Geo Factsheet

Number 94

Research and Development Parks

Research and Development is a current growth industry in western Europe, North America and south-east Asia. This Factsheet examines the rapid growth of Research and Development and its distinctive locational requirements.

What is Research and Development?

According to the OECD (1981), Research and Development is "creative work undertaken on a systematic basis in order to increase the stock of knowledge." In practice, Research and Development has four major stages:

1. Basic or pure research - the study of natural and social phenomena for their own sake.
2. Applied research - the use of the results of basic research to meet a commercial objective for a specific product or process.
3. Development - the further improvement, testing and evaluation of products or processes. Pilot plants may be designed and built.
4. Technology transfer - successful technology is installed and started up at an industrial site.

Research and Development started in the late nineteenth century as major firms in the USA and Germany established in-house research laboratories. There has always been a close link between university research and large companies. After 1900, governments became increasingly involved with research funding.

Exam hint: *Well-written essays should contain definitions of terms used in Economic Geography when these are relevant to the question. However, year after year, candidates adopt a careless approach. Many candidates use the term "footloose industry" for example without making its meaning clear.*

Table 1. Definitions of terms used in industrial geography.

Term	Definition
Industrialisation	The relative increase in the contribution of secondary industry (manufacturing) to GDP.
Deindustrialisation	The relative decline in the contribution of secondary industry to GDP.
Tertiarisation	The relative increase in the contribution of tertiary industry (services) to GDP.
Reindustrialisation	The recent increase in the contribution of secondary industry to GDP. It is asscіated the manufacturing of high-tech goods.
Diffuse industrialisation	Small-scale industrialisation of rural or small-town locations.
Light industry	Manufacturing of small products mainly to be bought by individuals. It is small-scale and only a limited amount of investment capital is needed, e.g. televisions, food processing and toys.
Heavy industry	Manufacturing of large products which are often bought by other manufacturers. It is large-scaleand a great deal of investment capital is needed in plant and raw materials, e.g. chemicals, steel, engineering, ship-building.
High-tech industry	Manufacturing of high-value products using modern technology. Heavy capital investment is needed in Research and Development, e.g. computers, business systems, communications equipment.
Industrial estate	A new industrial area where many of the occupants of units are manufacturing companies.
Business park	A new industrial area where many of the occupants of units are offices or research establishments.
Science park	A new industrial area where many of the occupants of units are research establishments. Unlike business parks, there is always a direct link with a university.
Footloose industry	An industry which can locate virtually anywhere because transport involves only a small proportion of its total costs.

The importance of Research and Development to manufacturing

"Research and Development Intensity" is the ratio of expenditure on Research and Development to sales. High-intensity Research and Development industries spend at least 4.4% of revenue on Research and Development.

Table 2. Research and Development intensity of selected industries (OECD, 1995)

Research and Development intensity					
High intensity industries		Medium intensity industries		Low intensity industries	
Aerospace	22.7	Motor cars	2.7	Ceramics	0.9
Computers	17.5	Chemicals	2.3	Food / drink	0.8
Electronics	10.4	Plastics	1.2	Shipbuilding	0.6
Drugs	8.7			Petroleum	0.6
Instruments	4.8			Printing	0.3
				Textiles	0.2

Research and Development is seen as critical to the success of high-tech industries. High-tech products have a short product life-cycle, so rapid technological innovation is needed. In addition, market demand for high-tech products has increased, from domestic consumers (e.g. personal computers), business customers (e.g. over 60% of UK factories use microchips in automated production) and governments (e.g. new defence technology).

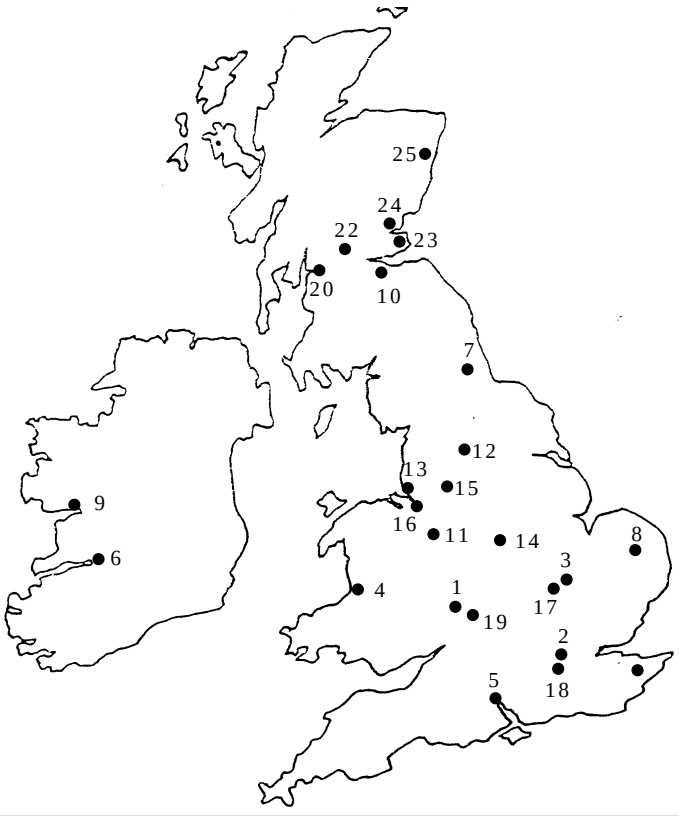
The location of Research and Development parks

In a multi-plant firm, Research and Development is separated from corporate headquarters and manufacturing plants because its locational needs are different. It is a **footloose industry**. Many Research and Development establishments are located in purpose-built parks. These are low-density landscaped facilities which are often built in greenfield locations.

There are approximately 25 recognised Research and Development parks in the UK. At a national scale, they are dispersed throughout south-east England and the Midlands. There is a regional concentration in central Scotland and only one in Wales. On a local scale, many science parks are found in urban-fringe locations, generally near market towns (e.g. Cambridge Science Park). Other science parks are found on brownfield sites in the inner-city (e.g. Aston Science Park near the centre of Birmingham). Science parks are always physically close to a university. See Fig 1.

***Exam hint**: Weak candidates refer to the "multiplier effect" and "cumulative causation" without explaining their meaning. Stronger candidates will always outline some of the positive and negative steps which are involved.*

Fig 1. Location of research and Development parks



1 Aston Science Park
2 Brunel Science Park
3 Cambridge Science Park
4 Cefn Lian Science and Technology Park
5 Chilworth Research Centre
6 Co-operative Education Centre
7 University of Durham Industrial Research Laboratories
8 University of East Anglia Industrial Liaison Unit
9 University College Galway Industrial Liaison Office
10 Heriot Watt Research Park, Unit,Edinburgh
11 Keele University Science Park
12 Listerhills High Technology Development
13 Liverpool University R&D Advisory Unit
14 Loughborough Technology Centre
15 Manchester University / Manchester Science Park
16 Merseyside Innovation Centre
17 St Johns Innovation Park, Cambridge
18 Surrey University / Surrey Research Park
19 University of Warwick Science Park
20 Scottish Development Agency and Universities of Glasgow, Strathclyde, and West of Scotland Science Park
21 Applied Statistics Research University of Kent, Canterbury
22 Stirling University Innovation Park
23 St Andrews Technology Centre
24 Dundee Technology Park
25 Aberdeen Science and Research Park

Why do firms locate in Research and Development parks?

- Links to universities or government research facilities. There is a pool of graduate labour nearby. Firms can advertise vacancies to university students cheaply. University research facilites may be used.
- Pleasant working environment - employees of Research and Development establishments are highly skilled. Senior researchers and managers will have been headhunted. A pleasant environment will attract talented individuals.
- Transport links - there are extensive road links to major cities. Business parks on the urban fringe are often connected to by-pass roads. Managers and researchers can move rapidly and cheaply to and from the park.
- Synergy - there is intense localised interaction between firms. Researchers can set up spin-off companies from older firms. Factory units may also share services, such as water and electricity supplies, which helps to reduce overheads.
- Incentives - Towns and cities compete to attract Research and Development. Local authorities may offer sweeteners, such as ready-built factory units.

Exam hint: *The effects of government on industrial location is a popular exam question. Weaker candidates write about an all-powerful national government. Stronger candidates will discuss the reasons for government assistance and the different agencies (e.g. Urban Development Corporations in the UK) through which national and local government operate.*

The advantages of Research and Development parks to an area

National and local governments have attempted to attract Research and Development to peripheral regions since the industry has many advantages. New science parks may be set up as growth poles. Research and Development establishments provide employment.

To governments, job creation is the first part of the multiplier effect. Myrdal (1957) refers to this process as "**cumulative causation**". In theory, employees of the new industries have high incomes, so they can spend more money in local shops and other services, such as restaurants. There is greater disposable income. Linked industries are attracted. The larger labour pool, expanded local market, and improved infrastructure and services attract even more economic activities. Indirectly, therefore, the wider community benefits.

Growth poles and increasing income are both powerful vote-catchers. Surveys of electoral geography have shown that fully employed and well-paid people are likely to vote for the government party.

Governments have also provided direct financial assistance to support research in strategically important industries.

The disadvantages of Research and Development parks

Many of the jobs available in Research and Development require highly skilled workers, who are often educated to post-graduate level. These jobs are not suitable for local residents, particularly if the new Research and Development park is located in a deindustrialised area. Instead workers commute from elsewhere and spend little money in the local community. The multiplier effect is small.

Research and Development parks are generally built on greenfield sites. Farmland and areas of natural wildlife habitat are lost. There are land-use conflicts between farmers, conservationists and developers.

Over time, the originally pleasant environment of the park will become more polluted and congested. Firms may start to abandon the park for newer, more attractive, locations.

The concentration of highly skilled workers in one area creates a culture of stress. Since the high-tech product life-cycle is so short, there is intense competitive pressure among researchers and managers. Stress contributes to health problems.

Exam hint: *When asked to discuss the consequences of economic development, stronger candidates will produce balanced answers which cover both benefits and problems. The cause and effect link should be made clear.*

Case study - Stanford Industrial Park and Silicon Valley

Stanford Industrial Park is the original core of the information technology industry. Several key inventions in micro-electronics were made here (e.g. Pianar Process to produce integrated circuits). The area surrounding the park, in Santa Clara county, California, is popularly known as Silicon Valley.

Regional innovation in engineering dates back to the 1920s, but it was not until Stanford Industrial Park was set up in the 1950s that high-tech industry became significant. Research graduates from Stanford University, and later Berkeley, were encouraged to set up businesses. The US government provided part finance for the development of military and aerospace technology in the 1960s. Throughout the 1970s and 1980s, the growth of personal computing and associated software contributed to Stanford's international reputation. Small indigenous companies, such as Apple and Hewlett Packard, have grown into transnational corporations. The basic locational factors are listed below.

- *University links - Stanford and Berkeley graduates and entrepreneurs stimulated further research. Until the early 1980s, many companies had fewer than five employees.*
- *Availability of government grants and private venture capital since the 1960s.*
- *Established businesses attracted new graduates, who later started spin-off firms. For example, William Shockley, who invented the transistor, moved to Silicon Valley in the 1950s. Many top scientists joined Shockley. Several of these scientists established the new company Fairchild Semiconductor. Later, workers from Fairchild left to create over 50 new companies, between 1959 and 1979, all located in Silicon Valley.*
- *Synergy between employees from different firms. Social networking has enabled workers to share ideas and stimulate further innovation.*
- *Cheap labour - profitable manufacturing of new products often required low-wage labour, which was provided by Hispanic migrants.*
- *Pleasant working environment - there is rapid access to the cultural and entertainment facilities of San Francisco and the western coast of the USA.*
- *Producer services - banks and consultancies are now clustering in Silicon Valley to serve the new industries. Personal contact is vital for new businesses to start up.*

Jobs have been created in Silicon Valley for local people. Yet there are growing disadvantages of location there. The price of land is increasing rapidly. Firms are relocating to cheaper locations elsewhere. There is increasing social segregation between highly-skilled and highly-paid researchers and marginalised local low income groups.

Case Study - Cambridge Science Park

The Mott Report into high-tech industry encouraged the UK government to press for closer links between universities and industry. As a result, Trinity College, part of Cambridge University, set up Cambridge Science Park in 1973. By 1992, 600 recognised high-tech companies were located in Cambridge, e.g. Olivetti. Many companies have grown rapidly; for example, Autonomy Corp, founded in 1990 as a software design company, was estimated to be worth $7 billion by July 1998 (Financial Times, 29/03/00). Cambridge is the UK's leading high-tech growth pole. Cambridge Science Park is home to 80 companies. The basic locational factors are listed below.

- *University links - many small firms have been established by university graduates and research workers.*
- *Availability of industrial sites - Firms were initially offered incentives to locate in Cambridge Science Park.*
- *Pleasant working environment - Cambridge is a historic city which is not far from scenic countryside (e.g. Norfolk Broads). Quality of life is high, so skilled workers and management are attracted.*
- *Transport links - The M11 motorway and electrified railway allow rapid movement to London. Managers can access Research and Development establishments quickly from corporate headquarters. Employees may use recreational facilities in London (e.g. West End theatres). International flights are available from nearby Stansted Airport.*
- *Synergy - Professional and social contacts between employees in different firms are frequent.*

Table 3. Results of a survey of high-tech companies in Cambridge to show the percentage of companies rating the locational benefits of the city.

Locational factor	% of companies
Availability of premises	74
Availability of labour	74
Reputation of area	73
Attractive area to live	73
Availability of scientific / technical staff	68
Good communications	60
Closeness to similar organisations	50
Availability of Cambridge University graduates	41
Government assistance	5

Although the university was the original reason for the location of Research and Development in Cambridge, most high-tech firms are now not connected with the university.

Advantages:

- *Low unemployment rates - in July 1999, only 2.0% of people were claiming Jobseekers' Allowance and counted as unemployed.*
- *High salaries - 31.8% of people in Cambridge and 38.8% of people in South Cambridgeshire were employed in high-tech industry in 1998. High earners have generated a strong multiplier effect.*

Disadvantages:

- *Rapidly growing population - Cambridgeshire's population grew by 22% to 550,000 during 1985-2000. The population is predicted to grow by a further 25% by 2021, according to UK government figures, which is faster than any other English county.*
- *Lack of housing - there is a serious shortage of accommodation in Cambridge. It is a small medieval city which grew up on the flood plains and terraces of the River Cam so growth is restricted. Extra housing threatens the architectural character of the university city. House prices have risen out of reach of many local people.*
- *Pressure on the green belt - the Department of Environment, Transport and the Regions has proposed the building of Britain's first new town for 30 years, probably on a disused airfield north of the city. 80,000 new homes are planned in Cambridgeshire by 2016. Countryside will be lost.*
- *Congestion - many workers in Cambridge live some distance from the city. Although new roads (e.g. A14 Cambridge northern by-pass) have been built, there is still heavy traffic congestion at peak periods.*
- *Competition from other centres - as Cambridge becomes more congested and the cost of living becomes more expensive, high-tech firms may be attracted to other centres. University cities in other parts of Britain (e.g. Oxford) and the European Union (e.g. Munich) are emerging as rivals.*

Practice questions

1. For a More Economically Developed Country you have studied:
   (a) describe the location of science parks. (5 marks)
   (b) assess the success of science parks in reducing unemployment. (15 marks)
2. Discuss the advantages and disadvantages of one economic development scheme. (20 marks)

Answers

1. (a) This must be about one More Economically Developed Country and you should make it clear at the start which country you are referring to. Questions which test your ability to give a geographical description are common at A-level. A weak list of places will not suffice. You should take care not to stray into explanation. Since this is not what the question is asking for, there are no marks available.

   There are approximately 25 science parks in the UK. At a national scale, they are dispersed throughout England. They are concentrated in central Scotland. There are few parks in northern England, south-west England, Wales or Northern Ireland. Science parks are found in urban-fringe locations, generally near market towns (e.g. Cambridge Science Park) or on brownfield sites in the inner-city (e.g. Aston Science Park near the centre of Birmingham). Science parks are built near to a university.

   (b) If "**assess**" is the command word, you are expected to discuss the successes and failures of science parks in reducing unemployment. A clear conclusion is needed. The successes are that science parks have provided many well-paid jobs, especially for graduates. There is a wider multiplier effect, so more jobs are created in shops, entertainments and in the public sector as incomes rise. The failures are that the jobs created are often not suitable for local people. Commuters may not spend much money in the surrounding area, so the multiplier effect may be limited.

2. Your answer can be divided into two sections: the "advantagess" and the "disadvantages" of the scheme. Cambridge Science Park is a valid example to use. A discussion of the scheme is needed, before a balanced conclusion is made. Strong candidates will examine ways in which advantages and disadvantages can be measured, e.g. effects on unemployment and changing incomes, regional GDP and local tax revenue.

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