industry of Meetjesland is examined and firms show stronger innovation competence when networking within the region and orienting towards the international market (Gellynck, Vermeire et al. 2007). In Greece the RIS of European regional policies in Central Macedonia, Western Macedonia and Thessaly have been examined (Kyrgiafini and Sefertzi 2003) and it has been concluded that innovation is observed in specific areas due to the ability of those locations to establish operative external environmental conditions. Critical aspects towards the creation of such an environment are collective sharing and transfer of knowledge. By studying the case of Flanders (Cabus and Vanhaverbeke 2006) it is concluded that RIS is based on local expertise, but there is always the need for distant

expertise as well. In other words, RIS does not necessarily have to be restricted within some geographical borders.

Finally, as opposed to all studies mentioned above, there are also authors who support that establishing a regional advantage is just not enough (Cooke 2007). Regional learning might be an inadequate way to regional development and the key to achieving regional development should be consistent policy platforms. A study of Randstad in the Netherlands (Wener and Stam 1999) showed no evidence of regional clustering despite the presence of strong high-tech firms in the region, while others support that for RIS to be successful it should be downscaled to a more local level (Nuur, Gustavsson et al. 2009).

References

Almirall, E. and R. Casadesus-Masanell (2010). "Open Versus Closed Innovation: A Model of Discovery and Divergence." Academy of Management Review 35(1): 27 - 47.

Arikan, A. (2009). "Interfirm Knowledge Exchanges and the Knowledge Creation Capability of Clusters." Academy of Management Review 34(4): 658 - 676.

Asheim, B. (2007). "Differentiated Knowledge Bases and Varieties of Regional Innovation Systems." Innovation 20(3): 223 - 241.

Aula, P. and V. Harmaakorpi (2008). "An Innovation Milieu - A View on Regional Reputation Building: Case Study of the Lahti Urban Region." Regional Studies 42(4): 523 - 538.

Baum, J., R. Cowan, et al. (2008) Network-independent Partner Selection and the Evolution of Innovation Networks. 1 - 25

Blundel, R. and M. Thatcher (2005). "Constracting Local Responses to Globalization: The Case of Volume Yacht Manufacturing in Europe." Entrepreneurship & Regional Development 17: 405 - 429.

Bosco, M. (2007). "Innovation, R&D and Technology Transfer: Policies Towards a Regional Innovation System. The Case of Lombardy." European Planning Studies 15(8): 1087 - 1111.

Brenner, T. (2005). "Innovation and Cooperation During the Emergence of Local Industrial Clusters: An Empirical Study in Germany." European Planning Studies 13(6): 921 - 938.

Bruijn, P. D. and A. Lagendijk (2005). "Regional Innovation Systems in the Lisbon Strategy." European Planning Studies 13(8): 1153 - 1172.

Cabus, P. and W. Vanhaverbeke (2006). "The Territoriality of the Network Economy and Urban Networks: Evidence from Flanders." Entrepreneurship & Regional Development 18: 25 - 53.

Charles, D. (2006). "Universities as Key Knowledge Infrastructures in Regional Innovation Systems." Innovation 19(1): 117 - 130.

Christopherson, S. and J. Clark (2007). "Power in Firm Networks: What it Means for Regional Innovation Systems." Regional Studies 41(9): 1223 - 1236.

Cooke, P. (2007). "To Construct Regional Advantage from Innovation Systems First Build Policy Platforms." European Planning Studies 15(2): 179 - 194.

Cowan, R. and N. Jonard (2009). "Knowledge Portfolios and the Organization of Innovation Networks." Academy of Management Review 34(2): 320 - 342.

Cowan, R., N. Jonard, et al. (2006). "Evolving Networks of Investors." Journal of Evolutionary Economics 16: 155 - 174.

Cowan, R., N. Jonard, et al. (2007). "Bilateral Collaboration and the Emergence of Innovation Networks." Management Science 53(7): 1051 - 1067.

Crescenzi, R. (2005). "Innovation and Regional Growth in the Enlarged Europe: The Role of Local Innovative Capabilities, Peripherality, and Education." Gwoth and Change 36(4): 471 - 507.

De-Laurentis, C. (2006). "Regional Innovation Systems and the Labour Market: A Comparison of Five Regions." European Planning Studies 14(8): 1059 - 1084.

Dettmer, R. (2008). Push and pull. Engineering & Technology: 26 - 29.

Doloreux, D., N. Amara, et al. (2008). "Mapping Regional and Sectoral Characteristics of Knowledge-Intensive Business Services: Evidence from the Province of Quebec (Canada)." Growth and Change 39(3): 464 - 496.

Elliott, D. (2004). "Energy Efficiency and Renewables." Energy and Environment 15(6): 1099 - 1105.

Elliott, D. (2009). "Marine Renewables: A New Innovation Frontier." Technology Analysis & Strategic Management 21(2): 267 - 275.

Fleming, L., C. K. III, et al. (2007). "Small Worlds and Regional Innovation." Organization Science 18(6): 938 - 954.

Fraenkel, P. (2001). Is the tide turning for marine current turbines? Modern Power Systems: 37 - 39.

Freeman, J. and J. Engel (2007). "Models of Innovation: Startups and Mature Corporations." California Management Review 50(1): 94 - 119.

Garnsey, E. and P. Heffernan (2005). "High-technology Clustering through Spin-out and Attraction: The Cambridge Case " Regional Studies 39(8): 1127 - 1144.

Gellynck, X., B. Vermeire, et al. (2007). "Innovation in Food Firms: Contribution of Regional Networks Within the International Business Context." Entrepreneurship & Regional Development 19: 209 - 226.

Gnyawali, D. and B.-J. Park (2009). "Co-opetition and Technological Innovation in Small and Medium-Sized Enterprises: A Multilevel Conceptual Model." Journal of Small Business Management 47(3): 308 - 330.

Godin, B. (2005). "The Linear Model of Innovation: The Historical Construction of an Analytical Framework." Project on the History and Sociology of S&T Statistics (Working Paper)(30): 1 - 36.

Heraud, J.-A. (2003). "Regional Innovation Systems and European Research Policy: Convergence or Misunderstanding?" European Planning Studies 11(1): 41 - 56.

Hobday, M. (2005). "Firm-level Innovation Models: Perspectives on Research in Developed and Developing Countries." Technology Analysis & Strategic Management 17(2): 121 - 146.

Hu, T.-S. (2008). "Interaction Among High-tech Talent and its Impact on Innovation Performance: A Comparison of Taiwanese Science Parks at Different Stages of Development " European Planning Studies 16(2): 163 - 187.

Iammarino, S. (2005). "An Evolutionary Integrated View of Regional Systems of Innovation " European Planning Studies 13(8): 497 - 519.

Isaksen, A. (2004). "Knowledge-based Clusters and Urban Location: The Clustering of Software Consultancy in Oslo." Urban Studies 41(5/6): 1157 - 1174.

Jacobs, K. (2004). "Waterfront Redevelopment: A Critical Discourse Analysis of the Policy-making Process within the Chatham Maritime Project." Urban Studies 41(4): 817 - 832.

Jauhiainen, J. (2008). "Regional and Innovation Policies in Finland - Towards Convergence and/or Mismatch." Regional Studies 42(7): 1031 - 1045.

Koch, A. and T. Stahlecker (2006). "Regional Innovation Systems and the Foundation of Knowledge Intensive Business Services. A Comparative Study in Bremen, Munich and Stuttgart, Germany." European Planning Studies 14(2): 123 - 145.

Kyrgiafini, L. and E. Sefertzi (2003). "Changing Regional Systems of Innovation in Greece: The Impact of Regional Innovation Strategy Initiatives in Peripheral Areas of Europe." European Planning Studies 11(8): 885 - 910.

Lopez, U., S. Lopez, et al. (2009). "Innovation in Industrial Cooperatives: Special Features and Potential of the Mondragon Model." International Journal of Technology Management and Sustainable Development 8(1): 39 - 56.

Lundequist, P. and D. Power (2002). "Putting Porter into Practice? Practices of Regional Cluster Building: Evidence from Sweden." European Planning Studies 10(6): 685 - 704.

Makri, M. and P. Lane (2007). "A Search Theoretic Model of Productivity, Science and Innovation." R&D Management 37(4): 303 - 317.

Moreno, R., R. Paci, et al. (2006). "Innovation Clusters in the European Regions." European Planning Studies 14(9): 1235 - 1263.

Munsch, K. (2009). Open Model Innovation. Research - Technology Management: 48 - 52.

Muscio, A. (2006). "From Regional Innovation Systems to Local Innovation Systems: Evidence from Italian Industrial Districts." European Planning Studies 14(6): 773 - 789.

Nuur, C., L. Gustavsson, et al. (2009). "Promoting Regional Innovation Systems in a Global Context." Industry and Innovation 16(1): 123 - 139.

Osama, A. and S. Popper (2006). "Creating Economic Clusters." Economic Development Journal 5(4): 6 - 13.

Ozman, M. (2009). "Inter-Firm Networks and Innovation: A Survey of Literature." Economic of Innovation and New Technology 18(1): 39 - 67.

Pandit, N. and G. Cook (2003). "The Benefits of Industrial Clustering: Insights from the British Financial Services Industry in Three Locations." Journal of Financial Services Marketing 7(3): 230 - 245.

Pekkarinen, S. and V. Harmaakorpi (2006). "Building Regional Innovation Networks: The Definition of an Age Business Core Process in a Regional Innovation System." Regional Studies 40(4): 401 - 413.

Porter, M. (1990). The Competitive Advantage of Nations.

Roberts, B. and M. Enright (2004). "Industry Clusters in Australia: Recent Trends and Prospects." European Planning Studies 12(1): 99 - 121.

Rodriguez-Pose, A. and R. Crescenzi (2008). "Research and Development, Spillovers, Innovation Systems, and the Genesis of Regional Growth in Europe." Regional Studies 42(1): 51 - 67.

Romanelli, E. and O. Khessina (2005). "Regional Industrial Idnetity: Cluster Configurations and Economic Development." Organization Science 16(4): 344 - 358.

Rothwell, R. (1994). The Handbook of Industrial Innovation, Edward Elgar Publishing.

Rowbotham, M. (2007). UK Commercial Maritime Activity: Lifeline or Resource Drain? Focus: 50 - 53.

Schilling, M. and C. Phelps (2007). "Interfirm Collaboration Networks: The Impact of Large-Scale Network Structure on Firm Innovation." Management Science 53(7): 113 - 1126.

Simmie, J. (2004). "Innovation and Clustering in the Globalised International Economy." Urban Studies 41(5/6): 1095 - 1112.

Smith, D. (2005). Why wave, tide and ocean current promise more than wind. Part II - European developments. Modern Power Systems: 18 - 21.

Tidd, J. (2006). A Review of Innovation Models. Discussion Paper, Imperial College London 1 - 15.

Tokumasu, S. and C. Watanabe (2008). "Institutional Structure Leading to the Similarity and Disparity in Innovation Inducement in EU 15 Countries-Finnish Conspicuous Achievement Triggered by Nokia's IT Driven Business." Journal of Services Research 8(1): 5 - 42.

Wener, E. and E. Stam (1999). "Clusters of High Technology SMEs: The Dutch Case." Regional Studies 33(4): 391 - 400.

Zabala-Iturriagagoitia, J., P. Voigt, et al. (2007). "Regional Innovation Systems: How to Assess Performance." Regional Studies 41(5): 661 - 672.

Zabala-Iturriagagoitia, L., L. Jimenez-Saez, et al. (2008). "Evaluating European Regional Innovation Strategies." European Planning Studies 16(8): 1145 - 1160.