Science in the City Region: Establishing Liverpool's life science ecology

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Abstract

This article focuses on the development of soft and hard infrastructures to support a life science ecology in a peripheral European city region. Liverpool City Region has received almost £1.7bn in capital investment through EU Cohesion Policy to redevelop the city region and reinvigorate its economy towards knowledge based industries. The analysis of the city regions life science ecology highlights the uneven development of hard and soft infrastructures. Due to the diversity of firms within the region it has proven difficult to establish soft infrastructure related to scientific knowledge. The outcome has led to soft infrastructures being more business support orientated rather than scientific knowledge based, reducing inter-firm connections on a product or service basis. The evidence shows that not all types of soft infrastructure emerge as an outcome of investment. Hence, policy makers need to provide a clearer narrative on their investments, focusing on fewer core competencies rather than breadth of activities.

Key words: Life science ecology, hard infrastructure, soft infrastructure, assets, Liverpool City Region (LCR)

Introduction

Governments and international organisations at all levels have seen the potential economic and social benefits that a strong regional life science industry can yield (Benneworth, 2002). Deloitte (2014) estimated that the global life science industry was worth over $1.5tn in 2012. If a region can develop appropriate hard infrastructures that enable the softer financial and knowledge flows associated with the industry to be captured, that may stimulate regional

development. Drawing on this hard/ soft distinction from Colapinto & Porlezza (2012), this article explores investments in particular hard infrastructures that are seeking to support the development of soft life science infrastructures in peripheral city-regions.

This article thus asks the research question of whether public investment in hard infrastructures can also stimulate the emergence of the soft infrastructures necessary for dynamic life science ecologies. The paper reports a case study from Liverpool, an old industrial region that shifted its economic development path from 1980s managed decline towards new creativity- and science-based industries. Drawing on primary qualitative data, the analysis highlights the problem of a cognitive distance barrier between firms. The article concludes that building new hard infrastructure can under certain conditions further the development of a life science ecologies in a peripheral region.

Ecologies: Life Sciences and Regional Development

Economic development no longer depends on the availability of traditional production factors such as land, labour and capital, but also knowledge capital. Where there are many firms that are active in the same kinds of knowledge fields, what Nooteboom (2000) calls cognitive proximity, then there can be positive linkages and feedback that produce increasing returns to scale. These places are then attractive as investment opportunities for others. Kleppers (2010) argued that places serviced well by venture capitalists and/or business angels tend to foster more entrepreneurial activity. Business angels are individuals or collectives who provide capital for a business start-up, usually in exchange for convertible debt or ownership equity (Festel, 2011). They usually invest both money and their time to the venture.

There has been much interest in the potential of life sciences as a quintessential knowledge-intensive industry to drive regional economic development within regions including South East England, Scotland and Central England (Cooke, 2004; Kasabov, 2011) but also internationally (Cooke, 2004; Moodysson et al, 2008). Given the 5 to 15 year timescales that exist in the commercialisation of new products in this industry, there are potential gaps that exist in the funding models between start-up and phase one approval. Life science firms in the USA and in Europe have noted that business angels are significant players in bridging the

gaps between early start ups and raising the levels of capital needed to sustain a venture (Festel, 2011). Birch (2011) argues further, that less favoured regions tend to suffer from a lack of venture capital that is able to service innovations through to commercialisation. These analyses highlight a number of key factors underpinning successful life science-based development:

(a) The presence of star scientists in research intensive universities (Zucker *et al*, 1998).
(b) Presence of government led research institutions (Klepper, 2010)
(c) Highly successful firms can well serviced by venture capitalists can accelerate successful spin-outs (Festel, 2011)
(d) A mix of star scientists, government institutions, venture capitalists and successful businesses collaborating with universities and public organisations (Cooke, 2004; Moodysson et al, 2008).

We conceptualise these factors as hard and soft infrastructures (Colapinto and Porlezza, 2012). Hard infrastructure are tangible structures such as roads, buildings, telecommunications and ports, whilst soft infrastructures are intangible such as networking, knowledge exchange, business environments, human capital and regional institutions. For these latter soft infrastructures, a greater cognitive distance (i.e. less cognitive proximity between actors) can reduce the overall benefits the soft infrastructures bring (Maskell et al, 2006). In this article 'ecology' is used to conceptualise the life science development in LCR. Toulmin (1990:194) states:

> '*Once we begin to think in ecological terms, we shall soon learn that every niche or habitat is one of its own kind, and that it demands a call for a careful eye to its particular, local, and timely circumstances. The Newtonian view encouraged hierarchy and rigidity, standardisation and uniformity: an ecological perspective emphasises, rather, differentiation and diversity, equity and adaptability*'

Much literature here emphasised specific factors that have led to success, overlooking factors that may have hindered regional development been liabilities to the regions development. The ecological perspective focuses on the configuration of firms and infrastructures in studying how a life science region develops over time and how individual infrastructure configurations develop within their respective contexts (Tsoukas and Dooley, 2011). Where

there are complementarities between knowledge infrastructures related to specific kinds of knowledge, skill and expertise and local actors, regions may develop innovation ecologies by stimulating knowledge networks and spaces whereby communities of practice can develop specifically to develop an innovation ecology (Coe *et al,* 2004:470; Shearmur, 2011).

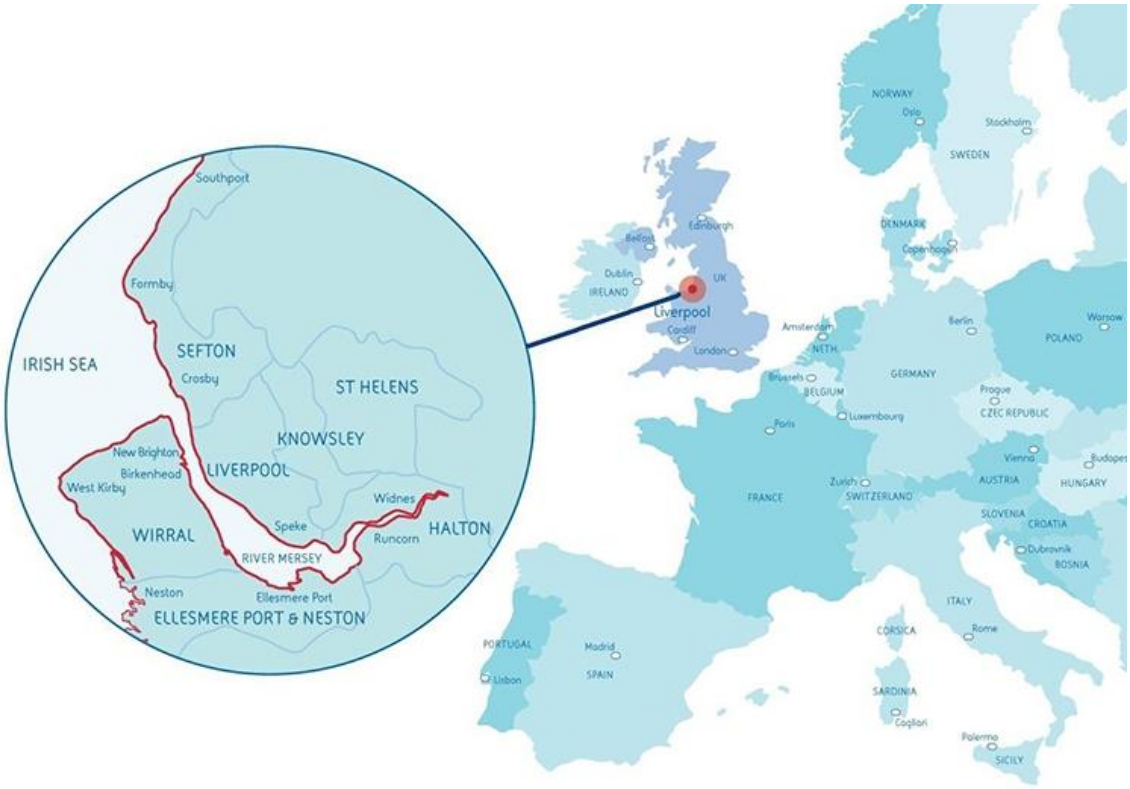
Method and Case: Liverpool City Region

This paper seeks to answer the overall research question drawing on a case study of the Liverpool City Region in the North West of England (see figure 1). In 2014, LCR had an economy of 1.5 million people, 38,000 VAT registered businesses worth £25.3 billion to the UK economy and has been one of the fastest growing UK regions outside of London (LCRLEP, 2014). Since the early 1990s, public money has been invested in developing new industries in the city-region (Southern, 2014). Recently, local institutions formulated a knowledge economy strategy identifying the life science industry as one of four key sectors for development. However, there has been no identifiable R&D activity in LCR by private pharmaceutical companies since 1961, supporting the rationale for public sector lead investment to support R&D.

The case study explores the development and outcomes of hard and soft infrastructure within Liverpool City Region. The primary empirical evidence for this case study is drawn from 25 semi-structured interviews with life science firms' managers and supporting institutions at a local and national scale during 2012-13. The research used the Bionow (2012) industry

directory verified via Companies House. Secondary qualitative and quantitative data was used to supplement the analysis and inform the broader economic and industrial context.

Figure 1 Liverpool City Region (Source: LCRLEP, 2014)



An overview of Liverpool's Life Science Ecology

There is a diverse range of firm activity in the LCR life science ecology (see Table 1). At the time of writing, the 53 life science firms were active and present in LCR, giving a relatively small ecology compared to the South of England and USA.

Table 1 Life Science firms by Activity in LCR

Activity	Number of Firms in 2012
Consultancy	7
Discovery (R&D)	13
Diagnostic	7
Drug Manufacturing	9
Medical Devices	8
Other	9
Total	53

The majority of firms have registered locations in designated science or innovation park developments (see Figure 2). These R&D sites are largely the result of publicly financed hard infrastructure developments.

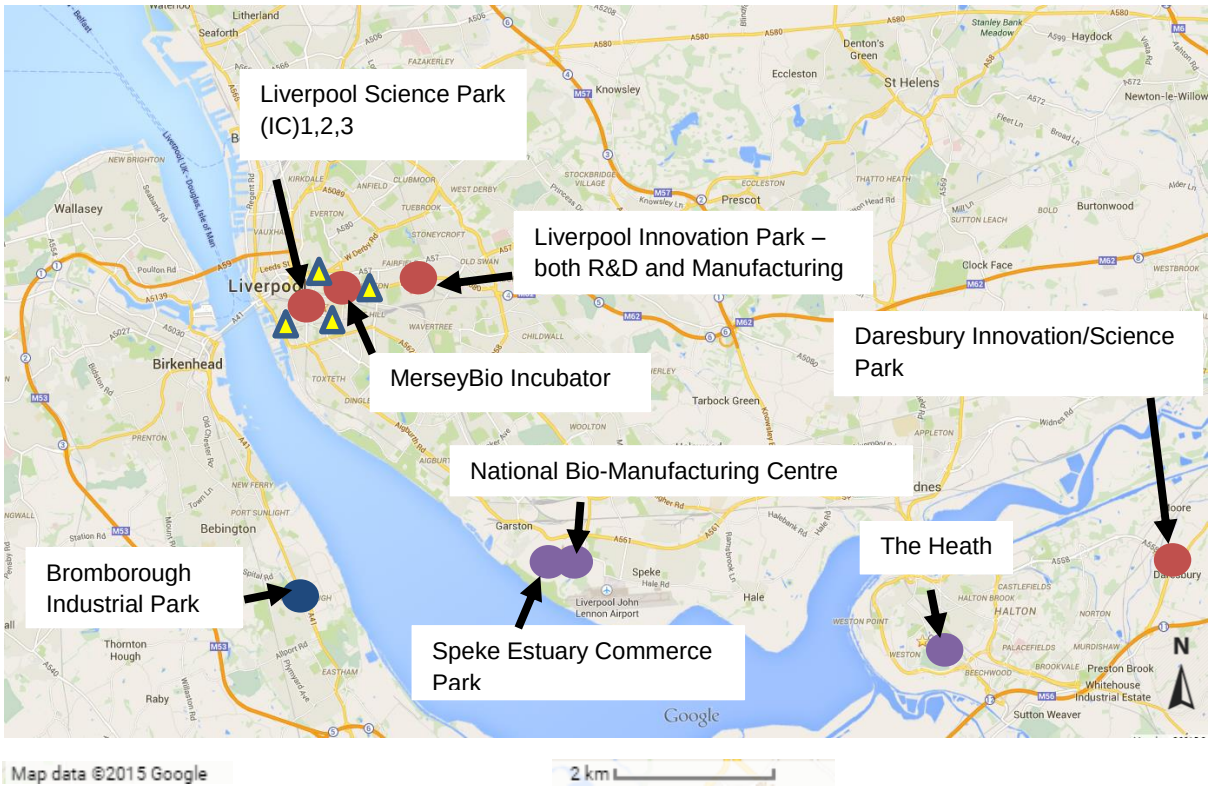


Figure 2 Life science firms by location

Alongside the firms are a set of organisations that are considered assets to the industry and which can hence be regarded as complementing the firm ecology. The National Bio-manufacturing Centre was completed in 2005 at a capital cost of £34m to provide facilities and infrastructure for life science related firms. It has subsequently attracted the largest concentration of pharmaceutical manufactures in Europe, making it a significant hard infrastructure development. Five further manufacturers are located outside the NBC, four of which are independent manufacturers that acquired sites already equipped with bespoke capabilities to increase operational capacity.

Local policy-makers have attempted to put in place a strategy to diversify this ecology towards more knowledge-intensive and high value-added activities such as R&D. The most significant

additional R&D infrastructure intervention came through the development of MerseyBio Incubator located at the University of Liverpool in 2001. In the interviews, the local policy makers identified a range of life science 'assets' in LCR; these are listed in Table 2 below along with their rationale for public support.

Table 2 Regional Assets in the LCR Life Science Ecology

Asset	Policy rationale	Issue
University of Liverpool	Offers education and research across the biosciences, medicine, dentistry, health sciences, tropical medicine and veterinary science.	The strategies recognise these assets are sources and infrastructures for innovation, spin-out firms and world leading research. All enrich the labour market with graduates. Graduate retention is low in the region. Employers in the sector cast doubt on the work readiness of graduates. Many jobs in the sector require post-graduate level education and training.
Liverpool John Moore's University	Has a long record of expertise in teaching, research, consultancy and knowledge transfer partnerships in life sciences.	
Liverpool School of Tropical Medicine	The first institution in the world dedicated to tropical disease. The institutions leads the field in research against infections, debilitating and disabling diseases.	
MerseyBio Incubator	State-of-the-art facility for developing biotechnology businesses. Offers office and laboratory space with access to high value capital equipment.	The facility has been managed by a consultancy firm with expertise in biotechnology commercialisation. Limited in size with 5 companies in 2012.
National Bio-manufacturing Centre (NBC)	Received £34 million capital investment to build state of the art manufacturing facilities and supporting infrastructures such as road and telecommunications.	Largest concentration of pharmaceutical manufacturers in Europe. Hosts four multinational firms that are large employers in the region. No R&D activity recorded on this site since 1960's. Seasonal production with limited linkages to city region firms.
Royal Liverpool University Hospital	Large provider of front line health services as well as being a centre of excellence and research for health issues such as cancer, neurology and pancreas translation research.	Undergoing £600 million rebuild designed to integrate bioscience infrastructures. Suffered delays due to changes in national government. Due for completion in summer 2017.

Towards a life science Ecology in Liverpool.

In LCR the development of infrastructures has seen a clear split between hard and soft infrastructures. Firstly, investment came in developing hard infrastructures such as MerseyBio incubator, science parks and road network improvements. Secondly, there has been substantial attention for the development of soft infrastructures such as networking, business support, scientific knowledge exchange, human capital and institutional bodies.

MerseyBio incubator encountered problems diversify the industry towards commercial R&D, with a perception that local universities were not full exploiting the commercial potential of their intellectual property in the life sciences. Primarily, scientists were reluctant to spin-out of the university and form a company due to perceived risks in investment. Furthermore, the universities lacked softer infrastructures to facilitate the spin-out process, supporting the commercialisation of IP and attracting new investment. Respondents attributed this primarily to underlying issues of control and ownership.

> *"This idea of spin-outs or doing something with your IP was something that sat there and you know people had it in documents but it was never, ever taken seriously. I think that was part of the problem."* (Consultancy Firm 3, 09/05/12)

LCR is not well served by venture capitalists or business angels. The majority of R&D firms stated they had received funding from national, regional and local government grants, that compensate for a lack of private funding available, but that do not come with sector specific investors who bring their own soft infrastructures.

> *"So people have to find it [money] somewhere. In the past people would look at a mixture, so it would be their own money, plus grants, plus some VC money. I don't think the VC money's been particularly good for life sciences in the North West let alone Liverpool."* (Consultancy Firm 1 26/06/12)

Furthermore, there has been be a mismatch between the quality of research and the level of funding available. As one participant commented:

> *"The science is normally terrific, the enthusiasm is unmatched, but it's matching money with the damp and hard edged enthusiasm of business, which is the hardest piece."* (Discovery Firm 5 15/08/12)

The 13 identified R&D firms are highly specialised and at various stages of development, with no identifiable inter-firm connections on a product or services bases, a high ''cognitive distance" in Nooteboom's terminology. The high fragmentation of life sciences activities shown in Table 1 and their highly specialised nature led to an inability to share knowledge, research focus and connections. Hence, firms must look beyond the ecology (e.g. attending conferences elsewhere) to build soft infrastructures and secure scientific knowledge assets and inputs. These tend to be held in the larger life science ecologies such as Cambridge (UK) or Boston (USA) with comparatively more firms, specialised in fewer subsectors or types of R&D. These regions have life science related hard and soft infrastructures in which Liverpool life science firms seek to temporarily participate to acquire knowledge assets. In short, despite over 15 years of public investment, the LCR is not recognised as a 'place to be' for life sciences in comparison to other regions.

> *"There seems to be a lack of awareness of what's in the North West [which includes LCR] because when you say life sciences people are drawn to think of London and Oxbridge because of their reputations"* (Public Organisation 2, 05/08/12)

Despite the hard infrastructures projects, the absence of international awareness further undermines the development of soft scientific knowledge based infrastructures. However, what is developing are soft business support infrastructures related to common problems faced by firms.

> *'Now they're [other firm] in completely different areas to us, but it shouldn't actually matter whether they're in different areas or not… we share common issues, we're going to have issues around funding, we're going to have issues around facilities, we're*

going to have issues around staff, we're going to have issues around the perception of the industry nationally and, national policy that's going to allow the industry to thrive. So it's important that those sort of links are engendered." (Discovery Firm 2, 23/10/12)

Concluding Discussion

The development of hard and soft infrastructures has been uneven in LCR. The hard infrastructures are expensive but have been easy to promote for policy makers and have supported the development of LCR so far. In comparison soft infrastructures are potentially inexpensive, but are harder to achieve in ways that help to make the region more attractive to knowledge and capital flows. The type of soft infrastructure that has developed is non-scientific relating to business support. Given the diversity of firm it has been difficult to develop scientific soft infrastructures relating to research and knowledge exchange for product development.

This paper has sought to explore how soft life science infrastructures emerge and contribute to the ecology's development. The soft infrastructures identified here have not been publically funded but were outcomes of bringing people together in hard infrastructure projects such as science parks. Although the level of funding available has not increased and at the same time government funding has become more centralised, these comparatively inexpensive soft infrastructures are highly valuable to the ecology's continued development.

Unlike other peripheral regions that saw scientific soft infrastructure emerge (Benneworth, 2002), not all ecologies can develop scientific soft infrastructures through funding hard infrastructure investment alone. Hard and soft infrastructure configurations need to provide a clear narrative, specialising in fewer core competencies rather than breadth of activities. In particular, further investment and support of the soft infrastructures, locally and extra-locally, can be used as a measure to further reduce the cognitive distance in the ecology and further the scientific soft infrastructures.

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