The Cluster Effect

Can Europe Clone Silicon Valley?

by Des Dearlove
From his office in a renovated five-story 19th-century mill house, Gordon Edge looks out on rural Cambridgeshire. He can see swans floating in the river Rhee, trees overhanging the water, lush greenery along the riverbanks. It’s the stuff of a pastoral England postcard. Walk beyond the mill to the flat-roofed campus of 1960s-style office buildings, and you get a sudden pull into the future. Harston Mill is the headquarters of the Generics Group Limited, which Professor Edge founded and which he serves as CEO. The company is in the heart of Silicon Fen, one of the emergent high-tech clusters some believe could be Europe’s answer to Silicon Valley.

There’s more than historical contrast to the location. The venerable Cambridge region has become a hotbed of high-tech activity, a nurturing environment for a company like Generics, which develops and exploits intellectual property. The University of Cambridge, one of the world’s leading science and technology universities, is a 15-minute drive from Generics. Within a 20-mile radius of Cambridge are more than 1,500 high-tech and knowledge-based firms. The energy of Silicon Fen — even without the emergence of dozens of other concentrations of high-tech activity in Britain and on the Continent — suggests that Europe may finally be getting its technology act together.

Generics is a new type of European high-tech firm. Part scientific research company, part technology consulting firm, and part incubator, this hybrid company funds research in optics, new materials, and telecommunications; licenses its intellectual property rights (IPR) to other companies, many of them in the U.S.; and spins out startups. A company so committed to turning scientific research into commercial products is a new and encouraging development in Europe.

Cambridge University has been producing groundbreaking research for centuries. It was at Cambridge, for example, that Sir Isaac Newton first propounded the laws of gravity, Charles Darwin described the laws of natural selection, and Professor J.J. Thomson discovered the electron. More recently, Cambridge physicists Sir John Douglas Cockcroft and Ernest Thomas Sinton Walton split the atom with the first nuclear particle accelerator in 1932, and Maurice Wilkes created the first digital computer in 1949. Francis H.C. Crick and James Dewey Watson published the structure of DNA in 1953, and for the last few years, Cambridge researchers have been busy unraveling the sequencing of the human genome.

Historically, however, the region — like the rest of Europe — has failed to convert much of its research into commercial applications. In Europe, there has been nothing to compare with the entrepreneurial powerhouse of Silicon Valley, where technological innovations are rapidly converted into business applications. This has meant that much of Europe’s IPR have gone to the U.S. for commercial development. Tim Berners-Lee, for example, created the protocol for the World Wide Web at a physics research institute in Switzerland, and Linus Torvalds originated the Linux operating system in Finland, but both innovations were converted into commercial applications by U.S. entrepreneurs.

The potential of reversing that trend is one reason Silicon Fen and other emergent European high-tech clusters excite European interest. The U.K. now has a number of such clusters, Silicon Fen being the most promising one. Others include Silicon Glen in Scotland, Silicon Ditch along the Thames Valley, and Motorsport Valley centered on Oxfordshire (see “Focus: Motorsport Valley,” page 5). Elsewhere in Europe are other springs of activi-
technology: around Munich and Stuttgart in Germany; at Sophia Antipolis in Southern France; at Kista in Stockholm; around Dublin; around Oulu in Finland; and in the Etna Valley in Sicily. For an area of the world that has been good at innovation but poor at exploitation, the new clusters may nurture a European high-tech industry that will finally rival that of the U.S.

The Paradox of Location

Europe’s emerging high-tech clusters are attracting the interest of European policy-makers, entrepreneurs, and investors, but clusters are not new. Concentrations of specialized companies are dotted around the industrial world and occur in virtually all industries. The Hollywood film industry and Detroit automotive industry are famous examples. A number of European clusters have existed for centuries, including the Italian leather fashion cluster, which includes Ferragamo and Gucci and a host of specialized suppliers around Milan; the flower-growing cluster in the Netherlands; and the financial district in London’s Square Mile.

Why and how these geographic concentrations of interconnected companies and institutions dominate their industries has long been a topic of interest to economists and geographers. The phenomenon was first observed by the Cambridge economist Alfred Marshall. He noted a tendency for specialized companies to cluster together in a way that produces geographic concentrations of expertise and economic activity, which he called “industrial districts.” (Economists refer to them as Neo-Marshallian nodes.) In his 1890 book, Principles of Economics, Marshall observes how “…great are the advantages which people following the same skilled trade get from near neighboring to one another…”.

Marshall’s analysis, however, largely overlooked the importance of the role of entrepreneurs. In the 1930s, Harvard economist Joseph Schumpeter acknowledged Marshall’s original insight, but highlighted the role of self-interested economic agents, who took risks in order to generate substantial profits. In Schumpeter’s model, entrepreneurs provide a vital link in technology transfer. They take emergent technology and invent new products, services, and production methods, and develop new ways of organizing economic activity to establish new markets. In this scenario, he argued, new economic activity is driven by new technology.

In the 1980s, Stanford professor Paul Romer developed a knowledge-centered theory of economic growth that suggests technological progress is caused by the search for new ideas by researchers interested in profiting from their innovations. Although he doesn’t explicitly equate entrepreneurship with innovation, his theory interprets growth as a process through which the research sector and other interested parties create new products for the market and obtain monopoly profits from new ideas. The model provides a theoretical underpinning for high-tech clusters.

In the 1990s, Professor Michael Porter of Harvard Business School examined the business cluster. His work confirms that the proximity of specialized companies leads to unusual competitive success. Professor Porter suggests that clusters encompass an array of linked industries and other entities important to competition, including suppliers of specialized inputs and providers of specialized infrastructure. Clusters also extend downstream to channels and customers and laterally to manufacturers of complementary products, and to companies in industries with common skills, technologies, or inputs. Clusters often include governmental and other institutions, such as universities, standard-setting agencies, and think tanks, as well as providers of specialized training, education, information, research, and technical support.

What is harder to explain is why geographic proximity should continue to confer a competitive advantage in the global economy of the 21st century. The success of Silicon Valley and other high-tech clusters highlights what Professor Porter calls the “paradox of location.” Despite conjecture that in a connected world geographic location is no longer a significant competitive factor, for high-tech firms, the reverse appears to be true: “Paradoxically, the enduring competitive advantages in a global economy lie increasingly in local things — knowledge, relationships, and motivation that distant rivals cannot match,” Professor Porter has noted.

What happens inside firms is important, but the cluster effect indicates that the immediate business environment outside a company plays a vital role in its success as well. Clusters appear to affect competition in three broad ways. First, they increase the productivity of companies in the region. Second, they drive the direction and pace of innovation. Third, they stimulate and trigger the genesis of new businesses within the cluster.

“Clusters are knowledge communities,” says Mark Jenkins, senior lecturer in strategic management at Cranfield School of Management, part of Cranfield University in Bedfordshire, one of the U.K.’s leading technology universities. Mr. Jenkins has studied Motorsport Valley and coauthored a number of academic papers on
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Success Breeds Success
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A study last year by the U.S.-based Milken Institute identified eight key elements in the creation of high-tech clusters. First, and most important, is the presence of cutting-edge research facilities and top educational institutions. “Research centers and institutions are indisputably the most important factor in incubating high-tech industries,” the report states. For example, many Silicon Valley companies have benefited from the proximity of some of the most prodigious technology research facilities and sites in the world — Stanford University, Xerox PARC, and Menlo Park among them. Military research has also been a prime source and spur for new technology in the U.S. (and in Israel, which also has a burgeoning high-tech cluster). A close network of research institutions, entre-

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Motorsport Valley drives the U.K.’s motorsport industry, one of the country’s key economic engines. It contributes close to £5 billion ($7 billion) to the British economy — almost one-third as much as the U.K.’s aerospace industry — according to the first definitive study of the U.K. motorsport industry, which was commissioned by the Motorsport Industry Association and released in January. In addition, the industry employs some 40,000 workers and provides more than £1.5 billion in exports annually. Roughly three-quarters of the motorsport cars used in more than 80 countries are built in the U.K.

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Dominating the world’s production of single-seat racing cars is Motorsport Valley, a highly specialized cluster of small and medium-sized companies in the motorsport industry. Located in a swath of southern England that stretches in a crescent from Southampton to Norfolk, with Oxfordshire at its center, Motorsport Valley comprises a core of some 400 firms, including a large proportion of the world’s designers and manufacturers of racing cars.

Consequently, Motorsport Valley attracts finance, sponsorship, drivers, parts, and expertise from all over the world. In recent years, most of the significant advances in the technological trajectory of single-seat racing car design — mid-engine layout, composite materials, aerodynamic designs — have been introduced by teams within this U.K. cluster.

Such is the competitive advantage enjoyed by Motorsport Valley that some multinational corporations, including Ford Motor Company and Mercedes-Benz, have their engines built by small specialist manufacturers within Motorsport Valley, which they wholly or partly own. This is despite the fact that both corporations have huge international capabilities in engine design, development, and manufacturing. In Ford’s case, all of its Formula One (F1) engines are built by Cosworth Racing, whereas Ilmor Engineering, a firm started by two former Cosworth employees, builds Mercedes’s F1 engines.

Industry experts say that British firms have a distinctive way of designing and constructing racing cars that produces superior vehicles, although a thoroughly international group of people who live in the U.K. are responsible for the work. This superiority of design is not attributed to a single, easily identifiable factor, but to a combination of factors that include broad design philosophies, attention to the minutiae of numerous incremental improvements, tacit knowledge, teamwork, and commitment to winning races.

Indeed, in the past decade, 80 percent of F1 world championship races have been won by cars built in Britain. The region dominated the F1 championship from 1983 until 2000, when Italy’s team Ferrari took the title. In the previous 16 years, only teams from Motorsport Valley had won the world championship. And in the U.S.-based CART series, more than 70 percent of the cars are built in the U.K.

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Why Companies in Clusters Win the Race

Focus: Motorsport Valley

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entrepreneurs, and risk-tolerant venture capitalists is the second significant element. In combination, they translate into rapid adoption of technology.

The remainder six ingredients identified by the Milken Institute are: a trained and educated workforce; technology spillovers from nearby high-tech industries; the availability of venture capital; high quality of place, such as a pleasant climate, low crime rate, and good schools; a reasonable cost of living, especially affordable housing; and factors that favorably affect the cost of doing business, such as low land prices.

Silicon Valley acts as a magnet for investors, entrepreneurs, and technologists. Further, the presence of a number of pillar companies — big-name success stories like Intel, Hewlett-Packard, and Apple — continues to attract talent to the region and stimulate spin-off companies, generating a self-perpetuating cycle. Once a region establishes itself as a technology hotspot, it can achieve rapid growth. This is the formula Europe hopes to replicate. If European clusters can achieve sufficient scale, they can also propel its high-tech industries.

Clusters and Growth
There are signs that Europe's high-tech clusters are now reaching just such a critical mass. In fact, the current prosperity and the history of Silicon Fen suggest it could be Europe's best prospect for rivaling U.S. clusters.

The Cambridge Phenomenon, as insiders call Silicon Fen, has created 40,000 jobs in the region, and an estimated 25 new high-tech business are formed there every
month. The annual revenues of the cluster are £5 billion ($7 billion), of which 40 percent comes from exports.

Generics is just one rising Silicon Fen star. Other regional success stories include: ARM Holdings PLC, which is on the FTSE 100 and specializes in advanced microprocessor design (it developed the RISC chip, which powers Apple computers); the Autonomy Corporation PLC, a Nasdaq-listed data-analysis software company; and the Web-server software company Zeus Technology Ltd.

The Cambridge area has a strong technology pedigree. It was the site of one of the U.K.’s first science parks, and pioneer businesses included the electronics company Pye and the Acorn Computer Group PLC, from which ARM is derived. A number of leading U.S. and European technology companies — among them Microsoft, which invested $80 million in a research facility, and the former Olivetti Research Laboratories (purchased in 1999 by AT&T Laboratories Cambridge) — have established a presence in the region.

The area’s educational heritage continues to provide a nurturing environment for high-tech startups: Cambridge University has an alliance with MIT that’s backed by £70 million ($99 million) of U.K. government funding. The Cambridge–MIT Institute Ltd. aims to be a catalyst for entrepreneurial activities in the region. The area also benefits from a network of angel investors and venture capitalists, including Amadeus Capital Partners Ltd., the investment vehicle of Hermann Hauser, who founded Acorn Computer Group in the 1970s.

Some in Cambridge also have designs to expand in order to create a super cluster, taking in the universities of Oxford and Cranfield and the region around Milton Keynes. This, they argue, would go some way toward easing what many Cambridge insiders say is one of the region’s biggest obstacles to rapid growth — local planning restrictions, which make land development tortuous and increase the cost of doing business. In 1997, the British government announced its ambition to develop Cambridge’s knowledge-based economy, highlighting clusters of computing and biotech companies as the key to future prosperity.

The Cambridge region has felt the fallout from the dot-com collapse. The share prices of ARM and Autonomy were both hit hard when high-tech stocks in the U.S. took a battering. But overall, the Cambridge region’s focus on patentable technology has meant that companies have been insulated from the worst effects.

Generics, for example, was valued at £242 million ($338 million) in June 2001, rising from £226 million ($330 million) in December 2000, when it was listed on the London Stock Market. The company incubates technology in its own labs, licensing the IPR to consulting clients and creating spin-off companies. CEO Gordon Edge believes that business model is ideally suited to Europe’s current high-tech environment. To date, Generics has spun out nine companies. Later this year, the completion of a new building will double the size of Generics’ current site.

According to Professor Edge, Cambridge’s strength is based on “sophisticated science,” which leads to genuine breakthroughs. This, he says, sharply contrasts with many dot-coms, which were not “true technology companies” because they lacked R&D capability.

The Cambridge area and other European high-tech centers are attracting U.S. investment. Such companies as Microsoft and Intel have established research facilities in Europe. The inward investment is stimulating economic growth, and the European hope is that the spillover effects of the American companies’ presence will accelerate the creation of homegrown technology companies.

Ireland’s current economic boom, for example, has been built on attracting high-tech multinationals. Technology now accounts for 20 percent of the country’s GDP. Although the benefits are being felt throughout the country, the most dramatic change is near Dublin, where a third of the country’s 3.7 million people live. The city features a number of technology parks. The Citywest Business Campus, located on the western fringe of Dublin, covers 330 acres and has been designated Ireland’s National Digital Park. Recent corporate arrivals to the Dublin region include Compaq, Hewlett-Packard, Microsoft, Oracle, Gateway, and SAP. But the high-tech influx began in 1989 with Intel’s decision to site its first European plant at Leixlip, a former stud farm just west of Dublin in County Kildare. Intel employs 4,600 people at the 270-acre site, and the company has invested more than $3 billion, with a future $2 billion planned. Giving new definition to the term “friendly neighbor,” Intel’s venture-capital arm has helped finance a number of startups in the Dublin area. Some 600 homegrown software companies, including the Nasdaq-listed Trintech Group PLC, call Ireland their home.

In contrast to Dublin’s success to date in developing local businesses, Scotland’s Silicon Glen cluster has not attained the positive results politicians had expected. Since the 1970s, Silicon Glen has been receiving government support in the form of tax breaks and other incen-
tives to attract foreign technology companies to the region. Although the area now accounts for 15 percent of Europe’s semiconductors and a third of all its PCs, Silicon Glen has not stimulated homegrown companies on the scale anticipated. Motorola’s recent decision to close a major mobile phone assembly plant in the region, and the resulting 3,100 lost jobs, were an unfortunate reminder of the region’s dependence on foreign technology companies.

The extent to which the presence of U.S. high-tech companies will stimulate larger homegrown companies remains unclear. Pillar companies have played an important role in building Silicon Valley and other U.S. technology clusters, but Europe’s clusters have so far spawned only technology minnows. Although larger European companies such as the Nokia Corporation and Ericsson have played an important role in the development of the Scandinavian clusters in particular, they are organizations with a long history, and are not direct products of those clusters. Many of the big fish in the European clusters are American, which raises concerns that rather than accelerating the growth of new European companies, U.S. companies may simply absorb the best European technology.

**Should Government Assist or Not?**

High-tech cluster creation is a hot issue for European policy-makers. The debate focuses on whether public policy can be a catalyst for cluster formation, or if the most useful role for government is to remove regulatory obstacles that hinder the free working of capital and talent markets — the view that currently holds sway in Silicon Fen and the U.K.

According to Professor Chong Ju Choi of the Judge Institute of Management Studies at Cambridge University, Europe has spawned two different types of high-tech clusters. One type is naturally occurring clusters, which grow up around research universities and resemble those in the U.S. The other type is clusters that have been kick-started by government subsidies of technology companies. Both can be viable, he suggests, although the first type takes a lot longer to form.

Silicon Fen, which possesses many of the Milken study’s eight key factors for high-tech cluster development, has developed largely without government intervention, and matches the U.S. model.

The largest science park in Europe — beating more than 300 other such facilities — is a government creation. In the 1960s, the French government declared its intention to create “the great European city of science in the sun.” The result was Sophia Antipolis. Located on the French Riviera between Nice and Cannes, Sophia Antipolis is about one-quarter the size of Paris. A planned extension to the north will double its size. The main technologies at the park are information technology (electronics and advanced telecommunications), medical and chemical sciences, and natural sciences.

Sophia Antipolis has been a slow-burning project, making steady progress over the years without grabbing the imagination. It is home to 1,164 companies, more than 20,000 engineers and technicians, and some 5,000 researchers and students. Some say that now it is reaching critical mass, and development is likely to accelerate. Job creation at the park has been rising, lending some credence to the claim. A number of leading companies have established research centers there, including Siemens, Lucent Technologies, Compaq, and SAP.

Advocates of policy-led cluster creation point to Ireland, where public policy has been a critical driver in the success of technology companies. Since the early
1980s, successive Irish governments have wooed high-tech industry by cutting business taxes and introducing technology-friendly laws. In 1981, for instance, corporate taxation for high-tech, pharmaceutical, and financial services companies was slashed from 46 percent to 10 percent, and a number of technology-friendly laws were introduced. Among the more recent laws are a digital signature bill (making electronic signatures binding: an effort to jump-start e-commerce), a telecommunications bill that encourages sharing between operators, and a copyright bill that addresses intellectual property issues.

Today, Ireland, an island with a population roughly the size of Connecticut’s, is one of the world’s leading software exporters. “We’ve moved from a vicious to a virtuous circle,” observes David Duffy, an economist at Dublin’s Economic and Social Research Institute. Obstacles remain, however. The country’s infrastructure still lags those in many parts of Western Europe.

Despite the accomplishments of Sophia Antipolis and Dublin, some are skeptical about the ability of governments to stimulate cluster formation. Artificial cluster creation is not a good idea, warns Peter Cohan, New Economy specialist and author of Net Profit (Jossey-Bass, 1999). “The basic problem with the cluster concept for policy-makers is that it implicitly assumes that regional economic strength can be mandated by government,” says Mr. Cohan. “The reality is that regional economic powerhouses became strong because entrepreneurs and research universities spawned new companies. Supporting industries, such as venture capital, law, accounting, and IPO underwriting, emerged to meet the needs of the entrepreneurs. The role of government in these geographic regions was primarily to stay out of the way of the entrepreneurs and to provide some incentives in the form of lower capital gains taxes. In regions where governments try to mandate entrepreneurial behavior they fail.”

For now, the British government appears to agree with Mr. Cohan. The Silicon Glen experience has not generated the local businesses that earlier politicians had hoped for. A report by the Department of Trade and Industry published in February of this year identifies 154 regional business clusters in Britain offering opportunities for economic growth. But the report, which examines how government agencies such as regional development authorities can support the development of clusters, concludes that new clusters cannot be kick-started by public policy initiatives.

The Wireless Advantage

If Europe’s emergent high-tech clusters become self-sustaining, then the continent’s current strengths, especially its early adoption of wireless technology and substantial investments in life sciences, could position Europe well in the next few years. Sweden and Finland, in particular, lead in wireless research, especially in the Global System for Mobile Communications (the GSM standard) technology.

Although there is a growing technology cluster in Helsinki, Finland’s widely recognized high-tech hub is 370 miles north of the capital in Oulu, on the edge of the Arctic. In 1959, a technology university was established in the town; by the 1970s, Nokia began to develop radiotelephones in the region for the Finnish army. Oulu Technopolis, a technology park built by 18 companies, followed in 1992 — today it has 150 companies that employ a total of 3,500 people. The cluster benefits from the presence of Nokia, which passed Motorola in 1998 to become the world’s No. 1 mobile phone manufacturer.

Finland also has more Internet hosts — or IP
addresses — per capita than any other country. Its small domestic market and traditional strengths in engineering make it an ideal test market for mobile technology. It has attracted the likes of Hewlett-Packard and others to set up research facilities.

Sweden’s high-tech hub is Kista Science Park, which is a center for wireless R&D located northwest of Stockholm. Last year, a Wired magazine survey of opinion shapers ranked Kista second (after Silicon Valley) among the locations that matter most in the digital economy. Ericsson is the park’s largest employer, and Nokia has a development center there. Bluetooth technology, which allows devices such as handhelds and PCs to talk to each other without wires, originated at Ericsson and is seen as a potentially competitive European innovation.

Sometimes called Kiseltsta (kisel is Swedish for silicon) or Wireless Valley, Kista Science Park contains about 700 companies employing a total of 28,000 people. Several multinationals, including Compaq, Hewlett-Packard, IBM, Microsoft, and Sun Microsystems, house their Scandinavian headquarters at Kista. In 1999, Intel established the Wireless Competence Center, a research center for mobile technology. In 2000, the Swedish Royal Institute of Technology established IT University, which is dedicated to information technology.

Can Clusters Compete?

Many European clusters encompass multiple industries and technologies. Some believe that such diversity gives Europe a competitive advantage over the U.S., which has tended to create single-species clusters.

Silicon Valley was built largely on the development of the silicon chip, which gave rise to the PC and software industries that developed there. Much of the region’s high-tech activity, including R&D, has been predicated on the continuing dominance of the PC platform. But if that dominance were to decline, then the region’s competitive advantage could be eroded.

In Europe and Japan, some commentators already point to the rapid spread of cell phones and, to a lesser extent, palmtop computers as evidence that the PC’s domination is declining. In the next few years, they argue, the development of wireless technology could inspire a large-scale migration from the PC platform to mobile computing that uses smaller handheld devices. Other technologies, such as life sciences, could also attract a larger share of venture capital.

Silicon Fen is the seat of a number of different kinds of technologies, including software, scientific instruments, wireless, technology consulting firms, and life sciences. The area accounts for roughly a quarter of all U.K. biotech companies, and 6 percent of the European total. If, as many predict, biotechnology proves to be the next economic growth engine following the IT boom, Europe could be a major beneficiary.

Ultimately, the competitiveness of Europe’s high-tech clusters may depend not on the quality of European technology, but on whether the continent can replicate America’s dynamic entrepreneurial environment to produce homegrown pillar companies. To do so will require a level of investment and tolerance for risk that has traditionally been lacking.

To date, Europe has succeeded in generating a steady stream of small high-tech companies with world-class proprietary technology. What it has failed to do is generate the explosive growth that could propel new technology companies to a scale that would enable them to compete with the U.S. high-tech giants. Diversity, cultivated in the multi-species cluster, may well be Europe’s greatest strength, but so far it has also been its Achilles’ heel.

“The biggest difference between Cambridge and Silicon Valley is diversity,” notes Gordon Edge. “The disadvantage [for us] is that focus on one technology tends to create bigger, stronger businesses. We haven’t seen any Intels in Cambridge.”

Whatever their potential, until European clusters produce companies of that stature — truly global players competing over the long term — they are likely to remain in the shadow of California’s fabled Valley.

Resources

Segal Quince Wicksteed, The Cambridge Phenomenon Revisited (research report), SQW Ltd.; www.sqw.co.uk/data/thought_cbphen.html
For more discussion on high-tech clusters, visit the strategy-business Idea Exchange at www.strategy-business.com/idealexchange/