Software and Services

EXECUTIVE SUMMARY

The software and services sector is one of the most rapidly growing global industries, currently exhibiting annual growth of around 12 per cent and generating revenues of $238 billion in 1996. The sector consists of three main sub sectors: packaged software, project services and processing services.

The UK software and services sector performs poorly compared with the US.

- Output per capita for packaged software and services combined is 27 per cent of the US level. Output is particularly low for packaged software at 12 per cent of the US figure. This is a function of low consumption in the UK and a very negative trade balance with the US. For the two software service sectors output is approximately half the US level.

- Labour productivity for the packaged software sub segment is 53 per cent of the US level. For project and processing services, however, labour productivity is about equal to the level in the US.

The primary cause of low labour productivity in the UK packaged software segment is a lack of successful companies of a comparable scale to those found in the US. Productivity for packaged software increases with output, as many labour inputs are fixed. The US contains six software companies with turnover of over $1 billion, and many with a turnover in excess of $100 million. In the UK there are only a handful of companies with revenues greater than $100 million.

One of the primary external factors influencing this lack of scale in the UK packaged software sector is a lack of leading edge demand for products in the UK from business customers. This lack of demand stems from lower levels of competitive intensity in some UK industrial sectors, which reduces the necessity for software tools which enhance productivity. UK companies also face a number of disadvantages in penetrating the US market, compared with US domestic competitors.

In addition, the UK lacks an infrastructure that can support high growth companies. A critical element of this infrastructure is venture capital funding. The UK venture capital industry does not focus on the high-tech sector and lacks

the skills of US venture capitalists that help nurture companies in the early stages.

In spite of historical performance the UK software sector should be viewed as a key area where the UK has the ability to create growth in output and employment. The UK possesses several industry sectors, for example retail and financial services, which have a leading edge appetite for IT and could provide the necessary stimulus to grow a globally successful software company. The focus for policy makers should be to increase competitive intensity in customer markets for the UK software sector in order to stimulate demand by, for example, revising product market regulations which restrict innovation and competition. In addition, the government should look to facilitate the removal of remaining infrastructural barriers.

Software and Services

INTRODUCTION

The external software and services sector is interesting because it is a relatively new market service sector, a source of high value jobs and subject to very little regulation. Furthermore, although it is currently relatively small, with UK sales representing only 1 per cent of GDP, we believe that the sector provides insights into how to grow other new, technology driven industries such as biotechnology. A successful software sector can also have a number of spin-off benefits for an economy. It can create high value jobs, both in software and in other service sectors, generate considerable personal wealth for entrepreneurs and facilitate productivity gains in other sectors, e.g. by reducing the cost of business to business interactions via the Internet, or improving supply chain management.

Software and services represent a substantial share of the world-wide computer industry (Exhibit 1), an industry that is growing at a rate of 10.4 per cent per annum. The sector itself can be broken down into three main sub sectors: packaged software, project services and processing services.

Packaged software

This sub sector generated worldwide revenues of $109 billion in 1996. It is dominated by US companies, which hold over 75 per cent of the market. The packaged software market can be further divided into nine segments, by software type and hardware environment (Exhibit 2).

On the software axes, systems infrastructure and applications tools products are primarily driven by the development of new technologies. Market share is concentrated in the hands of a small number of US companies such as IBM, Novell, Oracle and Microsoft, who together account for 35-40 per cent of the market (Exhibit 3). In most cases this dominant position has developed due to a number of industry forces which tend to push these markets towards natural monopolies. For example, for operating system software (50 per cent of the systems infrastructure market) companies prefer to invest in the most popular platform and applications developers will always build for the most widely used platform, re-enforcing the dominance. As a result IBM holds over 80 per cent of the operating system software market in the mainframe environment and Microsoft over 80 per cent in the desktop environment. Operating system

providers then have a number of advantages in developing and marketing basic application tools, e.g. spreadsheets and databases. The dominant share position of US companies like Microsoft, achieved in part due to their first mover advantage makes them relatively unassailable, until there is a major shift in technology. One such shift might be a move towards Internet PCs, which link directly to the Internet and require no operating system as such. Overall the systems infrastructure and application tools markets are dominated by US companies, with around 90 per cent market share.

The applications market is more fragmented and a higher share is held by non-US companies, with 35 per cent of the market. This market is driven primarily by the needs of business customers, with enterprise (i.e., non-consumer) software generating 90 per cent of revenue in 1996. Enterprise software falls into two categories. Vertical market software caters for the needs of a particular industry sector, for example banking. Horizontal market software caters for the needs of an industry function, for example human resources. The first mover advantage of US companies is less important in the enterprise software market and a number of non US companies such as SAP (Germany), Baan (Netherlands) and Misys (UK) have built a substantial presence in the last 10 years.

Consumer software accounts for less than 5 per cent of packaged software revenue. Success in consumer software is driven by strong brands and publishing and distribution channels. The US is by far the largest market for consumer software and so controls most of the successful brands and established channels to market.

In terms of software for different hardware environments, the mainframe environment is the most concentrated, dominated by IBM with a 30 per cent share. The client and server environments are more fragmented, but again with strong leading players such as Novell and Microsoft. The server environment, although currently the smallest, is growing the fastest and is currently the scene of a power struggle as Microsoft seeks to extend its dominance into this arena. Until recently, network computing was limited to servers operating within corporations. However the growth of the Internet together with the globalisation of many industries has led to the development of external networks, making use of very powerful servers and new computing languages such as Java, developed by Sun.

In spite of US dominance in many segments, the packaged software market still represents an attractive opportunity for non-US, new ventures and existing companies. The segments least dominated by US companies and most fragmented e.g., business applications in the server environment, are also growing the fastest, with annual rates in excess of 30 per cent.

Project services

Project services includes activities such as contract programming, systems integration, customised software, consultancy and training. In 1996 this sector generated global revenues of around $100 billion and it is growing at around 12 per cent per year. Unlike packaged software, which is a global industry, project services are generally supplied and consumed locally, as close customer relationships are critical. Output in any country is therefore directly related to consumption. Output in project services is also closely related to packaged software consumption, as many projects are concerned with its implementation.

In the US, project services is becoming an increasingly sophisticated market with companies like Cambridge Technology Partners leading the way in developing standard, branded service products. Historically US project services companies have found it more difficult to raise start up and expansion capital than packaged software companies, because their revenue potential was perceived to be much lower. However with the increased innovation and sophistication in the services sector, companies in the US are now attracting venture funds and achieving market capitalisations of up to ten times revenue.

Processing services

This industry has developed as a result of the trend for companies to outsource their routine IT driven activities. In 1996 it generated a global revenue of 30 billion US dollars. As with project services, processing services are generally traded domestically, although recently there has been a shift towards international sourcing from low cost providers such as India.

Comparison countries

This report compares UK productivity with that of the US, France and Germany (East and West). The UK's consumption of external software and services, as a percentage of GDP, lags the US but is ahead of France and Germany (Exhibit 4). The US, however, has a large positive trade balance for packaged software, whereas the UK imports around 70 per cent of domestic consumption. In terms of employment, precise measurements are difficult to obtain but we estimate that the sector employs around 100,000 people in the UK, approximately 0.5 per cent of market sector employment, and a similar percentage of the population in France and Germany. In the US we estimate the sector employs around 1.2 million people, closer to 1.2 per cent of market sector employment.

PRODUCTIVITY PERFORMANCE

We compared software sector performance in the UK with that in the comparison countries on the two main criteria of productivity and output. Details of the methodology used for calculating these are provided in the Appendix. For the overall sector, UK labour productivity is 72 per cent of that in the US and output 27 per cent of the US level (Exhibit 5). The three sub sectors are quite different in nature, so we also compare them separately.

Packaged software

In packaged software, output of all the European countries trails the US by a factor of around 8. Productivity fares somewhat better although the UK still lags the US by 50 per cent (Exhibit 6). Germany's strong productivity performance is related to the relative dominance of the highly productive SAP. In absolute terms the packaged software sub sector generates higher productivity than the service sub sectors, in all countries.

Project and processing services

In both project and processing services, the productivity of all the countries surveyed is similar. However output is 50 per cent lower in the UK, France and Germany compared with the US (Exhibits 7-8).

REASONS FOR DIFFERENCES IN PRODUCTIVITY AND OUTPUT PERFORMANCE

It is clear that the UK software and services sector has substantially lower output than the US, for all activities. However there is only a productivity gap in the packaged software sub sector. In this section we describe in detail the reasons for the productivity gap in packaged software and also the causes of the output gap for the entire sector. As the US is clearly the benchmark country, we restrict our analysis to comparison with the US.

Productivity performance

Exhibit 9 shows the framework with which we have analysed the productivity gap across all the sectors. It divides the causes of the productivity gap into three groups. At the lowest level productivity differences are caused by differences in production processes within firms. These differences are driven, however, by factors external to the firm, both within the industry sector and the economy at large.

Production processes

At the production process level, the most important factor explaining the productivity gap is the scale of UK software companies relative to their US counterparts, which stems from lower levels of innovation. Also of consequence but to a lesser extent is the product mix and skills levels.

- **Value added within category: innovation:** Success in packaged software relies on the development and commercial exploitation of innovative products, on a global basis. The UK software sector has failed to develop and market a sufficient number of world leading innovative products. As a result the UK has not grown companies of the scale of Microsoft, Oracle or SAP. This lack of scale, discussed below, is the main factor explaining the productivity gap with the US.

- **Scale:** Low output in a packaged software company has a direct impact on productivity as many of the labour inputs are fixed, for example product development staff. Successful companies with high output enjoy large economies of scale and generate high labour productivity. For example, Microsoft generates revenues of over $8 billion from a workforce of less than 20,000 people globally. The US packaged software sub sector has a core of very large companies such as IBM, Microsoft, Computer Associates and Novell with billion dollar turnovers, as well as a good number of companies with sales in excess of $100 million (Exhibit 10). The UK packaged software sector consists mainly of a handful of medium sized companies with revenues over $100 million and a large number of small companies with turnovers of less than $10 million (Exhibit 11). There are only two software companies with sales of over $1 billion outside the US: SAP (Germany) and Hitachi (Japan).

  We do not believe that the relatively small size of the UK market can be held responsible for the lack of scale in UK packaged software companies. The software market is global and the scale of successful companies such as SAP is not ultimately constrained by the size of their domestic market. However, as discussed below, low domestic demand does constrain innovation and therefore scale.

  For software services, labour inputs are largely variable with output, and hence economies of scale are limited. This explains why the UK service sub sectors can have a high productivity in spite of their relatively low output.

- **Product category mix:** In all the countries studied the packaged software sub segment has the highest absolute productivity. In the UK the sector represents only 27 per cent of the product mix, whereas in the

US it represents 59 per cent. The US total sector productivity is therefore boosted by this more favourable mix of sub sectors.

¶ **Frontline skills/trainability:** All start-up companies agree that finding the right skills is the one of the biggest challenges they face. Successful companies often aim to quadruple their size in a year in the early stages. Start-up software companies require technical, managerial and sales and marketing talent.

- The scarcity and cost of IT skills in the US have led a number of US companies to establish development centres overseas. If anything, this is an area of comparative advantage for the UK, which produces more IT graduates per capita than the US (Exhibit 12).
- However UK software companies find it hard to attract blue chip management skills in the early stages. Our interviews suggested that UK managers are more risk averse than their US counterparts, due to less flexible and forgiving job markets and lower personal wealth. In addition a manager from a large company will not necessarily possess the right skill set. In the US the large number of high tech companies provide a training ground for managers. In addition up to 20 per cent of MBA graduates from Harvard and Stanford now enter either high tech companies or venture capital firms.
- Proven sales and marketing skills in the software sector in the key US market are difficult for all companies to acquire. The ability to offer NASDAQ share options is generally a prerequisite for hiring the best sales and marketing staff, and whilst this is not impossible, it is clearly more difficult for UK companies.

External factors

From an external perspective, key factors explaining the productivity gap are other industries up and downstream and access to capital; of lesser importance are land use regulation and the less visible entrepreneurial culture in the UK.

¶ **Other industries, up and downstream:** We found four areas where issues relating to other industries up and downstream from the packaged software sector contributed to the productivity gap: demand from local leading edge customers, concentration of customer demand in the US, clustering and links with universities.

1. **Demand from local leading edge customers:** A healthy domestic industry requires strong local demand for products to stimulate innovation, and in general the UK market does not provide this demand.

- In the early stages start-up software companies need a critical mass of customers with a leading edge demand for technology in order to develop and refine their products. Exhibit 13 shows UK demand for packaged software is half the level in the US and moreover the gap has increased in the last 5 years (Exhibit 14). Exhibit 15 provides examples of software companies that have benefited from leading edge demand.

- The business sector is responsible for the majority of IT consumption in the UK. The low demand for IT products by UK business is driven by two factors (Exhibit 16). Firstly, output per capita in many sectors and in the economy as a whole is below the US level. This means that firms have less money available to invest in IT. Secondly the UK spends a lower proportion of its output on IT. The main driver of IT expenditure is usually a desire by firms to improve productivity by reducing costs or improving marketing. To create this drive for productivity growth, companies need to be operating in a competitive environment. In UK sectors such as wholesale financial services, which have undergone deregulation and are considered to be highly competitive, the appetite for IT expenditure is similar to the US.

- In some software segments the US government and its agencies act as 'leading edge' customers frequently sponsoring projects to pull through new technical standards. The policy in the UK public sector is to wait for technology to be proven, often in the US, before it is adopted. It is also more difficult and more expensive to spin-off commercial products developed as a result of government projects in the UK. For example, the UK insists on 'full cost recovery' pricing of products developed in a government sponsored project. In the US development costs are considered 'public goods' and products may be sold at replication cost.

2. **Concentration of customer demand in the US**: The packaged software market is global and low customer demand in the UK and Europe does not entirely explain the UK's poor performance. We have found that UK companies are also less able to access the key US market, compared with US domestic competitors. This is vital for software companies to grow to a reasonable size as the US currently consumes 50 per cent of the total global packaged software output. Even successful non-US companies such as SAP and Baan did not really take-off until they began to increase penetration of the US market (Exhibit 17).

- Non-US companies must establish credibility with US customers to be successful. This is particularly important if a new technology is involved. Credibility is most easily achieved if a software company

has a number of leading edge domestic customers who also operate in the US. These customers can then act as reference customers to establish credibility in the US market. For example Baan's breakthrough in acquiring Boeing as a client initiated their success in the US and SAP have pursued a strategy of using multi-national clients as a springboard into new markets.

- There are few sectors in the UK that contain customers with a leading edge demand for technology, who also have a significant presence in the US market. One sector which fulfils this criterion is wholesale banking. This is one of the few sectors where UK companies hold a substantial global market share, in the vertical market for applications software. In other vertical markets, like healthcare, US companies are dominant (Exhibit 18). US companies are able to develop reference customers in the US market at an early stage. Moreover standards developed in the US are frequently adopted globally. Hence US companies are then ideally placed to expand internationally.

- Other factors, which can lend credibility to a company in the US, are a NASDAQ listing or backing from a leading high tech venture fund. Both of these are less common among UK based companies.

3. **Clustering:** It is widely believed that the success of the US software industry derives from the early formation of successful high tech clusters such as Silicon Valley. In a successful cluster companies form mutually beneficial relationships with other companies up and down the supply chain, such as hardware companies or project service providers. Clusters form naturally when a number of demand side factors (e.g., the demand for silicon chips in California in the 1950s) and supply side factors (e.g., links with leading edge academic institutions) come together and reinforce each other.

   Software companies vary in their views as to the benefits of being part of a software community or cluster, generally depending on the segment of the software industry in which they operate. However we have identified a number of benefits enjoyed by companies that are part of successful clusters as found in the US. These benefits can be summarised as 'reduced interaction costs', i.e., the cost of dealing with and forming relationships with suppliers (of goods and ideas), potential employees, investors, competitors, partners and customers is lower because of geographical proximity.

- There are some software segments where proximity and partnership with companies and academic institutions making technological breakthroughs are advantageous. This is most true for companies operating in the systems infrastructure and applications tools area.

This helps explain the particular dominance of US companies in these segments (Exhibit 19). However it should be noted that it was a 'lucky break' that enabled Microsoft to develop the operating system for IBM PCs, thereby initiating their dominance, not geographical proximity.

- However, in the applications segment, proximity to and understanding of customers is probably more important than locating close to other IT software companies. To quote a London based software entrepreneur: 'There is little point being located in a science park off a motorway when my customers are in the City of London'. Some companies operating in this market do see benefits from clustering, for example locating skills and forming commercial partnerships. However this is not generally considered essential.

- An appropriate supporting infrastructure tends to develop around a successful cluster, e.g., professional service firms. This can facilitate the growth of start-up companies (Exhibit 20). The UK has been less flexible than the US in providing the infrastructure required to support fast growing businesses. For example, in Silicon Valley it is possible to obtain short (one year or less) leases. In the UK the minimum term is often five years. In the US lawyers and accountants often take equity stakes in start-ups in lieu of fees, and flexible contract professionals are readily available. These services also create significant employment, as much as one job for every two software sector jobs.

- Successful companies today form global networks of partners as 'virtual clusters' or webs, which are unrelated to geographical proximity. Companies such as SAP have achieved this very successfully, forming key partnerships with project service firms which have helped build their dominant market position. Increasingly, technology means that firms can exploit the reduced cost of interactions enjoyed by traditional clusters, without geographical proximity.

- Maximum benefit from clustering comes when a critical mass of successful companies in related fields are located together. Without this critical mass clustering has little value and in fact can have a limited or even negative value, for example it may facilitate skill poaching. A Cambridge based company told us 'our location represents little more than a prestigious address…, if anything proximity creates a more competitive market for skills'. The most successful clusters form naturally through market forces. Attempts by governments to create high tech clusters are often driven by the need to create employment, and hence are generally less successful. Governments should focus on removing the barriers to natural

cluster formation, rather than artificial intervention. In the UK the expansion of the high-tech community in areas such as Cambridge has been hampered by planning restrictions such as greenbelt regulation.

4. **Links with universities:** Successful software companies in the US often have affiliations with academics who provide technical insights and development stimuli. These links are easy to establish as many US academics have thriving commercial practices. UK universities have been slower to recognise the benefits of strong external links and still approach this in an ad hoc manner. This is due to the fact that UK University funding is based in part on research paper publication, creating a more internal and academic focus. However, although strong links with academia are considered helpful, these were not considered essential by most companies interviewed as part of this study. Most companies interviewed believed that development stimulus was provided more by the demands of leading edge customers than academic research.

   Several US universities have also put in place mechanisms to facilitate the commercial exploitation of research. For example Stanford operates an 'Office of Technology Licensing' for this purpose where royalties are divided, one third to the University, one third to individual departments and one third to academics. Some UK universities are beginning to set up similar mechanisms for high tech sectors, for example the Isis innovation at Oxford.

¶ **Capital markets: nature of UK venture capital market.** In the early stages both UK and US entrepreneurs use a mixture of private funds and bank loans as seed capital. However, further financing is almost always required to support a major expansion, both for product development and marketing costs, for instance when a UK company wishes to penetrate the US market. Software companies can have lead times of up to one year before a revenue stream is generated from a new market, making financing at this stage critical. The UK software industry has historically found it harder to raise capital at this critical stage (Exhibits 21-22). This is because the UK venture capital industry has historically chosen not to focus on this sector for a number of reasons.

- UK venture capitalists lack expertise and knowledge of the high tech sector and are often unsure how to value companies which are yet to establish a steady income stream. In the US, high tech venture capitalists generally have a technical education and background and their key skill is recognising the potential market value of a new technology. UK venture capitalists are generally finance professionals with limited technical knowledge.

- A substantial proportion of UK funds are 'captive funds' (directly linked to pension funds) and require a guaranteed future income stream. In addition 3i, one of the largest venture capital funds and the training ground for many industry professionals, has its roots in the relatively conservative clearing banks. UK venture capitalists also experienced low returns from start-up investments in the 1980s and have shifted their attention to more lucrative investments, for example MBOs (Exhibit 23).

- Historically there has been low demand from entrepreneurs in the software sector for funds, so this has not stimulated the development of a high tech venture capital sector. In addition many of the strongest UK companies today seek funds in the US. This is because US high tech venture capitalists act as a valuable and influential board member for start-up companies, helping in areas such as recruitment and marketing. For UK companies this 'insider help' is particularly important in penetrating the US market. Association with a high profile US fund also lends customer credibility to start-up companies.

- US start-up companies have in recent years found it relatively easy to raise capital, with the entire process taking as little as a few weeks. None of the US companies interviewed described raising capital as a barrier to growth, in contrast to the UK companies. The degree to which US venture capitalists subsequently help companies in other ways, through their extensive networks of contacts, varies according to each company's needs.

- A prerequisite for venture capital funding is a robust business plan. Our interviews suggest that many UK high tech companies may lack the management skills required to develop this in the early stages.

- The next stage on from venture funding is generally a public listing. NASDAQ has become recognised as the global market for software companies, providing both the highest valuations and the most liquidity (Exhibit 24). US customers view NASDAQ listing as a mark of credibility and the best US employees insist on NASDAQ stock options. The US venture capital system is entirely geared up to carrying companies towards a NASDAQ flotation, which is again an attractive proposition for UK companies. The strength of NASDAQ, together with the size of the US market leads many UK based companies to shift their centre of gravity to the US. Interestingly a lot of NASDAQ investment in high tech companies comes from Europe, indicating no inherent unwillingness to invest in high tech industries.

- However, a lack of venture capital for expansion into new markets need not always be a barrier for companies. Certain companies, notably Microsoft, have expanded rapidly by developing low cost distribution channels via partnerships with hardware manufacturers. Additionally, there is evidence that UK venture capitalists are starting to show greater interest in the high tech sector. A number of funds have recently been set up to foster the growth of high tech start-ups (Exhibit 25), and US venture funds are starting to look for overseas opportunities, as available funds exceed high quality demand in the US.

¶ **Product regulations: planning and building regulations:** As mentioned earlier, planning regulations, particularly in the Cambridge area, have restricted the expansion of high tech clusters. Successful clusters will only form if entrepreneurs are allowed to locate where they need to be i.e., where critical supply and demand side factors reinforce each other.

¶ **Country specific factors: less visible entrepreneurial culture:** Although it is difficult to quantify, there seems to be a less visible entrepreneurial culture in the UK than in the US. This limits the availability of role models to inspire others. Indeed, entrepreneurs like Clive Sinclair are often portrayed by the UK media as eccentrics. In contrast, successful entrepreneurs in the US are given positive publicity. For example, magazines such as Red Herring, Upside and Wired contain a constant stream of features on successful entrepreneurs. The strength of the US economy has also inspired a greater confidence amongst the US population. The price of failure (by accident rather than design) is low due to flexible and forgiving employment markets, coupled with a high demand for talent. In addition, in the US the availability of flexible contract staff and professional service firms, who will often take payment in share options, means that new companies require only limited seed capital.

Output performance

For the sector as a whole, the output gap is driven by lower consumption in the UK in all three sub sectors. The reasons for low consumption of IT by the business sector (which is responsible for over 90 per cent of consumption) were discussed earlier under '*Other industries, up and downstream*: *Demand from local leading edge customers*' and are the same for the services sectors as for packaged software. In addition, low output in the packaged software sector is driven by the UK's very negative trade deficit with the US (Exhibit 26). The reasons for the US dominance in the global packaged software market have also been explained in the previous sections of this report.

FUTURE OUTLOOK AND RECOMMENDATIONS

In spite of the current performance gap, the UK software sector should be viewed as a key area where the UK has the ability to grow both output and employment. The UK possesses several industry sectors, for example retail and financial services, which have a leading edge appetite for IT and could provide the necessary stimulus to grow a globally successful software company. The UK is also recognised as a source of high quality IT skills, by US companies that have established development centres here. Expansion into the US market should also be facilitated by a shared language and the presence of many US transplant operations in the UK.

The key message emerging from this case is that successful high tech industries are most likely to emerge where there is both early leading edge demand and an appropriate and flexible infrastructure to support rapid growth.

- **Leading edge demand:** As the UK wholesale banking sector demonstrates, leading edge demand is most likely to come from sectors which are relatively deregulated and also highly competitive. Therefore policy makers should focus on promoting widespread deregulation and competitive intensity. This will not only improve productivity directly in industry sectors but also create greater demand for technology such as software to further increase productivity. For example if demand per capita for project and processing services in the UK rose to US levels, up to 75,000 high value jobs could be created in the UK, each earning up to 60 per cent above the average wage level. Greater economic wealth in the economy at large will provide firms with additional output to invest in IT.

  The government might also consider removing the bureaucracy and cost surrounding the commercialisation of government funded projects. For example, in the US products are marketed at replication cost rather than at full cost recovery as in the UK.

  In addition, software companies should work hard to stimulate demand by educating customers on commercial applications for technology. For example, 'Internet entrepreneurs' in the US build their business by identifying ways in which the Internet could benefit a sector and then selling the idea to customers.

  UK companies should focus their efforts on those segments where the US first mover advantage is less important and market share position less dominant, such as business applications software. Within this segment there remain a number of vertical markets where no single dominant player has yet emerged e.g., retailing software.

- **Global marketing:** The government should promote UK success stories abroad to inspire confidence in the UK industry. One possibility might

be to develop a commercial support centre or embassy for UK companies in Silicon Valley, which could help companies secure finance and develop commercial partnerships. Another possibility might be to 'twin' start-up UK companies with UK entrepreneurs already successful in the US, an idea which is currently being developed in The Netherlands. Software companies should develop global alliances at an early stage to facilitate expansion into overseas markets.

¶ **Supporting infrastructure:** Action also needs to be taken to minimise infrastructural barriers.

- **Venture capital:** The UK either needs to grow its own high tech venture capital industry or use that already developed in the US. As mentioned earlier, high tech venture capitalists generally have a technical background themselves. Exhortations to the traditional venture capital industry in the UK, which lacks many of the required skills, are unlikely to be successful. Ideas such as a trade embassy in Silicon Valley or 'twinning' could improve access to the US venture capital sector for UK entrepreneurs. As high quality demand for venture capital increases in the UK, a domestic sector should grow, as is already apparent from the recent growth in high tech funds. Companies such as Oracle, that have established UK operations, should be encouraged to act as industrial venture capitalists, spinning off start-up companies as they do in the US.

  Europe lacks an exit market for start-up companies to rival NASDAQ. However NASDAQ is now recognised as the global market for high tech companies, offering the highest valuations and the greatest liquidity. Considerable efforts have been made to create a European market of similar strength. As access to NASDAQ is open to European companies, this effort could be misplaced.

- **Clusters:** Government support for high tech clusters in the UK has had limited success. It is likely that clusters will always be more successful when they evolve naturally due to market forces. Government should therefore focus its efforts on removing barriers to natural cluster formation, such as planning regulations. At the same time software companies should focus on developing global networks of partners and not rely on geographical proximity.

- **Universities:** Universities should look to exploit their research work externally and commercially to a much greater extent. In a healthy industry, as found in the US, universities and software companies feed off each other, one supplying ideas and talent, the other providing jobs for graduates and funding. In addition universities should address the content of courses to develop more potential high tech entrepreneurs. For example, IT courses could have a greater

business content, focusing on key start-up skills such as business planning. Business courses could have high tech elements, promoting the success stories and the rewards of entrepreneurship.

Appendix: Methodology for productivity calculations

To compare the performance of the UK software sector with that of other countries we investigated output, labour inputs and labour productivity.

- **Output:** Output was calculated using international packaged software spending (consumption) figures from IDC, which includes retailer margins. We then corrected consumption figures for estimated trade flows between the major global regions, North America, Europe and Asia Pacific. All country figures were then made comparable using OECD GDP PPPs. For project and processing services we assumed that consumption and production were co-located.

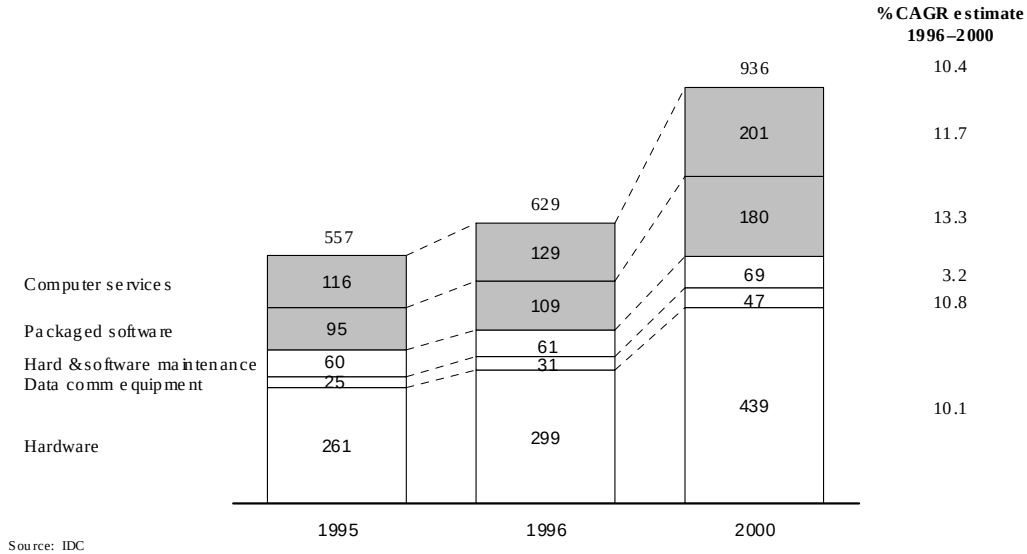
- **Labour productivity:** Labour productivity was estimated using a sample of representative companies for each of the countries studied. We chose this method because there are no consistent sources that give both output and employment figures at the country aggregate level. We estimated value added per employee by using world-wide sales per employee as a proxy. For packaged software we used global figures and therefore we did not need to correct for purchasing power differences. For project and processing services we used domestic sales divided by domestic employees and then applied OECD GDP PPPs.

- **Labour inputs:** Labour input was derived from the above two calculations. There are no national employment statistics which separate out the three sectors. Even within the computer services employment data, companies are not consistent in their classification.

Exhibit 1

COMPUTER INDUSTRY WORLDWIDE MARKET SIZE BY SECTOR

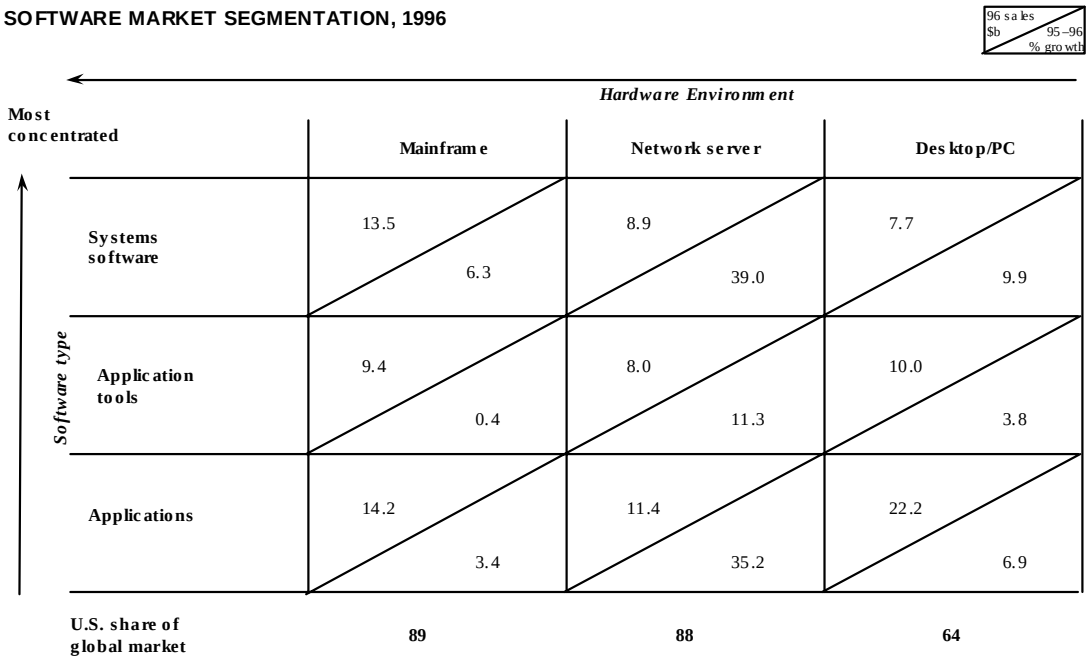
$b



Source: IDC

Exhibit 2

SOFTWARE MARKET SEGMENTATION, 1996

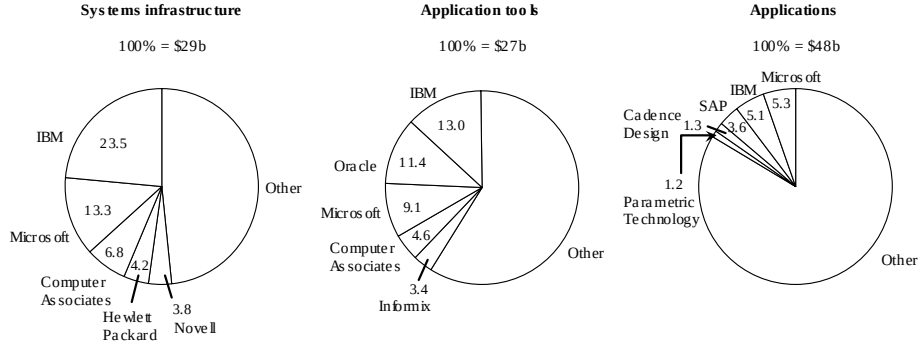


Source: IDC

Exhibit 3

PACKAGED SOFTWARE WORLDWIDE MARKET SHARE, 1996

%



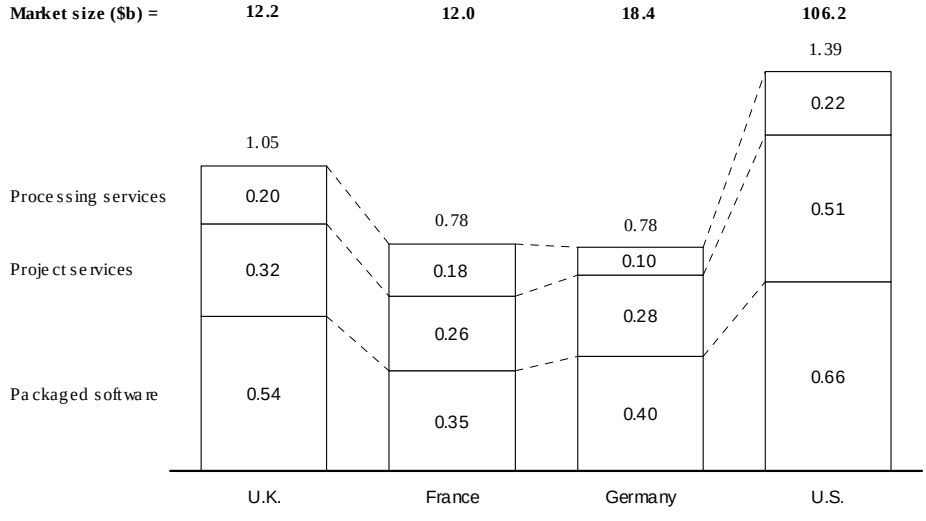
Top 5 players %share	**51.6**	**41.5**	**16.5**

Source: IDC

Exhibit 4

CONSUMPTION OF SOFTWARE AND SERVICES – COUNTRY COMPARISONS

% GDP*, 1996



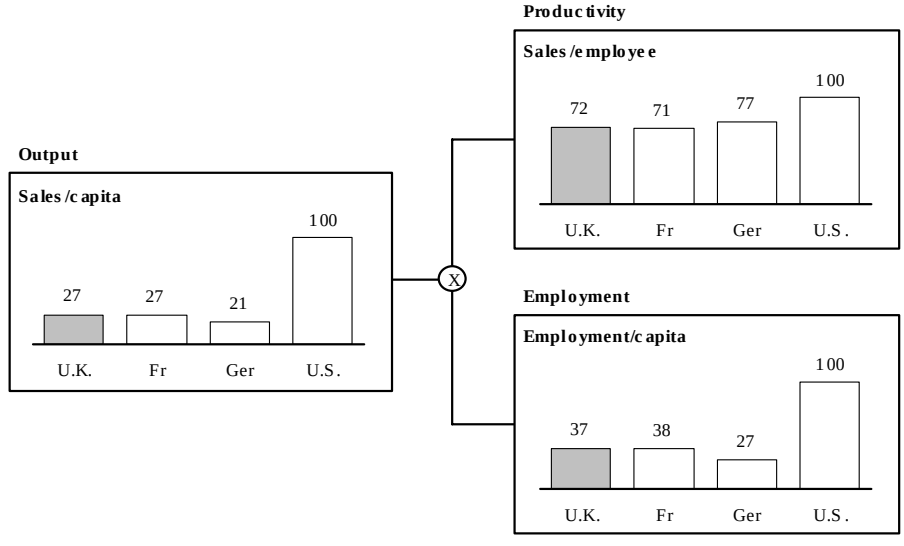
* Converted at 1996 average U.S.$ FX

Source: IDC

Exhibit 5

SOFTWARE AND SERVICES, PRODUCTIVITY COMPARISON

1996, Indexed to U.S. = 100

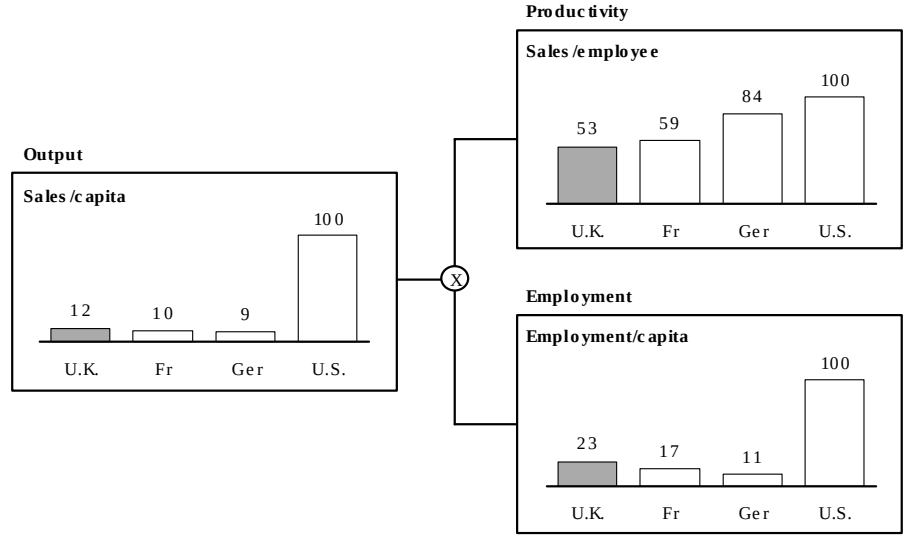


Source: IDC; OECD; Annual Accounts; Bloomberg; Lunundonk Studie

Exhibit 6

PACKAGED SOFTWARE, PRODUCTIVITY COMPARISON

1996, Indexed to U.S. = 100

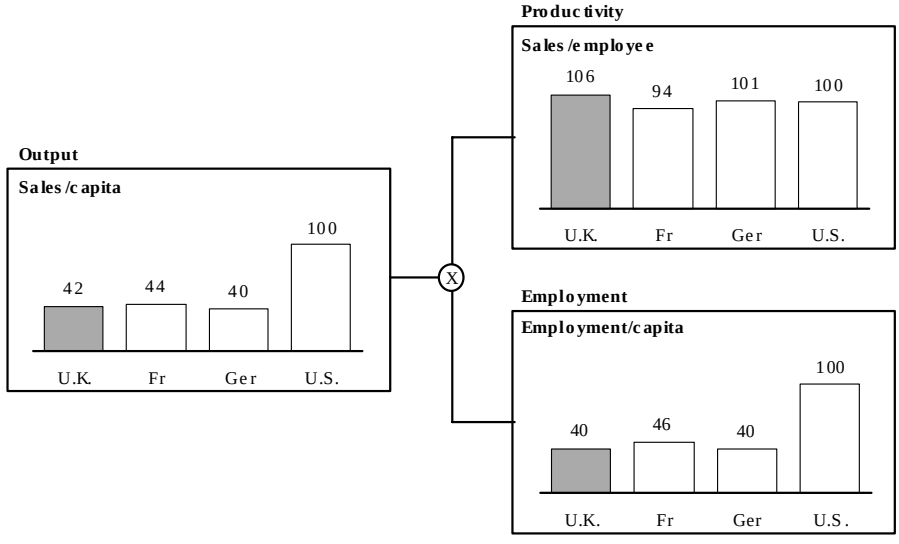


Source: IDC; OECD; Annual Accounts; Bloomberg; Lunundonk Studie

Exhibit 7

PROJECT SERVICES, PRODUCTIVITY COMPARISON

1996, Indexed to U.S. = 100

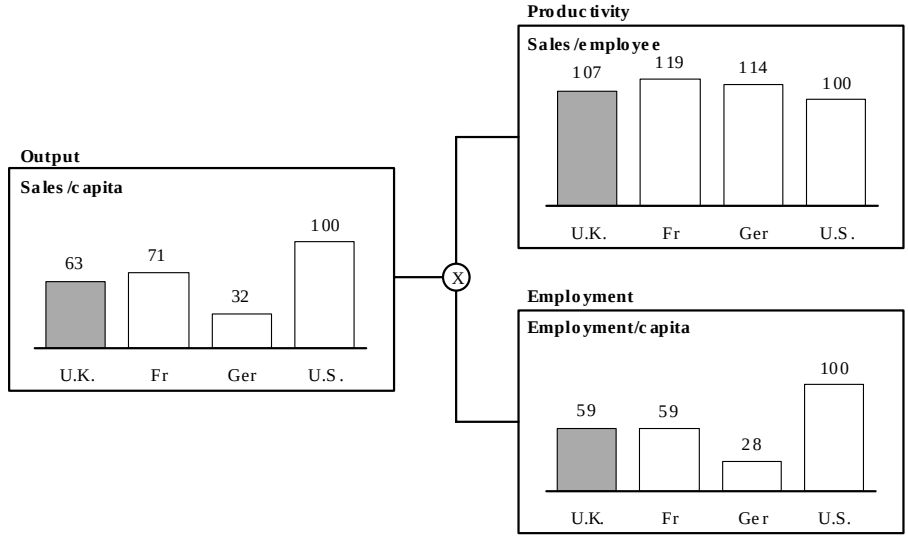


Source: IDC; OECD; Annual Accounts; Bloomberg; Lunundonk Studie

Exhibit 8

PROCESSING SERVICES, PRODUCTIVITY COMPARISON

1996, Indexed to U.S. = 100



Source: IDC; OECD; Annual Accounts; Bloomberg; Lunundonk Studie

Exhibit 9

CAUSALITY FOR LABOUR PRODUCTIVITY DIFFERENCES

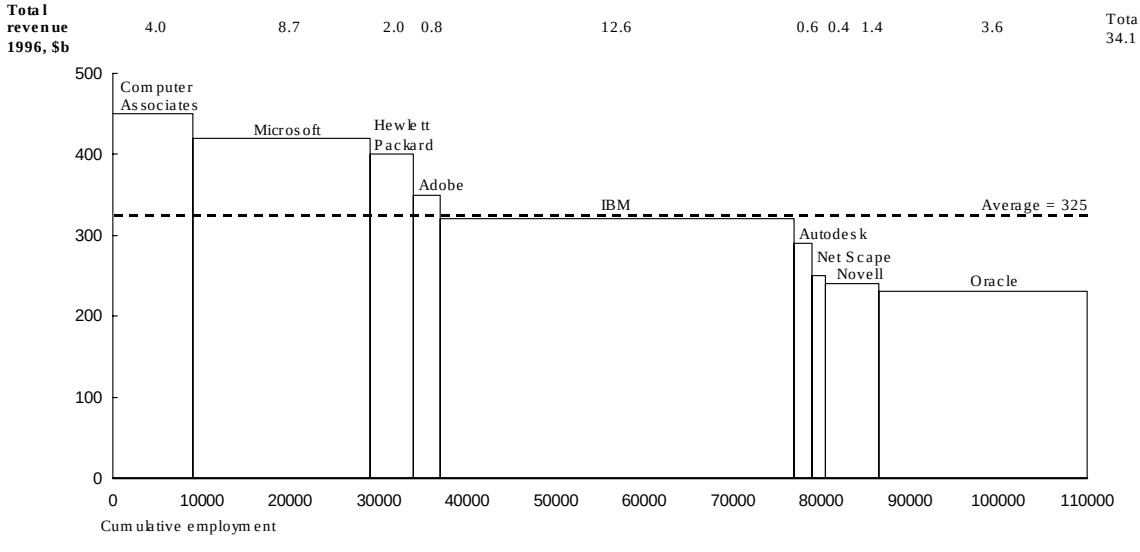
● Important (>10 points of gap)
○ Secondary (3-10 points of gap)
- Undifferentiating (<3 points of the gap)

		U.K. vs. U.S.
External factors	• Fiscal and macroeconomics environments	-
	• Product market	
	– Trade/FDI barriers	-
	– Product regulations	○
	• Labour market	
	– Labour rules/unionism	-
	– Relative labour cost	-
	– Education	-
	• Capital market	
	– Corporate governance/government ownership	-
	– Access to capital	●
	• Other external factors	
	– Other industries/up and downstream	●
	– Country specific factors	○
Industry dynamics	• Competition with best practice	-
	• Domestic competitive intensity	-
Production process	• Mix of products and services/marketing	
	– Product category mix	○
	– Value added within category	●
	– Product proliferation	-
	– Pricing structure/marketing	-
	• Production factors	
	– Capital intensity/technology	-
	– Scale	●
	– Front line skills/trainability	○
	– Matching capacity to demand	-
	• Operations	
	– Organisation of functions and tasks	-
	– Design for manufacturing	-
	– Suppliers and supplier relationships	-
	Productivity performance (comparison country = 100)	72

Exhibit 10

LARGEST AND MOST PRODUCTIVE U.S. SOFTWARE COMPANIES, 1996

Revenue per employee, $000

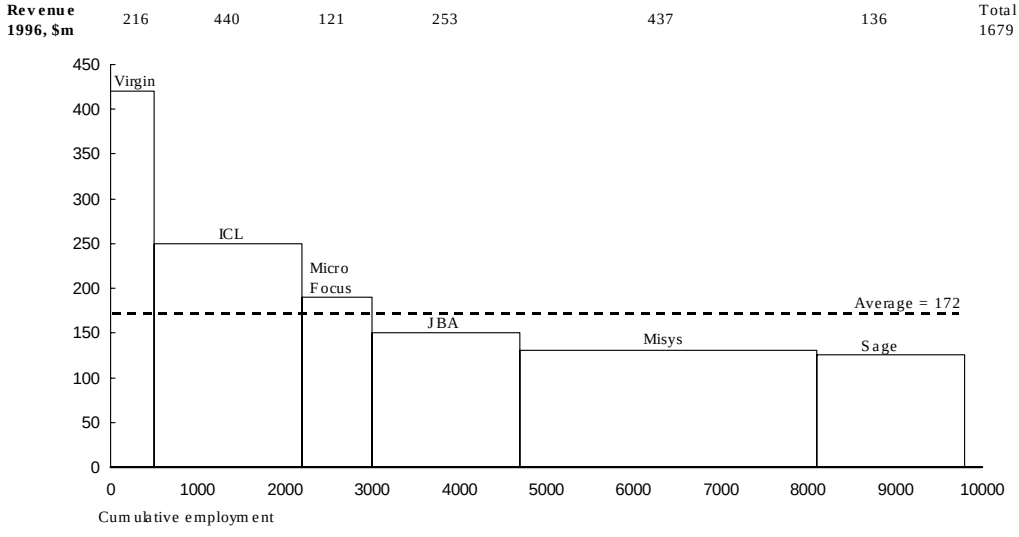


Source: IDC; Annual Accounts

Exhibit 11

LARGEST AND MOST PRODUCTIVE U.K. SOFTWARE COMPANIES, 1996

Revenue per employee, $000

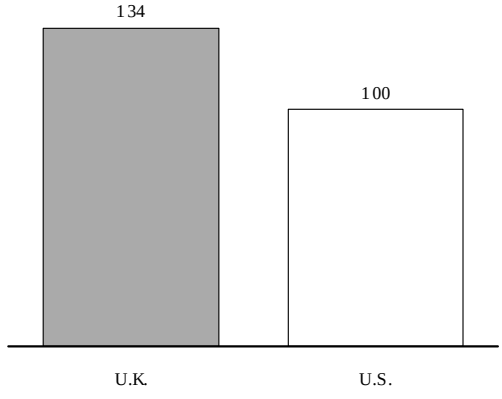


Source: IDC; Annual Accounts

Exhibit 12

IT GRADUATES IN THE U.S. AND U.K., 1995

Graduates/capita, Indexed to U.S. = 100

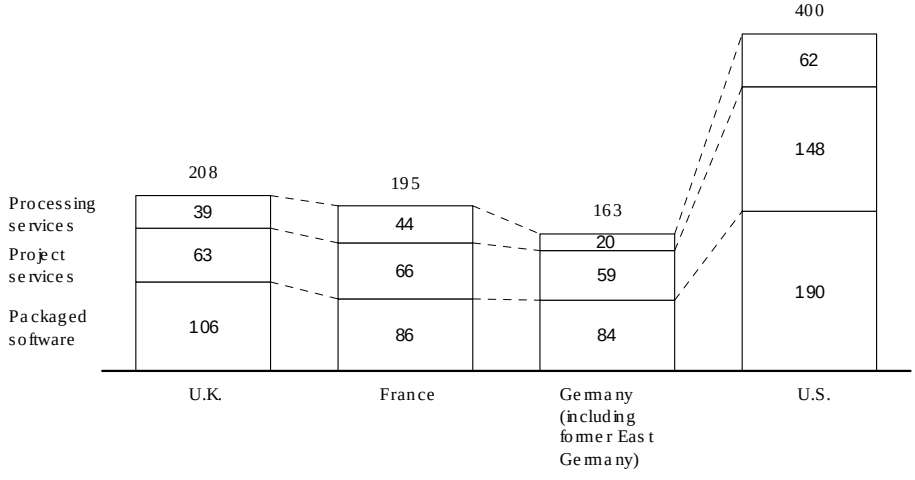


Source: Government data on university graduations

Exhibit 13

CONSUMPTION OF SOFTWARE AND SERVICES, 1996

$/capita

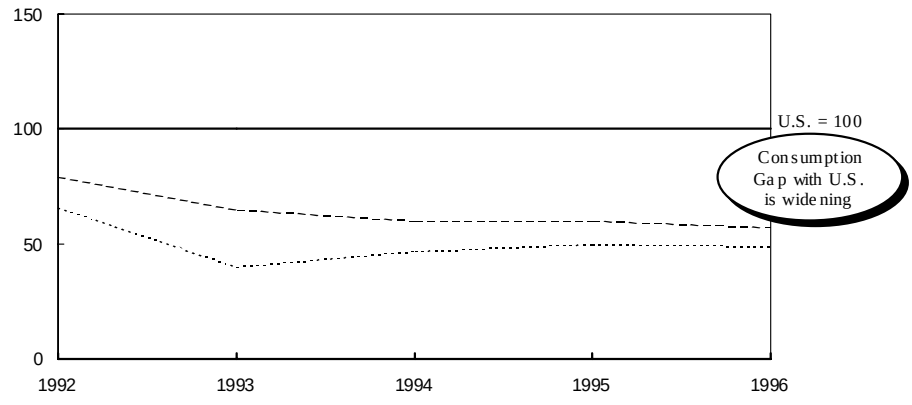


Source: IDC

Exhibit 14

U.K. CONSUMPTION OF PACKAGED SOFTWARE AND SERVICES, 1992–96

Consumption per capita, Indexed to U.S. = 100



Source: IDC

Exhibit 15

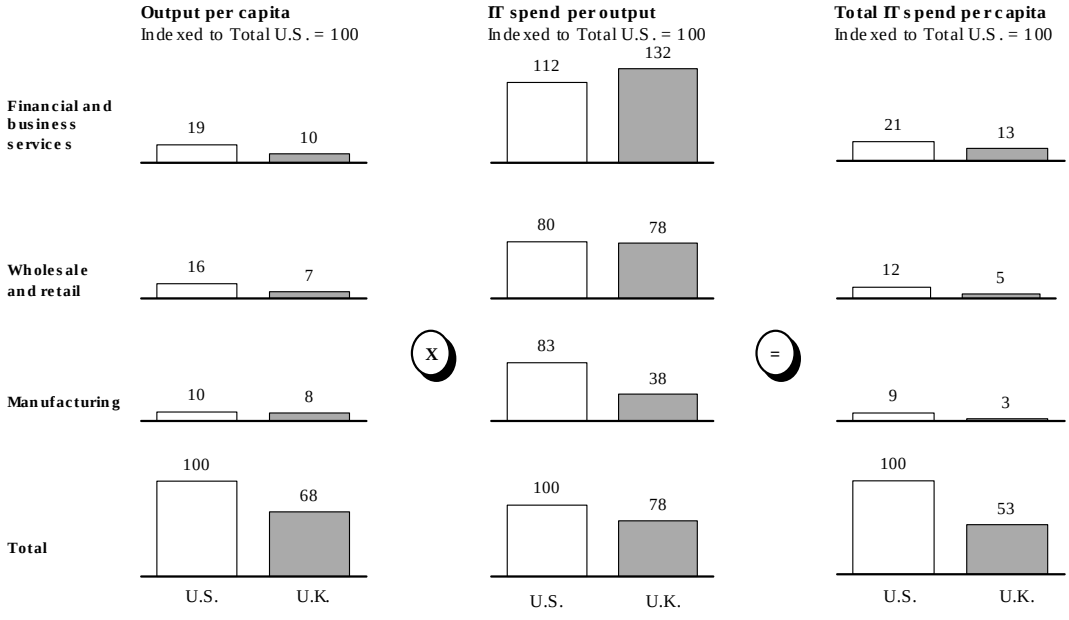
U.S. SOFTWARE INDUSTRY RESPONSE TO LEADING EDGE DEMAND – EXAMPLES

Software company	Comment
HBO &Co. (Founded 1974)	• Demand from U.S. healthcare industry for more efficient and cost effective patient information and hospital administration led to its first product, MedPro • HBO & Co. has since expanded its services to hospitals and now serve 52% of U.S. hospitals with total sales of $1.2b in 1996 • Company is well placed to take advantage of international healthcare opportunities
Adobe (Founded 1982)	• Demand for a computer language to transmit complex text and images to a printer, Adobe created PostScript which became the industry standard • As desktop publishing grew, Adobe created leading products like Illustrator (1987), Photoshop (1989) and, most recently, Acrobat (1993) for electronic documents • Sales $786m in 1996
Cadence Design (Merger of SDA and ECAD in 1988)	• Demand from leading U.S. electronics companies for ever more complex integrated circuits led to Electronic Design Automation software • Cadence is now leader in EDA with sales of $916m
Vantive Corp (Founded 1990)	• Increased competition to retain customers and improve customer service led Vantive to develop front office automation software called Customer Asset Management. First product launched in 1992 • Now has over 500 customers, is expanding internationally and has grown from $10m in 1994 to $64m in 1996

Source: Web sites; text lines; McKinsey analysis

Exhibit 16

SOURCES OF IT CONSUMPTION* GAP BY SECTOR



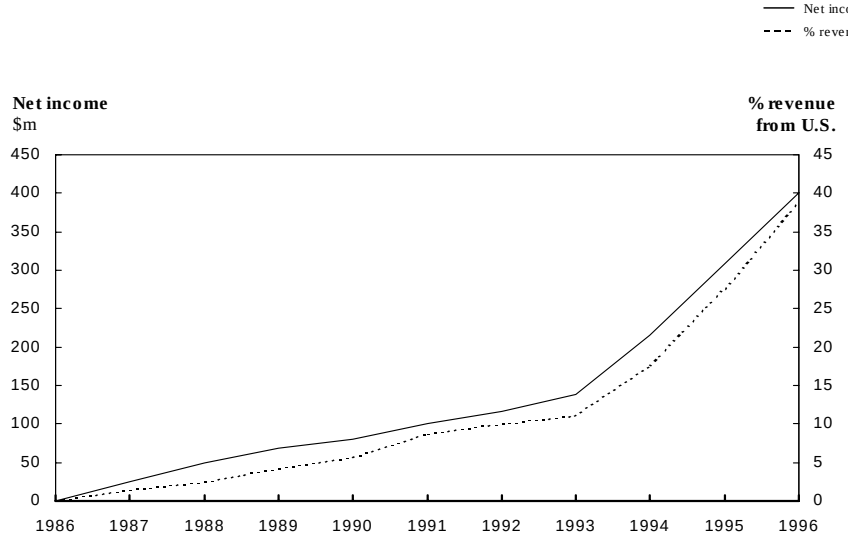
* Includes hardware and software

Source: Gartner Group; IDC; OECD; National Accounts

Exhibit 17

NET INCOME AT SAP AND U.S. MARKET PENETRATION

ILLUSTRATIVE

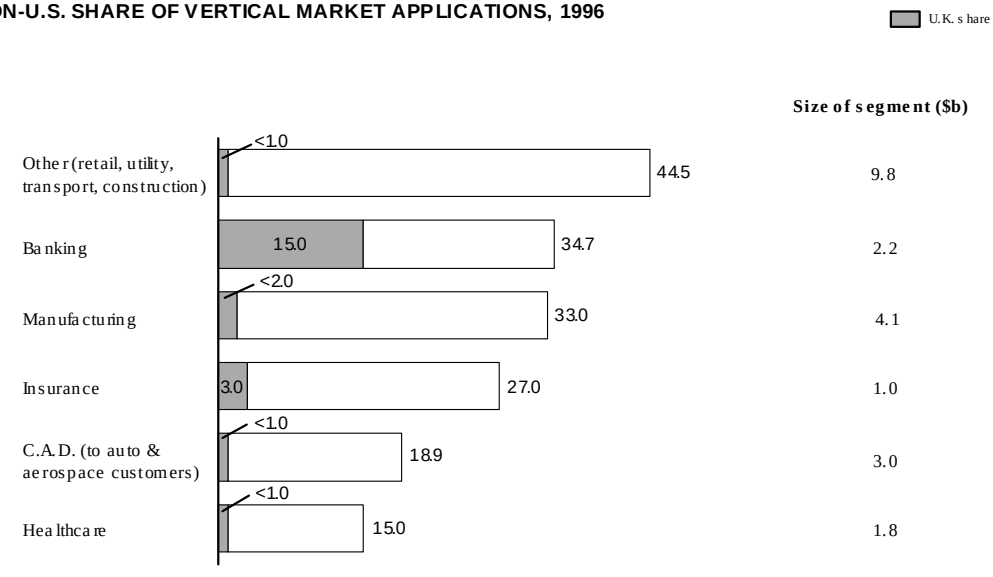


Source: McKinsey Software Review

Exhibit 18

NON-U.S. SHARE OF VERTICAL MARKET APPLICATIONS, 1996

%

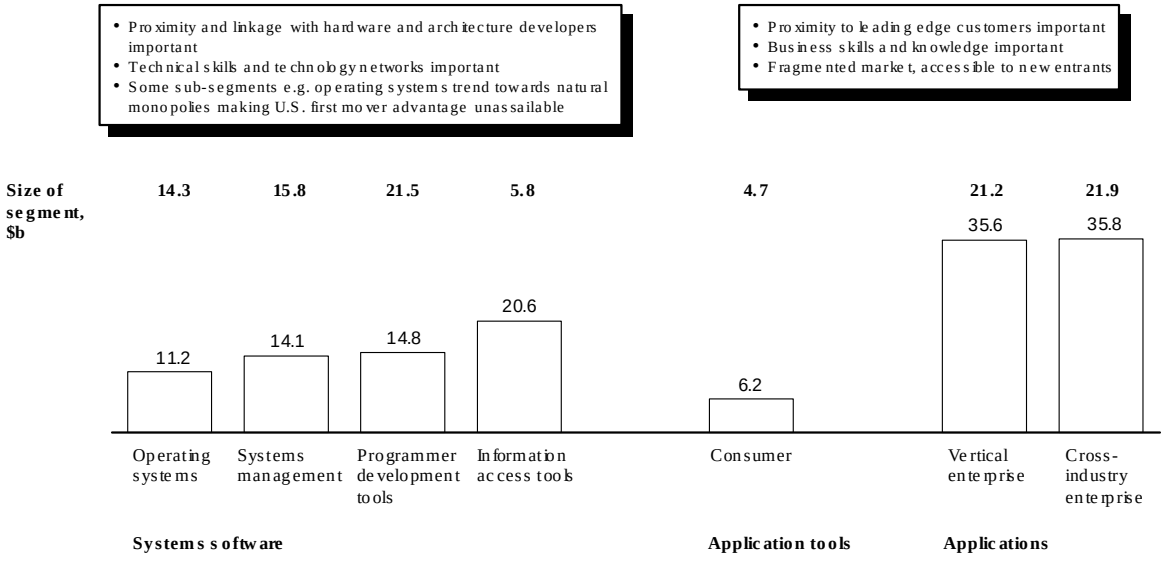


Source: IDC

Exhibit 19

NON U.S. SHARE OF PACKAGED SOFTWARE SUBSEGMENTS

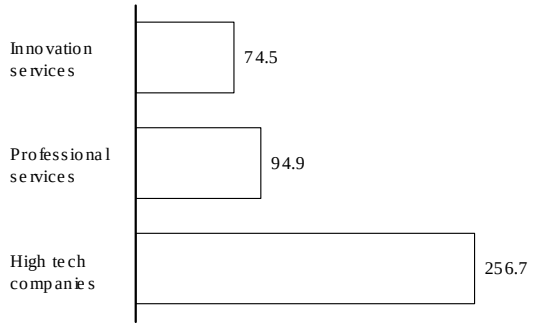
%



Source: IDC data

Exhibit 20

SILICON VALLEY INFRASTRUCTURE AND SERVICES



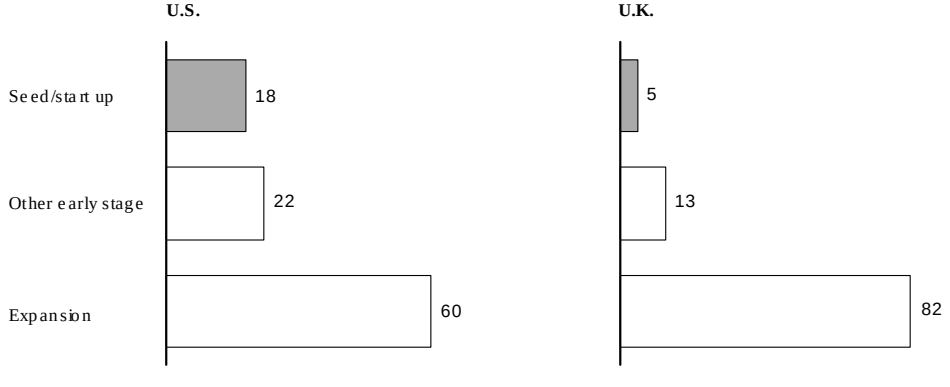
	% CAGR, 1992–96	Examples
Innovation services	7.2	Contract programming, testing services, specialist manufacturers
Professional services	14.8	Accountants, lawyers, venture capitalists, recruitment consultants
High tech companies	6.0	Biotech, computers, semiconductors, communications, software, aerospace

Source: Collaborative Economics; Joint Venture Silicon Valley

Exhibit 21

VENTURE CAPITAL INVESTMENTS BY STAGE*

% total, 1996



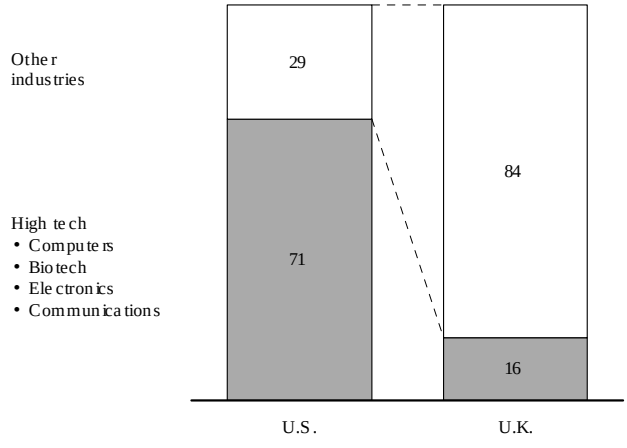
* Excludes MBO activity

Source: Venture Economics Review; BVCA

Exhibit 22

VENTURE CAPITAL INVESTMENT IN HIGH TECH: U.S. VS. U.K.

% $ invested, 1996

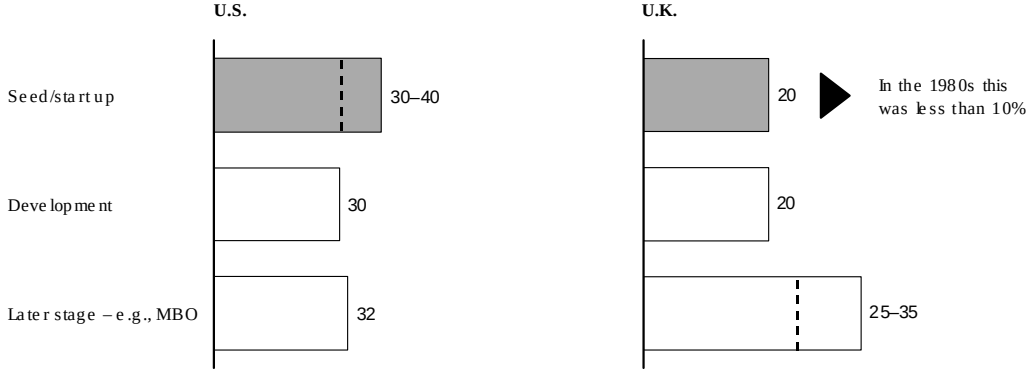


Source: Venture Economics Review; BVCA

Exhibit 23

IRR OF VENTURE CAPITAL INVESTMENTS U.S. VS. U.K.

% after 3 years, average



Source: Venture Economics Review; BVCA

Exhibit 24

MATURITY OF SMALL BUSINESS STOCK EXCHANGES

	U.S.	U.K.	Europe	
	NASDAQ	AIM	EASDAQ	Euro NM
Started	1971	1995 (formerly USM)	1996	1997
No. of companies	5,070	300	23	47
Computer related	560	30 est.	6	n/a
Market capitalisation 31 December 1997, $b	1,653	9.1	5.1*	4.6**

* As at 21 November 1997
** As at August 1997

Source: Web sites; FT; BVCA

Exhibit 25

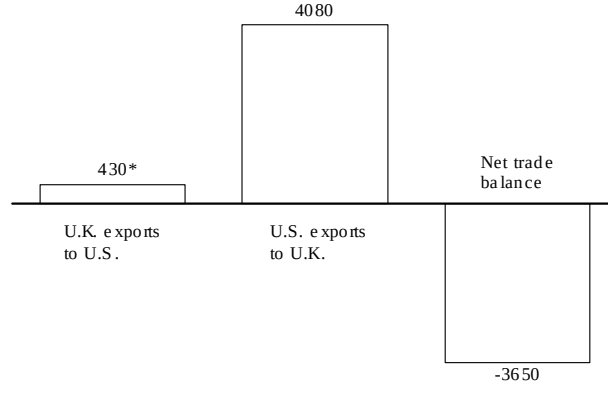
RECENT U.K. HIGH TECH FUNDS

Name	Description
Kennet Capital	Joint venture with U.S. Broadview Associates and Electra Fleming. £47m fund to invest in IT in U.K. and rest of Europe
Apax Partners	£100m fund to invest in IT over 3 years
Amadeus	£16m fund backed by Microsoft, intends to invest in 15–20 companies
Scottish Enterprise	£25m fund created from private investors
Technology Investments at 3i	Invested £115m in first 10 months of 1997

Exhibit 26

TRADE BALANCE BETWEEN THE U.K. AND U.S. IN PACKAGED SOFTWARE

$m



* Estimate based on U.K. share of non-U.S. supplied software

Source: IDC data