

**UNIVERSITY AND TECHNOLOGY: SCIENCE AND
TECHNOLOGY PARKS IN THE CAMBRIDGE REGION**

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By

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Abstract

This paper reviews the recent development and growth of small and medium-sized high-technology firms in the Cambridge region of the United Kingdom, as an example of an innovative and R&D-focused business cluster associated with a major international university and successful local science and technology parks. It discusses the concept of a local innovation system and the role of the UK's national innovation system, before attempting to assess the strengths and weaknesses of the Cambridge model of technology transfer and innovation as a possible paradigm of linkages between university research and local high-technology SMEs.

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Introduction

Many commentators argue that rapid recent economic and technological change in Europe reflects to a considerable degree the growth of a new 'knowledge-based' economic system driven by scientific research and continuous technological innovation (Porter, 1990; Secretary of State, 1998). This new knowledge-based system of economic growth embraces both large multinational corporations and small, new entrepreneurial firms, and is most evident in the rise of 'high-technology' industries. These include information and communications technology industries (telecommunications, computer software and services, e-commerce, web design and internet services), bio-technology and pharmaceuticals, digital and multi-media activities, robotics, opto-electronics, aerospace, and even motor racing cars and equipment. At the same time, however, the rise of the " 'new economy', sometimes referred to as the 'innovation economy', ...[as] part of a shift around the world towards knowledge-based enterprises, industries and supporting businesses that rely upon scientific research, technical talent and entrepreneurship to compete effectively", is by no means solely associated "with 'new' products or 'high technology' " sectors (Miller et al, 2001, 53). Older industries, such as Italy's 'industrial districts' and the UK's financial, media and creative industries (Miller et al, 2001, 57-63), also now operate in 'new economy ways', involving active research and development of new knowledge and resultant enhanced innovativeness and competitive performance.

The crucial importance of innovation and research for firm competitiveness in the new knowledge-based economy has in turn led to increasing interest by governments and academic observers alike in the role of national and regional 'innovation systems'. As defined by Lundvall (1992; quoted in Cooke, 1998, 11), "an innovation system consists of elements and relationships that interact in the production, diffusion and deployment of new and economically useful knowledge". As Cooke points out, "clearly, an innovation system is a social system, and innovations are a result of social interaction between economic actors". Effective innovation systems are thus characterised by high levels of co-operation and interaction

between firms, and between firms and 'learning institutions' such as universities, public research laboratories, business advice and training agencies. Countries or regions which have succeeded in developing effective innovation systems can also be viewed as 'learning economies' (Lundvall and Johnson, 1994), in which active processes of 'collective learning' (Camagni, 1991) by firms and learning institutions engender continuous incremental and radical innovation, often through the combining of technologies and the spinning-off of new enterprises. Such collective learning processes are especially evident in certain regions, characterised by Camagni as 'innovative milieux', such as Italian industrial districts, European high-technology regions (Keeble and Wilkinson, 2000), and localised media clusters in Hollywood, Paris or Soho, London (Nachum and Keeble, 1999).

Within the context of the innovation system and learning economy literature, this chapter focuses explicitly on one particular type of successful innovation system and milieu, namely that comprising the cluster of high-technology firms, research laboratories and science and technology parks in the Cambridge region of the United Kingdom. This cluster is widely seen as emerging from and closely linked to scientific research carried out by Cambridge University, with its global reputation for basic science and exceptional concentration of highly-qualified scientists and researchers. The UK government appears to view the 'Cambridge Phenomenon' (SQW, 1985, 2000) as an outstanding example of technology transfer and university/public research laboratory stimulus to the growth of local technology-based firms, especially new entrepreneurial start-ups in high-technology sectors such as biotechnology and information and communications technologies (ICT) (Secretary of State, 1998, 2000; Lord Sainsbury, 1999). How valid is such a view, what role have links with Cambridge University and public research laboratories played in the growth of local innovative high-technology firms, and what are the strengths and weaknesses of the Cambridge model of scientific research and technology transfer?

To assess the issues, the remainder of this chapter therefore examines in turn the growth of innovative high-technology firms in the Cambridge region, the nature of the UK national system of innovation and national science and technology policy within which this growth is embedded, the role of Cambridge University and other local 'learning institutions' in local technology transfer, collective learning and innovation, and the specific contribution of local science and technology parks, notably the Cambridge Science Park and St John's Innovation Park. The analysis will conclude by attempting to draw general conclusions of wider relevance to regional and national innovation policies.

The Growth of Innovative High-Technology Firms in the Cambridge Region

The success of the 'Cambridge model' of science- and technology-based innovation is most evident in the remarkable growth of high-technology firms and jobs in the Cambridge region¹ since the 1960s (Figure 1). By 2000, the region contained 920 high-technology firms (CCC, 2000), employing 31 thousand workers, compared with only 30 firms and perhaps 500 employees in 1960. This growth has transformed the Cambridge region from an economically placid, university-dominated, economy to one ranked by Barclays Bank (1998) as Britain's most entrepreneurial county (out of 55 counties), with the highest proportion of entrepreneurs involved in starting new businesses as a percentage of the local workforce. At the same time, at the European level, Cambridgeshire was ranked 1st out of 445 European regions in 1998 (Barré et al, 1998) for its rate of scientific publications in both engineering and biological sciences relative to GDP, 2nd for scientific publications in all sciences, and 14th – only after giant cities such as Paris, London, Munich and Milan – on an overall index of scientific and technological activity which also includes technology production through patents. Cooke and Huggins (2001) argue that "Cambridge is the leading location for biotechnology businesses in Europe". Though a very small economy², the Cambridge region is thus not just a national, but also a European centre of scientific research and technological innovation.

The growth of technology-based firms in Cambridge is also noteworthy because of these firms' exceptional R&D orientation, small size, and innovativeness. In contrast to Italy's sectorally-specialised industrial districts, the Cambridge high-technology cluster is exceptionally diverse sectorally (Figure 2). However, most firms share a common, marked and distinctive orientation to R&D³, actual production of goods being carried out elsewhere in Britain and overseas, frequently by licensing. An excellent example is ARM, one of the cluster's international success stories, whose growth from a staff of 12 on start-up in 1990 to 659 employees world-wide in 2001, and to inclusion in the London Stock Exchange's top 100 UK companies by stock market value, has been based entirely on R&D and the licensing of its unique micro processing technology for production by semi-conductor multinationals around the globe. R&D consultancies providing R&D services to clients also constitute the largest single component of the Cambridge high-technology cluster (Figure 2). This R&D orientation is a key reason for the dominance of service rather than manufacturing firms in the cluster's recent growth (Figure 3).

The Cambridge technology cluster is also a small firm cluster, dominated by small, entrepreneurial and locally-founded enterprises. 57% of local high-technology firms employ 10 or fewer workers, with 92% employing less than 100 (CCC, 2000). 88% of these began life in Cambridge as new start-ups or spin-offs, most spinning-off from existing local technology-based firms, such as the R&D consultancies (Keeble et al, 1999). Perhaps linked to this, the Cambridge technology cluster is also exceptionally innovative in inventing and developing new technology-based products and services. No less than 92% of a sample of 100 small high-technology firms interviewed in the Cambridge and Oxford regions in 1996 reported developing new product innovations during the preceding three years, with 65% of these firms deriving at least 50% of current sales from these innovations (Keeble, 2000). This is a significantly higher proportion than amongst small high-technology firms in Britain generally, the national average for such firms being 72% in 1997 (Keeble, 2000). Exceptional innovativeness is thus a further

distinctive feature of the Cambridge model of science- and technology-based economic growth.

A final very significant characteristic of the Cambridge model is the clear role in local innovation of active and dynamic 'collective learning processes' (Camagni, 1991), whereby new knowledge, both technological and managerial, is created, applied, diffused and shared between local firms and learning institutions. The three most important such learning processes are the local movement and spin-off of embodied technological and managerial know-how in the form of entrepreneurs and new firms; formal and informal networking, interaction and collaboration between local firms and between firms and learning institutions; and local flows of highly-qualified research and professional staff carrying new knowledge and expertise between firms. These processes have been powerfully encouraged by favourable 'preconditions for learning' in the form of an historic positive Cambridge University culture of research co-operation, and the active role of large local private R&D consultancies - which themselves evolved out of the University - in spinning-off and supporting new technology start-ups. The evolution of a significant local collective learning capability has however taken time - at least two to three decades - and requires a critical mass of firms and highly-qualified staff (Keeble et al, 1999).

The UK National System of Science, Technology and Innovation

The Cambridge model of technology transfer and innovation is of course embedded within and shaped by the national UK innovation system. Historically, this national system is widely viewed as being dominated by a 19th-century legacy of large firms and declining manufacturing industries, with a decline in the 20th century in numbers of innovative small firms and entrepreneurs. In 1988, for example, average firm size in the UK was double that in Italy (8 compared with 4 employees), with small firms (less than 10 employees) providing only 26% of UK employment compared with 48% in Italy (Storey, 1994, 22). Since the 1960s the UK has also experienced acute de-industrialization of its historic manufacturing

base, albeit along with substantial growth in financial, professional, consultancy, media and other services.

The UK's record in science and technology is also patchy. On the one hand, a number of its historic universities - Cambridge, Oxford, London, Edinburgh - have outstanding global reputations for scientific excellence and research. Since 1904, Cambridge University scientists alone have received no less than 60 Nobel Prizes for radical scientific discoveries, a total greater than that for many European countries. The UK is also a world leader, historically, in specific R&D-intensive industries, such as pharmaceuticals, aerospace and motor racing cars. On the other hand, UK firms generally invest less in R&D than do firms in many other major industrial countries (with the notable exception of Italy), UK government R&D expenditure is historically heavily biased towards defence industries (and has declined since the 1970s), and until the 1990s at least, UK high-technology industry's employment growth, output and productivity performance was "dismal" (Breheny and McQuaid, 1988, 305).

Although the Thatcher and Major Conservative governments of the 1980s and 1990s claimed to have promoted a new 'enterprise culture' in which high-technology entrepreneurs and start-ups could flourish, UK science and technology policy during this period was weak and government expenditure on public R&D and on university research was significantly reduced, not increased. These governments did however exert considerable pressure on universities to increase their links with industry, by seeking research funding, providing consultancy, and promoting university-owned technology spin-offs and science parks. The number of UK science parks (all of which have operational links with local universities or other knowledge institutions) thus rose from only 2 in 1981 to 51 in April 2001⁴. Private sector venture capital provision, some of it for high-technology firms, has also grown substantially in line with government encouragement.

Since 1997 and the election of the Blair 'New Labour' government, however, UK innovation, science and technology policy has been markedly upgraded, as indicated by three major recent government

White Papers announcing policy initiatives (Secretary of State, 1998, 2000, 2001). The policy emphasis is now on strengthening and enhancing university basic science infrastructure and research capacity (for example by a £1 billion partnership with the Wellcome Trust to renew university science buildings and equipment); on further encouraging and stimulating university-business links and collaboration (for example, via a new Higher Education Innovation Fund to strengthen university links with firms, especially small firms, and the establishment of a new national network of 'university innovation centres'⁵); and on supporting the development of local "clusters" of small technology-based firms linked to local universities (for example, via a new £50 million national 'innovative clusters' fund, and new Regional Innovation Funds). The Cambridge biotechnology cluster (Lord Sainsbury, 1999) has been publicised by the government as a national role model in this respect. Government policy towards university-business technology transfer and links is thus far more supportive than in the past, although these policy initiatives are too recent to assess their effectiveness.

The Cambridge Model of University-Business Local Research Linkages and Technology Transfer

In attempting to assess the nature, strengths and weaknesses of the Cambridge model of technology transfer and innovation as a possible paradigm of linkages between university research and local high-technology firms, three important qualifications need first to be highlighted.

Firstly, as a major world centre of scientific research, most of Cambridge University's technology transfer links with firms are national and global, rather than local. The fact that most of its research links are not local also reflects the historically very small scale of industrial activity in East Anglia, unlike universities located in major industrial regions such as those of Birmingham, Manchester, Turin or Milan.

Secondly, innovation in Cambridge also reflects active technology transfer from, and high-technology firm collaboration with, two other very important types of local learning institutions, namely R&D

consultancies and public research laboratories⁶. The former are perhaps a unique component of the Cambridge model, with consultancies such as Cambridge Consultants, Generics, PA Technology, and The Technology Partnership actively encouraging the spinning-out of numerous local technology start-ups. Up to 100 local firms now have at least one founder from one of these technology consultancies (SQW, 2000, 48). The numerous local public research laboratories – the Medical Research Council's Laboratory of Molecular Biology (scientists from which have won 9 Nobel Prizes), the Babraham Institute, the Sanger Centre – also act as important foci of new technology innovation and diffusion, again generating a significant number of spin-offs and start-ups. This said, it is of course also true that all these other learning institutions only exist in the Cambridge region because of the presence of Cambridge University. The public research laboratories were established locally in order to benefit from research links and collaboration with Cambridge University, while Cambridge Consultants, from which ultimately all the other consultancies owe their origin, was itself set up in 1960 by a group of newly-graduated Cambridge University engineers and scientists (SQW, 1985, 18).

Thirdly, in many ways the once-central role of Cambridge University in the Cambridge Phenomenon has been diminished in recent years by the rapid growth of numerous non-university local institutional initiatives, often business-led. These have resulted, in Amin and Thrift's phrase, in a significant "thickening" of the local institutional environment supporting innovation by technology-intensive firms. Amin and Thrift (1995) argue that successful local economies, and especially knowledge-based learning economies, need to develop an interlocking and integrated web of supportive organisations and institutions, characterised by synergies of interaction, collective representation and common purpose. In their view, "local institutional thickness can have a decisive influence on economic development", since thickness "nourishes relations of trust,...stimulate[s] entrepreneurship and consolidate[s] the local embeddedness of industry". Recent mainly non-university initiatives which have undoubtedly helped to "thicken" the local institutional environment

and encourage the continuing growth of the Cambridge high-technology cluster are outlined in Table 1.

While most recent institutional initiatives to promote local high-technology firm innovativeness and competitiveness have been business- or government-led, it is nonetheless widely agreed that the inception and growth of the Cambridge high-technology cluster has primarily been due to the role of Cambridge University as a global centre of scientific excellence, with its exceptional research performance and concentration of scientists, engineers and technological expertise. Five major, and to some extent distinctive, elements to the university's role in this respect are noteworthy, with changes in emphasis over the thirty years of growth of the Cambridge cluster.

First, the Cambridge model of university technology transfer via spin-offs and collaborative research links is historically based on a very liberal and benign "laissez-faire" institutional attitude to university researchers commercialising and exploiting their research expertise and innovations. As the Cambridge Phenomenon study (SQW, 1985, 69) pointed out, "the Cambridge approach stands in sharp... contrast to those of most other British Universities" in that it involves "a reliance on research excellence and on liberal ground rules governing its exploitation rather than by means of formal regulation and institutional devices". As a result, a high proportion of local high-technology firms in 1985 owed their existence to Cambridge University, either directly or indirectly by spin-off from firms which themselves originally spun off from university science departments. Even today, 16% of all local high-technology start-ups were founded by an entrepreneur from Cambridge University or a local public research laboratory (SQW, 2000, 32). Equally, 50% of local high-technology firms report research and collaborative links with Cambridge University since formation, with over half (56%) of these regarding such links as important for their firm's development (Keeble et al, 1999, 325). Some increased formalisation of ground rules on the sharing of financial returns from successful commercialisation of university research has recently been adopted by the University, but without fundamentally altering its traditionally

benign attitude to entrepreneurial and collaborative initiatives by its own researchers, in contrast to other British universities such as Oxford (Lawton Smith et al, 2001).

Secondly, Cambridge University was the first in Britain and possibly Europe actively to support the creation of a "science park", namely the Cambridge Science Park, established in 1970. It is important to stress that this was not set up by Cambridge University itself, but by one of its Colleges, Trinity College, an autonomous academic institution possessing substantial financial resources, land, and the ability to wait - unlike private developers - for no less than ten years before any net financial return from the Park was received. Trinity's Science Park was however a direct response to the 1969 University Mott report which recommended a pro-active University policy of supporting local technology transfer, the growth of small science-based firms, and the establishment of a science park along US lines. The University itself set up its own Industrial Liaison and Technology Transfer Office (now the Wolfson Industrial Liaison Office) in 1970 (Lawton Smith et al, 2001). The eventual success of the Cambridge Science Park has generated an invaluable global media 'image' and publicity for Cambridge as a centre of high-technology innovation, and has led to a succession of similar initiatives (see Table 1). The most significant of these is St John's Innovation Centre and Park (see Table 2), again created by a Cambridge College (this time St John's) which possessed the necessary 'patient' long-term finance and suitable site. 'Hands-on' property development by its Colleges which embodies informal if not formal links with Cambridge University science and engineering departments has thus been a further important component of the University's role in fostering local innovative firms.

A third feature of this University role is its recent adoption of a new 'embedded laboratories' policy towards large, often multi-national, high-technology companies. Historically, the Cambridge Phenomenon has centred on small, not large firms. Since 1996, however, and the appointment as University Vice-Chancellor of Sir Alec Broers, a former US IBM head of research, deliberate attempts have been made to attract major multinational R&D laboratories to

establish themselves alongside and collaborate with University science and engineering departments as 'embedded laboratories'. This new policy is based on the argument that in a modern global world, major technological innovations now require massive financial resources and R&D investment only available through collaboration with giant multinational corporations. From a university perspective, "big science needs big companies". Cambridge University is thus attracting a growing flow of multinational R&D laboratories, set up alongside appropriate university departments by companies such as Glaxo, Hitachi, Toshiba, Unilever, BP Amoco and Microsoft, whose Cambridge European Research Centre is being built alongside the University's new Computer Laboratory, the latter itself partly financed by Microsoft's founder, Bill Gates (SQW, 2000, 17).

A fourth element of Cambridge University's evolving technology transfer role are new university initiatives since 1999 to encourage entrepreneurship and commercial exploitation of university research by staff, students and local firms. These include the University's new Cambridge Entrepreneurship Centre, a new Cambridge University Institute for Manufacturing, the new Cambridge-MIT Institute to promote joint US-British research and innovation, and new business outreach programmes with government Challenge Fund (university spin-offs) and HEROBAC (Higher Education Reach Out to Business and the Community) funding. The University is thus moving into a new phase of active promotion of high-technology entrepreneurship and the creation of knowledge-based firms, building further on the work of its Wolfson Industrial Liaison Office. Since 1990, the University has spun-off at least 33 new technology companies.

Finally and indirectly, Cambridge University's scientific reputation confers global credibility and major marketing advantages on local high-technology companies simply by geographical association. In a recent survey, the second most frequently-cited region-specific advantage rated as important by local high-technology firms (70% of respondents) was "the credibility, reputation and prestige of a Cambridge address", the first (80%) being the region's "attractive local living environment for staff and directors". Both these are inseparable from the presence of the University.

The Role of Science and Technology Parks

The origins and role of Cambridge's two university-related science and technology parks, the Cambridge Science Park and St John's Innovation Park, have already been touched on in previous sections. As pointed out there, the Cambridge Science Park (see Figure 4) has played a very important role in publicising and symbolising local high-technology growth, but now provides only one-eighth of all local high-technology employment. It is not formally associated with or run by Cambridge University, but was set up by one of its autonomous - and wealthy - colleges, Trinity College, and is managed on behalf of Trinity by a local property company, Bidwells. The great majority of companies there are not university spin-offs. The more recent (1987) St John's Innovation Park has played a much more pro-active role in promoting small technology start-ups, including some university spin-offs, and in providing business support to other local technology-based enterprises (400 per year) through its Innovation Centre, as outlined in Table 2⁷. The Centre has close links both with Cambridge University and local government-funded business support agencies. Its successful outreach policies and continuing growth owe much to the entrepreneurial approach of its Director, Walter Herriot, a former local Barclays Bank high-technology manager, not a university academic.

Conclusions

The growth of a substantial cluster of highly-innovative technology-based firms in the Cambridge region over the past 25 years has been largely a spontaneous 'bottom-up' phenomenon, rather than one planned or orchestrated by either Cambridge University or government. That said, the role of the university has been central to its success in various contextual and direct ways. What then have been the strengths and weaknesses of the Cambridge model of scientific research, technology transfer and innovation, and what lessons from it might be of relevance to other regions and countries?

In terms of strengths, the Cambridge experience strikingly demonstrates the benefits and importance of regional *clustering* around a major university or learning institution for cumulative high-technology firm growth and innovation. Firms in the Cambridge cluster, like those in other European clusters, are significantly more innovative than high-technology firms elsewhere (Keeble, 2000), while high rates of firm spin-off and growth directly reflect the exceptional opportunities for entrepreneurial and technological combination, as well as access to capital, labour and business support structures, provided by a cluster. The local concentration of highly-qualified researchers, scientists, engineers, managers and professionals provides a pool of potential entrepreneurs and skilled labour which stimulates innovation and firm creation. Clustering is thus demonstrably beneficial for firm innovativeness and technology development. It is not surprising that the current British government is placing great stress on promoting clusters as a means of enhancing regional and national innovativeness and competitiveness (Secretary of State, 1998, 2000).

Another strength is the University's historically liberal regulatory attitude with regard to the commercialisation of research and knowledge by its staff and researchers. Most commentators agree that the University's willingness to share or even forego direct benefits in terms of intellectual property rights (IPR) has provided an exceptionally fertile environment for firm spin-offs, collaborative links and technology transfer, unlike the approach of most other British universities. At the same time, the historic presence of autonomous and wealthy colleges prepared to act entrepreneurially in establishing science parks, and to wait patiently for decades before enjoying financial returns, has also played an important role. The University's new policies of attracting multinational 'embedded laboratories' and greater active intervention in fostering spin-offs are perhaps too recent to warrant assessment, although both seem logical developments.

The Cambridge experience also however possesses certain weaknesses in terms of its relevance and transferability to other regions and countries. It is clear, with hindsight, that the Cambridge

region has enjoyed an exceptional if not unique combination of advantages for the growth of innovative, knowledge-based firms. These include the outstanding scientific achievements and reputation of Cambridge University, a very accessible location close to the world city of London with its global air communications and financial centre, and a local living environment perceived as highly attractive - within a British context - by the key human actors in the innovation story, high-technology entrepreneurs and research staff. Smaller and less prestigious universities, as well as universities in peripheral locations and old industrial regions, are much less favourably situated in these respects.

The Cambridge - and British - technology transfer model has also been criticised for failing to generate either effective local collaborative networks or large firms, as in US clusters such as Silicon Valley (Saxenian, 1988). This historic criticism is probably no longer valid with respect to local networking, with relatively high levels being reported by recent surveys (Keeble et al, 1999; Cooke and Huggins, 2001), while the small UK and still-fragmented European markets render rapid firm growth to a substantial size very difficult for new high-technology start-ups. A further possible weakness of the Cambridge model is its inability to generate substantial local manufacturing activity, high levels of R&D very rarely resulting in local manufacturing growth (Figure 3). This reflects the fact that the Cambridge region provides an inappropriate environment for modern manufacturing activity, in terms of high costs and limited availability of appropriate skills, labour, premises and management expertise. Firms therefore license or subcontract manufacturing resulting from their R&D activity to other, sometimes overseas, locations.

A further important issue of wider relevance relates to Cambridge's science and technology parks. Their history indicates even in this successful case science park development requires the availability of long-term, 'patient' capital, which is prepared to accept negative financial returns for a considerable period. This may well suggest the need for public rather than private funding of new university-related science parks, while government policy to promote innovative

technology-based clusters also needs to adopt a long-term, not short-term, perspective⁸.

Finally, in terms of wider relevance, the Cambridge experience shows clearly that government attempts to promote innovative technology clusters must be carefully tailored to the particular historic, social and spatial environment of a particular region; that successful clusters need to be built on existing strengths, notably strengths in terms of university research and scientific excellence; and that therefore only relatively few regions in any country are likely to offer favourable conditions for the promotion of an innovative technology-based cluster. Governments may also have an important role to play in helping to 'thicken' the local institutional environment for innovation in terms of supportive institutions and networks, many of the recent developments in the Cambridge case (Tables 1 and 2) reflecting recent government-funded initiatives and a new national UK policy of active promotion of innovation through university research, science and technology.

Notes

- ¹ The Cambridge region is here defined as the local government administrative districts of the City of Cambridge, South Cambridgeshire and East Cambridgeshire. This region extends outwards for approximately 20 kilometres from central Cambridge, and incorporates the main daily commuting hinterland of the city.
- ² In 1998, firms and organisations in the Cambridge region provided employment for only 150,500 workers (CCC, 2001).
- ³ SQW's 'Cambridge Phenomenon Revisited' study (Part Two, 2000, 42) found that across their database of 350 high-technology firms, average R&D expenditure was 28% of total sales, with science graduates making up on average 42% of each firm's workforce.
- ⁴ The latter relates only to parks which are members of the UK Science Park Association.
- ⁵ "These will be top class, long term research partnerships between major business interests and the university sector....They will be at the heart of cluster development and support for new start-ups and businesses...in business incubators. Through them, businesses will be able to make the most of the specialist knowledge that is available regionally" (Secretary of State, 2001, 3.15).
- ⁶ This term is used to include both independent non-university research laboratories which are largely funded through the government's Research Councils (for example the Babraham Institute, formerly the National Institute of Animal Physiology and Genetics), and laboratories largely funded by non-profit making Trusts (such as the Wellcome Trust's famous Sanger Centre at Hinxton Hall, which has mapped one-sixth of the human genome).

⁷ I am indebted to the Director of the St John's Innovation Centre, Walter Herriot, for the information in Table 2. See also <http://www.stjohns.co.uk>.

⁸ As for example with Sophia-Antipolis, which has taken 25 years to evolve as an effective innovative milieu exhibiting dynamic collective learning processes (Longhi, 1999).

TABLES AND FIGURES

FIGURE 1

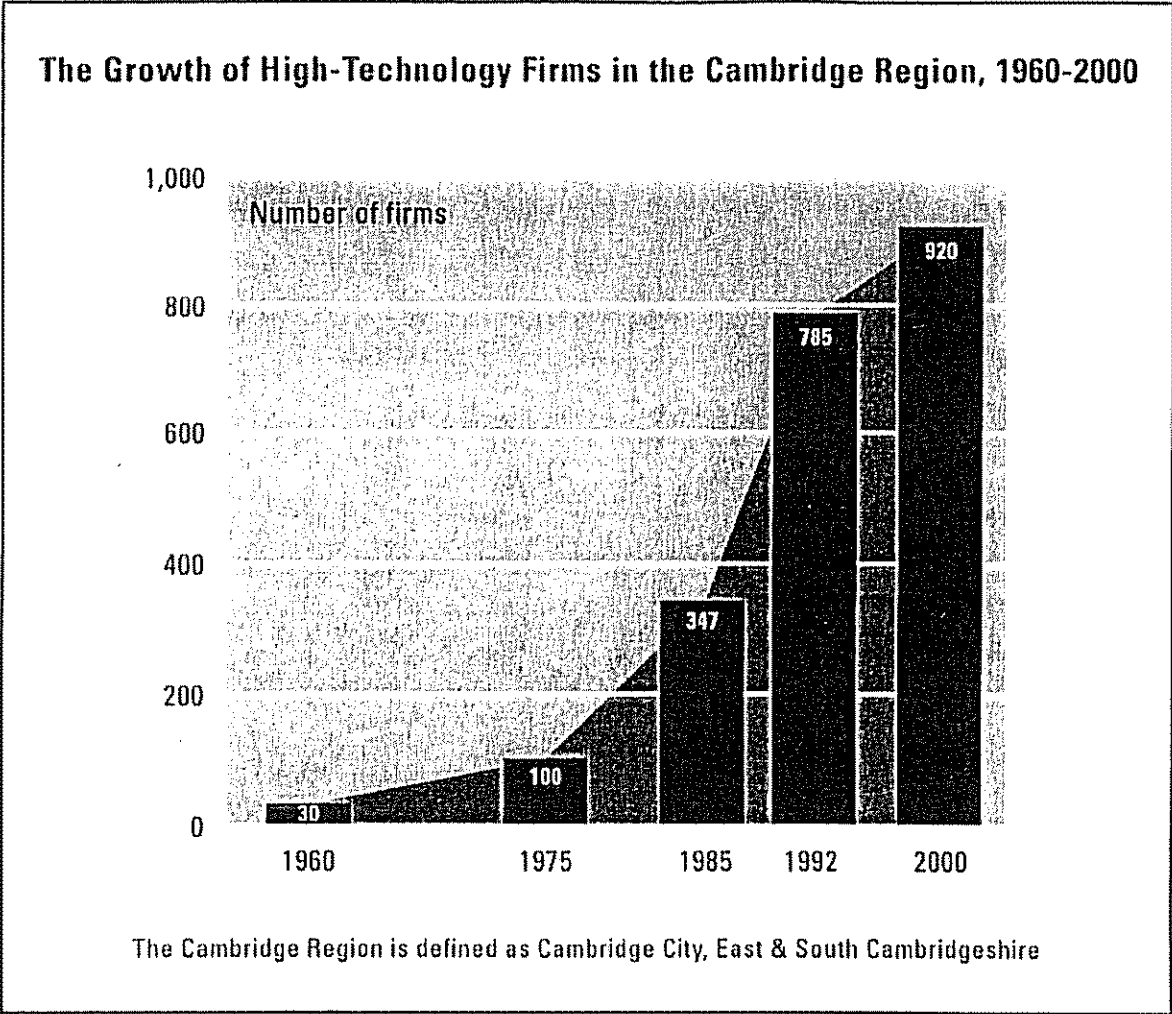


FIGURE 2

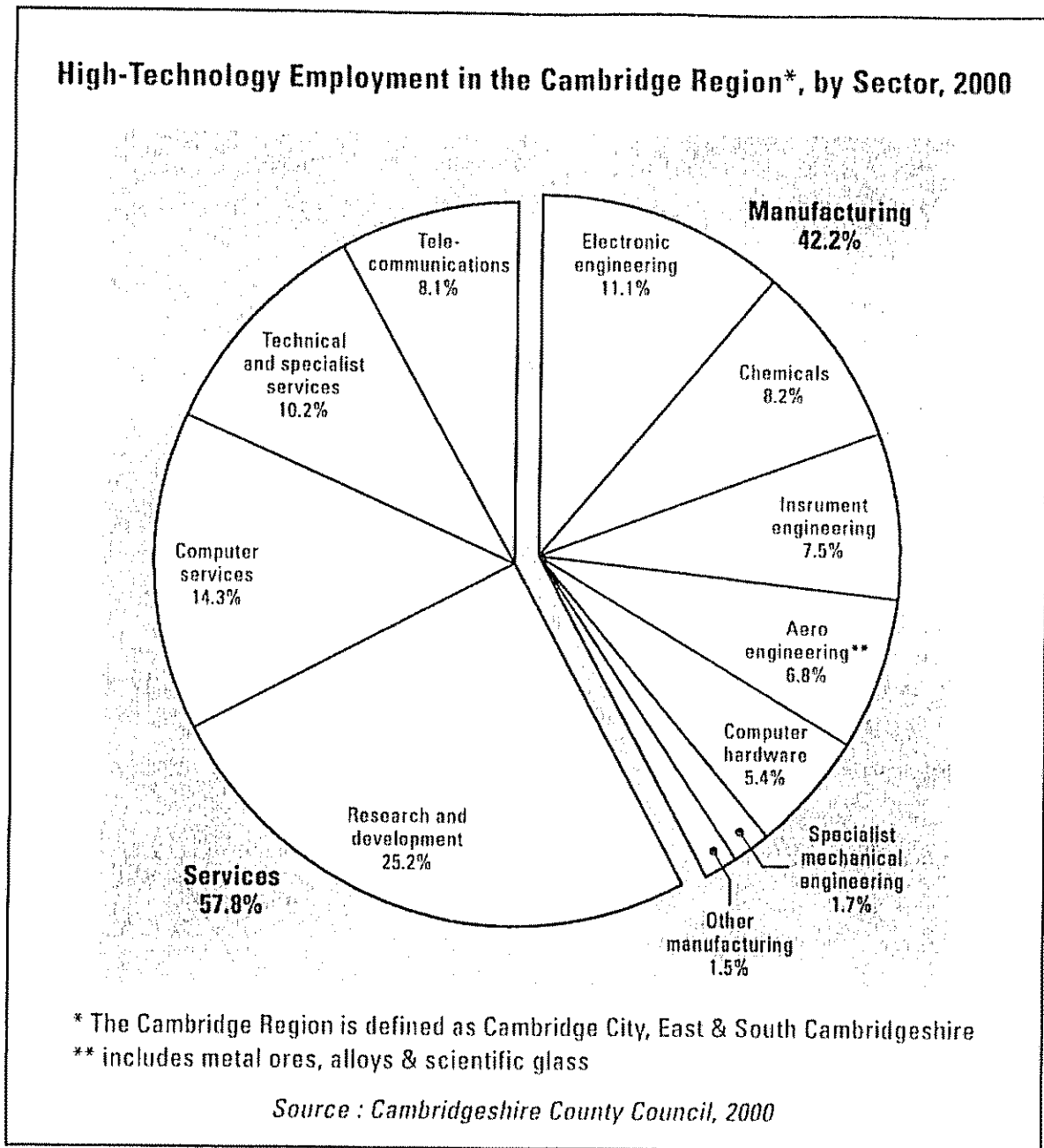
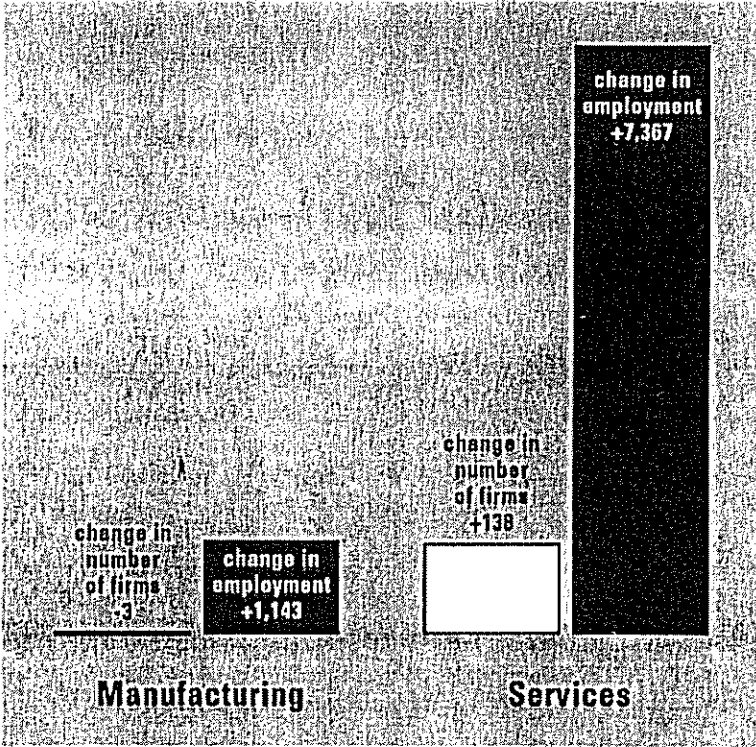


FIGURE 3

The Changing Balance of High-Technology Manufacturing and Services in the Cambridge Region, 1992-2000



The Cambridge Region is defined as Cambridge City, East & South Cambridgeshire

Source : Cambridgeshire County Council, 2000

FIGURE 4

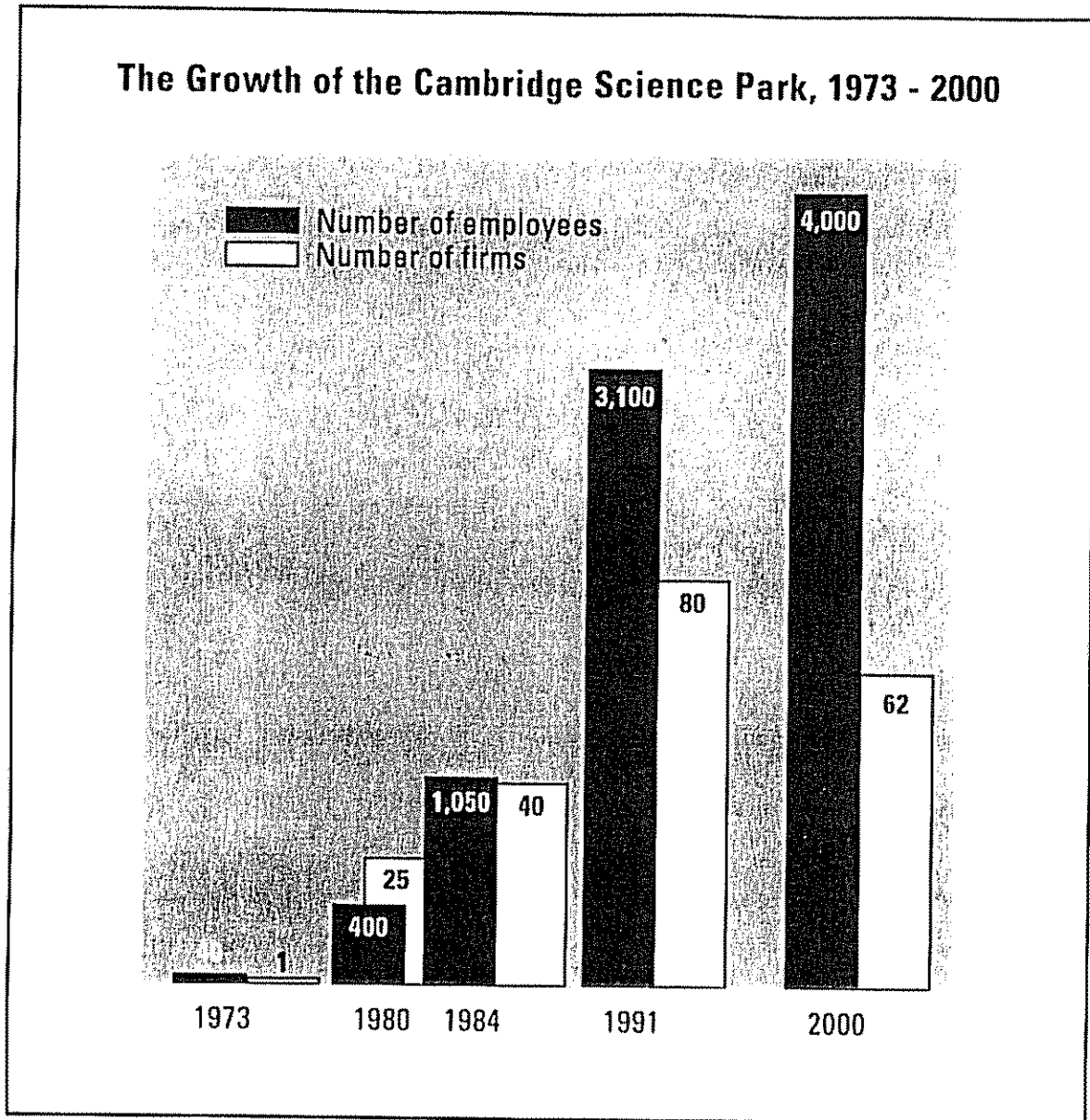


TABLE 1: Thickening the Institutional Environment: New Collective Initiatives in the Cambridge Region, 1998-2001

Cambridge Network

High-technology business-led initiative (Herman Hauser, David Cleevely) to raise global profile of and increase local networking by Cambridge IT companies. Incorporates Cambridge Connect, an interactive website modelled on San Diego Connect relating to the Cambridge subregion and business support facilities available to other businesses.

Greater Cambridge Partnership

Operating since 1998 to develop consensus between local business, government (county and districts) and university on future economic strategy for Cambridge region, in face of constraints and conflicts: strong business involvement, working groups on business development, planning and capacity constraints, employee skills, investment promotion and attraction.

Cambridge Futures

Academic and business alliance investigating, with private sector funding, alternative 50-year scenarios for accommodating anticipated growth: report published May 1999, work on local transport problems and infrastructure provision ongoing.

New Science Parks

Cambridge region now contains four Science Parks (Cambridge Science Park, St John's Innovation Park, Melbourn Science Park, and the new - since 1998 - Granta Park) plus a new BioIncubator (with 18 biotechnology firms) at the Babraham Institute, a new Bioscience Innovation Centre on St John's Innovation Park, and plans with government permission for a 26,000 square-metre biotechnology park at Hinxton Hall (associated with the Wellcome Trust's Sanger Centre Human Genome Project).

St John's Innovation Centre as Regional High-Technology Business Support Agency

Established 1987 to house new high-technology start-ups (50 current firms plus 100 "graduates" who have moved to larger premises), the St John's Innovation Centre on the St John's Innovation Park now plays a key role in providing support and advice to small technology-based firms throughout the region, in partnership with other agencies (see Table 2).

Proliferating Private Venture Capital Funds

Prelude Technology Investments

Amadeus Capital (includes Microsoft venture capital fund)

Cambridge Research and Innovation (CRIL)

Gateway Fund

Avlar bioscience seed fund

QTP high-technology seed fund

3i plc Cambridge Office

New Cambridge University Initiatives

Establishment of new Cambridge Entrepreneurship Centre, Cambridge University Institute for Manufacturing, Cambridge-MIT Institute (CMI), new business outreach programmes with government Challenge Fund (university spin-offs) and HEROBAC (Higher Education Reach Out to Business and the Community) funding, all since 1999.

New Cambridge-based Eastern Region and European Initiatives

Two major new government-funded regional development organisations, the East of England Investment Agency and the East of England Development Agency, have established their headquarters in Cambridge since 1998. The former is promoting inward foreign investment to the region, while the latter is developing a new Regional Innovation and Technology Transfer Strategy, with co-funding from the European Commission. The latter has also established a European Innovation Relay Centre in Cambridge, based at St John's Innovation Centre.

TABLE 2: St John's Innovation Centre, Cambridge

Phase 1: Incubator (1987-present)

Objective of housing early-stage innovative or embryonic high-technology businesses unable to afford commercial rents

8,000 square metres floorspace

50 current firms, plus 100 more "graduates" who have moved to larger premises since 1987

Winners - Symbionics/Tality, Muscat/Dialogue, Autonomy, Zeus, Technetix

Firm failure rate 1987-98 only 1% per year, despite severe 1990s recession (c.f. 5.5% per year failure rate 1988-92 for all Cambridge high-tech firms, itself less than half the UK average - Garnsey)

Phase 2: Internal Incubator Activity and Running Programmes for Firms outside the Innovation Centre (1994-present)

Equity Advisory Service (advice on financial and business planning: now 25-30 new clients every month)

Anglia Enterprise Network (experts - "ferrets" - employed actively to seek out new business opportunities emerging from Cambridge University science departments: began late 1997, now run by Cambridge University's Cambridge Entrepreneurship Centre)

Shell Technology Enterprise Programme (organises student placements with local high-technology firms)

Cambridge Entrepreneurship Conference, started 1997: now run by the University's Cambridge Entrepreneurship Centre

Phase 3: Fully Integrated Incubator and High-Technology Business Support Centre (1998-present)

With funding from the Gatsby Trust (not government)

All existing programmes plus:

European Relay Centre

High-Technology Business Club/Enterprise Link (in partnership with government-sponsored Business Link agency and Cambridge University)

Close cooperation and collaboration with new Cambridge Entrepreneurship Centre, Judge Institute of Management Studies, and Cambridge University Institute of Manufacturing

Close partnership with Cambridgeshire Business Services, the government Small Business Services franchise-holder for the Cambridge region

Cloned Innovation Centre Initiative (development of cloned centres in Littleport, St Neots, Knebworth 17 proposals under consideration)

Business Angel Database and close collaboration with Great Eastern Investment Forum

Support for the Oxford-Cambridge Technology Arc initiative

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