

Innovation and the city

How innovation has developed
in five city-regions

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Foreword

Cities provide an ideal environment for innovation: in the words of this report, they offer proximity, density and variety. However, some cities are more innovative than others, and policymakers have long been concerned with finding out why.

Unpacking this problem requires considerable effort. Cities are complex systems and they exist in the context of regions, nations and international relationships. Moreover, cities themselves rarely innovate – they are hosts for innovation by people, firms and organisations. This means that cities often support innovation indirectly – and that some of the most important things they do are not thought of as innovation policy at all.

The two overlapping models presented here provide policymakers with a robust way of thinking through these issues. ‘Urban hubs’ are large cities that will almost inevitably innovate – through sheer size, they can bring resources to bear that will result in innovation. But they can’t be complacent – innovation in the 21st century is a competitive sport and resting on their laurels might mean that smaller but more developed cities catch up or overtake. The ‘local links’ concept provides hope for those cities that don’t have the endowments of a London, New York or Barcelona. By intelligently combining existing resources, cities can become more than the sum of their parts and punch well above their weight.

NESTA cannot, alone, transform the UK’s capacity for innovation. We need to do it in partnership. In this project, we have been fortunate to work with a strong team from the Centre for Cities. Our next steps are to take the lessons that we have learned in this project and elsewhere and put them into practice. We look forward to working with you in doing that, and learning more along the way.

Jonathan Kestenbaum

CEO, NESTA

December, 2007

NESTA is the National Endowment for Science, Technology and the Arts.

Our aim is to transform the UK’s capacity for innovation. We invest in early stage companies, inform innovation policy and encourage a culture that helps innovation to flourish.

Executive summary

1. Cities, innovation and ‘urban factors’

Innovative activity in the private sector is concentrated in and around cities. **Firms** are the most important innovators, and cities support innovation by firms in a number of ways. This report sets out a model of urban innovation, drawing on two interlocking concepts: urban hubs and local links.

Our analysis illustrates how this model applies in real world cities. Cities offer access to large **markets**, local and global. Urban **assets** are critical in underpinning firms’ innovative activity and competitive performance – particularly big, specialised labour pools, transport infrastructure and density of activity.

A number of public **institutions** and actors support innovation – notably universities, individual ‘change agents’ and some economic development agencies. Urban proximity and connectivity also help business and knowledge **networks** to form, increasing the flow of innovative ideas and bringing products to market. Public institutions can help overcome co-ordination problems by promoting and sustaining networks.

A series of case studies undertaken for this report analyse the London fashion design sector, the engineering design sector in Coventry, the ICT sector in Reading and the biotechnology sectors in Dundee and Dortmund in Germany. Their main findings are in Chapter 3, with more detail in the appendices.

The case studies highlight a number of differences in urban innovation systems. Cities with strong **urban hubs** for innovation have large and diverse markets with international

reach. These cities have a well developed transport and communications infrastructure which enables businesses to access each other and urban institutions to conduct transactions in the market, collaborate, or share ideas. Conversely, cities with weak urban hubs have small or relatively under-developed markets with fewer local supply chains, and are poorly connected across the city-region or with other nearby urban areas. Weak urban hubs often mean that innovation specialisms of sectors are much narrower than in other cities that function as stronger hubs.

Cities and sectors with strong **local links** are those where firms have dense networks and diverse supply chains, and display cluster-type industrial structures with strong links to urban institutions. Innovation in sectors that need high levels of knowledge requires strong local links. Cities with weak local links have less dense networks and less strong links between firms and institutions. Innovation is consequently less reliant on local actors and institutions.

These are the ‘**urban factors**’ that explain why innovation is concentrated in and around cities.

2. Characteristics of the case studies

Coventry and engineering design: Innovation in engineering design occurs within an established industry cluster based across the city-region. Innovation is supported by internationally renowned university departments; and services and functions that support innovation such as design companies, and rapid prototyping businesses. Helped by well-developed formal and informal networks,

the innovation system is typified by the presence of large firms and innovative SMEs serving highly competitive global markets.

Dundee and life sciences: Innovation in the life sciences sector is driven by the research strengths of the university and the successful application of these to commercial R&D. The development of the sector has been assisted by effective collaboration between the university, public sector agencies and the private sector. The role of city assets has been limited in the innovation success of this sector.

Dortmund and life sciences: Dortmund is a leader amongst cities in its region (North Rhine Westphalia) in using innovation as the centrepiece of its future vision and strategy for the economy. Dortmund's innovation development model is characterised by strong public sector influence both in terms of funding and research specialisms, and provision of incubator space and business advice.

London and designer fashion: London's designer fashion sector operates within an international marketplace, yet innovation is

highly influenced by strong and diverse local links, typified by high levels of proximity, knowledge transfer and informal networking. The sector is also supported by a university base that trains fashion designers and acts as both a source of and continual hub for networks. The designer fashion sector also benefits from London's strong presence in retailing and fashion media, but is adversely affected by a lack of complementary manufacturing activities.

Reading/Thames Valley and the ICT sector:

Reading and the Thames Valley are very strongly performing and successful economies hosting a large number of innovative ICT companies. The major factors driving innovation are strong assets such as the skills base, transport infrastructure, and high quality sites and premises for businesses that have attracted major corporations and parts of their supply chain. Local networks, knowledge transfer and links are somewhat constrained by the corporate structure – as the innovation system tends to be dominated by large companies located in office campuses.

Figure 1: Urban innovation inputs and processes



3. Implications and recommendations for decision makers

City-regions matter for innovation and urban innovation systems are real

Many of the processes and activities necessary to create, develop and sustain innovation occur at the city-region level. Urban factors and processes explain why much innovation is concentrated in and around cities. Policymakers should:

- Explore whether policy is better designed and deployed for innovation at the city-region level. Government institutions should collaborate at the city-region level in areas of strategic importance to innovation such as transport, higher education and skills.
- Develop subregional partnerships, particularly in big conurbations, to plan and deliver innovation and economic development programmes.
- Push forward programmes to devolve policy and financial powers towards city-regions and local areas, to allow local leaders to develop tailored innovation strategies at the city-region scale.

Firms are at the heart of urban innovation

This research confirms what is well known – that firms drive private sector innovation. Both large and small firms have complementary roles to play. The best developed innovation systems are those with the most well-established sectors and clusters. Policymakers, therefore, should:

- Develop and implement a more substantial suite of actions to identify and embed innovative sectors at an early stage of development.
- Better use inward investment incentives and resources to attract anchor firms to locate near these sectors.
- Develop programmes to open up the procurement and supply chains of government organisations and to promote and encourage similar initiatives within private sector organisations to increase innovation opportunities in the city economy.

Cities offer firms excellent access to markets and markets drive and sustain commercially successful innovation

Market access is one of the main factors in influencing firms' location decisions. The resultant policy implications are to:

- Consider better how policy areas such as transport influence innovation by shaping market access.
- Address barriers or bottlenecks to market access and plan for increases in market activity, and demand for transport and communications infrastructure.

Urban assets play a critical and under-appreciated role in supporting innovative activity

The urban skills base and specialist labour markets are the most important of these urban assets. Transport connectivity is also important as it enables accessibility – which, in turn, increases the rate of collaboration and networking. Policymakers should:

- Invest in the continued recovery and growth of large urban cores, particularly in transport infrastructure, skills and housing.
- Make skills, transport, physical infrastructure, property and housing key planks of innovation strategies.
- Recognise the links between the built environment, spatial clustering and networking.
- Use design to influence the sustainability and development of spatial clusters.

Tailor the role of public institutions better to the innovation challenges and opportunities present in the city-region

The roles of public institutions are best tailored to what is required in each city and sector. Some situations require large scale investment and intervention; others require different support such as for networking development or promotion and raising awareness. Universities play an important role in innovation. Consequently, policymakers should:

- Give institutions and agencies the flexibility to design and deliver services tailored to the needs of their city-region.

- Establish more effective working relationships between government institutions at the city-region level. This could take the shape of city ‘compacts’ between government, regional development agencies and cities (including the higher education sector). This would help to consolidate funds and share responsibility for both policy and implementation.
- Continue to support urban universities, especially those with strengths in high-value and creative sectors and that have strong links to local industries.
- Encourage universities to be flexible enough to allow academic staff to become involved in commercial activities.
- Ensure that universities have procedures in place to retain star scientists and staff with research expertise with high commercial potential.

Urban factors support network formation and development

Networks help the flow of ideas, the production of innovative goods and services, and their movement to market. The dense infrastructure and diversity of firms in cities support the development of supply chains that are essential to successful innovation. Policymakers should:

- Undertake initiatives for the development of networks that currently do not work as effectively as they could.
- Build in a process for public sector organisations to step aside from networks once they are established.
- Promote knowledge networks and partnerships where appropriate – supporting HE and business actors to take a lead role.
- Work more closely with universities, jointly develop innovation policies, (particularly in linking researchers to SMEs), bring innovation advisory services closer to university sites, and develop emerging innovation networks.

Government legislation shapes innovation

Central policy shapes innovation either directly through investment in scientific research and higher education, or more indirectly through specifying new health and safety or financial rules for businesses. So, urban innovation partners and stakeholders should closely monitor the likely impacts and opportunities of central legislative developments.

Acknowledgements

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Part I: Introduction: Cities matter for innovation

1.1 Innovation matters for urban economic performance, but rates of innovation between cities are uneven

Innovation matters because it helps cities improve their economic performance. It creates new markets and helps drive up the productivity and competitiveness of firms, which in turn helps support income and employment growth.^{1, 2}

But rates of innovation are uneven across cities. Traditional innovation indicators show that some places – such as Cambridge and Reading – are punching well above their weight on innovation, whilst others – such as Stoke and Grimsby – are struggling.³

While it is important to recognise the limitations of traditional innovation indicators,⁴ a better understanding of why these differences occur will help decision makers address the barriers to innovation in underperforming cities.

1.2 Recent developments in city economies and the role of innovation

The UK is highly urbanised and its cities are centres of population and economic activity

Nearly 81 per cent of England and Wales's population is classified as urbanised. In Scotland, 78.7 per cent of the population can be considered as urban. Northern Ireland is slightly less urbanised – at approximately 65 per cent.⁵

While there has been an economic renaissance in many cities, rates of improvement vary

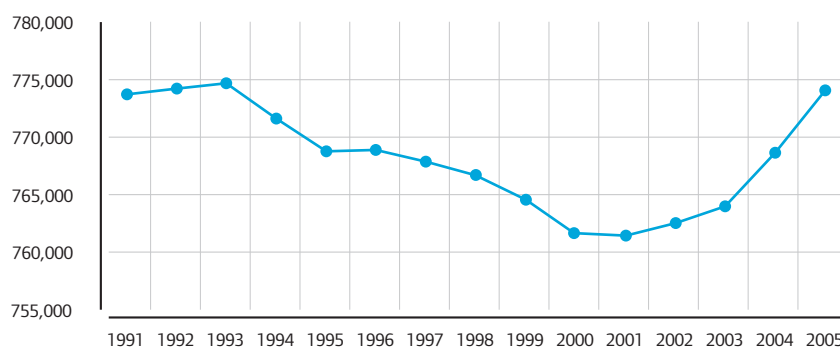
After going through a period of sustained economic and demographic decline between the 1950s and 1980s, many English cities are enjoying an economic resurgence and demographic growth.

As Figure 2 shows, major cities like Sheffield, Manchester, Birmingham and Liverpool have all reversed population decline between 1991 and 2005. These demographic changes reflect a turnaround in the economic fortunes of England's cities over the past 15 years – achieving the population inflows needed to support economic growth, and the resurgence of city centres as attractive places to live.⁶

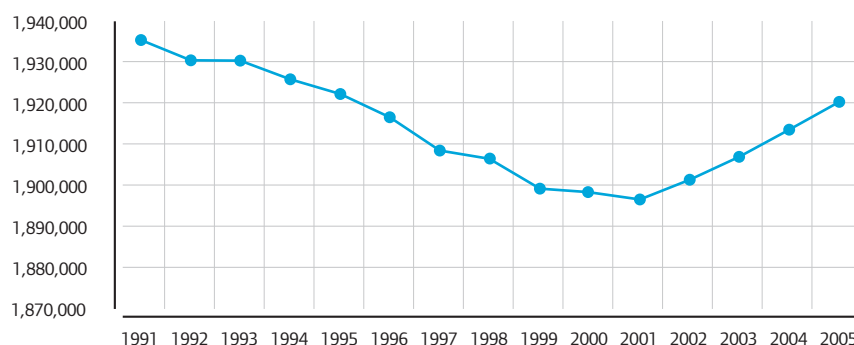
1. This report is primarily concerned with private sector innovation rather than innovation in public services or social innovation.
2. Romer, P. (1989) *Capital Accumulation in the Theory of Long Run Growth: 'Modern Business Cycle Theory.'* Barro, R. (ed.). Cambridge, MA: Harvard University Press.
3. DCLG (2006) 'State of the English Cities Report.' London: DCLG.
4. NESTA (2007) 'Hidden Innovation.' London: NESTA.
5. Definitions of 'rural' and 'urban' differ between the nations of the UK. England and Wales have consistent definitions. Northern Ireland and Scotland differ in their definitions. All statistics referring to levels of urbanisation presented here are sourced from official calculations that have used the 2001 Census of Population. Northern Ireland figures are according to NISRA estimates.
6. Nathan, M. and Urwin, C. (2006) 'City People: city centre living in the UK.' London: Centre for Cities.

Figure 2: Population change in selected core cities, 1991-2005⁷

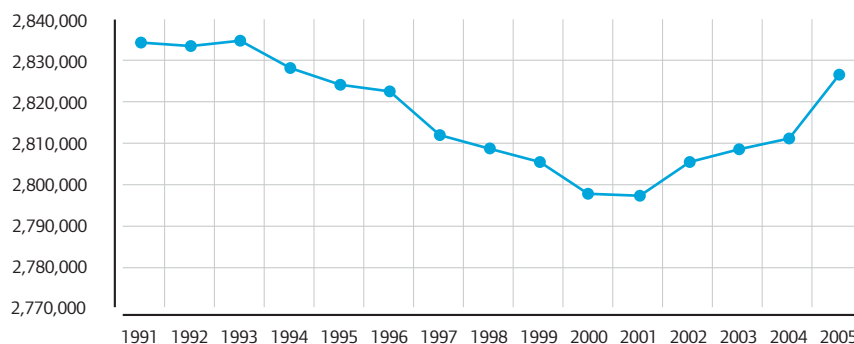
**Sheffield
population
1991-2005**



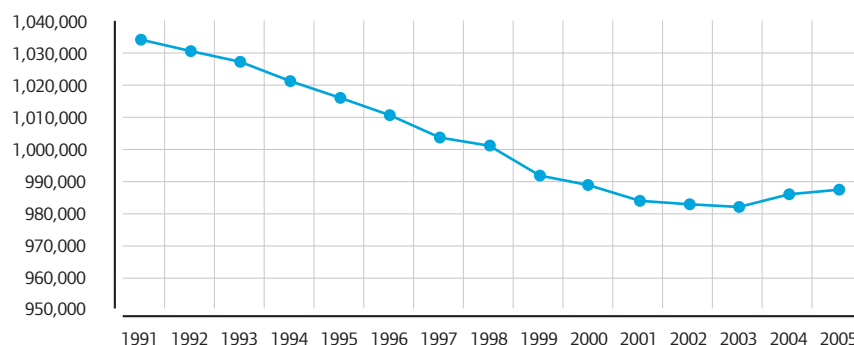
**Manchester
population
1991-2005**



**Birmingham
population
1991-2005**



**Liverpool
population
1991-2005**

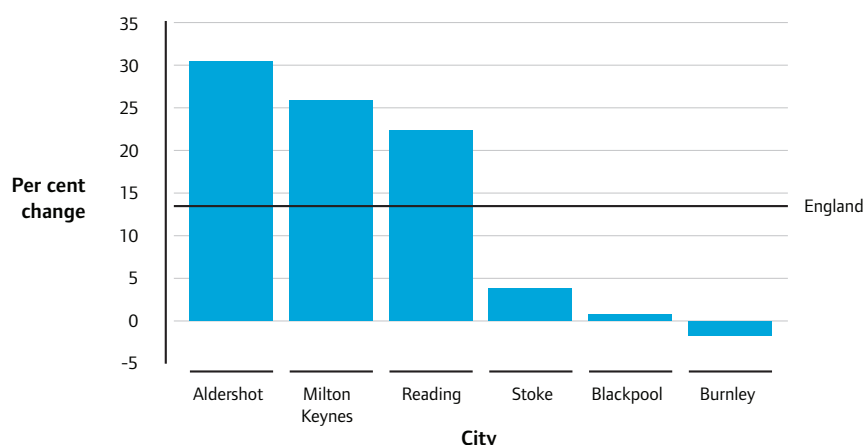


7. State of the Cities Database.
Available at: <http://www.socd.communities.gov.uk/socd/>

In recent years, several smaller cities and urban areas like Reading, Milton Keynes and Aldershot have also performed exceptionally well. As Figure 3 shows, between 1995 and 2005 all of these cities experienced employment growth well above the English

average. But the story isn't positive everywhere. Many urban areas – particularly smaller cities in the North – are still struggling. As Figure 3 shows, Blackpool, Stoke and Burnley have all performed relatively poorly when compared to the English average.

Figure 3: Per cent employment growth in selected smaller cities, 1995-2005⁸



The experience of Scotland's major cities has been positive in recent years. Edinburgh and Glasgow have been leading in terms of growth in employment between 1998 and 2002, with growth rates ahead of the Scottish average.

The national authorities in Wales and Northern Ireland have not undertaken comparable studies on the economic performance of their cities. However, research⁹ suggests that Cardiff has been performing well in economic growth.

England's cities continue the shift towards knowledge-based economies

Employment statistics show that whilst 77 per cent of England's total employment was concentrated in city-regions in 2005, 90 per cent of knowledge workers (an aggregate including those working in engineering-based manufacturing, manufacturing, knowledge intensive services and creative industries) were employed in these areas. This suggests

that cities are leading the transition into a knowledge-based economy.

However, cities have had different degrees of success in developing 'knowledge-based' economies. Figure 4 shows the growth in knowledge-based employment in selected city-regions between 1995 and 2005. High performing economies such as Reading have experienced considerably greater success in restructuring their economies than, for example, Burnley and Stoke.

Some of these findings need further explanation. For example, Blackpool's strong growth in knowledge-based employment is surprising. However, as Table 1 shows, Blackpool starts from a much weaker position on knowledge-based employment than Reading, Milton Keynes and Aldershot – with only 25 per cent of its workforce engaged in these activities.

8. ABI and rescaled AES data from State of the Cities Database. Available at: <http://www.socd.communities.gov.uk/socd/>.

9. Robert Huggins Associates (2005) 'UK Competitiveness Index 2005 – The Changing State of the Nation 1997-2005.' Pontypridd: Robert Huggins Associates.

10. State of the Cities Database. Available at: <http://www.socd.communities.gov.uk/socd/>.

Figure 4: Per cent change in knowledge-based industries employment as proportion of total, 1995-2005¹⁰

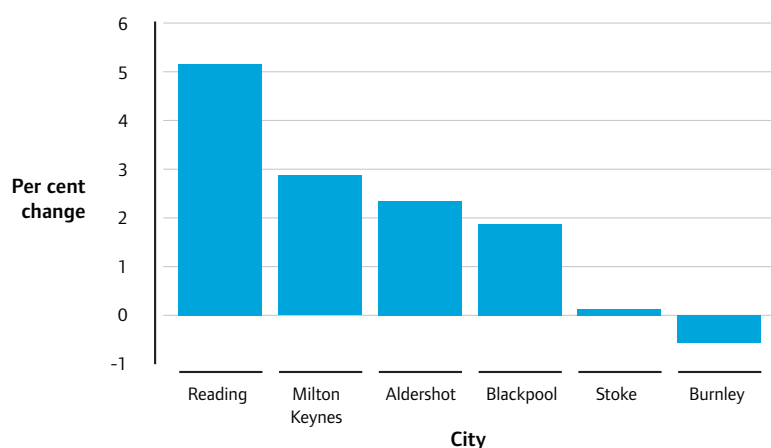


Table 1: Share of knowledge-based employment in total, 2005¹¹

City-region	Share of knowledge-based employment in total %
Reading	45
Milton Keynes	40
Aldershot	39
Blackpool	25
Burnley	23
Stoke	19
England	26

1.3 Innovation is unevenly spread among cities

While innovation can happen anywhere, in the UK it tends to concentrate in urban areas

It is no surprise that innovation in the UK concentrates in and around cities, since this reflects the concentration of population and economic activity in the country.

Measured on traditional indicators, England's biggest cities account for the lion's share of national innovative activity. For example, data for England's 56 largest urban areas show that, between 1999 and 2001, they accounted for 67 per cent of patent applications. Forty-three per cent of these applications came from just ten urban areas.¹²

Even when broader measures of innovation are used – such as the proportion of firms identifying themselves as active in innovation – there is similar evidence of the concentration of innovation activities in a select number of cities and adjacent regions.

Employment data reflect that too. In 2005, employment in most 'innovation active' sectors (engineering-based manufacturing, other manufacturing and knowledge-intensive services) was highly concentrated in and around cities. For example, 81 per cent of knowledge-intensive services employment was

located in the 56 largest urban areas in England in 2005.

Detailed data on innovation for Northern Ireland, Scotland and Wales are unavailable for cities and urban areas. However, European innovation scoreboard indicators suggest that Northern Ireland, Scotland and Wales have comparable innovation profiles to the Northern English regions.¹³

Innovation is uneven between cities¹⁴

Merely being a city or large urban area (with the concentration of businesses, assets and skills that this entails) does not necessarily correspond to high levels of innovation. There are large variations in innovation rates between urban areas.

For example, as Table 2 shows, Cambridge registered 81 patent applications per 10,000 adults between 1999 and 2001, whereas Blackpool registered just two. Table 2 presents the top five highest and lowest innovation performers – based on patents per 10,000 inhabitants.

A similar picture emerges from other indicators of innovation activity. Tables 3 and 4 show which English cities are the most and least innovative in terms of developing new products and processes – illustrating widely differing performances between urban areas.

11. State of the Cities Database. Available at: <http://www.socd.communities.gov.uk/socd/>

12. Ibid.

13. 2006 European Regional Innovation Scoreboard. Available at: <http://www.proinno-europe.eu/trendchart>

14. This analysis relates to English cities due to the lack of comparable datasets for cities in Northern Ireland, Scotland and Wales.

Table 2: Top and bottom five innovation performers on patents per 10,000 in England's largest 56 urban areas

Top and bottom five innovation performers on patents per 10,000 in 2001	
Top five performers	Bottom five performers
Cambridge (80.8 per 10,000)	Doncaster (3.1 per 10,000)
Oxford (50.1 per 10,000)	Luton (2.9 per 10,000)
Birkenhead (35.0 per 10,000)	Sunderland (2.3 per 10,000)
Swindon (34.4 per 10,000)	Blackpool (1.6 per 10,000)
Reading (30.7 per 10,000)	Grimsby (1.6 per 10,000)
England average = 13.7 per 10,000	

Source: SOCD. Note that rankings are based on absolute (not rounded) values.

Table 3: Per cent of firms introducing process innovations, 1998-2000, in England's largest 56 urban areas

Percentage of firms introducing process innovations, 1998-2000	
Top five performers	Bottom five performers
Northampton (31.3 per cent)	Liverpool (11.7 per cent)
Coventry (29.7 per cent)	Southend (11.0 per cent)
Crawley (29.0 per cent)	Gloucester (10.7 per cent)
Oxford (27.1 per cent)	Grimsby (10.3 per cent)
Chatham (26.0 per cent)	Wakefield (6.1 per cent)
England average = 17.9 per cent	

Source: DCLG (2006), Community Innovation Survey. Notes: areas with sample sizes below 25 firms were excluded from the analysis; rankings are based on absolute (not rounded) values.

Table 4: Per cent of firms introducing product innovations, 1998-2000, in England's largest 56 urban areas

Percentage of firms introducing product innovations, 1998-2000	
Top five performers	Bottom five performers
Cambridge (39.7 per cent)	Wigan (13.2 per cent)
Aldershot (37.5 per cent)	Wakefield (12.2 per cent)
Coventry (35.1 per cent)	Grimsby (10.3 per cent)
Derby (31.8 per cent)	Stoke (8.3 per cent)
Bradford (30.0 per cent)	Doncaster (6.1 per cent)
England average = 22 per cent	

Source: DCLG (2006), Community Innovation Survey. Notes: areas with sample sizes below 25 firms were excluded from the analysis; rankings are based on absolute (not rounded) values.

1.4 Why cities matter for innovation

Urban factors and processes help explain why innovation is spatially concentrated in cities

Of course, most of the UK's economic activity and population are concentrated within cities, so it may be tempting to conclude that innovation simply follows the spatial distribution of the economy. However, businesses and residents choose to locate in cities despite their relatively higher living costs and property prices and their traffic congestion. And, as we have seen, rates of innovation are uneven between cities.

Urban economies appear to be much more than the sum of their parts. Instead, there are a range of dynamic processes at play which result in some cities being more successful at fostering innovation than others.

Part 2: Urban hubs and local links: How cities support innovation

2.1 Cities still matter

For decades, commentators argued that the development of better transport and modern communication technologies would remove the need for cities. In their view, progress would make distance – and thus place – increasingly irrelevant.¹⁵ However, urban areas remain important centres of business and population, where spatial clustering of economic activities still occurs. Indeed, evidence suggests that urbanisation is increasing all over the world.¹⁶

Cities offer three overlapping benefits for people and firms – proximity, density and variety

Essentially, cities make it easier to do business through meeting people, sharing information, making deals, and selling things.¹⁷ For firms, the scale and choice of economic activity creates thick labour markets, enables access to a range of suppliers, and helps diffuse knowledge.¹⁸ Cities provide a deep and diverse pool of talent – their large, highly skilled workforces allow firms to adapt quickly to new challenges and opportunities. Proximity to suppliers and users means that firms can more easily find and use specialist inputs that improve their performance.

For residents and visitors, cities offer ‘agglomerations of consumption’ – that is, easy access to lots of different goods and services within a fairly small area.¹⁹ Many cities are sites of the growing ‘play economy’ – retail, tourism and leisure. For younger people, urban lifestyles are increasingly popular.²⁰ Big urban labour markets can help residents build careers.²¹

Critically, the concentration of people allows for frequent face-to-face contact. Knowledge-based activities, such as business services,

depend on building trust, maintaining relationships and exchanging complex information. These interactions are still best done in person.²² Cities allow ‘face time’, critical in the knowledge economy.²³

The role of cities as transport hubs – with key road rail and air links – can also be a significant benefit to businesses since this gives them good access to customers, suppliers and collaborators located elsewhere within the city-region. As the global economy becomes more integrated, international transport connections are becoming particularly important. For example, a main source of London’s competitiveness is the presence of Heathrow Airport, which allows business people from all over the world to access the capital quickly. In addition, urban areas still possess a major advantage over non-urban areas in the thickness and density of their communication infrastructures and IT networks. This is a major advantage for knowledge-intensive services activities.

This basic ‘urban offer’ makes markets work better and enables innovation. This helps explain why innovative activities cluster in urban areas.

2.2 ‘Urban hubs’ and ‘local links’: how cities support innovation

There is a vast range of theoretical literature and research exploring innovation in cities, and the different ways in which urban places support innovative activity – from traditional urban theory and economic geography²⁴ to the ‘new economic geography’²⁵ and innovation systems approaches that have taken a closer look at clusters and knowledge spillovers.²⁶

15. Cairncross, F. (1997) ‘The death of distance: how the communications revolution will change our lives.’ US: Texere Publishing; Gray, J. (1998) ‘False dawn: the delusions of global capitalism.’ New York: The New Press.
16. United Nations (2004) ‘World urbanization prospects: the 2003 revision.’ New York: United Nations.
17. Glaeser, E. (2000) ‘Demand for Density: The Functions of the City in the 21st Century.’ Brookings Review, Summer.
18. Marshall, A. (1920) ‘Principles of Economics.’ New York: MacMillan; Jacobs, J. (1961) ‘The death and life of great American cities.’ New York: Random House.
19. Storper, M. and Manville, M. (2006) ‘Behaviour, Preferences and Cities.’ ‘Urban Studies.’ 43:8, pp. 1275-1300.
20. Nathan, M. and Urwin, C. (2006) ‘City People: City centre living in the UK.’ London: Centre for Cities; Chatterton, P., Byrnes, B., Hollands, R. and Reed, C. (2003) ‘Changing Our Toon’: Youth, Nightlife and Urban Change in Newcastle.’ Newcastle: University of Newcastle.
21. Venables, A. (2006) ‘Shifts in Economic Geography and their Causes.’ CEP Discussion Paper 767. London: LSE.
22. Sassen, S. (2006) ‘Four Dynamics Shaping the Ongoing Utility of Spatial Agglomeration.’ Presentation to Cambridge Econometrics Conference, Greater Cities in a Smaller World. Cambridge, July.
23. Storper, M. and Venables, A. (2003) ‘Buzz: face-to-face contact and the urban economy.’ London: LSE, Centre for Economic Performance; Iammarino, S. and McCann, P. (2005) ‘The structure and evolution of industrial clusters: transactions technology and knowledge spillovers.’ SPRU Electronic working paper series, no. 138.
24. Traditional economic geography emphasised location theories of firms and population, such as the Weber Model. See Weber, A. (1929) ‘Alfred Weber’s theory of the location of industries.’ Chicago: The University of Chicago Press.
25. New economic geography focused on the role of local institutions and networks. This is typified by the work of Amin, A. and Thrift, N. (1994) ‘Globalisation, institutional ‘thickness’ and the local economy.’ in ‘Urban Management.’

These explanations have been drawn together into two broader perspectives on urban innovation: 'urban hubs' and 'local links'.

'Urban hubs' and 'local links' are useful classifications of existing schools of thought about the urban innovation process

'Urban hubs' and 'local links' are useful conceptual frameworks grounded in existing schools of thought about the urban innovation process – they are both overlapping, and should be seen as complementary concepts that aim to capture different sets of factors and actors that make innovation happen in cities.

Each stresses different aspects of an urban economy: 'urban hubs' approaches emphasise urban assets, market size and business networks; 'local links' perspectives focus on institutions, knowledge networks and public-private collaboration. Decision makers may use such concepts to identify the relative role of different forces in explaining innovative activity in given cities and sectors. Box 1 illustrates the role of 'urban hubs' and 'local links' in the fashion industry in New York City.

2.3 The assets and size of cities help firms to innovate in 'urban hubs'

The concept of 'urban hubs' is based on the notion of 'urbanisation economies', which postulates that it is the scale and choice of urban economies that helps firms innovate. Having a large and diverse population means that businesses in cities and urban areas can select the optimal mix of suppliers and workers. This 'pick and mix economy' of major cities like London helps explain the concentration of innovative firms in and around the capital.²⁹ Businesses in cities also often enjoy a wider and easier access to the international flows of money, ideas, people and goods.³⁰

As Jane Jacobs, the American urbanist, has argued, a city's economic diversity can also lead to cross-pollination between different sectors and specialisms.³¹ Cities facilitate knowledge spillovers across the urban economy, as businesses learn from others, workers move between companies and new paradigms form. As we see in Box 1, New York's vibrant art and music scenes help cross-pollinate the city's fashion, advertising and design worlds.

Box 1: Dress sense – how New York's fashion industry has become a hub of innovation

New York's fashion industry consists of hundreds of highly specialised fashion and media enterprises supported by a diverse range of more generalist firms and complementary industries.²⁷ It is a very innovative sector, which barely registers on traditional measures of innovation.

The Garment District – the historical heart of the city's fashion industry – has developed strong 'urban hubs' through its assets, such as the labour market and its product and service markets. Over time, a strong specialised supplier base and effective labour markets have been established. The city has a large and sophisticated local consumer base that can support cutting-edge fashion products and design ideas.

The city's garment industry also has

strong 'local links'. Strong networks and linkages exist between the world's fashion media industry, head office functions for many major US department stores and purchasing departments, garment designers and manufacturers. Global and national functions, linked to local enterprises, provide a global platform for their work. The diversity of business and innovation functions that are closely linked keeps New York as a focus of world fashion industry networks.

Local innovations are frequent. For example, new design boutiques, catering to more sophisticated tastes, have been formed as spin-out ventures from the mainstream market. These ventures are now influencing the wider market.²⁸

More broadly, ideas flow between the music, media and art sectors and the fashion sector. New York's 'Fashion Week', for instance, is as much about music, design, art, advertising and nightlife as it is about clothes.

26. Cooke, P. (2001) *Regional Innovation Systems, Clusters and the Knowledge Economy*. 'Industrial and Corporate Change.' 10:4, pp. 945-974; Etzkowitz, H. and Leydesdorff, L. (2000) The dynamics of innovation: from National Systems and 'Mode 2' to a Triple Helix of university-industry-government relations. 'Research Policy.' 29, pp. 109-123.
27. Webber, C. and Athey, G. (2007) 'The route to growth: transport, density and productivity.' London: Centre for Cities.
28. Rantisi, M. (2002) The Local Innovation System as a Source of 'Variety': Openness and Adaptability in New York City's Garment District. 'Regional Studies.' vol. 36, Issue 6, pp. 587-602.
29. Simmie, J. (2004) 'Innovation Clusters and Competitive Cities in Europe.' In Parkinson, M. and Boddy, M. (eds) *City Matters*, Bristol: Policy Press.
30. Liu, X. and Buck, T. (2007) Innovation performance and channels for international technology spillovers: Evidence from Chinese high-tech industries. 'Research Policy.' 36:3, pp. 355-366; Saxenian, A.-L. (2007) 'The New Argonauts: Regional advantage in a global economy.' Cambridge, MA: Harvard University Press; Simmie, J. (2004) 'Innovation Clusters and Competitive Cities in Europe.' In Parkinson, M. and Boddy, M. (eds) *City Matters*, Bristol: Policy Press.
31. Jacobs, J. (1969) *The Economy of Cities*. New York: Vintage.

2.4 The existence of strong 'local links' in cities helps firms and institutions network and collaborate to drive innovation

While some cities have the advantage of being hubs for many things, others have the advantage of possessing strong 'local links'. This is a feature of cities highlighted in the 'localisation economies' literature,³² which suggests that specialised connections and networks in cities help firms innovate faster. Essentially, proximity allows firms to establish business and knowledge networks within a given sector, or between businesses and public institutions. Cities allow a complex and deep division of markets and labour, and thus the formation of specialist firms and pools of skilled labour. Proximity encourages knowledge spillovers and helps organisations collaborate – for example, on new ideas, shared standards, skill requirements, or buying raw materials. Over time, distinct 'industrial districts' may form where innovation is 'in the air'.³³ Proximity also helps create a shared sense of identity that binds different players together in a community-like social network.

Michael Porter and others have used these ideas to develop the concept of 'clusters'. Concentrations of small, networked firms in sectors like ICT and advanced manufacturing seem to lie behind many regions' economic success.³⁴ Firms develop local supply networks, compete to offer new products, and share the same labour pools. Higher education and research institutions emerge and adapt to provide skills and research and development (R&D) for industrial clusters. Government organisations serve industries with the infrastructure that they need to develop and grow.

'Local links' models tend to stress the role of networks and institutions, and the importance of activist local government, public-private partnerships and 'change agents'.

2.5 The urban innovation system

Figure 5 identifies the main **components** of what may function as an urban innovation system. **Firms** are its most important actors, with the other components fundamentally supporting them. **Markets** – both in cities and further afield – are where the demand 'pull' for innovation occurs. Other critical components are **assets** such as location,

infrastructure, finance, property and the skills base; and **institutions** such as business/industry associations, government, universities and professional associations. Knowledge and business relationships in the form of **networks** between these institutions and the private sector also help drive and enable successful innovation.

2.6 Firms: the core elements of any innovation system

Firms and their entrepreneurs are the most important actors in urban innovation, as they are at the interface between the supply of innovation and the demand for new ideas.

Businesses develop new ideas, adopt others' thinking and market innovative goods and services. Since firms help to invent, adopt and disseminate, they are at the centre of urban innovation systems – applying and adapting ideas, and generating their own. To understand urban innovation, it is therefore important to understand urban business behaviour.³⁵

Similarly, businesses use urban assets and are influenced by public institutions and policy frameworks. Business strategies, supply chains and market size all shape urban innovation, with firms of different sizes playing important, complementary roles.³⁶

Start-ups and entrepreneurs tend to be concentrated in city-regions. For example, England's biggest cities contain one million VAT registered enterprises (out of 1.6 million in England overall). Small businesses and new firms can benefit from the scale, choice and networks that cities possess. Specialist R&D and spin-out companies tend to be very small firms or start-ups.

In contrast to smaller businesses, **larger firms** tend to spend more on R&D, as they have the means and money to do so.³⁷ There is tentative evidence that 'anchor firms' can help clusters start and develop, for example in the US biotech industry.³⁸

The **sectors (or industries)** to which firms belong are also important, as there is much variation in the nature and scale of innovation between sectors. Most of the literature on innovative firms has focused on **science and technology sectors**, such as bioscience, ICT and advanced manufacturing (e.g. electronics, defence and precision engineering). These

32. Piore, M. and Sabel, C. (1984) 'The Second Industrial Divide: Possibilities for Prosperity.' New York: Basic Books; Storper, M. (1997) 'Regional World: Territorial Development in a Global Economy.' London: Guildford Press; Marshall, A. (1920) 'Principles of Economics.' New York: MacMillan.
33. Marshall, A. (1920) 'Principles of Economics.' New York: MacMillan.
34. Piore, M. and Sabel, C. (1984) 'The Second Industrial Divide: Possibilities for Prosperity.' New York: Basic Books; Porter, M. (1990) 'The Competitive Advantage of Nations.' London: Palgrave Macmillan.
35. Martin, R. and Sunley, P. (2003) 'Deconstructing Clusters: Chaotic Concept or Policy Panacea?' *Journal of Economic Geography*, 3, pp. 5-35.
36. Frenz, M. and Oughton, C. (2004) 'Innovation in the UK Regions and Devolved Administrations: A Review of the Literature.' London: Department of Trade and Industry.
37. Griffith, R., Huergo, E., Mairesse, J. and Peters, B. (2006) 'Innovation and Productivity Across Four European Countries.' *Oxford Review of Economic Policy*, 22:4, pp. 483-498.
38. Feldman, M. (1999) 'The new economics of innovation, spillovers and agglomeration: a review of empirical studies.' *Economic Innovation and New Technology*, 8, pp. 5-25.

Figure 5: Urban innovation inputs and processes



39. Miles, I. (2001) 'Services Innovation: A Reconfiguration of Innovation Studies.' PREST Discussion Paper. Manchester: University of Manchester.

40. Graham, S. (2004) Beyond the 'dazzling light': From dreams of transcendence to the 'remediation' of urban life. 'New Media and Society' 6, pp. 16-26.

41. Castells, M. (2001) 'The Internet Galaxy: Reflections on the internet, business and society.' Oxford: Blackwell.

sectors have a very visible innovation profile, with high levels of R&D spending and patenting. They also tend to have a greater dependency on links to nearby universities and centres of excellence.

Innovation outside science and technology is also critical for cities. Firms in the **service sector**, for example, spend less on visible innovation – such as R&D, or patent registration – but often innovate by co-ordinating supply chain management (for example, large supermarkets) or through new technology (for example, call centres and internet banking).³⁹ For these types of firms, proximity to centres of research is less important than proximity to their market and suppliers.

2.7 Markets: the engine of the urban innovation system

Markets drive and sustain commercially successful innovation, and reflect the demand for innovation and new ideas. For innovation

to thrive, new ideas need lead markets – demanding consumers who provide an early customer base. There are several aspects of markets that are important within the urban context but these vary between sectors:

- **Local markets** that require high levels of density and interaction can be supported by cities. For example, the dotcom/new media sector is heavily concentrated in a few districts of major cities – inner London and Manhattan in particular.⁴⁰ Internet businesses draw in finance and know-how from financiers and researchers, and then sell to nearby media, publishing and advertising firms.⁴¹
- **Large markets** that facilitate the development of niches, specialist providers and subcultures can drive innovation. Big cities have large populations of consumers and customers in specific markets, with diverse tastes and preferences. Specialised or niche market preferences and tastes can often be provided for on a profitable basis from a city, as the market is of sufficient size to make this economically viable.⁴²

- **Global markets** in capital, product and labour tend to be more accessible via cities and large urban areas. Advanced producer service firms increasingly use major cities as hubs for global business networks. Similarly, big cities are sites of international migration – often highly-skilled people with new ideas and links to markets ‘back home’ (see Box 2 for an example of how global markets shape innovation in Silicon Valley).

2.8 Urban assets: the system base

A city’s urban asset base underpins economic and innovative activity, and shapes firms’ location and expansion decisions. Some surveys suggest that the main factors affecting business location are the availability of qualified staff, communications, low property and other costs, access to markets and good transport links.⁴⁷ The main types of urban assets and their role in innovation are set out and described below:

- **Connectivity (physical and electronic):** roads, hub airports and rail links increase cities’ effective reach and improve firms’ innovation potential.⁴⁸ Good transport

links and services mean that firms and institutions are closer in time and distance, facilitating collaboration, market transactions and networks. Such links also increase the potential size of markets for services, products and labour. Urban areas still possess a major advantage in terms of the density of communication infrastructures and IT networks, and are also able to provide faster and larger connections in international communications networks.

- **Skills:** the availability of highly skilled workers is a major factor for the location and retention of innovative firms in a city.⁴⁹ The diversity of skills and ability of large urban labour markets to support specialist skills are also important for innovation.
- **Property, land, built environment:** land and property availability impact on how firms configure production and distribution and also shape the types of developments permissible.
- **‘Quality of life’:** factors such as amenities and cultural diversity help underpin urban growth and innovation. They are important for the attraction and retention of firms and skilled labour.

42. Anderson, C. (2004) ‘The Long Tail.’ Wired, October.
43. Saxenian, A.-L. (1996) ‘Regional Advantage.’ Cambridge, MA: Harvard University Press.
44. Venables, A. (2006) ‘Shifts in Economic Geography and their Causes.’ CEP Discussion Paper 767, London: LSE.
45. Saxenian, A.L. (2002) Brain Circulation: How high-skill immigration makes everyone better off. ‘Brookings Review’ 20:1, pp. 28–31.
46. Saxenian, A.-L. (2006) ‘The New Argonauts – regional advantage in a Global Economy.’ Cambridge, MA: Harvard University Press.
47. Cushman, Wakefield, Healey and Baker (2004) ‘European Cities Monitor.’ London: CWHB.
48. Graham, D. (2005) ‘Wider Economic Benefits of Transport Improvements: Link between city size and productivity.’ London: Department for Transport; Rice, P. and Venables, A. (2004) ‘Spatial Determinants of Productivity: Analysis for the Regions of Great Britain.’ Unpublished paper. London: LSE.
49. Shown in interviews conducted with 160 innovative firms in five European cities as reported in Simmie, J., Sennett, J., Wood, P. and Hart, D. (2002) Innovation in Europe: A Tale of Networks, Knowledge and Trade in Five Cities. ‘Regional Studies.’ Vol. 36.1, pp. 47–64.

Box 2: Brain circulation – Silicon Valley’s globalising economy

Silicon Valley is one of the world’s best-known urban innovation systems – a cluster of settlements around San Francisco and the surrounding Bay Area, centred on the city of San Jose and the university towns of Berkeley and Stanford. The area’s success factors are well-known: a large urban core; a huge university ideas base; infusions of Federal defence spending, shaping demand for innovative ideas; highly competitive firm relationships, with a massive turnover of companies and ideas; and an ‘outsider culture’.⁴³

Silicon Valley has continued to thrive despite becoming progressively more crowded, congested and expensive. In part, this reflects the gravitational pull of a big urban centre, and the positive

feedback loops from earlier success.⁴⁴ But it also reflects the area’s increasingly open economy.

International migration is a key factor in the Valley’s long term sustainability. Over half of Silicon Valley’s scientists and engineers were born abroad, mostly in South and East Asia.⁴⁵ These migrant diasporas are highly entrepreneurial – running nearly a third of the Valley’s technology businesses in 2000 – and help attract a constant inflow of skilled people. They also forge links ‘back home’, either returning or setting up parallel businesses. The Valley is the home of an increasingly distributed global production system. This system of ‘brain circulation’ is win-win – helping Silicon Valley thrive, plugging US businesses into international markets, and helping migrant workers’ ‘home’ countries develop.⁴⁶

2.9 Public institutions that help build urban assets

Urban institutions – characterised as public or collective organisations including government, universities and business associations⁵⁰ – help to maintain the asset base. More importantly, they may often take an active role in supporting, facilitating, and shaping innovation. Of most relevance are city government, economic development agencies, the higher education sector, and individual ‘change agents’ or social entrepreneurs within and around public institutions.

The main types of urban institutions and their role in innovation are:

- **Government – national, regional, local:** Governments set the rules and frameworks around urban and national economies through regulation, information, tax and subsidies. They directly fund and provide public goods and services. This can be crucially important in driving innovation in certain sectors. Government can also take a role in shaping the supply side of innovation, most notably through the education system – from school to university, and through public research.
- **Universities and further education colleges:** These help build the urban asset base through the supply of skilled labour and graduates. They produce research that feeds innovation and house the technical expertise that firms need. Universities with research specialisms produce graduates and researchers with high-level expertise that is used by firms. Highly innovative university research can also stimulate sector growth through spin-out companies, licences and knowledge exchange.
- **Economic development and regeneration agencies:** Agencies like Urban Regeneration Companies play an important role in urban economic development, and in improving infrastructure. Some economic development agencies are also involved in brokering networks between researchers and the private sector.⁵¹ Urban networks are explained in more depth below.
- **‘Change agents’/star scientists:** Within institutions, change agents can help build or push innovation forward. Strong city leaders can make links between public, private and third sector institutions. Within universities, ‘star’ scientists responsible

for major breakthroughs can also impact a city’s innovation trajectory, and help attract businesses and further talent.⁵²

2.10 Urban networks that connect the system together

Urban networks facilitate the flow of ideas, skills, knowledge and deals. They underpin the supply of innovation, and demand for it. Cities support their own strong networks, and enable firms to access wider networks and flows in the regional, national and international economy.

The types of networks that are important include:

- **Local networks:** These feature formal and informal business-to-business collaboration between firms; and also between firms and public research institutions. Business-to-business collaborations occur at both formal and informal levels. Informal networks are also important in identifying business opportunities, acquiring knowledge and developing ideas.
- **University-business links:** These occur across many cities and are mainly concerned with co-operation and the use of university innovation, technological and scientific expertise.
- **Public-private networks:** These foster business engagement with government programmes and universities. For example innovative cities – such as Tampere⁵³ – exhibit strong networks between public sector actors, and between the public sector and the business sector (see Box 3).

2.11 Other factors: framework conditions and central government

Finally, it is important not to ignore the wider environment in which city economies operate, since this too can influence innovation outcomes – we might define this as the ‘framework conditions’ in which a city operates.

These wider economic and policy conditions and contexts are more often influenced by national, regional and global forces, including economic conditions and devolved administrations or other higher levels of governance. Exchange rates are influenced by

50. These could include government departments, public agencies, local authorities, public service providers, public-private partnerships and private institutions such as Chambers of Commerce and trade associations.

51. Frenz, M. and Oughton, C. (2004) ‘Innovation in the UK Regions and Devolved Administrations: A Review of the Literature.’ London: Department of Trade and Industry.

52. Mahroum, S. (2000) Global Magnets: Science and Technology Disciplines and Departments in the United Kingdom. ‘Minerva,’ 37:4, pp. 379-390.

53. Eurostat Community Innovation Survey, 2007.

international markets, and government policies influence innovation through taxation, trade, legislation and the public funding of research. For example, the UK Government implements R&D tax credits – where all companies with qualifying spending over £10,000 a year on R&D are entitled to a deduction on their taxable profits. Cities with greater political autonomies (such as Vienna, Berlin, or Dubai) tend to have greater control over such framework conditions. In most UK cities, however, these conditions tend to be under the control of national and devolved governments. Framework conditions influence innovation outcomes but tend not to be influenced or controlled directly by cities.

Box 3: from textiles to technology – urban innovation in Finland

Within three generations, Finland has moved from a poor, largely agrarian country to one of the world's leading high-tech economies. Finland's cities are the country's economic building blocks, and key sites of its innovation system.⁵⁴ Local initiatives and networks are an important part of the policy mix. City leaders have set up regional councils to collaborate across boundaries – planning together and sharing resources. Regional Councils are also used to draw down EU funding. City leaders were given increased autonomy in 1995, and have had over a decade to develop local initiatives of their own.

City leaders have helped Tampere – Finland's second city – evolve from a city of textiles and heavy industry towards a post-industrial centre of advanced engineering and ICT.⁵⁵ Universities – set up from the 1950s – helped create a cluster of engineering firms and skilled workers, and a science park – built in the 1980s – fostered

a number of knowledge and business networks.

During the 1990s the city was facing a major recession. So local politicians, officials and academics drew these strands together, forging a distinct urban innovation strategy for the city, based around public-private collaboration. Tampere has since developed a number of local innovation programmes.

For example, the Tampere strategy (2001–2005) was used to help kick-start the city's post-industrial economy. The idea was to improve economic growth and innovation in two ways: on the supply side, by subsidising investment and strengthening networks; and on the demand side, by creating a new public market for online public services.

Network-building programmes take time to develop, and it is too early to evaluate the full impacts of the eTampere programme. However, over the past few years, employment in the ICT sector rose in the city while falling across the rest of Finland.⁵⁶

54. Castells, M. and Himmanen, P. (2002) 'The Information Society and the Welfare State: The Finnish model.' Oxford: OUP.

55. Soturauta, M. (2007) 'Tampere's Innovation Journey.' Presentation to CURDS / NESTA seminar, London, May.

56. eTampere (2006): 'eTampere Programme 2001–2005: Summary.'

Part 3: Urban innovation systems in practice: Five case studies

3.1 Applying the urban innovation framework to five case studies

Five detailed case studies were undertaken to develop, test and refine the model:

- London (Fashion)
- Reading/Thames Valley (ICT)
- Coventry (Auto-engineering and design)
- Dundee (Life sciences)
- Dortmund (Life sciences and micro-technology)

The rich range of observations and findings from the case studies are discussed in sections 3.2 to 3.8. Further detail on the case studies is presented in separate appendices. This section focuses on the elements of the urban innovation system that were most prominent in the case study research.

3.2 Classifying each city's urban innovation system

This research considers a city to be a strong 'urban hub for innovation' if it has a large and diverse market with international reach, together with a well developed transport and communications infrastructure. Conversely, weak 'urban hubs' have small or relatively under-developed markets with fewer local supply chains and they have poor transport and communications connections across the city-region or with other nearby urban areas.

Cities with strong 'local links' are those where firms have dense networks and diverse supply chains. Their industries operate in clusters with strong links to urban institutions. Cities with weak 'local links' have less dense networks and less strong links between firms and institutions.

The main case study classifications are presented in Table 5. They break down into the following three groups.

First, cities with established sectors also have more developed innovation systems, along the lines of classic 'clusters'. These cities display characteristics of strong 'urban hubs' and strong 'local links', the former supporting the evolution of the latter. Examples include London and Coventry.

Second, cities with strong urban assets attract larger firms. Their innovation systems largely depend on their status as 'urban hubs', with large labour markets and good transport links. 'Local links' are much weaker. An example is the ICT sector in Reading/Thames Valley.

Third, in cities where innovation occurs mainly in R&D and technology, 'local links' appear to be the most important elements in the urban innovation system. These are often smaller cities without the 'critical mass' of other 'urban hub' locations. Examples include Dortmund and Dundee.

There is a strong sectoral dimension to the relative importance of 'urban hubs' and 'local links'. The assets and markets in 'urban hubs' are especially important for the sectors where there are large established markets and which tend to be dominated by large firms – such as in Coventry's automotive design sector and in Reading/Thames Valley's ICT sector. In the case

Table 5: Classifying the innovation systems of the case study cities

Hubs	Links	Example
Strong	Strong	<p>London (Designer fashion) World city with a huge domestic economy, and clusters in creative industries and financial services. A large city, it reaches out and is integral to international markets. Specialisation of sectors and subsectors.</p> <p>Coventry (Engineering design) Innovation embedded in established cluster. City assets supportive of the cluster. Specialisation of sectors and subsectors. Rich networks along the value chain of the cluster. Universities have highly relevant innovation specialisms and actively support and underpin the cluster.</p>
Strong	Weak	<p>Reading/Thames Valley (ICT) Major conurbation with strong assets that attract major corporations and parts of their supply chain. Large skills base that supports innovation. High levels of regional and international connectivity. Limited networks and links between businesses and institutions.</p>
Weak	Strong	<p>Dortmund, Dundee (Biotechnology) Small cities/urban systems driven by science and services. Strong growth in innovation-related industries and services, often linked to research strengths of Higher Education and research institutions. Limited role of city assets and characteristics in the innovation success.</p>

of Reading/Thames Valley, urban basics were some of the main reasons for the attraction and growth of the corporate ICT base over the past 20 years.

‘Local links’ are more important in sectors dominated by small firms and individuals, and in sectors where business functions tend to be more disaggregated by organisation, such as designer fashion in London. ‘Local links’ are less important in sectors dominated by large corporations such as ICT in Reading/Thames Valley. Fashion design appears more dependent on its local milieu and draws inspiration from it and its themes, whereas ICT is more global in outlook.

3.3 Firms are at the heart of urban innovation

This research confirms what is well known – that firms are the main components of any innovation system

This research confirms that firms are the key actors in urban innovation. The other components mainly serve to facilitate and enable their successful innovation. Firms may be the most important component of the urban innovation system, but all the

other components play significant roles in establishing the conditions, assets, skills and research that businesses use and combine to develop innovations. Firms are important actors in urban innovation and use their urban environment to thrive – applying and adapting innovations, and generating their own.

Innovation in mature sectors is more embedded in the local urban environment

In the cities with a more mature industry base, and with a range of firms active along the value chain (such as in Coventry’s engineering design sector), innovation is more embedded in the local urban environment. The urban assets, institutions and networks tend to be more developed in terms of their ability to support innovation. More mature sectors tend to support richer and more diverse networks and types of innovation. And innovation appears to yield higher economic impacts in terms of economic output and jobs. In Coventry, a range of large and small enterprises is active in a diverse range of market activities. The innovation function in engineering design occurs both within large corporations and in SMEs which have specific design specialisms.

Similarly, the London designer fashion sector is well-established, with clear links between fashion designers, retailers and

the larger 'cultural economy'. Innovators are freelance fashion designers or micro-businesses which serve the retail industry and independent retailers. Some fashion designers are employed with major retail chains. Compared with Coventry, however, a weakness in the innovation system is the relative underperformance of London-based textiles manufacturers.

Conversely, innovation in Dortmund and Dundee is dominated by SMEs, and is less embedded in the local and regional economy and industrial clusters than in Coventry, Reading/Thames Valley and London. This finding echoes research suggesting that cities with clusters of related businesses tend to drive up innovative activity.⁵⁷

Small and large firms play different but complementary roles in innovation

The case studies show that both large 'anchor firms' and SMEs are potentially important innovators. These findings strengthen existing research showing that firms of different sizes play important, complementary roles in urban innovation.⁵⁸

In each of the areas studied, smaller, more specialised firms often supplied innovations to larger businesses further up the supply chain. In Dundee, small businesses set up by scientists

often focused on the early stage research and development of new drugs and technologies before passing these innovations on to larger, multinational pharmaceutical companies. The multinationals brought their innovations to market. Examples of the size and activities of Dundee's biotechnology base are provided in Box 4. The role of the pharmaceutical companies was often critical through their funding of drug development.

However, one potential weakness identified for the future development of the life sciences sector in Dundee was the lack of large firms to anchor the sector – both in terms of innovation activity and as a customer and collaborator for innovation in smaller businesses. Building on the success of investment by international organisations such as the Wellcome Trust Biocentre, which operates as part of Dundee University, one of Dundee's (and Scotland's) life sciences development objectives was to attract or grow one of these larger firms to stimulate further cluster growth.

However, the presence of large firms doesn't necessarily lead to their full integration into the local SME base. In Reading/Thames Valley, there was collaboration between large firms and SMEs in projects such as Microsoft's Innovation Centre, and through spin-out companies from large ICT firms.

57. Audretsch, D.B. and Feldman M.P. (1996) R&D Spillovers and the Geography of Innovation and Production. 'The American Economic Review,' 80(3), pp. 630-640.

58. Frenz, M. and Oughton, C. (2006): Innovation in the UK Regions and Devolved Administrations. 'A Review of the Literature.' London: DTI.

Box 4: Spin-outs breathe new life in Dundee

CXR Biosciences: Spun out from Dundee University in 2001. 40 staff. Supplies a range of products and services aimed at accelerating drug discovery processes. Highly collaborative approach to business development. Headed up by Dr Tom Shepherd – Chair of Scotland's Life Sciences Alliance. Won UK Trade & Investment's UK Innovation Enabling Biotechnology Award in 2006.

Cypex: Spun out from Dundee University in 1999. Five staff. University research was product of partnership involving 15 pharmaceutical companies. Products used in drug development labs to predict the way new drugs will be broken down in the human body.

Axis-Shield: Spun out from Dundee University in 1982. 120 staff. Cluster's only PLC. Produces products for laboratory and surgery use in cardiovascular disease, rheumatoid arthritis, infectious diseases and diabetes.

Sentient: Spun out from Dundee University in 2005. Four staff. Developing a hearing aid device. Headed up by Professor David Young – a scientist and consultant who has worked on several different life sciences start-ups.

Cyclacel: Spun out from Dundee University in 1996. 60 staff. Drug discovery, development and commercialisation business focused on human cancers and other serious disorders. Series of link ups with larger drug companies including GlaxoSmithKline and AstraZeneca.

See case study 3.

Nevertheless, some stakeholders thought that large multinational ICT firms could be better connected to local innovative SMEs. Large firms were perceived to be less embedded into local economies because they tend not to use local SME suppliers for innovation services and products.

Firms: implications for policymakers

In the case study cities, the best-developed innovation systems were those with the most well-established industrial or service sectors. By contrast, the case study areas with a narrower range of firms and sector functions had less well developed innovation systems.

Innovation, enterprise and business support policy has tended to concentrate on SMEs as the main 'carriers of innovation'. This analysis suggests policymakers should take a broader approach, recognising the complementary roles of large and small firms in innovation. This could involve the promotion of 'open innovation' practices that open up large organisations' supply chains and procurement opportunities to SMEs.

3.4 Markets drive and sustain commercially successful innovation

Cities, innovation and market access

Markets are thought to be vital for successful innovation, and the research findings reflected this. One of the obvious advantages that cities offer firms is access to markets – both large local markets and larger national and international marketplaces. Urban firms can pick and choose from a wide range of suppliers and sell to a wide range of customers. As such, urban markets and market access play an important role in sustaining innovative activity. In the case studies, 'market access' is repeatedly cited as an important location factor.

Local and global markets

Local (city) markets are less important to innovative firms. Instead, the case studies show that most innovative businesses make use of urban connectivity to operate in larger national and global arenas. The exact market footprint very much depends on the sector in question.

However, business-to-business links are very important. The Coventry case study provided a clear example of smaller engineering businesses being constantly driven by the need to deliver the requirements of customers further up

the supply chain – these customers were based locally but connected to regional and international markets. The business needed to be in regular contact with these customers so that products could be produced to their specification. A combination of strong local, regional and international demand – and customers who know clearly what they want – were pulling innovations from the local market.

London is good example of the effect of market scale and scope on innovation. The size and diversity of the London market means that niche fashion designers have local markets for their goods and can engage with the subcultures, networks or arts communities that help feed their creativity. The designer fashion sector in London operates in very local and global markets. Designers use networks of friends to source staff and achieve small production runs. As firms grow, they make increasing use of textile manufacturers in Eastern Europe and South or East Asia. Some designers also locate in the city to access a small, but influential niche designer fashion consumer market.

In the other case studies, it was found that innovation in ICT in Reading/Thames Valley is strongly influenced by the global ICT market. Engineering design in Coventry serves a global market, and is influenced by changes to the market such as consumer preferences for fuel efficiency or design features.

Markets are where 'supply push' meets 'demand pull'

The importance of downstream markets varies. Some case study cities and sectors were also characterised by 'supply push' – that is, a supply of innovative goods and services actively shaped markets, rather than simply responded to customer demand. For example:

- The key strength of the biotechnology sector in Dundee was the ability to derive novel innovations, processes and solutions that realised new market opportunities.
- The designer fashion sector in London tended to shape markets. Even in large retail chains, fashion designers had influence in shaping their market offers.

There are always exceptions to these typologies. For example, in Reading/Thames Valley there were examples of firms that used new technology and business models to provide innovative new services and products

that were previously unavailable. In Dortmund, the role of the market was unclear. Innovation was very much led by public sector funding and R&D, and commercialisation projects were at a stage that was too early to assess how they related to the market.

Markets: implications for policymakers

Cities offer firms excellent access to markets – local and global, upstream and downstream arenas. This market access is one of the main factors shaping firms' location decisions. By putting customers within reach, it also plays a critical role in sustaining innovative activity.

Policymakers need to recognise cities' role as major markets, and hubs to other markets – and how this sustains innovative activity. For city leaders, this is an example of how 'urban basics' such as housing, transport, planning and skills can play a critical role in developing innovation systems alongside bespoke policies to boost R&D spending or facilitate networks.

3.5 Urban assets underpin innovation systems

Urban assets, including a city's housing stock, transport infrastructure, planning system and skills base are often seen as the 'basics'. These are the things that keep the city going.

The case studies reveal that these 'urban basics' underpin innovation activity, and so play a crucial role in supporting long term economic performance.

Whilst studying these examples, three key features were identified as being the most important assets in relation to innovation success: the urban skills base; the presence of large labour markets; and transport. Public sector services and quality of life, though important, were of secondary concern.

The urban skills base was perceived to be the most important location factor for innovation

Reinforcing the findings of other major studies,⁵⁹ the urban skills base was found to be an essential asset for innovation in our case study areas and sectors. The availability of highly skilled workers is a major factor in the location and retention of innovative firms. Over time, successful labour markets in innovation-rich sectors become magnets for talent. Successful specialist labour markets attract

further entrants, some of whom speculatively relocate to these areas.

Specific findings from the case studies are also revealing. In London, the fashion industry could draw on new talent from the city's fashion colleges or fashion degree courses. Fashion firms also depended on a constant supply of interns to carry out basic functions – their supply would be drastically reduced were the businesses not located in London. The capital's large pool of experienced and highly skilled fashion labour was also a very important factor behind innovation success in the sector.

In Coventry, the city's automotive industry left as its legacy a mature skills base across a wide range of specialisms. This had been maintained and developed by close collaboration between industry and education institutes.

In Dundee, life sciences businesses benefited greatly from the continual supply of highly trained scientists from the University of Dundee. The university had implemented staff retention policies to retain scientific talent, and had also shown flexibility in allowing academic staff to become involved in commercial ventures.

In Reading/Thames Valley, access to a very large labour market (London and the South East) was a major factor in attracting businesses to locate and start up there. This pool of labour also helped to support innovation. In Dortmund, there was a significant supply of graduate skills, but more expert skills required labour to be imported from other areas.

Good transport infrastructure and services deliver accessibility and proximity that are essential for market access and doing business

Proximity was found to be important for innovation in all the case study cities and sectors. The urban concentration of skills, firms and institutions also facilitated easy access for firms. This had two main elements: transport infrastructure; and 'co-location', where firms operate near each other.

First, most sectors and their innovating firms required a maximum of one hour's travel time to suppliers, markets and skills, or to an international transport hub. In Coventry, Dundee and London, reasonable travel times to universities and colleges were also essential. All the sectors studied served global as well as local markets, with global markets tending

59. Shown in interviews conducted with 160 innovative firms in five European cities as reported in Simmie, J., Sennett, J., Wood, P. and Hart, D. (2002) *Innovation in Europe: A Tale of Networks, Knowledge and Trade in Five Cities*. 'Regional Studies.' Vol. 36.1, pp. 47–64.

to take priority. International connectivity is therefore important. Transport infrastructure was cited as a major asset for facilitating business connections, networks and knowledge transfer.

Second, some sectors had a clear need for real proximity, or 'co-location'. This varied across the case studies. In the engineering design sector in Coventry and in the ICT sector in Reading/Thames Valley, activities were spread across the 'economic city' or city-region. In Coventry, where there was an established cluster of automotive and engineering industries in the city and the wider region, being within reasonable travelling time to customers and suppliers was thought to be important for business success. For life sciences in Dundee, reasonable proximity to the University of Dundee was necessary as the research specialisms and staff expertise played a major role in the sector's continued success.

Transport access and infrastructure proved most important in Coventry and London. Coventry's automotive sector originally developed as a result of its relatively central location and excellent road connections. These meant that materials could be brought in quickly while new cars could be distributed easily around the UK. Similarly, London's role as an international transport hub is an important benefit for its fashion designers, since they can be in Milan or Paris in a couple of hours, and New York in six. Other evidence reinforces this view, suggesting that hub airports and rail links increase cities' effective reach and improve firms' innovation potential.⁶⁰ In another study, project leaders in London's innovative firms used face-to-face contact extensively, with 20 per cent meeting executives from other firms at least once a week.⁶¹

The importance of property, land and the built environment varied by sector

In the case studies, property concerns tended to reflect the general needs of business. But there were some specific examples where property and the built environment have a direct impact on the ability to innovate. In Reading/Thames Valley, major ICT corporations tend to prefer campus-style headquarters and office facilities on well-equipped business parks. The physical layout of the business environment is seen as a potential barrier to achieving high levels of networking and knowledge transfer. In London, high property prices and rents threatened existing spatial clusters in the designer fashion sector, and has previously led to a forced relocation and

reconfiguration of these spatial clusters. The role of property and the built environment in these two cities is described in more detail in Box 5.

Quality of life was cited as important, but a secondary concern

Quality of life was quoted in many areas as helping to attract and retain firms and skills that enable innovation. In the non-London examples, the skilled personnel involved in innovation are predominantly suburban residents.

Yet London is the most obvious example of how wider quality of life and cultural offer factors can attract people and businesses to an area. Its position as one of the most diverse and culturally dynamic cities in the world makes it a highly attractive location for every profession. With fashion businesses in particular, London's role as an international cultural capital makes being located in the city an important source of competitive advantage – allowing designers to connect with a diverse range of sub-cultures that help inspire them.

In the short term, quality of life can attract talent and businesses. In the long term, it is essential for economic success. Without a good quality of life, cities cannot compete effectively to develop, attract and retain residents and businesses.⁶²

Urban assets: implications for policymakers

'Urban basics' play a critical, often underappreciated, role in supporting innovative activity. We have seen that labour markets and transport are particularly important. But the order of importance for different urban assets varies between sectors.

Proximity in general helps innovation, but 'relevant proximity' is even more important. For the life sciences sector in Dundee, being close to the university was more important than being close to an airport or the city centre. Proximity for 'urban hubs' enhances their prospects for innovation and ensures that many useful assets, institutions and firms are accessible. For 'local links', cities' proximity is critical, but it can sometimes be proximity to one particular asset, institution or firm that is the key. What this implies is that, in the development of a biotechnology cluster, for example, the most important factor in its initial establishment may be either the close proximity of a successful research institute or university or the presence of major customers. Transport and the built environment – two

60. Graham, D. (2005) 'Wider Economic Benefits of Transport Improvements: Link between city size and productivity.' London: Department for Transport; Rice, P. and Venables, A. (2004) 'Spatial Determinants of Productivity: Analysis for the Regions of Great Britain.' Unpublished paper, London: LSE.

61. Simmie, J. (2004) 'Innovation Clusters and Competitive Cities in Europe.' In Parkinson, M. and Boddy, M. (eds) *City Matters*, Bristol: Policy Press.

62. Nathan, M. (2005) 'The Wrong Stuff: Creative Class theory, diversity and city economic performance.' Centre for Cities discussion paper 1. London: Centre for Cities.

important urban assets – can facilitate this close proximity.

Policymakers need to recognise the role of urban assets in supporting innovation, and reconfigure innovation strategies to match. Central government should invest in urban transport infrastructure, skills and housing with a view to promoting a critical mass of economic activity across city-regions. City leaders should prioritise spending on transport and housing accordingly, and continue with programmes to improve the urban skills base and tackle worklessness. In some cases, the key transport links will be to hubs in neighbouring cities, such as existing regional airports. City leaders also need to use planning policy and the built environment to influence clustering or the concentration of certain types of firms such as

creative industries. This has been practically achieved in areas such as Hatton Garden for the jewellery sector in London.

3.6 Public sector institutions and agents help nurture and maintain innovation in cities

In the case study cities and sectors, universities were found to be a key resource that played many roles in creating, enabling and driving innovation. Significantly, universities played a role that went beyond pure research and training. They played an important part in the innovation process through activities such as:

- training and developing future innovators;

Box 5: Location, location, location – buildings, land and property influence innovation

In the case of Reading/Thames Valley, major ICT corporations tended to prefer campus-style headquarters and office facilities on high quality business parks. Although staff from corporations actively met with other organisations to conduct business, the physical layout of the business environment was not seen as conducive to achieving high levels of networking and knowledge transfer. Where corporate campuses provided services such as banking, retail, catering and leisure facilities, staff didn't feel the need to leave the office campus, reducing their opportunity to mix with external businesses and people. In this situation, internal knowledge and business networks tended to dominate, which may imply less networking with external organisations or development of innovation communities.

However, there were also some novel solutions to encouraging higher levels of collaboration and networking between businesses and innovators. Microsoft's Innovation Centre on their Reading campus was created as a physical location designed for collaboration and networking in developing innovations and business solutions amongst a range of enterprises

involved in serving a particular client or business process.

See case study 5.

The dynamics of the London property market threaten existing spatial clustering in the designer fashion sector, and have previously forced the relocation and reconfiguration of spatial clusters

In London, fashion designers required low-cost large premises adjacent to other designers and within reasonable travel times to educational, retail and media sectors. Evidence suggested that high property costs have forced central geographical clusters of fashion designers further out to lower cost locations – which is likely to have eroded benefits from proximity and agglomeration. For example, fashion designers are currently clustered in Shoreditch and Dalston, but many are moving further East or to South East London as premises became unaffordable. It is apparent that the designer fashion sector – where spatial clustering is evident, and innovation success benefits from proximity, collaboration and knowledge transfer – regularly has to readjust and redefine spatial relationships due to changes in the property market.

See case study 4.

- helping people meet and form cohesive communities and networks, developing and facilitating networks and being a hub for innovators;
- lending credibility and expertise to spin-out enterprises;
- servicing innovative SMEs with research specialisms; and
- providing collective goods, such as research equipment and conferencing facilities.

Specific examples of where universities provided these roles in the case study cities and sectors are provided in Box 6.

In our case studies, private sector R&D labs and SMEs specialising in R&D tended to converge around research centres in urban universities, particularly in Dortmund and Dundee, reinforcing the findings of other studies in the pharmaceutical and mechanical engineering

sectors.⁶³ This suggests that universities can become centres of knowledge spillovers, along the lines of 'local links' models.

Other findings related to the innovation process, and the role of universities within larger industrial clusters and markets.

Both Dortmund and Dundee's life sciences sectors could be characterised as research-led – where universities and research institutions with research excellence provide the foundation for entrepreneurial spin-outs. They had both successfully developed research with commercial potential, and given birth to enterprises that undertake commercial R&D and innovation. But both these cities faced a challenge in developing these sectors beyond R&D. There were no large-scale manufacturing facilities, nor were there any upstream or downstream activities of any scale. For example, most biotechnology enterprises in Dundee were engaged in commercial R&D, and were often so specialised in their research that they had few business

Box 6: University challenge – how higher education fosters innovation

The source and main driver of commercial innovation potential in Dundee's biotechnology R&D sector.

Dundee University founded Dundee's current biotechnology cluster through the research specialisms of its Department of Life Sciences and the individual drive of its former Head, Sir Philip Cohen.

Facilitating networks and being a hub for innovators in Coventry's engineering design sector. Coventry University played a critical role in the city's engineering design sector by being the key mediator in collaborative innovation between enterprises. Without the university's involvement, many firms had been wary of sharing proprietary knowledge and intellectual property.

Lending credibility and expertise to spin-out enterprises in Dundee's biotechnology R&D sector. Many of Dundee University's scientists held board positions in biotechnology enterprises in the city. This lent credibility to companies seeking customers and finance. It helped to

secure several venture capital investments.

Providing collective goods in Coventry's engineering design sector. The universities of Coventry and Warwick provided an array of research equipment including prototyping technology, and had begun to provide virtual conferencing facilities and virtual design studios to facilitate real-time collaborative working across large distances. This equipment was actively used by the engineering design businesses.

Providing research services to business for commercial success in The University of Reading's Knowledge Transfer Centre (KTC). The KTC brokered relationships between business and academic research expertise, delivering around 35 successful collaborations every year.

Founding innovation communities in London's designer fashion sector. London's universities and fashion institutes are where future designers first form networks that endure through most of their careers. Fashion designers continually used their former educational institutions as an innovation community and networking hub.

63. Abramovsky, L., Harrison, R. and Simpson, H. (2006) 'University Research and the Location of Business R&D.' London, Institute for Fiscal Studies; Feldman, M. (1999) The new economics of innovation, spillovers and agglomeration: a review of empirical studies. 'Economic Innovation and New Technology', 8, pp. 5-25.

relationships with each other. They occupied the same position in the biotechnology value chain. Co-location reflected a need to be close to the university, rather than for proximity with other life sciences businesses.

Companies value and will use a local university with relevant research expertise that can genuinely add value to their operation and a welcoming attitude to business. This research found that universities could be the centre of the innovation community if they had some research specialisms particularly relevant to particular sectors or businesses in the city-region. As in the designer fashion sector in London, universities also function as meeting places where business and deals are conducted. However, there are no general rules as to whether local sectors and businesses influence the development of university specialisms, or whether local sectors spring from university research.

As we have seen, universities in our study played a big role in innovation. However, businesses sometimes conducted their R&D and innovation themselves, or through the market. In these instances, they did not necessarily need university research expertise or involvement. Nor did all businesses perceive a need for collaboration with a university. Those that did see a benefit from such collaboration had experienced successful interactions and a high impact on their businesses. Being within reasonable distance of a university that has beneficial research specialisms was thought to be advantageous for all the case study sectors. Urban areas also offer a denser concentration of universities, which is another advantage of being in or near a city.

Individual change agents within universities, government and business can build innovation communities and push innovation forward

Within institutions, individual change agents can help build or push innovation forward.⁶⁴

This was particularly apparent in Dundee, where the university's Sir Philip Cohen had been central to the development of research capacity in biotechnology and its subsequent commercialisation. Sir Philip had also helped to secure £13 million and £21 million investments in the Wellcome Trust Biocentre and James Black Centre respectively. Further evidence from the US biotech industry suggests 'stars' are geographically concentrated, and may help knowledge spillovers in their surrounding cities – although they cannot anchor a new

industry in place.⁶⁵ Examples of the role of 'star scientists' as innovation change agents are provided in Box 7.

Change agents are also an important part of Dortmund's initiative to redefine the economic future of the city through 'The Dortmund Project'. City leaders have been instrumental in pushing through a vision of change that depended on collaboration and buy-in from local partners and the state government. The effective, personal working relationship between the Mayor and university Rector, for example, were cited as a reason why 'things got done' in Dortmund.

Private sector-led institutions (outside private-public partnerships) are not playing a strong role in innovation in most case study areas

We found few formally constituted private sector-led institutions that had the specific role of promoting, developing and supporting innovation in the case study areas.

In the UK there are many such private sector-led institutions, but they are not as proactive as in the US, especially in terms of influencing public policy. This may be because US government is less active in enterprise and innovation policy, so there is also a stronger culture of private sector intervention and philanthropic support for local economic initiatives.

In our case studies, one notable exception was in Reading/Thames Valley where the private sector led the economic development organisation, Thames Valley Economic Partnership (TVEP), which includes Innovate Thames Valley (ITV), launched in 2006 to promote innovation, and to connect and inspire innovators. ITV is a network organisation with 320 members including large corporations, SMEs, public institutions and universities. Through early research and assessment of initiatives and organisations in other parts of the UK and the world, it developed its own approach to promoting innovation. A part of this approach was the idea of a Commercialisation Centre – which would provide a virtual focus for networks and innovation advice and services, and have a physical presence as a network hub.

64. NESTA Regional Innovation Journey report (December 2007).

65. Feldman, M. (1999) The new economics of innovation, spillovers and agglomeration: a review of empirical studies. 'Economic Innovation and New Technology,' 8, pp. 5-25.

Economic development and regeneration agencies played a range of roles in enabling and supporting innovation and enterprise

There were a number of similarities in the functions undertaken by economic development and regeneration agencies in the case study areas:

- They championed innovative sectors, raising their profile as well as trying to ensure that other public services and policies could help their development.
- They were heavily involved in property, land and the built environment – developing science and technology parks, and helping innovating sectors with their property needs.
- They would often situate incubation or advisory facilities alongside science and technology parks.
- They helped facilitate and establish networks.

- They undertook initiatives to ease barriers to growth and development in innovative SMEs, by addressing skills shortages or providing access to finance.

Development agencies played a major role in Dortmund and Dundee. They were champions and major players in innovation in their sectors – providing significant resources for commercialisation advice, SME finance and incubator facilities.

In Dortmund, local agencies developed and agreed the Dortmund Project in 2000. This was pivotal in helping begin the transition from a fading industrial city to one with encouraging opportunities for growth. It led to the redevelopment of brownfield land into technology parks, investment in university and institutional R&D, and the establishment of incubation and advice facilities for technology start-up companies.

Box 7: Leading the way – the role of individual change agents

Sir Philip Cohen and Dundee's biotechnology sector.

Sir Philip Cohen – until recently Head of Life Sciences at Dundee – has been central to the development of research capacity at the university. Himself a world renowned scientist, Cohen has played a pivotal role in orchestrating large-scale investments in university facilities by building and holding together complex alliances of public and private sector actors. The result has been the creation of a series of state-of-the-art research centres, including the £13m Wellcome Trust Biocentre completed in 1997, and the £21m James Black Centre opened in 2005. At the same time, Cohen has been instrumental in nurturing and attracting scientific talent, and in securing public and private sector financing for research. He secured fresh talent by deliberately trying to attract other star researchers and up-and-coming scientists by targeting individuals for recruitment. On research financing, he built close relationships with pharmaceutical companies, public sector research bodies and charities to attract long-term funding.

See case study 3.

Fred Terman and Silicon Valley. Stanford University has been central to Silicon Valley's development since the mid 20th century. Fred Terman, the university's Provost between 1955 and 1965, is widely credited as a key figure in the Valley's early development. Terman fostered networks, established infrastructure and promoted talent, based around Stanford's electrical engineering department. Key initiatives included the Honors Cooperative Program, which allowed researchers in local technology companies to undertake postgraduate evening classes; and the Stanford Industrial Park – which leased university land to high technology companies. Terman tutored several of Silicon Valley's most successful entrepreneurs during their studies at Stanford and continued to assist them after they had left. These included former students William Hewlett and David Packard – whom Terman supported when starting Hewlett Packard. He deliberately recruited star researchers – including the Nobel Prize winning scientist William Shockley – and helped them in establishing spin-out companies.

In Dundee, Scottish Enterprise Tayside, the local enterprise agency, was proactive in supporting the biotechnology sector. Scottish Enterprise and the Scottish Executive also funded the Intermediary Technology Institute for life sciences in the city.

In London and Reading/Thames Valley, development agencies played a smaller role and tended to be focused on providing advice to start-up enterprises. In Coventry, the role of development agencies was cited as fairly minor compared to the activities of firms and universities.

Institutions: implications for policymakers

A number of public institutions and actors help nurture firms' innovative activity. In the case study cities, the key institution was the university, which had a number of roles – from training to forming networks and helping spin-offs. But from an innovation perspective, universities aren't always as well plugged-into downstream markets as they could be. Economic regeneration agencies also play a range of supporting roles – from directly leading the development of innovative sectors as in Dortmund, to supporting the early development of networks, as in Dundee and Reading/Thames Valley. Critically, individual 'change agents' in local government and higher education can play a significant role in developing innovation systems and working with the private sector.

The Government is right to highlight the key role of universities in current innovation policy. But it needs to recognise both their range of roles and the barriers to their success. In particular, central government should work with local government and universities to support and nurture change agents. Universities should develop more flexibility to allow academic staff to become involved in commercial activities. And both central and local government should support strong universities, especially those with strengths in high-value sectors. Knowledge Transfer Partnerships should be monitored carefully to see if there are more effective ways of promoting higher education-industry links.

3.7 Urban networks facilitate the flow of ideas, products and services

Urban assets and institutions help business and knowledge networks to develop – reinforcing the role of urban markets, and over time,

helping clusters to form. These networks are essential for firms to develop new ideas, turn these into innovative products and services, and bring them to market.

Formal and informal local networks

The evidence from this research and elsewhere suggests that formal and informal local networks matter, especially for high-tech sectors.⁶⁶ The collaboration between high-tech firms and public research institutions is linked to new patents and product innovation.⁶⁷

For example, at the formal level, a number of firms in Reading's ICT sector had spun out of large corporations to develop innovations that serviced the needs of the original 'parent' company. In Dundee and in Dortmund, some firms collaborated regularly over the early stage research and development of new drugs and medical technologies – although the wider frequency of business-to-business collaborations in these early stage clusters should not be overstated.

In the fashion industry, informal networks play a crucial role in developing design concepts – with designers embedded into wider cultural and creative networks around the city. In the Dundee life sciences sector, firms tended to be strongly networked with the University of Dundee (or with researchers based there). The businesses needed these connections to access the expertise that could help drive forward research processes and keep their knowledge of the latest research up to date. Developing and maintaining these networks was made easier by the fact that many of the researchers working in the private sector had previously worked at the university.

Several types of networks were operating in the case study cities and sectors:

- **Private sector-led networks** in Reading/Thames Valley's ICT sector and in designer fashion in London. These networks were largely self-organised.
- **Public sector-led networks** in Dortmund's life sciences sector.
- **Mediated networks** in Coventry and Dundee, where the universities played a key role in forging R&D collaborations and knowledge transfer between firms. In Coventry, there were barriers to firms sharing proprietary information and IP. In Dundee, firms tended to have such specialised products and R&D that there was often

66. Orlando, M. and Versa, M. (2005) 'Do only big cities innovate? Technological maturity and the location of innovation.' Kansas: Federal Reserve Bank of Kansas City.

67. Frenz, M. and Oughton, C. (2004) 'Innovation in the UK Regions and Devolved Administrations: A Review of the Literature.' London: Department of Trade and Industry.

little rationale for business-to-business collaboration.

Connectivity, proximity and networks

Urban proximity helps business and knowledge networks to form and be sustained. Sometimes these are very local – for example, in the London designer fashion sector, where frequent face-to-face contact is essential, designers preferred to cluster with other designers and creative types in specific neighbourhoods.

But in most other case study sectors, economic activity – and networks – were spread out over the wider city-region. For example, in the Thames Valley firms were distributed over a number of closely connected urban centres, with Reading as a hub. In this case, firms also had important links to customer, supplier and financial markets in London.

Universities can play an important role in networks

In many of the case study cities, universities played an important role in networks. They tended to act as a hub for innovators to attend events, discussions or participate in formal initiatives. In London's designer fashion sector, networks were founded and maintained in universities and colleges. In Coventry, the universities played a key role in forging innovation collaboration between firms, and in helping firms overcome the reluctance to share ideas.

Business or knowledge networks?

Business-to-business networks were regarded by the case study participants as a primary vehicle for transactions and knowledge transfer for innovation. However, these networks didn't always equate to innovative activity. Supply chain relationships didn't always involve knowledge exchange; some firms were cut out; and other businesses had knowledge relationships well outside their city-region.

The case studies suggested that an urban location helps all firms to develop supply chains – which form the basis for business networks. Supply chain relationships were considered essential to transactions. In most cases, firms also wanted to develop more proactive 'knowledge networks' – sharing ideas and collaborating.

This was not always successful. In Reading/Thames Valley, for example, networks tended to be functional around conducting business transactions, and facing potential barriers associated with the nature of corporate

campuses with large internalised markets. There was a perception that the local SME base found it difficult to enter the networks of large corporates and to be considered as potential suppliers or collaborators in innovation and R&D.

In Dundee, business-to-business networks were weak, as many biotechnology businesses occupied the same position on the value-chain. Many businesses tended to have specific R&D specialisms that were not complementary to other business specialisms.

Not all firms wanted to share ideas. In Coventry, business-to-business networks were strong, especially between suppliers and customers for innovative products and services. However, in some cases there was a reluctance to collaborate in engineering design innovation due to the perceived risk of giving away proprietary knowledge or IP to competitors.

Our findings point to the imperfect nature of knowledge networks and business relationships. Other studies reinforce this – knowledge networks have been found to be uneven (with many firms not included) and selective (with some 'leaders' in the sector opting out to forge strategic links with businesses well outside the urban area).⁶⁸ Collective learning is often not the dominant behaviour, even in high-tech clusters.⁶⁹

Networks: the public sector role

The problems with co-ordination and collective action set out above suggest a clear public sector role for mediators – to help overcome gaps or barriers to networking and collaboration – just as universities in Coventry helped developing collaborations between firms in the engineering design sector for innovation projects.

However, the role of formalised networks, especially public sector-led ones, is controversial. There was some perception amongst case study consultees that effective networks must be driven by business needs. The case studies suggested that networks that enabled effective public-private collaboration could be useful – as with BioDundee in Dundee (see Box 8). Public-private networks that provided added value and worked, seemed to be those where the public sector could offer the private sector genuine influence over the prioritisation, shape and nature of public investment and services.

68. Giuliani, E. (2007) The Selective Nature of Knowledge Networks in Clusters: Evidence from the Wine Industry. *Journal of Economic Geography*, 7, pp. 139-168.

69. Capello, R. (2007) Spatial Transfer of Knowledge in High Technology Milieux: Learning Versus Collective Learning Processes. *Regional Studies*, 33:4, pp. 353-365.

Networks: findings and implications for policymakers

A number of urban factors support business and knowledge networks – helping the flow of ideas, the production of innovative goods and services, and their movement to market. The case studies highlighted the critical importance of urban-enabled supply chains. Knowledge networks were patchier and had problems with co-ordination. There is a role here for well-designed public interventions to promote better connections between firms, and between the public and private sector.

Despite the clear need for public sector-enabled networks, a number of current interventions in case study cities were criticised. It was perceived that the best networks were market-focused, driven by business needs, and aiming to improve the effectiveness of existing relationships – rather than developing clusters from scratch. Experience suggests that while the public sector can facilitate the establishment of networks, it should step aside to allow networks to develop.

Urban universities can play an important networking role – one that firms readily identify with, providing collective goods, linking researchers with businesses, and supporting spin-outs.

3.8 Other factors: framework conditions, central government, city-regions and feedback effects

Outside the framework, what other factors shaped urban innovation? The case studies highlighted three.

First, in the UK public sector, power and resources are heavily concentrated in central government, which therefore plays a particularly pronounced role in shaping urban innovation – through public spending, setting standards, and deciding where to locate resources and investment. For example, in Coventry's engineering design sector, government policy has driven the need for innovation through changes to legislation on the environment and health and safety. Tougher emissions standards require innovative solutions. More stringent health and safety requirements entail design changes to automotive parts and vehicles. Similarly, government regulation has stimulated innovation in financial services.⁷⁰

Second – and by contrast – much urban innovation takes place at the city-regional scale. Production, consumption and household networks operate across a conurbation, or across a city centre and its surrounding suburbs. This suggests that local innovation strategies need to be designed at a similar scale, to reflect the 'economic city' rather than administrative boundaries. It also suggests that any devolution of policy needs to be to city-regions.

Lastly, the case studies suggest that the more established innovation systems benefit from positive feedback. For example, the reputation of London's 'designer fashion cluster' plays a big role in attracting new talent, both to universities and to work in the city. Similarly, the presence of a number of established automotive firms around Coventry helps attract talented engineers who know they can build a career in the area.

70. The OECD Report on Regulatory Reform (2007). Paris: OECD Publishing. Available at: <http://www.oecdbookshop.org/oecd/display.asp?sf1=identifiers&sf2=9789264155190>

Box 8: BioDundee – effective public-private networking in Dundee

BioDundee is a partnership between the public, private and academic sectors in Dundee. Its key aim is to market the life sciences cluster and to promote further growth by organising events and supplying

business support tailored to the needs of the cluster. The project has achieved strong buy-in from stakeholders in the local area, with all life sciences businesses using or engaged in developing its services.

See case study 3.

Part 4: Implications and recommendations for decision makers

4.1 Central, regional and national policies tend to impact on firms

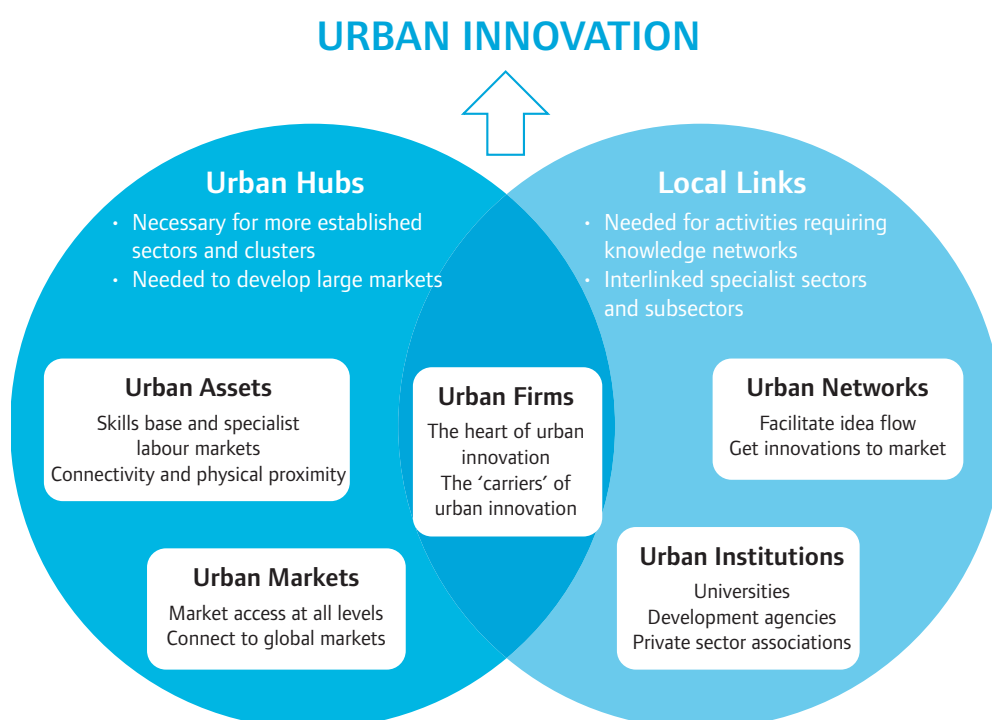
There are specific policies and initiatives at the UK level to incentivise research and development, and regional policy tends to focus on providing support and advice for SMEs. Overall, policy is partial at best in its support for the firms that are at the heart of any urban innovation system.

For **markets**, policy is minimal, and reflects the general approach of government to act as

market regulator, and to maintain conditions favourable to the efficient operation of markets. There are a few examples of policies and initiatives at the regional level such as public procurement initiatives or the promotion of supply chain development, but these are limited in scope and scale.

For **assets**, central government and the devolved governments are the main policymakers. They lead, for example, in transport policy where there is little regional or urban control over expenditure priorities. At

Figure 6: Urban innovation inputs and processes



the regional and urban level there is a focus on the built environment such as provision of site assembly, premises and infrastructure. In skills, policies and priorities at the level of central government and devolved administrations tend to dominate. Higher education (HE) funding is allocated at the central and devolved level. Further and other educational expenditure is managed at the regional and local level. Generally, urban assets are not seen as innovation-relevant at most levels of policy.

In terms of **institutions**, there are many initiatives led by local and regional government agencies and authorities. There are some university-led initiatives at the city scale. Central government policy has tended to support the development of local institutions serving city-regions, through initiatives such as the higher education Innovation Fund (HEIF).

Policies for **networks** are extensive at all levels of government – from national to local.

Currently, central government and devolved administrations dominate innovation policy. In a number of the important factors for urban innovation, such as firms, markets and assets, policies remain under-developed at the city-region level.

For cities, local authorities have a statutory duty to promote the economic well being of their local community,⁷¹ and regional development agencies implement initiatives and programmes for innovation at the regional and subregional level. Does this represent enough control of the right policy levels at the most appropriate geographical scale? Could these urban factors be better developed and deployed for innovation at a city-regional level?

4.2 Implications and recommendations for decision makers

City-regions matter for innovation and urban innovation systems are real

Many of the processes and activities necessary to create, develop and sustain innovation occur at the city-region level. Urban factors and processes explain why much innovation is concentrated in and around cities. Policymakers should:

- Explore whether policy is better designed and deployed for innovation at the city-region level. Government institutions should

collaborate at the city-region level in areas of strategic importance to innovation such as transport, higher education and skills.

- Develop subregional partnerships, particularly in big conurbations, to plan and deliver innovation and economic development programmes.
- Push forward programmes to devolve policy and financial powers towards city-regions and local areas, to allow local leaders to develop tailored innovation strategies at the city-region scale.

Firms are at the heart of urban innovation

This research confirms what is well known – that firms drive private sector innovation. Both large and small firms have complementary roles to play. The best developed innovation systems are those with the most well-established sectors and clusters. Policymakers, therefore, should:

- Develop and implement a more substantial suite of actions to identify and embed innovative sectors at an early stage of development.
- Better use inward investment incentives and resources to attract anchor firms to locate near these sectors.
- Develop programmes to open up the procurement and supply chains of government organisations and to promote and encourage similar initiatives within private sector organisations to increase innovation opportunities in the city economy.

Cities offer firms excellent access to markets and markets drive and sustain commercially successful innovation

Market access is one of the main factors in influencing firms' location decisions. The resultant policy implications are to:

- Consider better how policy areas such as transport influence innovation by shaping market access.
- Address barriers or bottlenecks to market access and plan for increases in market activity, and demand for transport and communications infrastructure.

71. Enacted by legislation such as the 1989 Local Government and Housing Act and the 1994 Local Government (Scotland) Act.

Urban assets play a critical and under-appreciated role in supporting innovative activity

The urban skills base and specialist labour markets are the most important of these urban assets. Transport connectivity is also important as it enables accessibility – which, in turn, increases the rate of collaboration and networking. Policymakers should:

- Invest in the continued recovery and growth of large urban cores, particularly in transport infrastructure, skills and housing.
- Make skills, transport, physical infrastructure, property and housing key planks of innovation strategies.
- Recognise the links between the built environment, spatial clustering and networking.
- Use design to influence the sustainability and development of spatial clusters.

Tailor the role of public institutions better to the innovation challenges and opportunities present in the city-region

The roles of public institutions are best tailored to what is required in each city and sector. Some situations require large scale investment and intervention; others require different support such as for networking development or promotion and raising awareness. Universities play an important role in innovation. Consequently, policymakers should:

- Give institutions and agencies the flexibility to design and deliver services tailored to the needs of their city-region.
- Establish more effective working relationships between government institutions at the city-region level. This could take the shape of city ‘compacts’ between government, regional development agencies and cities (including the higher education sector). This would help to consolidate funds and share responsibility for both policy and implementation.
- Continue to support urban universities, especially those with strengths in high-value and creative sectors and that have strong links to local industries.
- Encourage universities to be flexible enough to allow academic staff to become involved in commercial activities.

- Ensure that universities have procedures in place to retain star scientists and staff with research expertise with high commercial potential.

Urban factors support network formation and development

Networks help the flow of ideas, the production of innovative goods and services, and their movement to market. The dense infrastructure and diversity of firms in cities support the development of supply chains that are essential to successful innovation. Policymakers should:

- Undertake initiatives for the development of networks that currently do not work as effectively as they could.
- Build in a process for public sector organisations to step aside from networks once they are established.
- Promote knowledge networks and partnerships where appropriate – supporting HE and business actors to take a lead role.
- Work more closely with universities, jointly develop innovation policies, (particularly in linking researchers to SMEs), bring innovation advisory services closer to university sites, and develop emerging innovation networks.

Government legislation shapes innovation

Central policy shapes innovation either directly through investment in scientific research and higher education, or more indirectly through specifying new health and safety or financial rules for businesses. So, urban innovation partners and stakeholders should closely monitor the likely impacts and opportunities of central legislative developments.

Appendix A: Project methodology

A.1 Project questions

This research set out to answer the following questions:

1. How do cities enable innovation and how does innovation help cities grow?
2. What helps or hinders innovation in cities?
3. Innovation policy for cities: what works, and what improvements can be made?

A.2 Structure of the project

The project was structured as follows:

- **Evidence review.** A detailed review of existing research and literature on urban and spatial aspects of innovation was undertaken. A brief review of current policy frameworks was also conducted.
- **Data review.** Analysis of CIS and other available data on city economies and 'visible innovation' performance across 56 of the largest English towns and cities. (More detail on the geographical scope of the project is given below).
- **Model-building.** Drawing on the evidence and data reviews, a conceptual model of urban innovation processes was developed. The model aimed to draw together insights from a range of literature, particularly the fields of New Economic Geography and Regional Innovation Systems.
- **Case studies.** The model was tested through a series of five city-level case studies. Each

aimed to highlight different aspects of the model; overall, the aim was to rank the key 'urban factors' supporting real world innovation in cities.

The cities chosen for case studies included a selection of large and small, northern and southern, and a range of UK growth sectors, all of which have an urban footprint. A variety of sectors were selected according to the criteria of 'Traditional' (e.g. Automotive), 'high tech' (e.g. ICT and Life Sciences) and 'creative' (e.g. Designer Fashion). The cities and sectors eventually selected were Coventry (Automotive Design); Dortmund (Life Sciences); Dundee (Life Sciences); London (Designer Fashion) and Reading (ICT).

- **Analysis.** Drawing on material from case studies, model, evidence and data reviews to produce the final report.

A.3 What is meant by a 'city'?

There are many ways of looking at cities. This project focuses on the 'economic city' – that is, the urban economy.⁷² This is also known as the 'metropolitan city'.⁷³ Urban economies often stretch well beyond administrative boundaries, into the wider 'city-region'. For example, Manchester's economy extends far beyond the city council's borders to include Bury, Oldham, Stockport and others.

Cities are part of wider urban systems, and urban economies are part of larger economic networks. There are several ways of perceiving the role of cities and their spatial connections – as islands in an archipelago of connected urban

72. Marshall, A. and Finch, D. (2006) 'City Leadership.' London: Centre for Cities.
73. CLG (2006) 'Strong and Prosperous Communities: The Local Government White Paper.' London: CLG.

centres;⁷⁴ or as hubs in a larger ‘space of flows’, networks of people, information, money, goods and services.⁷⁵ These perspectives inform the thinking behind this report.

A.4 Data sources and scope

Throughout this paper, ‘city’ or ‘urban area’ refers to the economic city or city-region, unless otherwise stated. For much of the data, Travel to Work Areas (TTWAs)⁷⁶ are the geographic units used in this analysis – largely due to data availability for innovation indicators. TTWAs approximately map to city-regions.

The bulk of the analysis in this report looks at English cities. This is because detailed innovation statistics for urban areas outside of England are largely unavailable. A key dataset for this analysis is the UK Government’s State of the Cities Database, which covers the 56 biggest cities in England (those with populations of 125,000 or more).⁷⁷ This dataset includes a range of innovation indicators; however there are no comparable data sources for Northern Ireland, Scotland or Wales.

Patterns of urbanisation are broadly similar across the UK, so the policy messages derived from data on English urban areas are likely to be relevant for the other UK nations.

74. Veltz, P. (2004) ‘The Rationale for a Resurgence in the Major Cities of Advanced Economies.’ Presentation to LSE Symposium on the Resurgent City, London, April.

75. Castells, M. (1996) ‘The Rise of the Networked Society.’ Oxford: Blackwell.

76. Within the UK, travel-to-work-areas (TTWAs) are often adopted as convenient approximations to ‘local labour markets’. TTWAs are based upon the commuting patterns of the ‘average worker’ using Census of Population data.

77. The full datasets are available at www.socd.communities.gov.uk/socd/. Sourced data is tagged ‘SOCD’.

Appendix B: Case study reports

Case study 1: Coventry – building on a legacy of automotive engineering

Introduction

This case study focuses on Coventry's automotive design engineering sector. It illustrates the importance of 'urban hub' factors such as connectivity, knowledge infrastructure and a critical mass of expertise. It also strongly reinforces the role that history can play in determining the structure and nature of an innovation system.

Coventry was once well known for heavy engineering, but has now developed a reputation for innovative, high-value automotive design.⁷⁷ This new sector covers a broad spectrum of activities across the full life

cycle of road vehicles – from initial concept design, through to production, use and end of life (re-use, recycling and vehicle disposal).

Innovation in design engineering is a problem-solving process that evolves through a series of overlapping phases – from problem identification, through to the development of different conceptual solutions, designing a favoured solution and working out details of the physical artefact.⁷⁹ Rarely is this process presented as linear; there is feedback and iteration across all stages – a continuous cycle of trial and error involving a high degree of uncertainty.

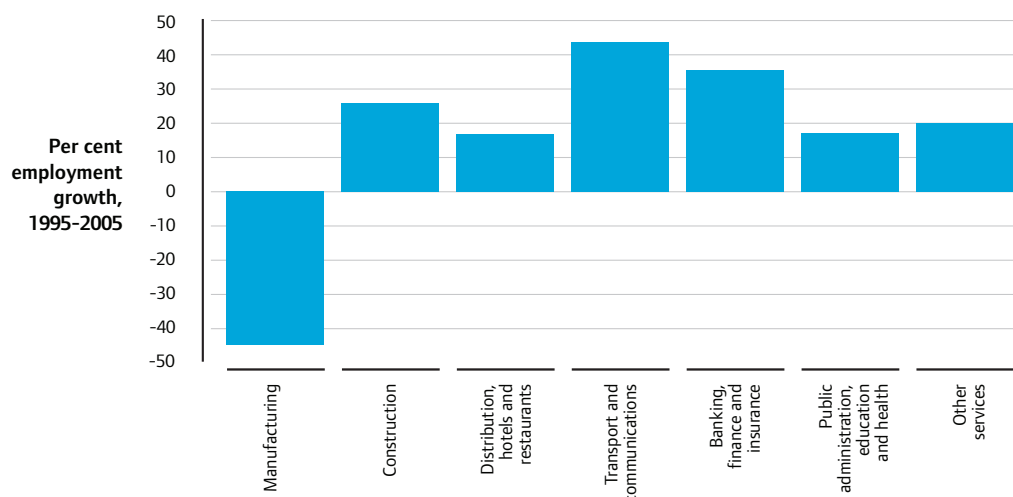
Table 6: Selected economic indicators for Coventry⁸⁰

Population 2005 590,000 (1.1% of England total)	Population change 2000-2005 0.4% (England average 3.1%)
Employment rate 2006 71.9% (England average 74.3%)	ILO unemployment 2006 6.3% (England average 4.7%)
% working age educated to degree level 16.7% (England average 19.9%)	Average weekly wage 2006 £471.20 (England average £454.50)
% firms introducing new products, 1998-2000 35% (England average 18.0%)	% firms introducing novel products, 1998-2000 12% (England average 15%)
% of firms introducing new processes 30% (England average 8.0%)	% of firms introducing novel processes, 1998-2000 15% (England average 5%)
Patents per 10,000, 1999-2001 14 (England average 9)	VAT registrations per 10,000 adults, 2003 34.7 (England average 42.0)
Business stock (VAT registered businesses) 2001 13,325 (0.8% of total stock in England)	VAT registered businesses per 10,000 adults, 2001 228 (England average 384)

Source: State of the Cities Database, 2007; Office for National Statistics 2007.

- 78. DTI (2006) 'Success and Sustainability in the UK Automotive Sector.' London: DTI.
- 79. Salter, A. and Gann, D. (2001) 'Sources of Ideas for Innovation in Engineering Design, Science and Technology Policy Unity.' Electronic Working Paper No. 74.
- 80. Statistics are for the Coventry City Council Area.

Figure 7: Coventry industrial employment trends 1995-2005



Source: State of the Cities Database, 2007; Office for National Statistics 2007.

Coventry's economy has experienced significant restructuring over the past 30 years as its large manufacturing base has declined and a service sector has grown up in its place.

The city's economic history has been one of continual reinvention in response to changing market demand and international competition. Coventry's manufacturing industry grew rapidly during the 18th century. By 1890 it had developed the largest bicycle industry in the world and by the 1930s the industry had capitalised on its technical links to evolve into motor manufacturing.⁸¹

The city's motor industry boomed during the

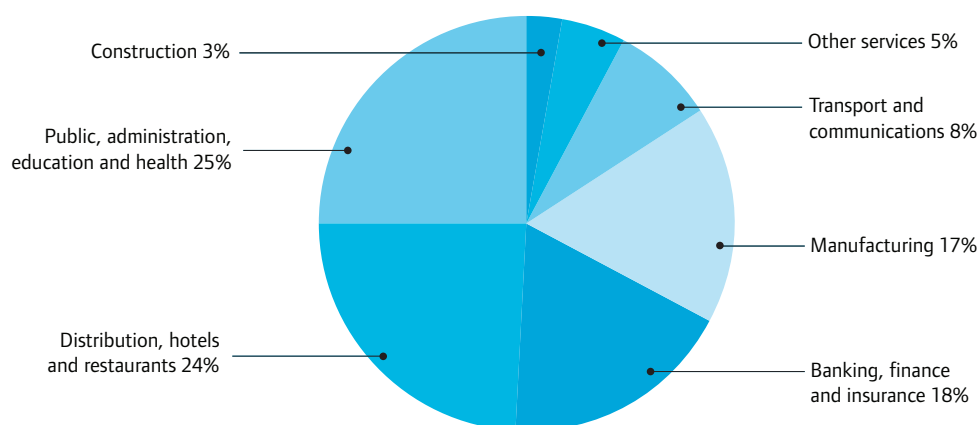
1950s and 1960s. It became specialised in the areas of vehicle production, mechanical and electrical engineering, and was dominated by a few large enterprises, many of which were branch plants of externally owned companies.⁸²

Local firms have been hit particularly hard by the gradual globalisation and consolidation of the industry since the 1970s. Recession in the early 1990s resulted in further rationalisation. These trends and events have reduced manufacturing employment significantly. The number of jobs in manufacturing fell by 46 per cent between 1974 and 1982. As Figure 7 shows, the decline continued between 1995 and 2005 – with a further 46 per cent fall.

81. Thoms, D. and Donnelly, T. (1985) 'The Motor Car Industry in Coventry Since 1890s.' Coventry: Croon Helm.

82. European Monitoring Centre on Change (2004) 'The Automotive Cluster in the West Midlands.' Dublin: European Foundation for the Improvement of Living and Working Conditions.

Figure 8: Coventry industrial structure – share of employment by industry, 2005



Source: State of the Cities Database, 2007; Office for National Statistics 2007.

Manufacturing now accounts for just 13 per cent of total employment in the city, down from 16 per cent ten years ago. Figure 8 shows a breakdown of the structure of the local economy.

While Coventry's manufacturing base declined, growth in service industries helped soften the blow. Between 1995 and 2005 total employment grew by 11.9 per cent – with good growth in financial and business services as well as transport and communications (see Figure 7).

The city also performs fairly well on other socio-economic statistics – with, for example, a relatively high employment rate of 75.6 per cent (up from 64.8 per cent in 1996).

Coventry's recent economic history may have been turbulent. But the data shows that the city has been relatively successful in restructuring its economy.

The sector and its innovation system

Coventry's auto-manufacturing sector has declined overall, but has evolved and specialised in higher value, design engineering. This sector is focused on the early-stage development of new products across a range of automotive and wider engineering fields.

Using a broad definition of the industry, the sector employs between 10,000 and 12,000 people across 200 companies in Coventry itself – although many of these firms are micro-businesses. Across the **Coventry/Solihull/Warwickshire** sub-region, the sector accounts for around 500 design engineering firms, including a range of tier 2 and 3 suppliers forming a cluster employing 30,000 people. Box 9 below gives some examples of the types of design engineering businesses found in the Coventry area.

The sub-regional cluster has three key elements that support innovation: large firms; small and medium-sized enterprises (SMEs); and universities.

Box 9: Examples of businesses operating in the design engineering sector in and around the Greater Coventry area

Aston Martin: High-tech production facility based at Gaydon – a purpose-built facility employing 1,800 employees.

Land Rover and Jaguar: Land Rover and Jaguar's design and development centre. Based at Whitely (a Jaguar plant since 1985). Corporate headquarters is at Gaydon, a state-of-the art site, featuring the Product Engineering Centre, Head Office and a number of core teams creating future products.

Motor Industry Research Association (MIRA): Leading independent provider of product engineering, testing, consultancy, certification, research and information. Employs 500 people locally.

ProDrive: Leading motorsport and automotive technology business, employing 1,000 people based in Kenilworth, just outside Coventry (with global operations).

NPL Technologies: Founded in 1962. 90 employees. Rapid prototyping business with a global market. Operates 24/7 with four shifts, and 12 3D CAD (computer-aided design) stations.

Coventry Prototype Panels: Founded in 1995. 50 employees. Specialises in rapid prototyping and low-volume manufacture of vehicles and components. Particular expertise in forming of automotive panels from aluminium, magnesium and steel sheet.

Lear Corporation: Founded in 1917. Provides complete seat systems, electronic products and electrical distribution systems and other interior products. Strong international trade – with links to 33 countries.

Stadco: Founded in 1925. Employs 200 people locally. Design, engineering and manufacturing of automotive bodies for major vehicle manufacturers and the design, manufacture and assembly of urban transit buses.

- Large firms: there is a strong presence of large premium brands such as Aston Martin and LTI Taxis. Land Rover and Jaguar have retained their corporate and research headquarters in the city – leading in the adoption of new technology.
- SMEs: there is also a significant R&D presence across the sub-region, including design and styling engineering companies, such as MIRA, Ricardo and TATA.
- The universities of Warwick and Coventry are also important components of the local innovation system.

Innovation is a major focus throughout the sector. There are various forms of product and process innovation, and innovations are often more about making incremental improvements to existing products than creating entirely new products.

- For premium vehicle producers, innovation is often focused on creating brand differentiation through body-styling, colour and other aspects of visual design.
- For smaller firms further down the value chain, innovation might be more focused on finding ways to cut costs and improve on quality and reliability. For example, firms aim to reduce material and energy consumption or incorporate new lightweight materials into existing designs.
- For universities, innovation meant successfully applying internationally leading research to the market.

The sector's footprint crosses national and international markets – with many firms having stronger international business links than UK links. In particular, premium brand names have strong links with Japan, the US, Germany and China, amongst others. Further links are also being developed with Eastern Europe. Not all the design work is conducted in the city alone – for example, some firms effectively work 24 hours a day by having a UK and an Indian base to cross over design tasks and maximise productivity.

By global standards, Coventry's engineering design sector remains small and vulnerable. The city only provides a small share of innovations in the sector – which are mostly accounted for in Japan and Germany. But it is still 'punching above its weight' in many areas, including fuel cell development and safety engineering.

The public sector's role in Coventry's innovation system

The key public sector components of the innovation system are: the regulatory framework; the Department for Business Enterprise and Regulatory Reform (BERR); Advantage West Midlands; and Coventry City Council.

National and European Regulations

The national and European regulatory framework is a major driver of innovation in three areas:

- **Environmental legislation:** the UK commitment to the Kyoto protocol (a 12.5 per cent reduction in CO₂ emissions between 2008-2012), and targets to improve re-use to 95 per cent of vehicle weight and recycling to 85 per cent by 2015, are driving the design of environmentally friendly products and systems, including new lightweight materials and structures.
- **Health and safety:** targets to reduce deaths and serious injuries by 40 per cent by 2010 are driving innovation in advanced electronics, sensors and telematics (for example, pedestrian and vehicle sensing) and advances in design to reduce crash impact.
- **Mobility:** Transport 2010, the Government's 10-year Plan, requires a modern, safe and high quality network – driving improvements in advanced Intelligent Transport Systems and road user charging. Such developments all need to be taken into account in vehicle design.

Department for Business Enterprise and Regulatory Reform (BERR) and Department for Innovation, Universities and Skills (DIUS)

BERR has built relationships with the sector through the Automotive Unit. The Unit was set up to promote competitiveness through encouraging best practice in design, supporting inward investment and ensuring that regulations and tax policy reflect the interests of the sector. In 2001, the Unit established the Automotive Innovation and Growth Team (AIGT), which set out a series of recommendations, including:

- Establishing an Automotive Academy to raise skill standards throughout the industry (later merging with the National Manufacturing Skills Academy).

- Establishing Centres of Excellence in sustainable transport and low carbon propulsion, helping to build a competitive advantage of UK industry in these areas.
- Using the Low Carbon Vehicle Partnership to accelerate the move to a low carbon future through joint stakeholder activity.
- Placing the Foresight Vehicle Network⁸³ under SMMT to provide industry ownership and improve responsiveness to industry needs.⁸⁴
- Developing a Supply Chain Group programme to increase efficiency of the supply chain through promoting best practice supported by £15 million of funding.

industrial paradigm. The council encouraged economic diversification by working closely with local businesses and attracting inward investment.

Local policy did not prop up declining industrial sectors, but encouraged change. The city invested in modern business space and encouraged university-industry links. As a result, several high-tech software and engineering firms located in the area. These firms acted as anchors to attract further high-end design companies.

The role of other components in Coventry's innovation system

Coventry's urban offering

A strong engineering legacy

History has played a pivotal role in embedding innovative design engineering in the city. Coventry's history as a 'motor town' means that businesses are still able to find the products and services needed to make a complete vehicle within a ten-mile radius.

The automotive legacy left behind a critical mass of highly skilled workers and component manufacturers with the necessary knowledge and experience to support a competitive design engineering sector.

Building on these synergies, local universities flourished and high technology design firms invested in the area to access these resources. This instigated changes to business activities, as new approaches and technologies were adopted and old manufacturing practices were abandoned.

Local skills base

Firms also stress that 'having a pool of people who know how to put widgets together' was also important. Many firms stay because of the knowledge base. Coventry offers firms a labour pool with a wealth of experience and expertise. The labour force has the core competencies that businesses need. While mobility between firms could help to spread ideas, there is a relatively low turnover of labour.

Transport links

Coventry also benefits from its location and transport links. Design engineering is becoming increasingly dependent on sophisticated IT software and connections, which decreases the pull of urban areas, but firms still needed to

BERR is also active in funding demonstrator programmes to showcase technology more widely and Knowledge Transfer Networks (national networks of technical experts) to build sources of new knowledge to further business innovation performance.

The Department for Innovation, Universities and Skills (DIUS) also plays a more generic role. Of particular relevance are its new Innovation Platforms – introduced to position business and government closer together to generate innovative solutions to policy challenges (such as the Low Carbon Vehicles Innovation Platform).

Stakeholders believe the Government's policies in this area – including support for higher value activities, the adoption of new technologies, encouraging R&D and collaborative ventures⁸⁵ – helped to provide direction and a broad strategic framework.

Advantage West Midlands (AWM)

Businesses tend to see regional innovation policies as more relevant to their needs. AWM's approach has been to encourage the development of innovative high value added sectors and apply new technologies and skills to the more traditional sectors that have a significant presence in the region (with an emphasis on manufacturing design).⁸⁶ In particular, AWM's High Technology Corridors and business clusters initiatives, which have a strong focus on design engineering, are seen as performing well.

Coventry City Council

Coventry City Council played its most important role during the 1980s when it proactively helped to change the city's old

83. The knowledge transfer network for the industry – a collaboration between industry, academia and government to identify and demonstrate technologies for sustainable road transport.

84. The Society of Motor Manufacturers and Traders represents the automotive industry across a range of issues from environment, legislation, safety and security, through to education, innovation and competitiveness. Many of their programmes promote collaboration between vehicle manufacturers and component suppliers.

85. DTI (2005) 'Technology Strategy: A Call To Action.' London: DTI.

86. Advantage West Midlands (1998) 'Regional Innovation Strategy Action Plan 2004-10.' Birmingham: Advantage West Midlands.

get raw materials to and from their business. The city is well served by both rail and road networks, being approximately five hours drive from anywhere in the UK, and with easy access to Coventry and Birmingham airports.

The role of public sector institutions in Coventry's innovation system

Coventry and Warwick Universities

Coventry is home to Coventry and Warwick Universities. Both universities have strong specialisms in technology research and design and with more than 35,000 students between them are a source of research expertise and labour.

Coventry University's design courses are internationally renowned. Their students typically gain placements in automotive design houses. Local firms rely heavily on hiring recent graduates with the right specialist skills; they also encourage existing employees to enrol on the university's courses.

The science and technology parks of both Warwick and Coventry Universities play an important role in generating new design ideas and fuelling technology transfer. Their high quality sites, high-end facilities and flexible tenancies have encouraged high-technology firms to move to the city.

Coventry University Enterprises (CUE), a subsidiary of the university, operates the Technology Park. CUE has helped over 300 SMEs become established through their innovation and enterprise support programmes. Tenants benefit from services, including technical design support, networking programmes and access to high-end facilities without the overheads. A good example is the university's Advanced Digitising and Modelling Laboratory, which provides full-sized vehicle design and styling facilities.

Warwick University has also developed a strong reputation for business collaboration through the application of its research to the industry. The Warwick Manufacturing Group (WMG) helps improve competitiveness in the sector, with research delivered through:

- **The International Automotive Research Centre:** a £60m research programme including laboratories in design analysis, rapid prototyping, materials and hybrid technologies.

- **The International Manufacturing Centre:** for research into the internal drivers of competitiveness, including design and innovation, strategy and operations management.

- **The Digital Laboratory:** a £50m initiative covering modelling and simulation, graphics and virtual reality techniques to be applied from manufacturing to healthcare.

- **The National Business to Business (B2B) Centre:** established to help small and medium sized businesses evaluate and adopt technology to support their business growth and development.

- **The Warwick Innovative Manufacturing Research Centre (IMRC):** supporting blue-skies research in manufacturing in Intelligent and Eco-friendly Vehicles, partly funded by the Engineering and Physical Sciences Research Council (EPSRC).

The Universities also provide the infrastructure to stimulate informal networking through events and meetings at the Technology Park.

The role of firms in Coventry's innovation system

Firms are the key drivers of innovation – where local supply chain linkages, R&D collaborations and internal processes all act to drive up innovation.

Anchor firms

In the past, anchor firms (such as Peugeot and Rover Group) were critical drivers of innovation. Their position has diminished somewhat now, though they continue to play an important role. The firms act as an important source of demand for innovative products from local businesses – with some large firms contracting out their design engineering to smaller local businesses. Larger firms often set the problems for their suppliers to solve, using their demand to pull innovations from the market.

Collaborations

Inter-firm collaborations are not widespread, though they are gradually becoming more common. Some firms have formed groups (mostly consisting of competitors) to work on specific R&D projects. Smaller firms collaborate to varying degrees – often as a means of competing with larger firms and gaining economies of scale.

Internal innovation

Much of a firm's innovation still goes on in-house. Companies are continually striving for more effective business practices and internal structures to help drive innovation – including stronger leadership skills, communication, collaboration and financial incentives.

The role of networks in Coventry's innovation system

Large firms have different types of networks locally and internationally according to their role and function

Though international markets are important to Coventry's large firms, they can also rely on local supply chain networks. The industry is commonly described as highly competitive and secretive. This is a serious barrier to the transfer of information. Research institutes have to mediate between firms and facilitate knowledge exchange and collaboration.

Confidentiality contracts, IP agreements and reputations for independence are integral to collaborative working practices. Confidentiality is important and networking takes place only with highly trusted people, with relationships built up over many years.

Smaller businesses tend to have stronger informal networks

Informal, self-mediated networking is important for smaller firms. Many smaller businesses have a much more local outlook than the city's larger businesses. As a result, they have much stronger links with local customers and suppliers.

Formal networks

Several formal networks have been created by the public sector to support the exchange of information. Formal networking tends to be instigated through seminars, university workshops or local business dinners mediated by the Chamber of Commerce and AWM. Many are cross-sector, revealing scope for the transfer of ideas between industry sectors as well as opening opportunities for non-competitive 'contextualised' networking (such as how to deal with the tax regime or the university IP office).

Supply chain networks

Informal knowledge-sharing along the supply chain is also a source of new design ideas and innovation, albeit a relatively marginal one. For example, businesses will let their suppliers know if they have ideas that will improve

their products. Proximity is crucial to the communication of these new ideas.

The role of markets in Coventry's innovation system

End-user markets

For larger firms, the global marketplace acts as the main source of demand for innovation. Firms regularly scour the international marketplace for ideas, through the internet, trade press and existing contacts.

Other firms find that their ideas get tested against the market, rather than coming from the market. In the end, the market will determine whether a new design succeeds or fails. For many engineering design firms, innovation is the only way of staying ahead of the competition.

Consumers are increasingly demanding tailor-made features, which is leading to a greater diversity of models and ranges. Vehicles need to evolve and be reconfigured to meet changing fashion and lifestyle requirements, cutting product life cycles and batch production lines.

Supply chains and critical mass

Supply chains are largely local in scope, but are becoming increasingly international.

The sector's supply chain is focused on the Coventry area with a critical mass of local businesses driving demand and innovation between each other.

What's driving innovation in this sector?

Although many firms displayed no real attachment to Coventry's city centre, with many progressively moving towards the suburbs, the sector relied heavily on the type of infrastructure and assets only available in urban areas. These include the urban basics of accessibility and connectivity, the knowledge infrastructure and research institutions, and access to markets. As long as firms had relative ease of access to these assets, they could locate anywhere within Greater Coventry and the immediate surrounding area.

In Coventry, some of these basic assets had been customised for the engineering design sector and have become intrinsic to Coventry as a place. Supply chains and the expertise and linkages that have developed in the city

over the 20th century support innovation. The universities have developed departments, research specialisms and other services for the engineering design sector.

Innovation in the sector is demand-pull and innovation-push, shaped by the core components of both the 'urban hubs' and 'local links' identified in our innovation model. However, different elements varied in importance, depending on where firms were positioned in the supply chain. A distinction was also emerging between the factors that were understood as 'enabling' innovation, including assets such as technology, transportation, skills, the availability of good quality sites and institutional infrastructure, and the drivers of innovation, which were perceived to be firms, markets and networks (in addition to legislation). However, networks need greater development if the sector is to reach its innovative potential.

In terms of future challenges, new technology was seen as potentially working against the embeddedness of the sector in the city, enabling firms to locate further away. Stakeholders also mentioned that technology was becoming cheaper, enabling firms to increasingly invest in equipment (such as for rapid prototyping) themselves, instead of accessing the university's facilities. Although the consensus was that 'tangible centres' were still needed 'to hold it all together', there were mixed views about the longer term impact on the city.

Globalisation and continued outsourcing were perceived as threats, but their effect was also seen as pushing firms to innovate and stay ahead of the market. Markets have become more globalised due to the reduction of trade barriers and the emergence of suppliers and customers from emerging economies (such as China, India, Brazil and Russia). Low cost manufacture is no longer a viable product-market strategy for UK industry. One of the main areas of competitive advantage for UK engineering design companies is its ability to provide knowledge-based services including innovation and design.

Some stakeholders were also concerned about the impact the climate change agenda may have in the future. As one of those we consulted put it: "Congestion charging is the flavour of the month, but if the council gets its car-free city, it will lose the car manufacturing industry and have no economy." But others

saw this as an opportunity to drive innovation forward.

What of local barriers to innovation? Many stakeholders felt that innovation was more company constrained than locally constrained. The focus needed to be on improving business models, internal capability and willingness to innovate; complacency and risk aversion were perceived as key challenges. None of the firms cited skills as a barrier, raising the question of whether firms were aware of what skills were necessary to drive innovation forward. However, low productivity was identified as a constraint and the 'cluster' still needed to develop critical mass. Networking was widely regarded as fundamental to future success yet many perceived local firms as too closed and averse to networking. There was a perceived need to instigate a culture change and break down the silos within industry. Finding more effective mechanisms to bridge the divide between research and commercial exploitation, as in Warwick's Innovative Manufacturing Research Centre, was identified as a key challenge in moving forward.

Although public policy was perceived as a marginal player in the innovation system (legislation aside), initiatives promoting networking, the dissemination of information and university-industry relations were identified as significant; and local policy was perceived as having played an important role in the diversification of the economic base. Stakeholders called for firms to be better engaged in the innovation agenda and for policy to focus on generating critical mass. Policy needed to be more consistent. Grant funding, in particular, was too short term, with many firms unaware of what support was available, a fact reflected in the low take-up of R&D tax credits.

Firms were more likely to view the public R&D funding process negatively than positively. Stakeholders reported problems in making a case for funding the exploitation of research: "It is difficult to justify more government funding if you cannot prove the outputs. How do you quantify the value of engaging businesses in university research?" The Government needed to look beyond targets for raising levels of R&D expenditure and devote greater attention to encouraging the wide spectrum of innovative activities that are taking place, much of which took the form of 'hidden innovation'.

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Case study 2: Dortmund – bringing modern science to life in a city of strong ‘local links’ amid a large urban hub

Introduction

This case study looks at the closely linked life sciences and microsystems technology sectors in Dortmund, Germany. It shows how strong public sector leadership and partnership working across stakeholder groups can drive forward cluster development processes.

Dortmund’s life sciences sector focuses on the early-stage research and development of new biotechnologies. It has grown significantly over the past ten years, developing into Germany’s leading location for the microelectronics and micro-optics industries.

After a period of industrial decline in the 1970s and 1980s, Dortmund has gradually developed a reputation across Europe as a fast growing, innovative, knowledge-based economy. The city recently won the Eurocities Award for Innovation.

Focusing on Dortmund’s life sciences sector has allowed us to draw comparisons between the Dortmund and Dundee experiences. We have been able to highlight common themes and key differences in the way the sectors operate in the two cities and to compare public policy frameworks surrounding the industries.

Dortmund has experienced significant economic change in recent years. A former industrial powerhouse, its core coal, steel and beer industries had guaranteed economic prosperity until the 1960s. Following the

decline of these sectors, Germany’s ‘steel city’ has transformed itself into a thriving modern city, hence its growing European reputation as an innovative location for technological development.

Dortmund is located in Germany’s Westphalia region. It lies on the north-west edge of the Ruhr area, bordering Sauerland to the south-west and Münsterland to the north. It is well connected by road, rail, water and air. Dortmund is the largest city in Westphalia and the Ruhr Metropolitan Region and one of the biggest cities in Germany. The city itself has a population of 588,700 people⁸⁷ while a further nine million inhabitants⁸⁸ live within a 30 minute drive of the city centre.

The Dortmund economy is growing, but it struggles with high levels of unemployment. The most recent data shows that GDP grew faster than the national average between 1996 and 2001 – growing at 3.8 per cent.⁸⁹ However, the city’s unemployment rate is high, with the most recent figures from Dortmund’s employment office showing it to be 18.1 per cent in 2005.⁹⁰

The economy is no longer characterised by steel and coal manufacturing, but has a large service sector with a variety of companies in insurance, software development, multimedia, microsystems engineering and telecommunications. The structure of the economy in 2004 is illustrated in Figure 9.

Table 7: Selected statistics for the Dortmund economy

Population 2005 585,678 (0.7% of German total)	Population change 2000-2005 0.0%
Employment rate 2001 70.7% (German average 69.8%)	Unemployment rate 2006 18.1% (German average 11.7%)
Patents per 10,000, 2005 (Nordrhein Westfalen) 4.5 (German average 5.9%)	% firms introducing new products, 2003 (Nordrhein Westfalen) 20% (German average 30%)

Source: EU-competite project (<http://www.competite-eu.org/benchmarking>); Die Landesregierung Nordrhein-Westfalen (2006), Innovationsbericht; <http://statistik.dortmund.de>

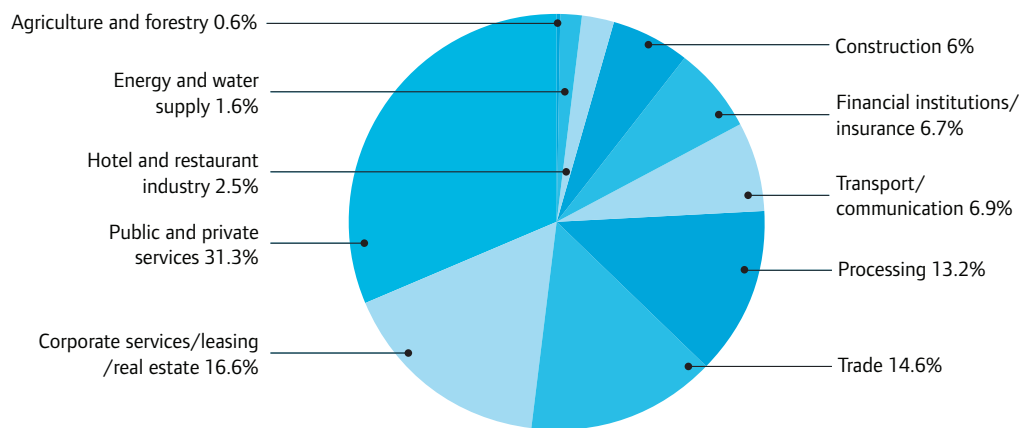
87. Stadt Dortmund (2007) Statistisches Jahrbuch 2007: Dortmunder Statistik, Dortmund: Stadt Dortmund. Available at: http://statistik.dortmund.de/upload/binarydata_do4ud4cms/21/27/14/00/00/00/142721/statistischesjahrbuch2007_web.pdf

88. Ibid.

89. LUZ data - State of European Cities data (2001).

90. Stadt Dortmund (2007) Statistisches Jahrbuch 2007: Dortmunder Statistik, Dortmund: Stadt Dortmund. Available at: http://statistik.dortmund.de/upload/binarydata_do4ud4cms/21/27/14/00/00/00/142721/statistischesjahrbuch2007_web.pdf

Figure 9: Sectoral structure of employment in the Dortmund economy, 2004



Source: City of Dortmund, Economic Development Agency (2004 figures).

Corporate and financial services have expanded significantly and the sector now includes insurers, banks, software developers, IT and logistics companies. Due to Dortmund's central location, logistic companies have historically been successful in the city and surrounding area, and continue to be an important component of Dortmund's economy with over 650 logistic firms now working in Dortmund alone.

The life sciences sector and their role within the wider Dortmund innovation system

Dortmund's microsystems technology and life sciences sectors have developed into two of the city's most promising new industries.

The microsystems technology cluster has around 40 companies with over 2,000 employees. The cluster has grown rapidly since the inception of the city's 'Dortmund Project' in 2000.⁹¹

The life sciences sector is smaller and consists of around 20 businesses from the fields of biomedicine, medical technology and biotechnology – all of which have close ties to the area's universities and many research institutes. Companies in this field have a global focus for their products and are mostly SMEs.⁹²

Both of these sectors are primarily concerned with product innovation. Competing on a domestic (primarily with Munich and Heidelberg in South Germany) and international stage is vital

for their continued success. Product excellence is the key goal, and innovation across disciplines features very strongly. Companies in the life sciences and microsystems technology fields frequently collaborate with academic research bodies and businesses in complementary fields to develop new innovations.

A range of other actors, links and assets are involved in the innovation system in Dortmund, including the city's universities, and a host of other research and support organisations.

Much work has been done since 2000 to kick start innovation and transform the economic base of the city under the auspices of the Dortmund Project. This flurry of recent activity has led to the rapid establishment of institutions, networks, a specialist incubator space and business start-ups in biotechnology, nanotechnology and microsystems technology.

The geographical scope of both clusters extends beyond Dortmund and the domestic market. The fields of life sciences and microsystems technology have an international reach with potential customers all over the world. The current company base includes branches of companies originally formed in the US as well as spin-out companies from other countries such as Russia. The main attraction for these companies has been the presence of specifically related research specialisms and skills in Dortmund, as well as attractive incentives for inward investment. Such investments have led to the development of strong links with their countries of origin, links

91. Stadt Dortmund (2007) Statistisches Jahrbuch 2007: Dortmunder Statistik, Dortmund: Stadt Dortmund. Available at: http://statistik.dortmund.de/upload/binarydata_do4ud4cms/21/27/14/00/00/00/142721/statistischesjahrbuch2007_web.pdf

92. Ibid.

which are actively maintained as a source of potential future collaboration and networking.

The public sector's role in Dortmund's innovation system

The authorities in Dortmund and its surrounding region have worked hard to develop a research environment and business support framework that can effectively complement the innovation process.

Dortmund's innovation system benefits from a complete support package covering everything from finance, premises and business support to leading edge research and specialist networks. This 'complete package' has attracted many companies.

As part of this package, we can identify a number of strategies and policies that have been implemented at the city and regional levels to support the microsystems technology and life sciences sectors in Dortmund.

City strategies

The Dortmund Project

The City of Dortmund created the Dortmund Project in 2000. The Project is widely viewed as the cornerstone of the city's recent success, and reflected a need for a vision that would transform the city following the decline of the coal, steel and beer making industries.

Dortmund's mayor strongly supported the Project's approach to growth, which was based on the concept of creating a cluster. This strong, consensual vision for change and the resulting strategy brought substantial support from Federal, State and European Union funds to kick start the process. Key facets of the Dortmund Project are:

- Future-oriented sectors: company formation, start-up competitions, access to finance, business support and development, business location/relocation in growth clusters, access to networks.
- People and skills: apprenticeship schemes, academic courses, training provision in IT, links with schools, mentoring programmes for young people.
- Future-oriented locations: provision of high quality business space for growth clusters on former industrial sites (e.g. Phoenix West), plans to develop an attractive new lakeside location for living, working and leisure at Phoenix See.
- Networks: frameworks for building university-to-business and business-to-business linkages are considered fundamental to successful technology transfer in the city.

The MST Factory

The City of Dortmund was also responsible for the development of MST Factory Dortmund, a dedicated microtechnology and nanotechnology centre of excellence widely hailed as a key contributor to Dortmund's rapid transformation. The facility is owned by the City of Dortmund (which invested 50.5 million Euros in its development) and has its own management. Its focus is to provide the right environment for fledgling companies to implement their innovative ideas quickly, turning their prototypes into commercially successful products. The centre provides clean room and laboratory facilities as well as wide-ranging business support services, start-up assistance (including access to finance) and links to various networks and other support services. MST Factory has no financial stake in any of the companies it supports.

Box 10: Company Profile – Berlingher Ingleheim Microparts, GmbH

A success story for Dortmund has been the relocation of Berlingher Ingleheim Microparts GmbH from South Germany. The company was looking to enhance one of its existing pharmaceutical products (to

treat asthma) by utilising micro-structures technology.

The 'know-how' on micro-structures resided in Dortmund and the company exploited these synergies to develop an enhanced asthma inhaler. The whole company is now located in the Technology Park and is one of Dortmund's biggest employers.

BMZ Dortmund

Similarly, BMZ Dortmund is a competence centre for new and existing biotechnology and biomedicine companies. Financed by the City, the BMZ works under the umbrella of the Technology Centre. It uses the Life Sciences Innovation Platform to provide laboratory space, clean room facilities, business support services, knowledge exchange and research co-operation for its tenants.

Regional strategies

The Ministry of Economic Affairs

The Ministry of Economic Affairs is generally concerned with the second phase of the technology transfer process. This includes second phase R&D, infrastructure provision (through cluster specific technology centres, for example), business support packages for SMEs and other links to wider economic development outcomes. The costs of its projects are shared with the European Regional Development Fund (ERDF).

The Ministry of Innovation, Science, Research and Technology

The Ministry of Innovation, Science, Research and Technology is concerned with the promotion and support of innovation across the North Rhine Westphalia region. It complements the role of the Ministry of Economic Affairs and focuses on the provision of support at the 'front end' of the innovation process, through:

- Providing legal frameworks and 'controlling' operations of the universities and Universities of Applied Sciences in the region.
- Advising the universities/Applied Sciences universities.
- Allocating R&D funds to universities.
- Supporting the ideas exploration and product development phases of innovation.

The urban components that help to make Dortmund a centre for life sciences

Dortmund's specific urban offering

A highly skilled pool of labour

One of Dortmund's biggest assets is its highly skilled labour pool. Firms can access it easily to support innovation and growth. The

concentration of related firms and the presence of Dortmund's universities and research institutes also create a good supply of the researchers and technicians that life sciences and microtechnology firms need to feed their product development processes.

Heritage and availability of land

Dortmund's heritage has played an important role in its recent success. The city's industrial past has endowed it with an abundance of easily convertible, former industrial sites that can be used for key growth sectors including the life sciences and microtechnology industries.

Good national transport links

Dortmund's geographical location is a significant advantage for its firms. The city benefits from being at the centre of a wider, highly populated metropolitan area. And it has excellent transport links by road, rail and waterways to all parts of Germany. This enables businesses located in Dortmund to access a large and diverse labour pool and to collaborate easily with firms and institutions in the surrounding area and beyond.

The role of public sector institutions

The institutional framework for industrial development in Dortmund is well developed. Over the last decade it has effectively created the conditions that have supported innovation and growth in key industries. The main advantages conferred by public sector institutions include the following.

Development of the Technology Park and Technology Centre

The city's long-established Technology Park and Technology Centre have helped to support growth by providing flexible work and laboratory space, specialist equipment, consultancy services, access to finance and other support services. Established in 1985, the Technology Centre now houses around 200 businesses in various branches of life sciences, microtechnology, logistics, IT and environmental technologies.

A strong academic research base

Early-stage life sciences and microtechnology sectors, such as those in Dortmund, depend greatly on a strong academic research base. They need both business spin-outs and access to scientific expertise.

Dortmund's universities and research institutes are highly specialised in the science and technology disciplines upon which these local

industries are based. For example, the Max Planck and Fraunhofer Institutes produce world-class biomedical and applied science research that feeds the local economy's innovation system with knowledge and ideas.

The role of firms in the Dortmund Innovation System

National and international focus

Firms tend to have a national or international focus rather than a local one. For example, in the microtechnology sector, 40 per cent of businesses have the majority of their customers in regions outside Dortmund's, compared to just 20 per cent inside the Dortmund region.⁹³ Similarly, in life sciences, businesses depend on a complex network of local, national and international links.

The role of networks in the Dortmund Innovation System

Networks play an important role in supporting innovation and business development in both sectors.

University-to-business links

Major networking benefits revolve around increased access to knowledge and expertise at the universities and research institutes. In the life sciences sector, these networks are a key source of competitive advantage.

Business-to-business links

Businesses in both fields also benefit from being close to other firms in related fields – with informal networks particularly important in both sectors. As noted above, firms have identified business incubator facilities as providing useful opportunities to meet business people and experts from other fields in a non-competitive exchange of knowledge and ideas.

The role of markets in the Dortmund Innovation System

International market demands

The continued growth of the microsystems technology and life sciences clusters is more dependent on increased global demand from other parts of Europe and further afield in Asia and the US than on the local market. While the local market is not a dominant feature of innovation in Dortmund, concerted efforts are being made by the local research community to ramp up links with business to shape future research efforts. As in Dundee, most companies are in the very early stages of developing products with limited scope for local buying

and selling. Local and international demand may grow as these companies mature and products move into mass production.

Conclusions and policy learning: 'urban hubs' or 'local links'?

Dortmund displays characteristics of both of the innovation models set out in our interim paper, but it leans more towards the 'local links' model than the 'urban hubs' framework. This is perhaps to be expected given the city's location in a conurbation of other cities, which somehow function as a broader de facto 'urban hub'.

The city's institutional and research base is well-established and technology transfer well supported by the state, city and university. Institutional collaboration around the Dortmund Project is integral to the innovation model as is the role of networks to support ideas development, new product formation and incubator services.

Dortmund's physical land and property assets operate as a main driver of new cluster development, as does the level of financial investment from the public sector to develop the supporting infrastructure.

Individuals have also played an important role in supporting Dortmund's success. The effective, personal working relationship between the Mayor and university Rector, for example, was cited as a reason why 'things get done' in Dortmund. Key actors getting together on a regular basis also help to generate new ideas on how to support innovation more effectively – or even to identify future innovation opportunities.

However, the role of markets is less clear here. Strong efforts were made to create the conditions in which new clusters could thrive and grow, but there is little evidence that innovation has become more market-driven, which (as discussed below) may be storing up problems for the future.

What are the main challenges for microsystems technology and life sciences in Dortmund over the next ten years? And what is the role for public policy – if any?

Moving into production

Whilst some benefits of the Dortmund Project are already apparent, much of this work is still at a very early stage. Rapid development

93. Van Den Berg et al. (2005) 'European Cities in the Knowledge Economy,' Aldershot: Ashgate.

of the infrastructure and associated support services has created some excellent conditions for attracting the right types of company to start or locate in Dortmund. The question now is whether these new companies will go on to produce and sell their products successfully in domestic and international markets.

Retaining companies

Another issue is whether companies will choose to remain in Dortmund as they move to the next phase of their development – or will other locations be in a position to offer a more attractive package of support to growing companies?

Some of the building blocks are in place to keep Dortmund on the map as a competitive location for innovating companies in high technology sectors. Most interviewees cited the growth of a more mixed economy as advantageous with a good combination of large employers and new, innovative SMEs. They also agreed that a more concerted effort to market the success of Dortmund and to promote its offer internationally is a high priority.

Decreasing levels of public investment

The high level of public sector investment has perhaps led to some complacency around how much support to expect in future. Many projects intend to bid for further State/EU funds, despite widespread acknowledgement that there will be less money around. It is not clear how much investment the private sector is prepared to make in future. Yet sustainability of this model could depend on attracting more private funding – especially as new companies are formed or others move into the area.

Embedding the innovation system

It is clear the energy, vision and commitment of some individuals within Dortmund's economic development environment has been vital to the city's success to date. Again, future success could be compromised if these individuals move on. The innovation system, and the organisations, structures and networks within it, must have the capacity to develop beyond relying on particular individuals.

Case study 3: Dundee – how strong ‘local links’ are stimulating innovation outside the Scottish Central Belt

Introduction

This case study focuses on Dundee’s life sciences sector. It shows how the city’s range of urban assets – including the university and its networks, star scientists, and the presence of a highly skilled local labour market – combine to support innovation and growth in the sector.

The life sciences industry includes “companies that use modern biological, bio-manufacturing or bioinformatics to develop products or services, as well as the associated support organisations such as biosciences departments, medical schools, hospitals, medical research institutions and charities.”⁹⁴

By its nature, life sciences activity is highly innovative. Academic research is focused on the continual development of cutting edge scientific knowledge and techniques. University research generates not only publications, but also patents, licences and business spin-outs, all of which represent innovations. In businesses, activity is mixed between the exploitation of existing scientific innovations and the discovery, development and commercialisation of new products and services.

Over the past ten years, the life sciences business has become a major focus of economic development policy in the UK

– with decision makers at all levels seeking to nurture its expansion.⁹⁵ But much more work needs to be done to further the public sector’s understanding of the nature of innovation in the life sciences sector, and the players and policies that support it.

The Dundee economy: an overview

Dundee grew rapidly during the 19th century as the local jute processing industry expanded. However, over the course of the 20th century the jute industry declined – with the last mill closing in the 1970s. Industrial decline has left the city with high levels of unemployment that it has found difficult to remedy. The authorities have also had to grapple with the challenge of regenerating the city’s physical environment following years of underinvestment.

Figure 10 illustrates the industrial structure of the Dundee economy. Compared to Scotland as a whole, the city has a higher proportion of public sector jobs (42 per cent vs. 36 per cent) and a lower proportion of finance and business services jobs (13 per cent vs. 19 per cent).⁹⁶ This imbalance is partly due to Dundee’s large regional hospital and its two universities – the University of Dundee and the University of Abertay.

94. LDA (2003) ‘Life Sciences Strategy & Action Plan 2003–2007.’ London: LDA.

95. Sainsbury (1999) ‘Biotechnology Clusters.’ London: DTI; LDA (2003) ‘Life Sciences Strategy & Action Plan 2003–2007.’ London: LDA; Scottish Executive (2005) ‘Scottish Life Sciences Strategy 2020 Vision: achieving critical mass for sustainable growth.’ Edinburgh: Scottish Executive. Manchester Enterprises (2006) ‘The Manchester City Region Development Programme 2006: accelerating the economic growth of the North.’ Manchester: Manchester Enterprises.

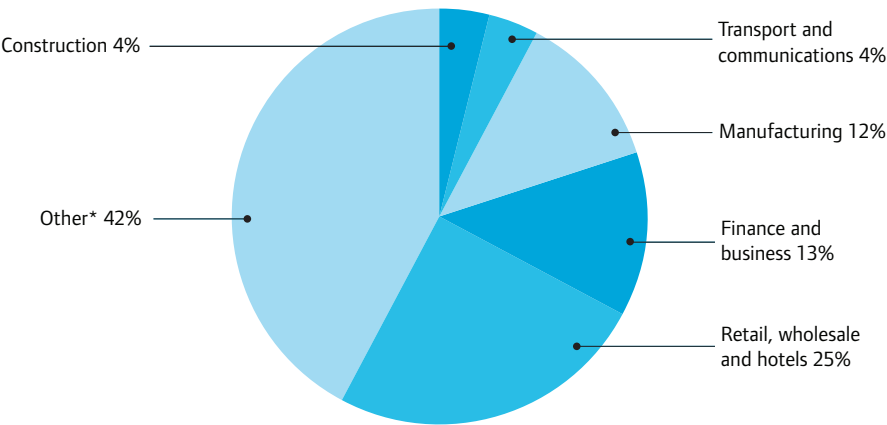
96. Scottish Executive (2007) ‘Dundee City Economic Statistics Briefing.’ Edinburgh: Scottish Executive.

Table 8: Selected statistics on the Dundee economy

Population 2006 142,000 (2.8% of Scotland total)	Population change 2001–2006 –2% (Scotland = 1%)
Employment rate 2006 72% (Scotland average = 76%)	Claimant count unemployment 2007 4.6% (Scotland average = 2.7%)
% working age educated to degree level 18% (Scotland average = 19%)	Average weekly wage 2006 £422 (Scotland average = £432)

Source: Scottish Executive, 2006.

Figure 10: Structure of the Dundee economy, 2005



Source: Scottish Enterprise. Other* includes health, education and public administration.

Figure 11 shows the per cent change in total employment alongside the per cent change of employment in key sectors between 1995 and 2005 for both Dundee and Scotland.

Dundee’s economy has been restructuring away from manufacturing towards services. There has been strong growth in retail employment as the city has established itself as a key regional shopping centre. Digital media and life sciences have also been growth industries. The digital media sector is focused primarily on the development of computer games. According to a recent report, the sector accounts for 350 businesses employing between 2,700 and 2,900 employees across the Tayside area with 55 per cent of firms located within Dundee itself.⁹⁷

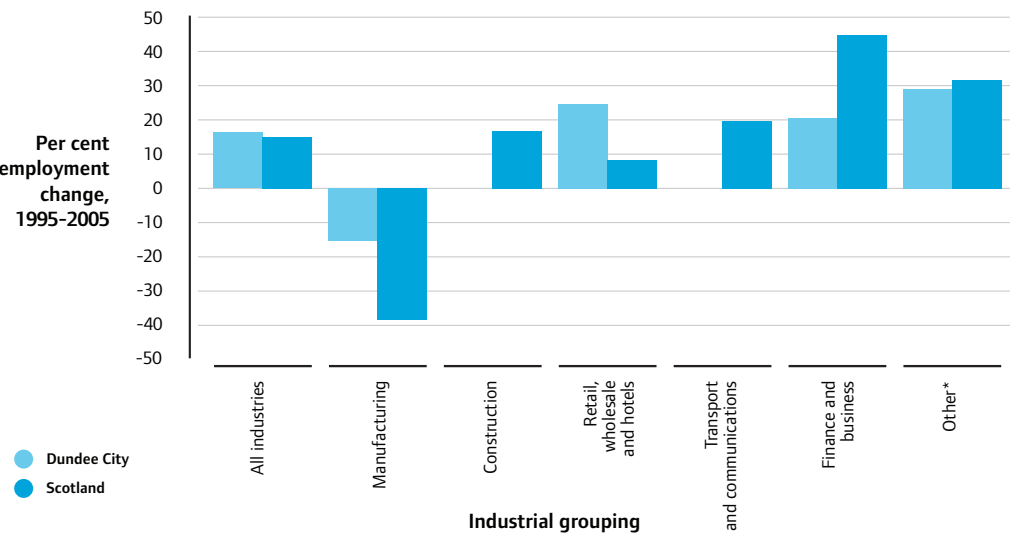
The physical regeneration of the city has been one of the success stories of the past ten years. Approaching a billion pounds of public and private money has been invested in the development of new sites and improving the physical appearance of the city.⁹⁸ This investment is set to continue with more than £800 million of planned investment along the banks of the River Tay over the next 15 years.

Overall, the economic picture in Dundee is one of large-scale investment in the physical environment and dynamism in certain sectors, mixed with the decline of traditional industries and falling, but relatively high, levels of unemployment.

97. Dundee City Council (2005) 'Economic Development Plan 2005-2007.' Available at http://www.dundeeccity.gov.uk/dundeeccity/uploaded_publications/publication_29.pdf

98. Dundee City Council (2003) 'Dundee: A City Vision.' Dundee: DCC.

Figure 11 : Total and sectoral employment changes in the Dundee economy, 1995-2005



Source: Scottish Executive. Other* includes health, education and public administration.

The sector and Dundee's innovation system

In 2006, Dundee's life sciences sector employed almost 4,000 people across more than 50 different organisations (including Dundee University and Ninewells Hospital). The sector accounts for around 15 per cent of the city's total employment – and is predicted to grow at ten per cent per year between 2007 and 2010.⁹⁹

The core private sector element of the cluster focuses on medical biotechnology – although there are also approximately 30 agricultural biotechnology firms in the area.

The three main components of the cluster are Dundee University, the private sector and Ninewells Hospital.

- **The University of Dundee:** a world leader in research linked to cancer, diabetes, cardiovascular diseases and several other types of illnesses. Research has shown that, between 1993 and 2003, 22 of the research team leaders at the School of Life Sciences were in the top one per cent most quoted scientists in their field, and in the areas of biology, biochemistry and genetics the university was either the first or the second most cited university in Europe – ahead of

Cambridge, Oxford and University College London.¹⁰⁰

- **The private sector:** most of the businesses in the core cluster are university spin-outs. They are engaged in a variety of activities including the development of new drugs and medical devices as well as the provision of diagnostic goods and services. See Box 11 for some examples of the types of businesses operating in the cluster.

- **Ninewells Hospital:** a key teaching hospital with medical academics operating across a wide range of disciplines, particularly in the development of medical devices.

The geographical scope of research and business relationships activity is not limited to Dundee. The life sciences industry is a highly integrated international network in which large pharmaceutical companies (predominantly from the US) have a global reach, and in which client bases are frequently more international than local. The result is that Dundee's life sciences innovation system is influenced by a range of connections between actors, not only at the local level, but also at the national and international levels.

From a national perspective, Scotland's life sciences sector is seen as a regional

99. BioDundee (2007) 'BioDundee Directory 2007.' BioDundee: Dundee.

100. Dundee University (2003). Available at: <http://www.dundee.ac.uk/pressreleases/praug03/citation.html>

Box 11: Examples of businesses operating in the Dundee life sciences cluster

CXR Biosciences: Spun out from Dundee University in 2001. 40 staff. Supplies a range of products and services aimed at accelerating drug discovery processes. Highly collaborative approach to business development. Headed up by Dr Tom Shepherd – Chair of Scotland's Life Sciences Alliance. Won UK Trade & Investment's UK Innovation Enabling Biotechnology Award in 2006.

Cypex: Spun out from Dundee University in 1999. Five staff. University research was a product of partnership involving 15 pharmaceutical companies. Products used in drug development labs to predict the way new drugs will be broken down in the human body.

Axis-Shield: Spun out from Dundee University in 1982. 120 staff. The cluster's only PLC. Produces products for laboratory and surgery use in cardiovascular disease, rheumatoid arthritis, infectious diseases and diabetes.

Sentient: Spun out from Dundee University in 2005. Four staff. Developing a hearing aid device. Headed up by Professor David Young – a scientist and consultant who has worked on several different life sciences start-ups.

Cyclacel: Spun out from Dundee University in 1996. 60 staff. Drug discovery, development and commercialisation business focused on human cancers and other serious disorders. Series of link-ups with larger drug companies including GlaxoSmithKline and AstraZeneca.

grouping focused on a Dundee/Edinburgh/Glasgow triangle. International links are an important factor. As highlighted above, large, multinational pharmaceutical firms act as investors and financiers of research at Dundee and other universities. But they are also involved in financing research and product development at individual firms. Several of Dundee's life sciences businesses have relationships with large pharmaceutical companies, and their customers are also often spread around the world.

The public sector's role in Dundee's innovation system

The three main players in Dundee's economic development community are Dundee City Council, Scottish Enterprise Tayside and Scottish Enterprise (national).

The three organisations work closely together across the full range of economic development issues including business sector development strategies and interventions, skills programmes and regeneration schemes. Other key stakeholders include the European Union (primarily through the European Regional Development Fund), universities and emerging industries such as the life sciences and digital media sectors.

There are a range of initiatives and investments in life sciences aimed at promoting innovation and growth in the cluster. Flagship programmes include the life sciences Intermediary Technology Institute, the Proof of Concept Fund and BioDundee.

Dundee City Council

Innovation forms a key part of the city's economic development strategy. As well as supplying generic business advice, the council has focused much of its attention and support on nurturing the biotech and digital media industries.

A good example of such support is BioDundee – a partnership between the public, private and academic sectors aimed at developing strong networks across the life sciences sector in the city through events and business support programmes. The project has achieved strong buy-in from stakeholders in the area, with every life sciences business using or engaged in developing its services.

Scottish Enterprise Tayside and Scottish Enterprise National

The life sciences Intermediary Technology Institute (ITI) was set up by the Scottish Executive in 2003. Its aim is to identify and finance the research and commercialisation of life sciences technologies and ideas. Using established experts and research to assess the potential of proposals, it works with partners in the public and private sectors to finance and oversee the research and commercialisation process.

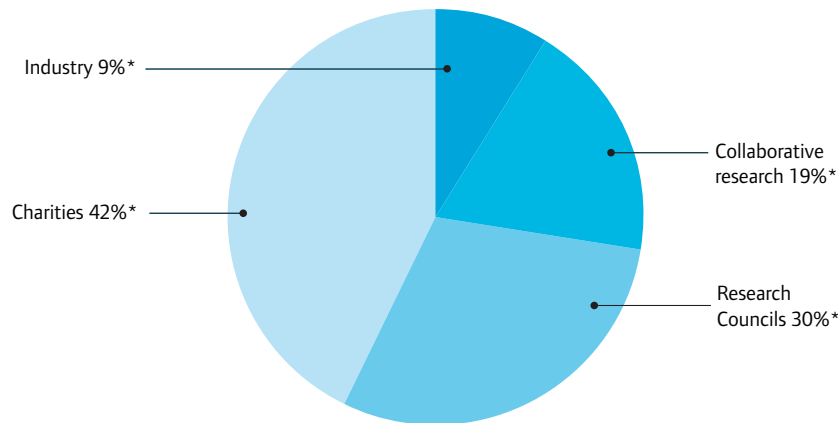
The Proof of Concept Fund was established in 1999 and supports the commercialisation of technologies from Scottish universities and research institutes by supplying pre-seed financing for new ideas and products. The fund was originally established with £11 million from Scottish Enterprise, but further contributions from Scottish Enterprise and the European Regional Development Fund have increased its value to £79 million. The project is considered to be highly successful, with firms identifying it as one of the most effective policies in the support toolkit.

Overall, life sciences business support initiatives in Scotland and Dundee appear to have achieved a high degree of success. Gaps – such as the absence of research and commercialisation financing for early-stage start-ups – have been identified and plugged with policies that have attracted praise from businesses.

Tailored initiatives have aided the development of the cluster. But the most critical element of public sector support for innovation in life sciences is the financing of research. Government agencies and funding bodies channel money into university research by a variety of means, including through charities. Without substantial public sector support, research capacity at the University of Dundee would be severely restricted.

Figure 12 illustrates the various sources of research funding going to the university in 2005/06, showing that charities and research councils alone accounted for nearly 75 per cent of research financing.

Figure 12: University of Dundee sources of research financing



Source: University of Dundee. *Numbers rounded up.

The urban components that make Dundee a location for the life sciences industry

This section asks if innovation in this sector is an urban phenomenon, and discusses the key urban and non-urban factors.

Dundee's urban assets for innovation in life sciences

A large pool of highly skilled labour

Life sciences businesses in Dundee can draw upon a large and easily accessible pool of highly skilled labour. The university plays a critical role in meeting the private sector's demand for trained scientists with specialist skills. Having this resource locally reduces recruitment costs and gives firms flexibility as they develop their products. Life sciences businesses can both bring in researchers with the skills needed to carry out everyday research functions and they are also able to hire scientists with the specialist knowledge that can address more high level research challenges.

Star scientists

The role of Sir Philip Cohen – until recently Head of Life Sciences at Dundee – has been central to the development of research capacity at the university. Himself a world renowned scientist, Cohen has played a pivotal role in orchestrating large scale investments in university facilities by bringing and holding together complex alliances of public and private sector actors. The result has been the creation of a series of state-of-the-art research centres, including the £13m Wellcome Trust

Biocentre completed in 1997 and the £21m James Black Centre opened in 2005.

Cohen has also been instrumental in nurturing and attracting scientific talent, and in securing public and private sector financing for research. He deliberately set out to attract other star researchers and up-and-coming scientists by targeting individuals and implementing more professional relationship management practices. To secure research financing, he has built close relationships with pharmaceutical companies, public sector research bodies and charities to attract long-term funding. One of the clearest examples of this is the Division of Signal Transduction Therapy, which is a collaboration between the university and six of the world's leading pharmaceutical companies. Established in 1998, the agreement was renewed for a further five years in 2003 with core funding of £15m from the private sector.

Ninewells Hospital

In addition to its role as an active research organisation (discussed below), Ninewells Hospital is also an important asset for the cluster as a provider of essential medical services. Many of the businesses need to have access to medical facilities to carry out clinical trials, and being located close to a large hospital supports their work.

Quality of life

The quality of life in Dundee has been identified as an important factor in attracting scientists to the city. The successful regeneration of the city centre over the past 10-15 years has made the city a significantly more attractive place to live and work. Equally,

the affordability of property and commuting times compared with places like Cambridge and London are an increasingly important lure for researchers.

National transport links

Dundee's national transport links are also excellent, with Glasgow and Edinburgh – the other points in Scotland's life sciences triangle – only an hour away.

Challenges

Perceived remoteness and poor

international links: Despite daily flights between Dundee and London City Airport, the lack of international connections may act as a barrier to future growth.

However, there is no evidence to suggest that Dundee's relatively poor international connectivity has yet discouraged multinational firms from investing in the city. As already noted, large US pharmaceutical companies have close ties to the city.

The role of public institutions in the Dundee innovation system

The University of Dundee

Dundee's life sciences cluster has emerged around its university – which has developed into a world leader in life sciences research since being made independent from the University of Edinburgh in 1967. The university feeds knowledge and ideas into the private sector through patents, licences and spin-outs (see Table 9). At the same time, its concentration of expertise and facilities also acts as an important resource for local businesses.

The university's value to the cluster stretches beyond its research. Academics regularly sit on the boards of local companies to advise

them as they develop new products. Having respected scientists as board members lends firms credibility in the eyes of the life sciences community and increases their prospects of attracting finance from larger pharmaceutical companies, which itself enables the continuation of research and innovation. Firms are able to pay to access the range of costly technologies available at the university as they need them, rather than buy them in themselves. In these areas, the benefits of proximity are obvious. It is much easier to access university scientists and facilities on a regular basis if your firm is located in the same city as them.

One reason why Scotland's universities perform so well in research may be that investment in research per capita is 40 per cent higher than the UK average.¹⁰¹ If stakeholders in economic development want to increase the scope for science- and technology-based economic growth they should remember that investment in university research is a crucial driver of opportunities for business growth.

Public sector and charities

The public sector and charities like the Wellcome Trust, have also played an important role in supporting innovation. Most crucially, the two supply the majority of research financing for the university, enabling it constantly to build on the research base and feed innovations into the market.

Scottish Enterprise and Dundee Council have invested in facilities for life sciences businesses and introduced policies aimed at improving business skills and life sciences financing. Scottish Enterprise's Proof of Concept Fund and Dundee Council's BioDundee project have been particularly effective. BioDundee has helped build networks between different actors in the cluster – facilitating some of the informal links that have spread business knowledge

101. Scottish Executive (2005) 'Scottish Life Sciences Strategy.' Edinburgh: Scottish Executive. Available at http://www.scottish-enterprise.com/publications/life_sciences_strategy_document.pdf

Table 9: University of Dundee life sciences innovation performance, 2001–2006

	2001/2	2002/3	2003/4	2004/5	2005/6
Patents (filed)	32	59	29	34	39
No. of licences	13	14	29	28	24
No. of spinouts	4	2	2	3	3

Source: University of Dundee.

around the life sciences community. And the Proof of Concept Fund is helping to plug some of the gaps in early stage commercialisation financing.

The role of firms in Dundee's innovation system

Commercialising ideas and inventions

Firms play a key role in commercialising the ideas and inventions of academics and clinicians. Many are also active in developing new products or making incremental improvements to existing products. There are some good examples of formal inter-firm collaboration over research and development, with proximity acting as an important enabler for these alliances. However, these innovation processes often take place in-house or with firms located elsewhere.

The role of networks in Dundee's innovation system

Informal networks

Informal networks enable academic and private sector researchers to discuss projects and ideas and build knowledge.

Informal business-to-business links occur over the exchange of knowledge and ideas on business strategy, as well as over research and product development. Firms talk to one another through workshops, collaborative groups facilitated by the public sector, and through existing contact networks. Informal connections are difficult to track, but there is a clear sense that these untraded information flows are influential in the evolution of the cluster. The exchange of knowledge on business practices and management may be particularly significant. This is primarily because, in the absence of any prior experience or formal training, the development of business expertise amongst scientists heading up spin-outs or other businesses is crucial.

Often these relationships are pre-existing because researchers in the private sector have previously worked on Dundee research teams and therefore retain a strong contact network at the university.

Relationships with the university

Underlying the relationship between knowledge exchanges and proximity is the need for firms to have regular face-to-face contact with university researchers. By being located close to the university, firms are better able to overcome research problems as they

arise and move the knowledge and product innovation process forward. Some information can be communicated easily by email or over the telephone, but where more ambiguous or highly technical concepts need to be conveyed it is often necessary for individuals to meet face-to-face in order to explain, discuss and understand. Importantly, these linkages tend to be untraded and therefore come at minimal cost. Were the firms located elsewhere they would not be able to leverage these contacts as economically.

The role of markets in Dundee's innovation system

Local market demand

Local market demand only plays a minor role in driving innovation. Life sciences research at Dundee University is not driven by commercial demands, though it is indirectly aligned with it. In the private sector, most businesses are involved in fairly distinct, early-stage product development areas with relatively limited scope for significant trading between firms at the local level.

Conclusions and policy learning – 'urban hubs' or 'local links'?

The life sciences cluster in Dundee is overwhelmingly the product of its world-class university. And it is the university that remains the key driver of innovation – pushing new knowledge into the private sector as it progresses with its research.

The private sector component of the cluster grew up as the university emerged as a leading international centre for life sciences research. Most of the city's life sciences businesses are university spin-outs. Its Department of Life Sciences continues to feed the private sector with innovations through licences and spin-outs. Businesses need access to the university's facilities and expertise as they develop their products and services. And it is the university that supplies firms with much of the skilled labour they need to carry out their business.

The Dundee example points strongly towards the value of our 'local links' innovation model. The university's central position in the innovation system and the importance for firms of remaining close to the university to access its expertise, facilities and labour supply, all suggest that the 'local links' model is useful in

explaining innovation in Dundee's life sciences sector.

What are the main challenges for life sciences in Dundee over the next ten years? And what is the role for public policy – if any?

Scotland's life sciences strategy¹⁰² identifies a series of key challenges, all of which support the overall objective of generating critical mass. The vision is one of academic research excellence with a vibrant, diverse private sector that operates across all parts of the life sciences value chain and is a major source of employment for Scotland. Some of the challenges identified of particular relevance to Dundee include the following.

Stronger links with – and support from – Scotland's financial services industry.

Gaps in early-stage financing restrict the development of the business base. Links between Scotland's finance and life sciences industries are not as well developed as they might be. Stakeholders have identified the need to strengthen these links in order to address finance gaps. However, the financing system for life sciences is a highly integrated international network and more work needs to be done to understand the extent to which a more localised financing system can address gaps.¹⁰³

More large firms

Larger businesses are an indication of success and can act as major employment generators and sources of demand. It makes sense to try and support the development of these businesses in Scotland. However, there is some disagreement over whether it is realistic to attract large, established pharmaceutical companies to Scotland (and Dundee). A more fruitful approach might be to focus on the development of smaller indigenous firms with the aim of helping these firms grow into larger businesses.

Stronger entrepreneurial skills

Dundee (and Scotland more widely) is highly successful in the creation of new scientific knowledge. As with many other life sciences industries around Europe, the city has been less successful in the commercialisation of this knowledge. Financing is one reason for this, but entrepreneurial skills gaps are another. More attention could be paid to attracting business expertise into the sector and to developing the business skills of scientists-turned-entrepreneurs.

Lessons for other economic development agencies

Not every city can expect to create a life sciences cluster. As discussed, Dundee's cluster is based around an exceptionally high performing university that continually feeds the private sector with new knowledge and ideas with the potential for commercialisation. This expertise has been built up relatively quickly from a low base. But it is not realistic to expect that all universities can be transformed into international centres of excellence in life sciences research, since the talent needed to achieve this is extremely scarce.

However, more encouragingly, the Dundee example demonstrates that if a city has the right mix of urban assets and strong 'local links', investment in the science base can generate significant opportunities for business growth.

102. Scottish Executive (2005) 'Scottish Life Sciences Strategy.' Edinburgh: Scottish Executive. Available at http://www.scottish-enterprise.com/publications/life_sciences_strategy_document.pdf

103. Martin, R., Berndt, C., Klagge, B. and Sunley, P. (2005) Spatial Proximity Effects and Regional Equity Gaps in the Venture Capital Market: Evidence from Germany and the UK. 'Environment and Planning A.' 27, pp. 1207-1231.

Case study 4: London – world class fashion in a strong hub with fragile links

Introduction

This case study focuses on London's designer fashion sector. It shows how the capital's range of urban assets – including cultural scenes, infrastructure, and economic diversity and critical mass – combine to support innovation and growth in the sector.

The designer fashion business tends to concentrate in particular cities around the world. London is a key centre, and sits alongside the likes of Paris, New York and Milan as one of the world's fashion capitals. The industry consists of a highly complex network of actors interacting at different levels to bring a continual supply of cutting edge clothing designs to market. To a significant degree the business is about developing new products, but there is also a strong focus on process innovation.

Fashion represents an important part of London and the UK's creative economy. And, as such, it is now beginning to receive more attention from policymakers at the regional and national

levels.¹⁰⁴ However, the policy community is still far from understanding the nature of the sector. In particular, despite the clear tendency for fashion design firms to concentrate in urban areas, there has been very little research into the specific role played by urban factors in driving forward the innovation process.

London is a huge, dynamic city – but with uneven growth, and high levels of inequality. The capital's industrial strengths are well known. London has now overtaken New York as the world's leading financial and business services centre – with the City acting as the capital's key driver of growth. One third of the world's largest companies have their headquarters in London. It is the UK's key centre for telecoms and internet-related businesses, with BT, Virgin, Globix, Yahoo and QXL all located in the city.¹⁰⁵ Multinational pharmaceutical firms – such as GlaxoSmithKline – are also based in London. And the capital has an enormous retail sector – with the West End particularly well known as one of the largest retail centres in the world. Figure 13 shows industry employment growth between

104. GLA Economics (2007) 'London's Creative Sector: 2007 update.' London: GLA Economics; The Work Foundation (2007) 'Staying Ahead: The economic performance of the UK's creative industries.' Report to DCMS. London: TWF.

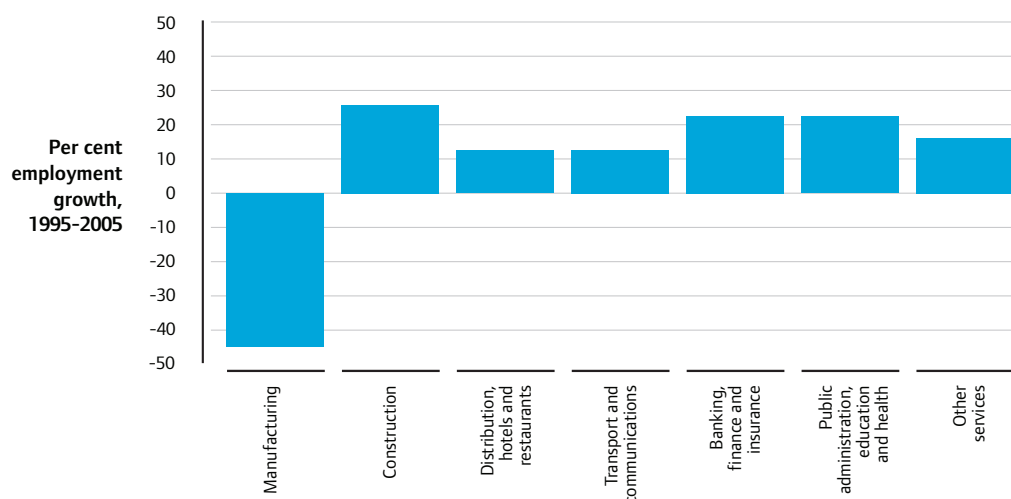
105. UKTI. See <https://www.uktradeinvest.gov.uk/>

Table 10: Selected statistics for the London Economy

Population 2005 9,294,800 (18.4% of England total)	Population change 2000-2005 3.4% (England average 3.1%)
Employment rate 2006 70.7% (England average 74.3%)	ILO unemployment 2006 6.3% (England average 4.7%)
% working age educated to degree level 16.7% (England average 19.9%)	Average weekly wage 2006 £675.10 (England average £454.50)
% firms introducing new products, 1998-2000 20% (England average 18%)	% firms introducing novel products, 1998-2000 9% (England average 15%)
% of firms introducing new processes 30% (England average 8.0%)	% of firms introducing novel processes, 1998-2000 6% (England average 5%)
Patents per 10,000, 1999-2001 14 (England average 9)	VAT registrations per 10,000 adults, 2003 60.3 (England average 42.0)
Business stock (VAT registered businesses) 2001 380,370 (25% of total VAT stock in England)	VAT registered businesses per 10,000 adults, 2001 419 (England average 384)

Source: State of the Cities Database, 2007; Office for National Statistics 2007.

Figure 13 : Industry employment growth, 1995-2005



Source: State of the Cities Database, 2007; Office for National Statistics 2007.

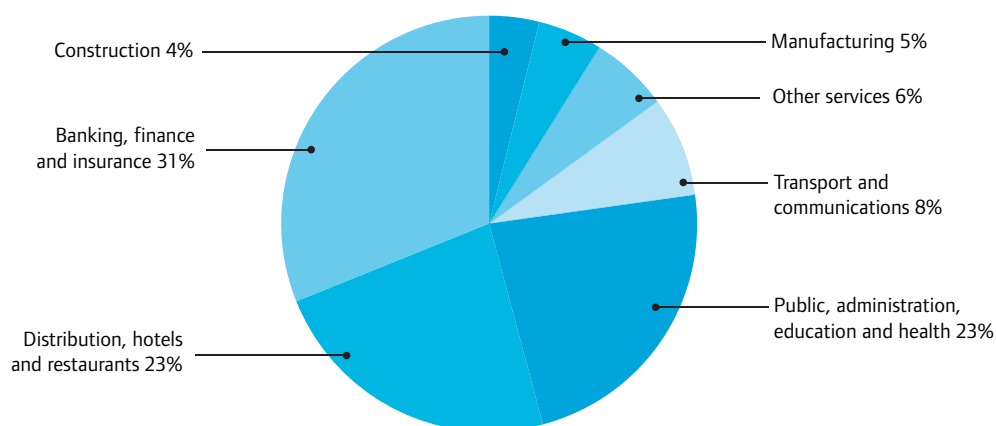
1995 and 2005. Figure 14 shows the industrial structure of the London economy in 2005.

London is also the UK's cultural capital and one of the cultural capitals of the world. It is also a major centre for the creative industries. A wide mix of interlinked cultural scenes gives London a cultural vibrancy that is probably unsurpassed anywhere in the world. Closely linked to this, London also has a highly successful range

of creative industries – including publishing, music, theatre, film, television and fashion.

But the economic picture is very mixed. Large parts of London – particularly in the east of the city – suffer from high unemployment, child poverty, low educational attainment and poor housing. Despite London's great wealth, it is still home to many of the UK's most disadvantaged communities. There is much work for the authorities to do in addressing

Figure 14: London's industrial structure – employment shares by sector in 2005



Source: State of the Cities Database, 2007; Office for National Statistics 2007.

Table 11: London designer fashion employment, 1994–2005 (DCMS definition)

	1994	2001	2004	2005
London designer fashion	2,400	4,800	4,100	4,400
GB designer fashion	9,000	16,000	17,000	19,000
London creative industries	250,600	381,400	341,300	359,500
GB creative industries	765,000	1,114,000	1,097,000	1,138,000

Source: GLA Economics (2007).

these problems and ensuring that all of the city's inhabitants share in the fruits of growth.

The sector and the London innovation system

London dominates UK fashion, and the designer fashion sector. In 2005, 359,000 people worked in creative industries or occupations in London (Table 11). Of these, 4,400 (1.2 per cent) worked in the designer fashion sector. London's share of UK designer fashion sector employment was over 23 per cent in 2005.

The sector experienced strong growth from the mid 1990s until the early 2000s, followed by a sharp downturn between 2001 and 2004 and a turnaround in 2005.

This mirrors a broader pattern of employment change in London's creative economy. Overall, fashion sector and creative economy performance has been strongly pro-cyclical – growing faster than the rest of the private sector when the economy is doing well, and shrinking faster in downturns.¹⁰⁶

Within the city, fashion sector jobs – design, manufacture and retail – are largely located in an axis from Dalston, the City Fringe (Shoreditch and Hoxton) through the West End to South West London (including Hammersmith and Kingston). There is also a fast-growing nexus of jobs in outer West London around Hounslow. The largest concentrations are in Westminster, West London and the City Fringe.¹⁰⁷

There is a range of innovative behaviours by different actors across the designer fashion sector. These include:

- **Among designers** innovation involves the basic processes of creativity and inspiration. Specifically, it often involves applying product and process innovations from the manufacturing sector – for example, finding new uses for textiles and cutting techniques.
- **For manufacturers** innovation principally involves new products (for example, high-performance or 'smart' fabrics) and/or processes (for example, new printing or cutting techniques, or just-in-time production systems that allow customisation). Typically, textile innovations have a number of applications beyond fashion, such as medical or military.¹⁰⁸
- **Retail** is increasingly a site of product and process innovation. Examples include applying advanced manufacturing techniques; raising the demand for innovative goods by 'platforming' designers; and directly translating innovative designs from catwalks to their own ranges. The latter is controversial, with some recent court cases over copying (e.g. Camber 2007).

The public sector's role in the London Fashion innovation system

Department for Culture, Media and Sport
National 'fashion policy' is led by DCMS, which also has responsibility for the other twelve creative industries. DCMS's Creative Economy programme was set up in late 2005 to provide a strategic overview of all thirteen creative industries. Among its activities was a Fashion Summit in 2006.

106. GLA Economics (2007) 'London Creative Sector: 2007 update.' London: GLA Economics.

107. GLA Economics (2002) 'Creativity: London's core business.' London: GLA Economics.

108. Mootee, I. (2005) 'Customer Experience Innovation in the Fashion and Luxury Goods Industry.' Presentation to the 7th Conference of Fashion and Luxury Brand Entrepreneurs, Madrid.

Greater London Authority and London Development Agency

London-wide public policy for designer fashion is led by the Greater London Authority (GLA) and the London Development Agency (LDA). The 2004 GLA Cultural Strategy aims to make London 'a world-class creative city'.¹⁰⁹ In 2004, the LDA set up the Creative London agency to oversee strategy and programmes for the London creative economy. Creative London's objectives are to:

- Ensure the continued growth of London's creative industries.
- Maximise their contribution to London's economy.
- Enhance the regenerative capacity of London through the increased engagements of its citizens in the arts and other cultural activities.
- Make sure that London's diverse communities benefit from, and contribute to, this expansion.¹¹⁰

Until recently Creative London has run a number of projects, including:

- City Showcase: an annual festival for music and fashion.
- Fashion @ Work training: delivering specialist training in Islington.
- Fashion capital portal: an online information hub.
- Creative Spaces project: a three-year programme to develop workspace and public space for the creative industries.
- Centre for Fashion Enterprise: see below.

Creative London is currently involved in a major rethink of this strategy. From late 2007, Creative London will move away from the current approach of supporting many small programmes towards a more enabling role – financing industry-facing bodies to deliver programmes, and monitoring results. The three key elements will be:

- Working with the Centre for Fashion Enterprise to support designers.
- Working with City Fringe Partnership CGS to support manufacturers.

- Working the British Fashion Council to support London fashion's brand, profile and reputation.

Centre for Fashion Enterprise

The Centre for Fashion Enterprise (CFE) is a business development programme working with emerging London designers. The aim is to provide intensive support to a small number of designers with star potential. The CFE provides grant and seed funding for design, PR, marketing and business training, as well as links to manufacturers and potential investors. An advisory board includes representatives from the private sector, media, advertising and trade bodies. The CFE is based at the London College of Fashion, and is currently 50 per cent funded by Creative London.

British Fashion Council

The British Fashion Council (BFC) is the national umbrella group for the fashion industry. Its key activity is organising the bi-annual London Fashion Week. It also organises the annual British Fashion Awards, runs the Colleges Council – which promotes university-industry links – and runs a small business development programme. Around 50 per cent of the BFC's funding comes from Creative London; the rest is sourced from private sector sponsorship.

University of the Arts

Set up as The London Institute, and converting to a university in 2004, the University of the Arts links London's six art colleges: Camberwell College of Arts, Central Saint Martins College of Art and Design, Chelsea College of Art and Design, London College of Communication, London College of Fashion, and Wimbledon College of Art. The university has more than 19,000 students studying art, music, design and other subjects. Of these, Central St Martin's and the London College of Fashion have a particular focus on the designer fashion sector. Outside this group, the Royal College of Art and Goldsmith's College also have a strong interest in textiles and clothing design. Overall, London has 24 universities and 60 further education colleges, with over 100,000 students studying creative industries (LDA 2006).

Fashion Retail Academy

The Fashion Retail Academy is a business backed 'National Skills Academy' established in 2005 that aims to provide vocational training combining design, 'fashion education' and learning the retail business. The Academy seeks to make links between London's designer community and the retail end of the fashion

109. London Development Agency (2006) 'Creative London.' London: LDA.

110. Ibid.

business. Based in Oxford St, it is supported by The Arcadia Group (which includes Topshop), Next, Marks & Spencer and GUS. The Academy currently has 350 students.

What makes London a home to the fashion designer industry?

London's urban offering to the Fashion Industry

London's size, history, diversity and infrastructure are the most important drivers of innovation in the capital's designer fashion sector.

The industry fits into – and feeds off – a wider cultural economy

The designer fashion sector in London – as in other big cities – needs to be seen in the context of a bigger 'cultural economy' of art, music and design.¹¹¹ In London, the fashion scene has a distinct character shaped over decades. There are clear links between fashion, art, design and music; and more broadly, between fashion and pop culture in general. London is one of the world's key centres for the cultural industries. Sub-cultures feed each other with creative ideas and innovations. Designers need to be in London to be part of this, and remain at the leading edge of cultural trends.

Critical mass of people and businesses in related fields

Closely linked to this, London also houses a critical mass of people and businesses in related fields. Their concentration in one city feeds the flow of ideas between them and creates a strong local demand. By locating in London, designers are able to hook into the specialist networks surrounding these industries and feed the ideas generated into

their designs, as well as accessing opportunities for work.

London's role as a media centre is particularly important

London's position as the centre of the national print and broadcast media is a key component of this wider system – allowing businesses to pick up ideas and promote their designs more easily. At the most basic level, 'outside London you can't get the basic magazines you want to look at'. More broadly, London's media cluster – with its specialist fashion and style press – means the city is the best location for getting known and getting exposure. Physical proximity means it is relatively simple to meet and build up relationships with journalists.

Job opportunities in related fields

The complementary job opportunities provided by being part of London's wider cultural economy are another important benefit. Most London designers – like other creatives – lead a fairly hand to mouth existence. Designers need to be flexible to survive. There is a history of designers who also work in styling, modelling, journalism, or as disc jockeys. A portfolio of activities often subsidises the core business (see Box 12). London has an enormous depth of opportunities in these areas and designers need to be in the capital to access them.

Local creative communities also play a role – especially around Shoreditch and Dalston

London's overall cultural offer and businesses are important, but there is also clear evidence of neighbourhood-level spatial clustering. Local creative communities – especially those in Shoreditch and Dalston – also help drive innovation through the pooling and dissemination of creative ideas, knowledge of emerging fashion trends, and technical knowledge.

Box 12: Catherine Lucci¹¹²

Catherine Lucci is a menswear designer. A Royal College of Art graduate based in East London, she has run her own firm since summer 2006. Before that she worked for a number of companies to learn the business. She showed her work at the London and Paris Fashion Weeks in 2006. Catherine's

own label is her 'main line'. She has also designed a capsule collection for a national retailer which launched in the 2007 London Fashion Week. Catherine also works as a consultant for other labels, does some styling work and has just taken up a part-time teaching post at a university in the North of England.

111. Currid, E. (2007) 'The Warhol Economy: How fashion, art and music drive New York City.' Princeton: Princeton University Press.

112. This is a pseudonym used to maintain the confidentiality of a consultee in this case study.

Reputation

London's role as a cultural, creative and fashion industry capital combine to make it a prestigious city for fashion businesses to locate – 'Made in London' is a selling point.

London Fashion Week

London Fashion Week is a key event for fashion designers, and being based in the capital increases their ability to take advantage of it. Run twice a year, it sets trends, builds reputations and stimulates demand for innovative products. London Fashion Week – like similar events in other cities – works because of proximity and synchronicity: everyone is there at the same time. The concentration of press, designers and buyers make it easy to do a lot of the 'invisible work' in the fashion workflow, as well as buying and selling.

Connectivity

London's other big advantage for fashion designers is its role as an international transport hub. Designers need to have regular access to international customers and suppliers and they need to attend fashion events elsewhere in the world. London's international transport connections make it an ideal location for business.

The role of institutions in the London Fashion innovation system

University base/University of the Arts

London's arts colleges feed designers into the fashion sector in at least three key ways. First, they train designers and professionals. Many of the top designers in London's fashion scene were educated at the London College of Fashion (Jimmy Choo, Harold Tillman, Linda Bennett) or Central St. Martin's College (Stella McCartney, Bruce Oldfield, Jeff Banks). Nowhere else in the UK can match London for the provision of specialist fashion courses. Students want to come to London to take advantage of its cultural offer, but they also need its arts colleges to acquire the technical skills needed to be a designer. Second, arts colleges also play a crucial role in helping fashion designers and other arts students build the informal networks on which they depend throughout their careers (see networks discussion below).

Third, for designers, universities also provide a steady stream of cheap or free labour to work in studios. Work placements are critical for designers; and for the students themselves, as a way of learning the business. Many see work

placements as a key resource in keeping young fashion labels going.

Campuses in cheaper parts of town may also promote local creative communities, especially in South East London. But the evidence for this is less clear.

University base

London's wider university base also supports growth. It helps supply a skilled workforce – not all designer fashion industry workers are educated at London's arts colleges – and provides the basis for designers to build networks. Multi-disciplinary environments promote flexible working and broaden networking activity.

Public sector

The main sources of support to the fashion industry are through the Creative London programme. Agencies such as the LDA have supported London Fashion Week and associated events; they also offer tailored support and advice to fashion entrepreneurs.

The role of firms in the London Fashion innovation system

Critical mass of fashion sector activity

The size and scope of the fashion industry in London drives innovation in the design sector – the large number of fashion designers creates competition which fosters creativity and innovation.

The role of retailers – boutique platforms, chain collaborations and the dissemination of couture

London's fashion designers have two main sales channels: independent boutiques, and chain retailers. These play three roles in the innovation system:

- Providing a platform for designers.
- Enabling active collaboration with designers (e.g. through capsule collections).
- 'Disseminating' couture trends to the High Street market.

Designers often prefer to sell through independent boutiques, because they feel that this gives them greater control over the sales process. Independents are not felt directly to drive innovation, although they occasionally provide feedback on what is selling well (or badly). Rather, they are attractive because of their size, air of exclusivity, and because they offer designers the chance to push their

collections on relatively even terms. They provide a platform for innovation.

Designers are also increasingly interested in collaboration with major retailers. High-profile partnerships have formed for some years (such as Designers at Debenhams, M&S Autograph, Topshop and H&M capsule collections). Both sides have different motives:

- Retailers collaborate as part of a product differentiation strategy, and 'to introduce a message about the brand'.¹¹³
- Designers collaborate to make money (e.g. to subsidise their 'main line'), and to improve their profile.

Chain retailers also shape the market by 'translating' designer trends from catwalk shows to their own product lines. To do this they employ their own teams of (often London-trained) designers. Again, there were very mixed views of the impact of 'translation' on London-based designers. Some stakeholders suggested local designers were in danger of being ripped off. Others argued that big chains largely copied established brands, and that the effect on London designers was positive – enlarging the general market for innovative clothes would indirectly benefit the designer community.

The role of manufacturers – quality problems and work practice mismatches

Most London-based designers want to source and manufacture their clothes in the city. Garments tend to be complex; quality of materials and finish is critical. Ideally, designers want good local firms who will take small orders. Manufacturers 'need to be round the corner, you need a relationship with them'.

However, only a few London firms meet these criteria. UK clothing manufacturers traditionally supplied High Street firms – stakeholders suggested that many are still trying to operate on a low-quality, high-volume business model. Most London-based manufacturers have outdated equipment, poor skills and unsuitable business strategies.

Designers' working practices exacerbate the problem. Short orders require firms to be very flexible, but designers' demand peaks before major events. Nobody wants to overload firms and find they cannot get a last-minute job done.

The shortage of appropriate manufacturers is a real constraint on designers' ability to take their ideas forward, and to fully exploit product and process innovations in the textiles sector. Good firms can use price as a means of rationing demand, and this means designers' products – however innovative – are at a disadvantage in the marketplace. UK designers are competing with foreign firms' superior supply chains. At worst, the 'London overhead' can mean a local designer is more expensive than Prada.

The role of networks in the London Fashion innovation system

Networks are a crucial source of knowledge, ideas and opportunities. The designer fashion sector – like art, music and the rest of the creative industries – relies heavily on social activity and networking. Designers are either self-employed or are micro-businesses. So, they join networks partly to find external suppliers, services or collaborators to deliver their products and services competitively; and partly to find markets. All these services and suppliers are in London. Equally, fashion industry workers need to be closely hooked into the fashion scene to identify (or be identified for) job opportunities. Being in London makes it easier to sustain these relationships and networks. There are three key types of networks in London's designer fashion sector.

Networking through sub-cultures

London's existing cultural scenes make networking easy and rewarding. Almost all social interaction may be useful – 'designers never stop working'.

College or university networks

Many networks and network connections are founded early in the designer's career in London's Further or higher education courses. These networks are essential for identifying opportunities and exchanging ideas.

Inter-firm networks

Designers need to be highly networked with other businesses – including customers, suppliers, services and designers. London has strong networks amongst fashion designers that also reach into other creative sectors and activities. These networks provide both direct and indirect support for innovation. Networks provide support directly, as fashion designers derive inspiration and ideas from other peers, suppliers, or customers. And they apply indirectly as fashion designers are highly networked with other creative and cultural sectors and workers – they draw inspiration

113. Retailers are also developing celebrity branded ranges for the same reasons (e.g. Kylie at H&M, Kate Moss at TopShop, Penelope and Monica Cruz at Mango).

and ideas from other arts and wider cultural influences.

The role of markets in the London fashion innovation system

Consumer demand

The high demand for designer fashion in London and the size of the capital's market means that London can sustain a larger number and a greater range of fashion design businesses.

Market outlets

Market outlets for fashion designers are either independent designer fashion boutiques or retail chains. Both have a significant presence in London, and most major UK retailers have their headquarters and buyer functions in London. Independent retailers have always had the smaller market share. In recent years, the number of independent stores has been declining – partly due to competition with chain stores, and partly due to high property costs in central London and in regenerating districts such as Shoreditch. This is one of the factors pushing many designers towards the retail chains to market their goods.

Market competition is high and market entry is challenging

Designer fashion is by its nature highly competitive, with a large number of businesses. The London scene is particularly so. For designers, this exacerbates other difficulties in getting goods to market. First, alongside changes in retail market structure (above) boutiques only stock a limited range of designers; and major retailers tend to either use internal staff designers or have partnership deals with a selected number of (usually famous) designers.

Second, costs are high for independent fashion designers due to the costs of business, labour and supplies/services in London; and the lack of local manufacturing facilities means costs are pushed up further by the need to negotiate the sourcing of finished products abroad.

Access to consumer markets

Many in the sector see London as a hard market in which to sell, with so much competition from High Street retail chains.

Conclusions and policy learning: 'urban hubs' or 'local links'?

The London fashion system seems to be characterised by a mix of 'urban hubs' and 'local links'. The city's size, connectivity and position as a cultural centre are all important. Equally, there are clear local creative communities where people want to live and work, with neighbourhood-level spatial clustering. Informal networks and social activity are critical to getting on. Spatial proximity helps people meet, make connections and share information.

The fashion industry is highly successful. In London, the 'designer fashion system' has a number of strengths, and is highly innovative. So what is the role for public policy – if any?

Information gaps

Stakeholders generally felt there were too many initiatives aimed at designers, and a lack of information about what each could deliver. Funding is seen as hard to access, with designers having to 'bend themselves' to qualify in many cases. This suggests that simpler policies and effective intermediaries would both help.

Designers' business skills

Fashion designers are not well-known for their business skills. Most successful designer fashion companies involve a designer and a business-orientated partner. For those who lack this, mentoring, financial support and marketing advice are all important. Designers also need access to people with technical skills.

Designer-manufacturer links

Stakeholders identified this as a serious issue for designers. Without reliable access to high quality manufacturers, designers will find it hard to take forward innovative ideas. They will also pay a premium for work done, which makes it harder for them to sell against international competition. Relying on overseas manufacturers cuts costs, but makes quality control harder and raises risks. Public sector actors need to support the expansion of the fashion manufacturers – moving many of them away from low quality towards high quality manufacturing. There are three main areas for improvement: skills, equipment and business strategies.

Workspace

Lack of affordable and accessible workspace is the other major issue for designers. Fashion designers operate machinery and need to store

materials; they need significantly more space than (for example) graphic designers. They feel London's cost of living more than many. There seems to be an undersupply of fashion-specific workspaces in the capital. This has two consequences for innovation:

- First, lack of cheap space makes it hard to operate as a business.
- Second, lack of access to neighbourhoods with a high concentration of creative people limits designers' ability to benefit from London's proximity and ideas flow.

This suggests there that there may be a rationale to intervene in the property market; either to protect workspace, or more productively, to promote flexible terms and to co-ordinate the availability of property in key neighbourhoods.

The long term challenge: retaining talent, sustaining success

Ultimately London's position as a designer fashion centre depends on its ability to attract and retain talented people, and to nurture successful firms. Stakeholders suggested that in the long term, London faces some challenges here:

- London-based firms lack the more formal career structures and systems of other cities; designers attracted to less risky environments may move abroad.
- London-based manufacturers do not provide enough high quality support. Many designers aspire to move their supply chains out of the UK.
- London's reputation as a talent pool may work both ways – firms from around the world seek to hire from the London labour market. Will London's attractions be enough to hold on to a critical mass of talented people?

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Case study 5: Reading – a strong urban hub creating the UK’s version of Silicon Valley

Introduction

This case study focuses on the Reading and the Thames Valley information and communications technology (ICT) industry. It shows how the region’s range of urban assets – including strong national and international transport connections, the availability of land, and the presence of a large skilled labour force – combine to support innovation and growth.

The ICT industry is a major component of the sub-regional economy. There are large national and international corporations that act as originators and users of innovation, as well as small, innovative technology companies. These are complemented by major research facilities, universities and other research institutions.

Reading and the Thames Valley are highly successful economies. Innovation is strong and diverse and the area is often referred to as the nearest thing that the UK has to Silicon Valley. But despite this, the nature of innovation and the players and policies surrounding it are little understood. There are important unanswered questions about the location factors that are responsible for attracting and developing innovation; about how the presence of large corporations shapes the type, and nature, of innovation; and about how the innovation system operates across the sub-region and the wider South East.

Table 12: Selected economic statistics for Reading

Population 2005 409,900 (0.8% of England total)	Population change 2000–2005 1.7% (England average 3.1%)
Employment rate 2006 80.6% (England average 74.3%)	ILO unemployment 2006 3.5% (England average 4.7%)
% working age educated to degree level 33.8% (England average 19.9%)	Average weekly wage 2006 £646.00 (England average £454.50)
% firms introducing new products, 1998–2000 24% (England average 18%)	% firms introducing novel products, 1998–2000 12% (England average 15%)
% of firms introducing new processes 16% (England average 8.0%)	% of firms introducing novel processes, 1998–2000 6% (England average 5%)
Patents per 10,000, 1999–2001 31 (England average 9)	VAT registrations per 10,000 adults, 2003 52.7 (England average 42.0)
Business stock (VAT registered businesses) 2001 19,890 (1.3% of total VAT stock in England)	VAT registered businesses per 10,000 adults, 2001 370 (England average 384)

Source: State of the Cities Database, 2007; Office for National Statistics 2007.

The Reading economy: an overview of the city-region¹¹⁴

This case study is concerned primarily with Reading, but our consideration of economic and innovation issues often extends into the Thames Valley. This is because the functional economic area around Reading covers a wider area than local administrative boundaries, and the important economic and market linkages and flows for Reading are sometimes more appropriately considered at the scale of the Thames Valley.

Reading's urban area consists of the local authority districts of Bracknell Forest, Reading and Wokingham. The Thames Valley has no defined boundaries, but is classified by the South East England Development Agency (SEEDA) as an area that stretches from Heathrow in the East to Newbury in the West; and from High Wycombe in the North to Basingstoke in the South. Importantly, the Thames Valley is also immediately adjacent to London and a number of nationally significant research and enterprise clusters located in the South East of England such as those found in Oxfordshire.

Reading has performed very well as an economy in recent years – with strong productivity, good growth in jobs and low unemployment. Between 1995 and 2005, the city added 43,000 net new jobs, with high growth in knowledge-based service sectors, such as ICT and finance. Figure 15 shows employment growth across key sectors of the

economy between 1995 and 2005. Figure 16 illustrates the structure of Reading's economy in 2005.

Reading and the Thames Valley are also major locations for innovation in the UK. There is a legacy of high technology innovation and a rich range of research spread across the region in universities, public sector research institutions and enterprises. Many large and highly innovative businesses have located in the area and Reading University has been successful in producing science- and research-based innovations.

Reading performs outstandingly well on available innovation indicators – ranking in the top five cities in the UK on patents per 10,000 residents, on the percentage of firms introducing product innovations and the percentage of firms introducing process innovations.

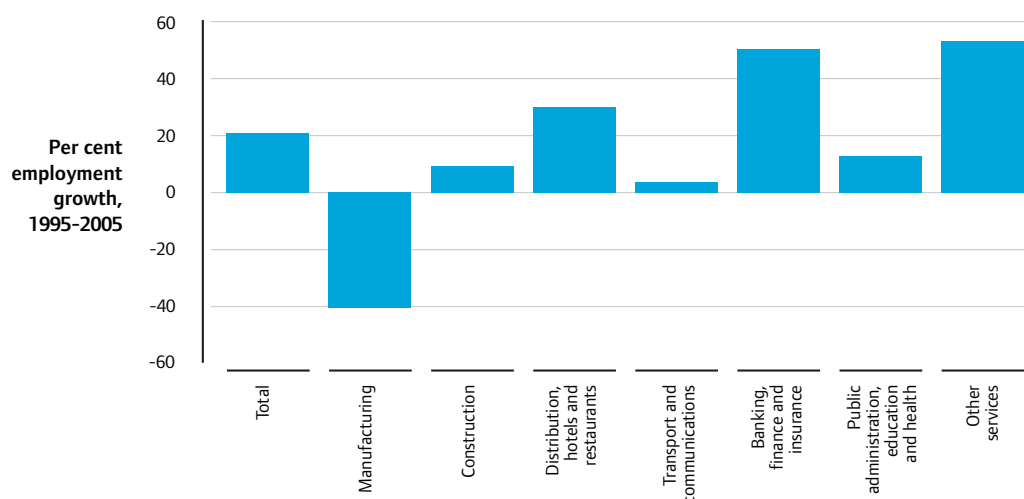
The sector and the Thames Valley innovation system

The Reading and Thames Valley area is the UK's leading location for the ICT industry. And the sector provides direct employment for a large number of people across the sub-region. For the Thames Valley, this employment can be broken down as follows:

- Computer and related activities: 43,056.

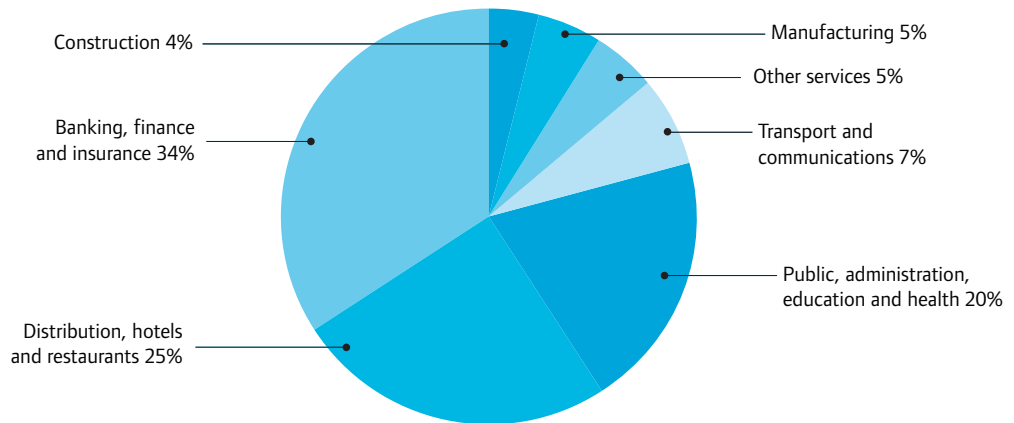
114. The profile and statistics discuss the city-region economy as defined by the Department of Communities and Local Government's 'State of the English Cities' work. All statistics refer to the City Region 'Primary Urban Area' as defined in this work – classified as the local authority areas of Reading, Wokingham, and Bracknell Forest.

Figure 15 : Industry employment growth in Reading, 1995-2005



Source: State of the cities database, 2007; office for national statistics 2007.

Figure 16: Reading's industrial structure – employment shares by sector in 2005



Source: State of the Cities Database, 2007; Office for National Statistics 2007.

- Post and telecommunications: 26,391.
- Manufacture of radio, TV and communication equipment: 2,011.

Firms like Vodafone and O2 have been a long-term corporate presence. Others, including Microsoft have come into the area more recently. The sector covers a wide range of ICT specialisms with both small firms and large national and international businesses. Industry specialisms and some examples of the firms that are active in these areas are set out in Box 13.

Innovation occurs in diverse ways in the ICT sector in Reading/Thames Valley – there is no narrow range of typologies of innovation. Innovations are developed, diffused and adapted in Reading/Thames Valley's ICT sector. They can be procured from external providers both internationally and locally, or developed

in-house from local facilities or overseas R&D labs.

A main area of innovation is in software. Due to the nature of the activities of corporate headquarters in the area, some innovation has been in business models and services, involving the application of technology and software rather than solely the development of hardware and software applications. For example, some small businesses have developed software and services using existing mobile telecommunications technologies to deliver new business solutions for clients.

The market footprint of the sector is international as well as local. Many firms service large international markets from their Reading/Thames Valley base. But only a relatively small number of these firms are actually established in the area with Vodafone and ARM among the few examples of large

Box 13: Reading ICT specialisms and example businesses

- Mobile telecoms: O2, Vodafone, 3G, Virgin.
- Telephony: Energis, MCI Worldcom, Global AT&T.
- Mobile phone manufacturers: NEC, Alcatel, Samsung.
- Hybrid Devices: Blackberry, Spinbox.
- Hardware: Dell, Hewlett Packard, ARM.
- Software: eight of the world's ten top selling software companies have facilities located in Thames Valley, including Microsoft and Oracle.
- Small companies: Arieso (a Vodafone spin-out), Appswing, Black Spider Technologies.

home-grown companies. Many of the foreign-owned firms have been attracted by the ready base of technical expertise – skills, companies and institutions – in London and the South East of England.

Subsidiary research labs located in the Thames Valley include those of Johnson Matthey (Sonning Common), ICI Paints (Slough), Honda F1 R&D (Bracknell), Castrol lubrication labs (Pangbourne), and a variety of subsidiary sites of Thales and Procter & Gamble.

Reading University is the main research-active university in the Thames Valley. It has particular research strengths in computer science, informatics, systems engineering, environment, built environment, agriculture, food sciences and meteorology.

More collaborative forms of innovation have been emerging in recent years – with the advent of spin-out companies, and the use of Reading University's Knowledge Transfer Centre. Companies like Microsoft have also established greater collaboration with businesses who use their products and who seek novel applications to new business areas or clients. The Microsoft Innovation Centre in Reading supports collaboration between companies to address new market opportunities, clients, and market needs – devising innovations in software, processes and business models.

Many commentators believe there is a nascent 'open innovation' model developing in the Thames Valley. Companies such as Oracle and Microsoft have opened up their R&D

procurement to external sources. Vodafone closed its 'future products' divisions. In the case of Vodafone, this led to former employees setting up a number of innovative start ups such as Arieso (see Box 14). Following the open innovation model of the kind experienced in Silicon Valley, there have been a small number of spin-outs in recent times – where experienced executives from large companies have developed innovative SMEs, most often to service their original 'source' company with a product or service.

The public sector's role in the Thames Valley innovation system

The main public sector actors involved in the sub-region's ICT innovation system are Reading Borough Council, the South East England Economic Development Agency, and the Thames Valley Economic Partnership.

Reading Borough Council

The local authority plays a key role relating to innovation, including involvement in infrastructural provision, land ownership and assembly, property development, inward investment promotion and economic leadership.

An important example of the Council's role is the Green Park business and technology site in South Reading, where companies such as Cisco Systems, Symantec Software, Logica CMG and Regus are located. The Council led the lobbying and action to win funds to upgrade the rail infrastructure in Reading, eventually securing a

Box 14: Open innovation – Arieso

Arieso is an SME spin-out from Vodafone. Established in Newbury in 2002, Arieso is recognized as a world leader in the development of innovative solutions that help wireless operators and service providers improve the performance of their networks at a lower cost. Arieso has been providing solutions in the areas of automatic network optimisation and capital budget management since 2002. The company was founded on the development of an algorithm that calculates where to position mobile phone antennae to get

the best signal across the country. Before Arieso's system, this job was done manually, with engineers trying to predict where people would get a strong or weak signal. The system enables phone companies to get the same coverage with 30 per cent fewer mobile phone base stations. Clients include O2, Vodafone, Nokia, Telefonica and Cingular. A company goal is to create self-healing networks – an intelligent system where the network itself realises that a site has gone down, and other sites automatically cover the lost areas of signal until that site is repaired.

half-billion pounds development after ten years of partnership building and lobbying work.

The Council has also been instrumental in the upgrading of Reading city centre as a retail and commercial space. Reading Borough Council is perceived as business-friendly, and undertakes a lot of activities to secure business confidence and investment. For example, Reading was quick to establish a Business Improvement District¹¹⁵ – it was the first one established in the South East of England, and was up and running within nine months of announcing it.

South East England Economic Development Agency (SEEDA)

SEEDA covers Reading and the Thames Valley. This Regional Development Agency has an annual budget of £160 million, and spends approximately £20–25 million on innovation activities under several themes and programmes. These include:

- Innovation collaboration: encompassing networks, partnerships collaborative R&D and innovation platforms. In the area of Knowledge Transfer Networks (KTNs), SEEDA funds facilitation of collaboration and project development amongst networks based around universities and innovation sectors and activities. The Networks have 1,400 members in total, 40 per cent of them small businesses.
- PoCKeT (Proof of Concept for Knowledge Transfer) awards of to £30,000 to innovative SMEs to fund activities such as technology validation, research by specialist academics or use of a university's facilities and equipment. This funding helps enable the business and a university jointly to exploit Intellectual Property Rights (IPR) at the proof of concept phase of commercialisation.
- SEEDA funds deeper R&D collaborations in four areas of technology – nanotechnology, energy, healthcare, and intelligent transport (providing £10 million in funding over three years). This programme of assistance operates through calls for proposals to develop innovations with commercial potential.
- The Innovation Advisory Service provides an adviser for 15 sub-regions of the South East of England, to help existing businesses improve their innovation activities and speed up product and service development. Each adviser has a specialist role – in Reading, the IAS adviser is an IT specialist. IAS provides

up to ten free days of advice to SMEs, and diagnosis and brokerage to other specialist provision where available.

Thames Valley Economic Partnership (TVEP)

TVEP was established to promote inward investment into the area. Since its inception, it has expanded into providing local economic strategies, sustainability plans and activities, and technology/innovation activities and networks. As part of this expansion of its portfolio, TVEP established a number of spin-out networks and ventures including: Innovate Thames Valley (described below); Thames Valley Investment Network in 2003 to link companies that wish to access funding and expertise with investors seeking high quality investment opportunities; and Thames Valley Life Sciences Network with the University of Reading to develop and promote this sector and accelerate technology transfer.

In 2006, TVEP launched Innovate Thames Valley. It is a network organisation with 320 members. It currently seeks to expand its role through the development of a Commercialisation Centre – which will provide online information, advice and networking, as well as having a drop-in centre in Reading.

The Thames Valley urban offering

A large pool of highly skilled labour

The availability of skilled labour in the area is a major source of competitiveness for local firms. Local businesses can access a large, highly skilled and diverse sub-regional labour market, which stretches across the Thames Valley into West London and the South East. In the Thames Valley itself, 48 per cent of the local workforce is educated to degree level – one of the highest rates in the UK.¹¹⁶

Quality of life

Quality of life is perceived to be high in the Reading and the Thames Valley region – making it easier to attract and retain skilled workers. Residential areas are of high quality, with good leisure facilities, green spaces and high performing schools.

National and international transport links

Good national and international transport links are also an important factor behind the success of the ICT sector in Reading and Thames Valley. The area benefits from the combination of a nearby international airport (Heathrow), good connections to road networks (the M4),

115. A Business Improvement District is a precisely defined geographical area within which the businesses have voted to invest collectively in local improvements to enhance their trading environment. Reading was one of 22 announced by the Deputy Prime Minister in 2004.

116. Thames Valley Economic Partnership (2006) 'Economic Challenges Facing the Thames Valley.' Reading: Thames Valley Economic Partnership.

and good rail links to London and the rest of the South East. These links allow colleagues, clients and suppliers from elsewhere in the UK and abroad to access (or be accessed by) firms located in Reading quickly. And firms based in the area are able to access wider national and international labour markets more easily.

Availability of workspace

For small businesses, high commercial rental values and lack of suitable workspace are regarded as a potential disincentive to more innovative and technology-led SMEs starting up or locating in Reading. Generally, commercial space for smaller businesses has been occupied very quickly, signifying high levels of demand. This appears to be being addressed recently with the development of serviced business space through the Davidson House development.

Many of the assets mentioned have made the area a major recipient of inward investment. It is estimated that Thames Valley gets two-thirds of the South East of England's inward investment projects (excluding London).

The role of institutions in the Thames Valley innovation system

Overall, institutions have played less of a role in directly stimulating the growth of the ICT sector in Reading than they have with life sciences in Dundee and Dortmund or with design engineering in Coventry.

Reading University

Reading University is well regarded amongst public and private institutions, and its Knowledge Transfer Centre has an excellent reputation amongst stakeholders and companies for being very business-facing and delivering successful collaboration projects. The university actively serves the ICT sector with its research specialisms. However, in Reading, the university and other public sector research bodies do not play as critical a role in the innovation process as they do with life sciences in Dundee and Dortmund. Instead, the lion's share of innovation takes place in the private sector with only relatively limited involvement from publicly funded research bodies.

The Reading University Knowledge Transfer Centre brokers relationships with business and academic research expertise. Every year about 35 collaborative projects are delivered, mostly with SMEs. The Centre tends to serve sub-regional clients although it has worked with national and international clients where

research specialisms are at this level. The Centre also delivers the Shell STEP programme. The research specialisms for collaborative projects are wide, and include ICT sector-related research in computer science, electrical and electronic engineering, cybernetics, informatics and systems engineering.

Public Sector Research Establishments (PSREs)

Public Sector Research Establishments are both present in the Thames Valley, and immediately adjacent to the sub-region. Farnborough is the base for the UK's Defence Science and Technology Laboratory and QinetiQ (a defence technology company). The Harwell Campus is the location of the United Kingdom Atomic Energy Authority, and Aldermaston is the location of the Atomic Weapons Establishment (responsible for the design, manufacture and support of warheads for the UK nuclear deterrent).

The role of local government

Local actors have played a crucial part in the ICT sector's growth through the provision of infrastructure and in facilitating the development of key sites. Local authorities have helped in developing commercial sites, on which many large ICT corporations are located through planning, site assembly and infrastructural provision. Wokingham and Reading Borough Councils have also worked together on transport provision including Junction 11 on the M4, and the Reading Park and Ride scheme. Although not directly related to innovation, these initiatives have helped establish and maintain this location as a successful business location for ICT companies.

The South East of England Economic Development Agency

As described above, SEEDA invests significantly in supporting business and innovation processes. Without detailed evaluation studies, it is not clear how great an impact these schemes have on the innovation system as a whole. The portfolio of initiatives and services appears to be very much geared towards working with markets and existing networks – an approach which seems well suited to the economy of the region.

The Thames Valley Economic Partnership

Thames Valley Economic Partnership is a private sector-led and -funded network which aims to pursue economic development aims, and to maintain and develop Thames Valley as a competitive business location. Recently the partners have taken the lead in attempting to

address gaps in the innovation system in the sub-region. Private sector members include major corporations, and very senior executives from these companies.

The role of firms in the Thames Valley innovation system

Firms stand at the centre of Reading and the Thames Valley's ICT innovation system. There is a significant presence of research-intensive firms. Out of BERR's top 500 research-intensive companies, 46 have their national, European or global headquarters in the Thames Valley and include such corporations as Vodafone, Nortel Networks, Motorola, Shire Pharmaceutical, Celltech, and Eli Lilly. The majority of these companies have their R&D centres (where they have one) outside of the Thames Valley. This is balanced by those corporations with their research labs in the region, and a number of major R&D sites that are subsidiaries of companies with HQs elsewhere.

In-house research and development

The private sector innovation system is highly complex, with multiple innovation models operating simultaneously across the area. The most dominant model remains in-house research and development, rather than different types of collaboration or open innovation. This suggests that, to-date, firms have benefited more from location factors like the presence of a highly skilled labour market and close proximity to customers and suppliers (discussed below) than they have from formal business interactions, such as research collaborations or takeovers.

The role of networks in the Thames Valley innovation system

Business-to-business links

Highly developed business-to-business networks act as key enablers of deal making. All firms network to do business – whether with suppliers, clients or support services. The proximity of a vast range of up- and down-stream suppliers, clients and businesses in the ICT sector within one hour's travel time from any location in Thames Valley was seen as a big advantage.

However, the physical layout of business premises and location militates against networking in close proximity. Campus style offices can lead to the internalisation of networks, and do not easily facilitate social networking.

The role of markets in the Thames Valley innovation system

The demand 'pull' of the market

In Reading and Thames Valley, the demand 'pull' of the market is the key driver for innovation. Large companies located in this area look to do business with other large companies, either in sourcing innovation or in developing new business models. For innovative companies such as Oracle, who service many corporate clients, their market is very close – 80 per cent of customers are within 45 minutes journey time of Oracle's HQ in Reading. And the customer needs of corporate HQs are very much aligned to internal processes such as customer database management, sales analysis and other HQ market analysis functions.

Access to these markets is a significant factor for success in innovation. The corporate base is significant and diverse, and contains many global and European HQs (such as Vodafone and Verizon for example). Access to London's financial sector is also good. Reading and the Thames Valley's corporate base has global reach, and global market decisions and sourcing take place in this location.

The existing and potential market in Reading/Thames Valley is large. The presence of major ICT corporations, many of them undertaking UK, European or global HQ functions, provides a major market presence, with international reach into other corporate offices and functions.

Conclusions and policy learning - 'urban hubs' and/or 'local links'?

The ICT cluster in Reading and the Thames Valley is driven by the presence of important urban assets and strong 'local links'.

The assets and markets in the area play a key role for the ICT sector in Reading/Thames Valley and are largely responsible for the significant corporate presence. Skills, land availability, high quality business parks and infrastructure are major attractors for inward locating and expanding company headquarters and large scale operations. The strength of the market demand for innovation, and the commercial application of innovation, are key pillars of innovation in this area.

'Local links' are also important, and becoming increasingly so. They are also one of the main areas of development in public/private innovation policy development. This is demonstrated through such initiatives as TVI, The University of Reading's Knowledge Transfer Centre and Microsoft's Innovation Centre.

What are the main challenges for ICT in Reading and the Thames Valley over the next ten years? And what is the role for public policy – if any?

Innovation in the region is occurring across a range of organisations, from universities and spin-outs to major corporations, and fast-to-market small companies. Nevertheless a number of strategic assessments¹¹⁷ suggest that more can be done to unleash the region's full innovation potential. The separate strands of innovation activity in Reading and the Thames Valley are not always connected – corporations are not fully engaged in the local innovation ecosystem; and the rate of enterprise start-ups and spin-outs (especially from large companies) could be improved.

Possible public policy solutions include the opening up of supply chains of major corporations to small enterprises and research institutions; and better support for entrepreneurship.

Encourage and implement 'open innovation' models

There is significant potential to implement and encourage 'open innovation'¹¹⁸ models amongst large companies in Reading/Thames Valley. This has started to happen, but the potential for more corporate spin-outs remains. There is also significant potential for large companies to alter their procurement policies and practices to

encourage the development of local innovative small firms.

Develop strategies and practices to encourage greater networking

Informal networking to do business seems to be lacking in the area due to the presence of large corporations in campus-style accommodation. Large firms dominate the economy. Many with large headquarters functions are not well embedded into their local supply chains and economic networks. Initiatives such as TVI are a good start to encourage the development of a networked innovation community, and have further plans in the pipeline – to provide a commercialisation centre to act as a hub to link businesses to services, or to broker collaborations. They have conducted a study into the provision of this commercialisation centre (TVEP, 2007) and this project is currently in development, and is seeking funding for implementation.

Increase public funding for commercial advice and support

Provision of publicly funded advice and support is limited due to a lack of resources. Reading University's support is successful, but oversubscribed and mainly focused on university-based collaborations. SEEDA advice and guidance, although successful, is limited in scope and scale. Some stakeholders believe that the demand for support outpaces supply, though this was not the view of some small firms. During this study, not enough evidence was collected to assess the provision of private sector support services.

117. Such as the report by Conduit Partners (2006) 'Understanding R&D in the Thames Valley.' Reading: Thames Valley Economic Partnership.

118. Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. For more, see Chesbrough, H (2003) 'Open Innovation: The New Imperative for Creating and Profiting from Technology.' Cambridge, MA: Harvard Business School Publishing Corporation.

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