Parks and Valleys
Growing Asia's software industries

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Preface

Parks and valleys: Growing Asia's software industries is an Economist Intelligence Unit white paper, sponsored by the Business Software Alliance. The research was based on interviews, conducted in October and November 2007, with executives of companies based in software parks in Asia, administrators of the parks and employees of venture capital companies. Our thanks are due to all the interviewees for their time and insights.

The findings and views expressed in this report are those of the Economist Intelligence Unit alone. Claire Beatty was the editor of the report. The cover image was created by Dan Page.

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Executive summary

Replicating Silicon Valley by creating an indigenous, export-driven software industry with fast-growing, high-margin businesses is the dream of emerging economies worldwide. The irresistible lure of creating a cutting-edge "knowledge economy" compels governments to nurture software development by building software parks. The logic seems sound, particularly given the successful precedent for industry-specific business parks in the region. Asia's booming high-tech manufacturing industries flourished as a result of integrated real estate and infrastructure investments. But do software parks provide sufficient return on the colossal investment that they require?

Parks and valleys: Growing Asia's software industries, an Economist Intelligence Unit white paper, sponsored by the Business Software Alliance, examines the effectiveness of four of Asia's software parks (Cyberjaya in Malaysia, Dalian Software Park in China, Nankang Software Park in Taiwan and Quang Trung Software City in Vietnam) in promoting start-ups and domestic software firms, and the extent to which they foster innovation. The report also discusses how countries with successful software industries (including Israel, Ireland and India), used assets such as a skilled workforce and an open investment environment to establish the industry.

The research suggests that although they do provide a number of benefits, parks do not promote software in the same manner as they did hardware manufacturing. Software developers need access to vibrant environments where ideas, capital and people move quickly—something isolated parks far from central commercial districts do not offer. Rather than using software parks as the main route to development, governments should aim to create and sustain policy environments that make their entire country attractive to those who build technology businesses and those who finance it.

The main findings of the report include:

• **Start-up firms benefit from the low rent and tax breaks available at software parks**
Each of the software parks examined in this report has an incubator to help launch start-up companies. Facilities offered by the incubators include shared R&D resources, low rent, tax breaks and business administration support. The survival rate of start-ups after two years ranges from 43% at Cyberjaya in Malaysia to 80% at Nankang Software Park in Taiwan—considerably higher than survival rates outside the parks.

• **Asia's software parks have not become innovation hubs**
Despite providing opportunities for knowledge sharing, software parks have not lived up to their promise for promoting technological innovation. Tenant companies often focus on outsourcing or software services. Poor intellectual property protection makes multinational software firms reluctant to locate core R&D abroad, which presents a barrier to innovation and technology transfer. Unlike Silicon Valley, the location of the parks, far from commercial centres, does not position them as magnets for the best and brightest software engineers.

- **Export-focused software services dominate the parks**

Building an export-focused software industry generates investment and economic development, but an approach tipped too far towards exports could pose long-term growth issues. Increasing domestic demand and the growth of indigenous IT companies will reduce Asia's vulnerability to an economic slowdown in Western markets.

- **Asian governments can do more to promote venture capital**

In Asia, many of the regulatory structures governing foreign direct investment were established to protect projects of national significance. Yet restrictions around ownership, governance and capital repatriation can dissuade quick investments in the technology sector, where financiers may seek larger stakes of smaller firms. Asian governments have often used public funds to stand in for venture capital (VC). In some cases this practice can be helpful in jump-starting software industries, but it risks crowding out private investors.

- **Fast and cheap telecoms services are best promoted through liberalisation**

There is a tendency for Asian policymakers to treat telecoms services as a component of public infrastructure. However, to increase penetration and reduce costs, a market-driven approach through liberalisation is more effective than a public planning approach. For example, governments should not limit the number or type of telecoms services licenses in a market.

- **Education policy needs to be directed to create sufficient numbers of highly skilled graduates**

The quality of surrounding academic institutions is a central consideration for companies weighing up whether to relocate to a software park. Higher-education facilities need to produce a sufficient number of graduates with the most highly valued skills to supply the industry. The focus of some Asian universities on teaching means they lack the kind of research capabilities that foster innovation in the software industry.

Introduction:
Desperately seeking software

Perhaps no other industry better epitomises a modern economy than software development. From basic home computing to automating complex business processes, software is not only an area for innovation in itself, but it also enables innovation and competitive differentiation in many other industries. The software industry has low barriers to entry and permits small companies to operate at the cutting edge of technological development, with the promise of high margins. Compared to other industries (such as IT hardware production), it emits little in the way of pollution and requires minimal physical investment. The speed and efficiency with which a software industry can blossom also distinguishes it from most other export-led industries. With this combination of benefits on offer, it is no surprise that governments in many developing economies have pursued the creation of a software industry as a strategic priority.

While for many Asian economies software development is not yet a major contributor to their IT economies, there are plenty of examples of success for governments to aim to emulate. For example, according to India's National Association of Software and Services Companies (NASSCOM), the country's US$47.8bn IT-enabled business is growing at about 30% annually and now accounts for 5.2% of GDP, up from 4.8% in 2006. North Asia's success in technology markets today shows that a solid grounding in software production can kindle the growth of related knowledge-intensive industries, such as optical storage, mobile telephony and robotics. (For the purposes of this report, the products and services that comprise the software industry include shrink-wrapped packaged products, embedded applications, intellectual property licensing, software development outsourcing and IT-enabled services such as training and support.)

To encourage the development of software industries, governments often devise long-term planning and investment strategies to complement market-driven activity. Replicating an approach that worked well in Asia's technology-manufacturing sectors, many Asian governments have decided to make large investments in developing software parks. In addition to emulating past manufacturing successes, these parks have each drawn upon the templates provided by other countries that have developed software industries, such as India, Ireland and the grandfather of all high-tech clusters, northern California's Silicon Valley.

Their attempts raise two questions: can strategy and policy alone provide the foundations for a software industry regardless of locale, and can software parks enable developing economies to leapfrog their peers by providing an attractive environment in which the industry can thrive? This report seeks to answer these questions in two ways. First, we examine the foundations of successful software industries, analysing the factors that contributed to the success of the world's pre-eminent software producing countries. Second, we focus on the development and operation of four software parks in Asia: Cyberjaya in Malaysia's Multimedia Super Corridor (MSC), Dalian Software Park in China, Nankang Software Park in Taiwan and Quang Trung Software City (QTSC) in Vietnam.

In sum, our analysis has found that in focusing on software parks, policymakers are attempting to achieve a set of (usually national) strategic objectives with the wrong tools. Remotely located, hermetically sealed technology parks may be ideal for hard-disk- or semiconductor-manufacturing companies that need controlled physical plants to operate precise machinery. However, apart from cheap rent and tax breaks, the benefits that such parks offer are often not well matched to the needs of software-producing businesses.

In fact, our research suggests that what is needed to cultivate a software industry is not contained within the confines of an isolated technology campus. It exists in the vibrant quality of life that attracts young creative professionals, in world-class universities that attract scientists, and in legal and policy environments that attract venture capital.

Foundations of a software industry

It is not straightforward for governments to identify what they need for a domestic software industry to bloom. Encouragingly, it seems that software industries can take root and grow almost anywhere. For example, despite having had some of the world's most expensive international bandwidth, India managed to build a software-processing business that has grown steadily to be worth nearly US$40bn in 2007, according to NASSCOM. To make up for its infrastructural shortcomings, the government allowed companies to use satellite technology to bypass the expensive national telecoms carriers.

India's most important asset is a plentiful source of highly skilled, English-speaking and relatively low-cost engineering staff. But other assets are also necessary. Countries that can boast cheap and plentiful labour may be able to develop basic labour-intensive software industries, but moving into higher-value business often requires government policies that develop other assets, such as building the telecommunications infrastructure and liberalising the regulatory environment. This chapter examines the basic requirements (both organic and policy-related) for the development of a software industry, with reference to the most successful software-producing countries worldwide.

A vibrant venture capital industry
Silicon Valley is the original and most successful software zone, with over 101,000 staff directly employed in software roles out of a total workforce of 1.2m people. The cluster would not have succeeded without a policy environment that supported its growth. The combined effect of policies such as the non-punitive bankruptcy laws and regulations permitting limited-liability partnerships for venture companies created an environment where venture capital firms had the confidence to take risks. Other beneficial policy and business environment factors included actively traded stock markets, a powerful securities regulator that enforces financial disclosure and transparency, low levels of corruption, political stability and a convertible currency. All these attributes limit the risk that VC firms face when making investments. Companies in and around the San Francisco Bay area continue to attract about one-third of venture capital funds raised in the US, which increased by 8% in 2007 to nearly US$30bn.

However, the US did not encourage local governments or state-owned banks to become venture investors, preferring the function of venture capitalism to be performed by the private sector. Policymakers were aware that government investment can crowd out better-suited private venture capital initiatives. Most governments in Asia, by contrast, have traditionally let public funds stand in for venture capital. For example, rather than encouraging venture capital and private equity, the Chinese government is setting up its own funds to rival international firms. In 2006, Chinese authorities established a private equity fund worth about US$2.8bn to invest in high-tech companies in the country's Tianjin area. A year on, the government is replicating this model elsewhere, despite the fact that the original fund still has not made a single investment.

There is often a practical logic to heavy state-led development of the industry. China's technology sector, telecoms in particular, owes much of its current momentum to the government's active role in investing in the network service carriers that consume large amounts of software and hardware (an average of US$50bn annually throughout the last two decades), but also create the network infrastructure for other technology industries to thrive on. The Chinese government is also actively involved in directing technology standards and policies rather than letting market forces dictate them. This intervention includes favouring products from domestic rather than foreign software firms. Along with state-invested banks and telecommunications firms, government purchasing accounts for half the total software market in China.

Government spending can certainly serve as an industry catalyst and a focus point for technology development. Governments can then append venture capital and investment funds to foster innovation in the desired technology areas. Israel is a noted example of a country that has leveraged defence spending and a serendipitous influx of R&D skills to forge a leading IT-orientated VC industry (see box).

While there is clear room for improvement, through sheer government doggedness much of Asia is making itself more attractive to venture capital. Vietnam has attracted technology-centric venture funds such as IDG Capital and Mekong Capital by liberalising the investment environment around technology start-ups. The country has made tremendous strides in creating greater transparency and reducing bureaucracy around small business investments. Fleet-footed VC investors are responding.

As part of its strategy to compete with Singapore in the financial services sector, Malaysia has been improving its attractiveness

Software success story: Israel—A fertile venture capital environment

Israel, with a US$3.17bn software industry focused largely on high-value applications and security technologies, took an approach that combined fostering venture capital with promoting investment into R&D. In 1977, the Israeli and US governments established the BIRD Foundation. Its role was to fund joint cooperation in R&D between Israel's start-ups and established US firms. The Israeli government financed half of designated companies' R&D expenditure in return for royalties if the project led to a commercially viable, locally manufactured product.

The Israeli government set up its first VC fund, Yozma, in 1992. Although this was a government initiative to begin with, Yozma was privatised after five years. The skills base and access to finance persuaded many of the world's leading technology companies to locate their R&D centres in Israel.

The Israeli government reduced the risks to early VC investors by providing tax deductions on investments, co-investing and offering a share buy-back after five years at the original cost. Yozma invested US$20m directly and another US$80m through ten private funds on condition that they obtain matching investments from established foreign VCs. By 1999, this government initiative had resulted in a vibrant, local VC community investing over US$1bn.

Israel did establish a number of high-tech parks, mainly around urban universities, but they never housed software firms exclusively. Nor have the parks been a central feature of the growth strategy for the Israeli software industry.

as a lower-cost location for private banking and specialist funds such as Islamic financing. Courting the finance sector has created a more beneficial environment for investment overall.

Taiwan uses a model, in part influenced by Japan and South Korea, which blends hands-on government management, investment and promotion of technology research with harnessing the resources of private equity funds. Overly rigid and bureaucratic at times, yet Taiwan's ability to focus government attention on technology projects gives investors the confidence that they will be carried out.

A software talent pool

The role of education in developing the requisite software skills cannot be overstated. This is why Silicon Valley was so successful—and goes some way to explain the difficulty of recreating its success elsewhere.

Northern California's pre-eminent technology industry did not start out as a software zone. It was borne out of a hardware-centric industry cluster. Like Israel after it, Silicon Valley owes a good deal of its success to the fact that much of early demand for its products came from US military clients who were themselves recruiting scientific talent from the rich pickings of universities such as Stanford and UC Berkeley. The US government played an indirect role in nurturing Silicon Valley's growth. It gave military contracts to a cluster of aerospace firms in California and funded many of the projects that employed the region's engineers. However, more significant were the ambitions of Stanford University's dean during the 1940s to

1960s, Frederick Terman, who is often referred to as the father of Silicon Valley.

After the Second World War, Mr Terman was keen to find ways to prevent a brain drain of engineering talent from California's bay area to the large companies based on the US East Coast. He also wanted to generate some income from a surplus of land that the university owned adjacent to its campus. To encourage big eastern companies to open branch offices near Stanford, he promised a reliable stream of new recruits and established work-study programmes to permit continuing education for those already employed. Moreover, outreach programmes were set up to give established firms access to university research before publication and facilitated close university-government collaboration, particularly on the naval contracts that many of the large companies were working on.

A major aim of Asian governments in developing software parks is to create hubs of innovation. This is an area where Asia has often lagged behind Europe and the US. Critics blame Asian educational systems' emphasis on rote learning for the region's relative lack of creativity. It seems as though university research itself does not make the difference. Few patents come from university laboratories in the US or UK, and companies rank their contacts with local universities as being of little importance to developing their technology.[2] However, institutions that do have strong research capabilities produce better trained graduates to populate the technology workforce. Asian universities tend to focus on

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[2] *Strengthening China's Technological Capability*, World Bank Policy Research Working Paper 4309, August 2007

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teaching rather than research and as a result are relatively weak in this area.

India does have excellent academic institutions, although there are some concerns that they develop technical expertise rather than soft skills such as project management and critical thinking. The greater problem is that they produce too few graduates to sustain the software industry's growth.

One way to create the foundations for a software industry is to leverage and adapt a pre-existing skills base. Ireland serves as an example of a country that was successfully able to achieve this by building on its financial services expertise. It was also able to reverse a decades-long brain drain.

Software success story: India—Trained in the USA

It's easy to forget that Silicon Valley is not the only, or even first, US technology cluster that fostered a software industry of note. Other US cities such as Boston, Austin, Seattle and Durham in North Carolina have software clusters of their own that sprung up in most cases because of a surrounding density of world-class universities. India has followed these examples to create industry hubs around its premier science and technology universities. Seven of these prestigious institutions are known as the Indian Institutes of Technology (IITs).

But India's software industry has its roots in the demand from Silicon Valley and other US technology clusters. During the dotcom bubble of the late 1990s, surging demand for IT professionals in the US sparked an exodus of skilled workers from India. These individuals either emigrated by themselves or were sent abroad by IT

services companies to do project work. By 1999, Indian nationals constituted the highest percentage (14%) of all foreign-born science and engineering professionals working in the US. The subsequent dotcom crash started to stem this flow. Indian returnees put their experience to use, establishing IT services companies themselves or continuing to work for the firms that sent them abroad. These emerging IT service companies still focused on delivering software services to international customers.

However, the industry is now facing capacity constraints and there are signs that the government and industry associations may have to play a greater role. The IITs and 20 more-recently established National Institutes of Technology serve only a sliver of India's population. The IITs produce just 12,000 graduates annually.

As well as a shortage of skills,

India, like China, faces a rapidly eroding labour cost differential. Some parts of the Indian workforce command wage increases of between 20% and 30% annually. Additionally, India's currency is appreciating and competitive threats loom from software development operations in lower-cost markets like Vietnam, the Philippines and Eastern Europe. With its strong links to the US software industry, India will be particularly vulnerable to an economic slowdown in the American economy. NASSCOM appreciates this potential threat and has begun to build a skills database of IT professionals, validated by third-party vetting processes. The aim is for the database to strengthen the security and quality credentials of Indian software firms and to enhance their competitive advantage. The database had over 125,000 registrants by mid-2007 and NASSCOM hopes to increase this to 500,000.

Communications infrastructure

Software technology firms cannot develop their products or deliver their services without a robust communications infrastructure. Governments must either provide the infrastructure themselves, or liberalise the sector so that market forces will spur the rapid development that many Asian countries require in this area.

In many of Asia's developing countries, high-speed Internet access has been variable, insufficient or expensive. Advanced infrastructure essentials such as optical fibre are not widespread. In countries that practice online censorship or content filtering, restricted access to international Internet gateways can mean significantly longer upload and download times. Without sufficient network speeds, certain software applications will either not work properly or will fail to function at all.

This is not to say there is no progress in this area. High-speed networks are being built rapidly in some countries and the increase in international capacity has caused tremendous downward price pressure. Bandwidth is fast becoming a commodity, and its increasing ubiquity in those countries that have prioritised its development means that specific locations cannot rely upon it as a sole differentiator. Software parks or technology zones that offer advanced telecommunications infrastructure as part of the value proposition to prospective tenants are finding the gap between the infrastructure offered by the parks and that available elsewhere is closing.

Software success story: Ireland—Leveraging assets to create a niche

Ireland focused on building infrastructure and convincing its talented graduates to stay (or return) by stimulating investment and job creation. Like Silicon Valley had decades before, Ireland suffered from a brain drain in the 1970s and early 1980s. In 1986, the government's inward investment agency, Enterprise Ireland, devised a strategy to reverse this trend by encouraging multinationals to set up operations in Dublin. Ireland offered an educated, English-speaking workforce, proximity to Europe and a low 10% corporate income tax rate. The Irish government invested heavily in infrastructure and training with help from the European Union's regional aid funds.

As a result, Ireland became a major offshore centre for global companies, particularly from the US. By 2007, half of the world's top 50 banks located some of their back-office operations in a cluster known as the International Financial Services Centre (IFSC).

With extensive back-office process expertise and investment in communications infrastructure by the government and resident multinationals, the OECD frequently ranks Ireland in first place among member countries for the significance of the high-tech sector in its economy. However, the country's low corporate tax rate, designed to lure in the multinationals, paradoxically discourages them from locating their R&D facilities there—they can benefit from greater tax write-offs by putting R&D in locations with higher tax regimes.

Despite efforts to promote R&D, Ireland deals mainly in mature technology that others have developed elsewhere. By 2000, Ireland had become the world's largest exporter of software products, largely because companies like Microsoft had located their regional packaging, localisation, distribution and logistics processes there. Ireland's indigenous companies have had a marginal role in this rapid growth in exports of high-end software products, with foreign firms accounting for 90% of the exports.

There are several examples illustrating the importance of telecoms liberalisation. Until 2002, India's telecommunications industry was constrained by the state-owned monopoly, which offered some of the world's most expensive international call rates. Hesitating to reform the sector, the Indian government did allow private very small aperture terminal (VSAT) links in the country's technology parks to bypass the public network, so that companies were able to lower the costs of calling abroad. The sector really flourished after liberalisation, when bandwidth costs dropped to a fraction of their monopoly levels.

When Malaysia's Cyberjaya opened, the government marketed the park's state-of-the-art infrastructure as a key attraction. In recent years, many other countries including Malaysia's neighbours have caught up and even overtaken the nation in average broadband speeds and penetration rates (13% as of 2007). Despite losing its monopoly in 1994, the state-owned Telecom Malaysia still has a 95% share of the fixed line market. A lack of competition in the telecommunications industry and bureaucratic red tape involved in granting communications-related licences are hampering the sector. Newcomers focus on the mobile telephony market.

As well as benefiting the software industry, liberalisation also drives Internet usage and e-commerce. Hong Kong's telecommunications policy in recent years has been aimed at increasing competition in both the fixed-line and mobile markets. Intense price competition has made Hong Kong one of the cheapest and most efficient places to host data centres in Asia, attracting a greater market-share in this area than rival centres such as Singapore or Kuala Lumpur. Hong Kong has become a hub for e-commerce in Asia, and was placed fourth in the Economist Intelligence Unit's 2007 e-readiness ranking (an index of over 100 qualitative and quantitative factors that show the "state of play" of a country's information and communications technology infrastructure and the ability of its consumers, businesses and governments to use ICT to their benefit).[3] Hong Kong's government has taken a strong role in driving digital adoption; 90% of government services were online by 2003.

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[3] *The 2007 e-readiness ranking*, Economist Intelligence Unit, 2007

Four Asian software parks

Asia's software parks have been built on the theory that with the right infrastructure and policies, governments can create industry-specific clusters from scratch. The theory says that placing similar knowledge-based companies and research institutes within close physical proximity will encourage innovation and expertise-sharing among professionals, and will employ an ever-renewing supply of skilled graduates. In principle, the cluster will also increase the productivity of the firms based there and stimulate the establishment of new companies. Is this borne out by the software parks already in operation across Asia? To find out, the remainder of this report focuses on the development and operation of four software parks in Asia: Cyberjaya in Malaysia's Multimedia Super Corridor (MSC), Dalian Software Park in China, Nankang Software Park in Taiwan and Quang Trung Software City (QTSC) in Vietnam.

The development of these parks follows the precedent set in the 1980s and 1990s when governments across the region built large out-of-town parks to house the industrial operations of foreign high-tech companies. Incentives to relocate there included competitive rents and tax breaks. Initial tenants were usually firms looking to bring down the cost of assembling consumer electronics and IT hardware components, before moving into more technology-intensive production such as microprocessors. Asian high-tech industrial clusters such as Penang in Malaysia and Hsinchu in Taiwan proved highly successful, drawing in billions of dollars of foreign direct investment and prompting policymakers in the region to try to emulate this success but with software rather than hardware.

Phases since founding and total government investment in four software parks

	Cyberjaya	Dalian	Nankang	QTSC
Year of founding	1997	1998	1999	2001
Phases since founding	2	2	3	1
Total government investment (US$m)	1000	55	612	14

Source: Administrators from each of the software parks either provided the data in these and subsequent exhibits about the parks or confirmed numbers found in secondary sources.

Malaysia paves the way

One of the first to build a software park was Malaysia. In the mid-1990s Malaysia's then prime minister, Mahathir Mohamad, had a vision to capitalise on newly developed Internet technologies and create a Multimedia Super Corridor (MSC). It opened in 1996 and covers 750 square kilometres, an area larger than Singapore. The centrepiece of the MSC is Cyberjaya, which opened in 1997. Malaysia's

bold step resulted in a scramble by other Asian countries to keep up and develop their own software parks. The hope was to generate a software outsourcing boom similar to that of India.

The MSC scheme was not an unqualified success. Early on, prohibitive immigration laws made it difficult for companies to hire expatriates. The MSC had other unpopular policies, such as dress codes in its buildings and a venture fund that favoured *bumiputras*,

or ethnic Malays. To generate interest, the government exempted tenants from positive discrimination laws governing *bumiputra* hiring and ownership, as well as those concerning Internet censorship.

A marketing drive in 2005 boosted what had been a slow uptake by tenants, and there are now 1,870 companies in five "cyber-cities" across the MSC. As of 2007, Cyberjaya itself had 419 companies, a multimedia university, 34,000 workers and 14,000 residents. Nightlife and affordable housing are limited but there are plans to open an international school, hospital, shopping centre and recreation club to lift the area's appeal. The MSC continues to expand, with plans to open a US$90m Cyberport in 2009. The Cyberport will aim to provide a nearshoring destination for firms in Singapore, which is just across the border.

In 2007, an A.T. Kearney survey of top IT outsourcing locations worldwide put Malaysia in third place. Just four years earlier, it had not even made the top ten.[4] In recent years, Malaysia's prime minister, Abdullah Badawi, has helped secure major investments by companies such as Dell and Satyam. In 2005, Mr Abdullah identified shared services, creative content and biotechnology as strategic priorities. Like India, Malaysia has IT skills and English-language speakers. It has successfully leveraged these assets to create an international offshore business.

Taiwan builds on high-tech legacy

Nankang Software Park opened in 1999 on the outskirts of Taiwan's capital, Taipei. The largest software park in Taiwan, Nankang covers 27 acres and houses 274 tenant companies. Now in its third phase of expansion, the park focuses on specific market niches of integrated-circuit (IC) design (such as system-on-a-chip for embedded computers), digital content and biotechnology. Tax incentives, low rent, credit availability and its location have made Nankang consistently popular with local firms. Although the park's website is five years out of date and it has no active marketing programme, its occupancy rate stands at an enviable 98%.

With the much larger Neihu Science Park and Taipei Tech Park nearby, Nankang forms part of Taiwan's high-tech corridor that extends to Hsinchu Science Park, an hour's drive to the southeast of Taipei and the linchpin of Taiwan's high-tech manufacturing might. Hsinchu is itself a creation of the government's systematic investment in research and development facilities.

From the beginning, apart from its broader role as a seed investor in R&D infrastructure, the Taiwanese government has been actively involved in cultivating other aspects of an IT ecosystem at Nankang. It recruited expatriate Taiwanese entrepreneurs from Silicon Valley, reduced the investment risk for early VC firms, and eased capital controls and public listing requirements for high-tech firms. With software, Taiwan hopes to copy the success it enjoyed with technology hardware. In the 1990s, Taiwanese companies were the world's dominant manufacturers of computer products such as scanners and IC chips.

Taiwan has a combination of valuable assets similar to those of Silicon Valley, Israel and

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[4] 2007 A.T. Kearney Global Services Location Index™

Ireland. It has deep IT expertise and many of its early technology entrepreneurs are Taiwanese returnees from Silicon Valley. Nankang tenants give positive reports on Taiwan's IT workforce. "We hire locally, mostly PhDs and Masters, as the talent pool is very good," says Matt Huang, Chief Operating Officer of Armorize Technologies (one of *Red Herring* magazine's top 100 technology start-ups in Asia), "Taiwan is so small that you can tap into its best universities."

Taiwan also has an attractive business environment, with funding schemes and industrial coordination methods that are similar to those used by Israel to promote a positive investment climate. Finally, like Ireland, Taiwan has proven able to append a software industry to pre-existing domestic industries. Domestic IT industries in the semiconductor and mobile device manufacturing sectors are both key anchor industries that help fuel Nankang's development, particularly with regard to developing software solutions for system-on-a-chip applications. Taiwan's Nankang is the most successful of the Asian software zones examined in this report.

Foreign investment spurs Vietnam

Low production costs, skilled labour, government incentives, political stability and an extensive expatriate community have propelled Vietnam to 17th position in a 2007 A.T. Kearney global ranking of countries for software outsourcing. In 2005, Vietnam had not even made the top 40. Turnover in software and software services reached US$300m in 2006, up from US$250m in 2005. According to the Vietnam Software Association, software outsourcing services have also grown rapidly in recent years, reaching US$70m in 2005, an increase of over 55% since 2004.

Vietnam is perfectly positioned to capitalise on foreign multinationals' "China plus one" strategies under which they are diversifying their investment locations for political reasons and to spread risk. Having attracted technology giants such as Intel and Foxconn, the Vietnamese government has proved its will and ability to draw in investment in the high-tech industry. Technology parks are a central part of the strategy. By providing in-house customs clearance and investment licensing, and independent power, water and sewage, the parks allow tenant companies to bypass many of the challenges faced by firms located outside.

Located on the outskirts of Vietnam's Ho Chi Minh City, QTSC opened in March 2001 with the aim of having up to 20,000 workers and students by 2015. It was part of the government's five-year economic plan for the city. The collective revenue from QTSC's tenant companies is approximately US$30m, and 46 of its 77 firms are wholly foreign owned enterprises. QTSC tenants employ 3,000 engineers and have access to a pool of 4,000 students who are based in or around the park. Since 2004, QTSC has been able to cover its costs without subsidies from the government. In total, the park has received US$50m in investment, with this figure projected to more than double by 2008.

QTSC has a Sun training centre, an IBM service centre, an incubator to support start-up firms that is funded by the European Union

and a USAID-funded marketing initiative. The park attracts firms with tax incentives, value-added-tax rebates, services for processing tax and business applications, and relaxed entry and exit permits for expatriates. It is currently negotiating with foreign investors specialised in software production, business process outsourcing, data centres and call centres. While the park offers some relief from Vietnam's infrastructure shortfalls, one drawback is its isolation. While road links to the park have improved, QTSC's general manager, Chu Tien Dong, notes that its surroundings lack attractive expatriate residential areas.

The Vietnamese software industry is still in an early stage of development, but does have potential for nurturing a successful industry similar to India. Vietnam has an increasingly favourable investment environment and an inexpensive, well-trained workforce. It has already attracted some of the global software firms and related financial services industries.

Dalian creates outsourcing niche

Dalian Software Park is one of 11 national-level software parks designated by the Chinese central government in 2001. Founded in 1998, Dalian Software Park serves as one of China's six bases for national software exports. Its tenant firms generated nearly US$930m in software-related revenue in 2006 and this figure is growing at 45% per year. Foreign companies account for 43% of Dalian Software Park's 389 firms, which employ 25,000 people. Despite its 22 universities with 200,000 students, more

than half of whom study engineering or the sciences, companies at Dalian largely focus on software services and outsourcing rather than more innovative work.

Of the Asian software parks discussed in this report, Dalian's development of an IT industry most closely resembles that of Ireland. It is conveniently located near to the larger and wealthier markets for IT services—Japan and South Korea. As well as a compelling talent repatriation programme, Dalian has the requisite Korean and Japanese language skills to service these markets effectively. But focusing on Japan and South Korea is no guarantee of success for Dalian in the longer term. On one hand, it may offer an outsourcing niche and a sustainable source of competitive advantage. On the other, if Dalian seeks to build larger, global IT industries, this niche focus could be its downfall.

If Dalian is the Chinese software industry's "factory", Zhongguancun Science Park (Z-Park), a software park located in the Haidian district of north-west Beijing, is its "brains". Z-Park is the largest software park in China and consists of five science zones. It is also in close proximity of China's elite institutions, Tsinghua University and Beijing University. The Beijing area is emerging as a major source of software talent. It has twice as many programmers as China's closest competing city, Shanghai.

VanceInfo (formerly named WorkSoft) is a leading provider IT services and offshore software development services based at Z-Park. It was founded in Beijing in 1995 and relocated

to Z-Park in 2003. The company, which employs 3,675 staff as of end 2007, also has subsidiaries in six other high-tech parks or economic zones around the country. According to Chris Chen, the CEO, "Z-Park is in an attractive area that resembles Silicon Valley." The firm's affiliation with Z-Park boosts its appeal with international clients and the relocation reimbursement offered by the district government was an additional incentive to move.

Too far from the action

As with any property development, location is the main factor in determining a software park's value to tenants and its ultimate construction costs. To build large-scale developments on affordable land, developers select sites that are far from a capital city's central business district or in secondary cities like China's Dalian. However, these are often destinations that prospective staff may find unattractive.

For companies assessing software parks, access to skills is a critical issue. Location becomes most important for activities higher up the software value chain. These functions rely on attracting the highest-calibre individuals, who demand access to cultural amenities and top-quality schools for their children.

Hong Kong's Cyberport, which opened in 2000 at a cost of US$2bn, was only 75% occupied in 2007. Touted as a centre for digital media, Cyberport is far from Hong Kong's main media production facilities and has no subway link into the city. Malaysia's Cyberjaya also had a slow take-up rate in the late 1990s because of its location and lack of facilities. While Nankang and Dalian software parks are only 30 minutes' commute from their respective central business districts, Cyberjaya and QTSC are twice this distance. A lack of proximity to the capital city is a hindrance. However, this can be overcome if the area around the park is made sufficiently attractive.

Business facilities form only part of the incentive to locate to a software park; executives have to want to live there too. Historically, executives working at Cyberjaya have preferred to live in Malaysia's capital, Kuala Lumpur, and commute every day. This is beginning to change, with significant investment in transport infrastructure to the city and high-quality expatriate living accommodation.

Location is also a challenge for QTSC. Glass Egg Digital Media is one of Vietnam's software success stories but the company has had no affiliation with any software park. Founded in 1999 by Phil Tran, a Vietnamese returnee from the US, Glass Egg develops multimedia video games for leading US companies. A workforce of skilled local programmers is paid less than one-tenth the wages of American counterparts and enables the firm to earn profit margins above 50%.

Mr Tran acknowledges that QTSC has good facilities and rent is competitive, yet he would not relocate to the park. "QTSC is too far from Ho Chi Minh City's universities and our expatriate managers would not want to live there because it is an hour's drive from the city's central business district." Instead, Glass Egg has its office in a modern building downtown called "E-Town". Its main competitor, Alive Interactive, is also located within the central business district rather than QTSC.

While it's fair to say that none of Asia's software parks offer the programmers' playground that is Silicon Valley, developers are aware of the need to provide an attractive lifestyle environment and are making progress in that direction.

Entrepreneurialism over innovation

The level of government investment into software parks proves how deeply held is their belief that the parks will support start-ups, enable innovation, and promote domestic companies as well as foreign firms. The question is whether the parks are able to successfully meet these objectives.

Launching start-ups

Each of the four software parks examined for this report has an incubator that provides subsidised rents and other support for start-up companies such as access to government grants and sources of seed funding. In return, successful incubator tenants act as showcases for visiting delegations. Those that succeed in incubators generally outgrow the facilities and relocate to elsewhere in the park. Incubator facilities also provide business centres to help young firms apply for government-sponsored R&D grants. Founders of high-tech start-ups usually have engineering—rather than business—backgrounds, so they welcome efforts to provide administrative support.

Although executives with start-ups in software parks praise the incubator facilities, some observe that government R&D grants are too small to be of much use—particularly once a company has grown beyond about ten employees. To address this need, parks also have programmes to link their more established firms with VC funding to make up the shortfall.

Nankang's incubator and R&D activities are managed by Taiwan's Institute for Information Industry, a non-profit quasi-governmental organisation. The Institute invited a Silicon Valley start-up, Armorize, to locate its R&D operations within the incubator. Before agreeing, Armorize's Taiwanese co-founder,

Matt Huang, examined the two main centres for Silicon Valley's outsourced R&D: China and India. Mr Huang found costs in India higher than expected and China's political environment too restrictive. Moreover, the Nankang incubator, which had a stringent application procedure, offered half-price tenancy to its member companies and streamlined procedures for participating in government projects and receiving research grants.

Taiwan's government emphasises research and often requests that engineers doing their two-year compulsory military service work in research firms free of charge, which is a great benefit to start-up companies. In 2005, Taiwan's Industrial Technology Research Institute (ITRI) also set up an incubator in San Jose, California, to link Taiwanese VC firms and technology companies with entrepreneurs based in Silicon Valley.

However, venture capitalists interviewed for this report state that when making investment decisions it is immaterial whether or not a company is located within a software park. More persuasive factors include the firm's technology, quality of management and business plan.

The survival rates of start-ups vary enormously. QTSC's director, Mr Chu, reports that start-ups within the park have a 65% survival rate after

Incubator survival rates after two years
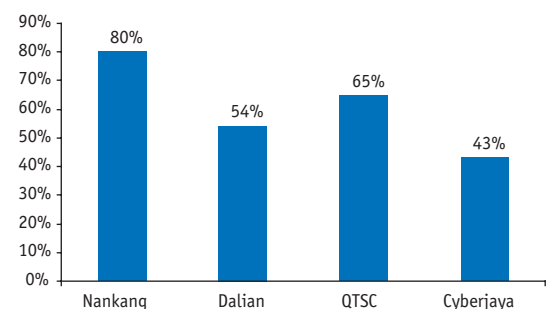
Source: Software park administrators

two years in comparison with 30% outside the park in Ho Chi Minh City, the country's commercial capital. This result is consistent with findings from the OECD and the US Small Business Innovation Research (SBIR) programme, which show the efficacy of incubators in doubling the survival rates of member firms. Cyberjaya has a high throughput of start-up companies—250 from 2004 to 2007. The park is able to host 35 companies in its laboratories at any time and another 30 in the incubator.

Knowledge sharing and innovation

Software park tenants describe few formal opportunities for intra-park collaboration between firms, although they do participate in reciprocal exchanges with visiting delegations from overseas parks. Nankang runs frequent "match-making" events for tenant companies but they are described as not particularly useful from a learning perspective. The park's "CEO club" has become a showcase for prospective tenants rather than a genuine opportunity to share experiences of the incubator.

Informal knowledge sharing is more common. The close proximity of tenant companies, particularly within the incubators, fosters information exchange at all levels. Indeed, firms constantly poach one another's technical experts. With so much start-up activity within the parks, newly formed companies help to absorb the staff from less successful businesses that may be shedding employees.

Although the parks' focus on attracting multinationals is effective for kick-starting an export industry and providing the resources to support start-ups, there is little evidence that this results in technological innovation by domestic companies or technology transfer. Multinational companies either hesitate to locate core R&D abroad or they spread their research across multiple locations or countries to protect their intellectual property. In China, two-thirds of the 50,000 patents awarded in 2006 went to non-residents or foreign companies.[7] If these patent holders leave the country their intellectual property goes with them.

An Economist Intelligence Unit survey of 260 executives found that few companies are shifting global oversight of R&D to Asia.[8] Only a small percentage, 5% of respondents, indicated that they are moving R&D management out of headquarters and to the places where research is being carried out, predominantly China and India.

The reasons for moving R&D include getting closer to customers or suppliers as well as better access to skills. Only one respondent cited costs as the primary motivating factor. China and India were voted the first and second most attractive destinations for locating R&D facilities. Singapore and Vietnam also received high marks. The results show that the latter two markets as well as Malaysia are becoming more attractive as R&D destinations. In contrast, other North Asian markets including Hong Kong, Japan and Taiwan are perceived as becoming less attractive places to locate R&D, due to high costs and competition for resources such as skilled labour.

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[7] *WIPO Patent Report: Statistics on Worldwide Patent Activity*, World International Patent Organisation (WIPO), 2006

[8] Economist Intelligence Unit, Corporate Network Survey, 2007

A serious hindrance to innovation, particularly in packaged software, is the rampant piracy in Asia. An annual study conducted by BSA (the sponsor of this report) and a technology research firm, IDC, into global software piracy states that in 2006, 88% of the software used on PCs in Vietnam was pirated. This amounts to a global loss of revenue of US$96m. China also suffers from a high rate of software piracy, measured at 82% in 2006.[9] As a result, firms shy away from producing easily-copied consumer packaged software in favour of software services.

Fostering home-grown companies

While securing multinationals as anchor tenants is a crucial success factor to making the parks economically viable, ultimately the ambition is to create a flourishing *domestic* software industry. Building an export-focused industry that comprises mainly multinational companies generates investment and economic development. However, an approach tipped too far towards exports could pose long-term growth issues. The future for India's software industry is at the centre of this debate, as it is particularly vulnerable to a slowdown in the US. One of the strategies may be to build a domestic software product industry in India as opposed to the current emphasis on services.

Of the four Asian software parks, Nankang and Cyberjaya have the greatest proportion of

domestic tenants. QTSC, the newest of the parks has the smallest, although the park's incubator will play a central role in increasing this percentage.

Percentage of domestic and foreign companies within each of the software parks
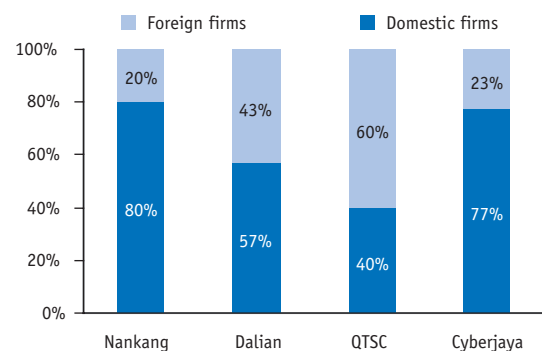
Source: Software park administrators

Red Herring magazine produces an annual list of the 100 most promising start-ups in Asia, selected for being the most innovative. Of 2007's 100 winning firms, 37 are in China, four are Malaysian, and Vietnam and Taiwan produced only three each. Of these winners, very few are located within the software parks discussed in this report, instead preferring locations that are in the commercial capitals where they have access to the best and brightest students and faculty from top technical universities.

[9] Fourth Annual BSA and IDC Global Piracy Study, 2007

Official performance metrics

Since software parks are major government investments, they must account for their performance. Some do so by tracking the number of tenant firms and the revenues they generate and levels of employment.

A measure of performance that provides more insight is occupancy rate. Companies and employees make their preferences known by either moving to the parks or staying away. By this measure, Nankang in Taiwan is the most fully occupied park.

Number of park tenants, revenues and employees (2007)

	Nankang	Dalian	QTSC	Cyberjaya
Number of companies in park	274	389	77	419
Tenants' annual revenues (US$m)	4000	930	30	N/A
Employees	8,000	30,000	3,000	34,000

Source: Software park administrators

Occupation rates of software parks (2007)

Park	Rate
Nankang	98%
Dalian	95%
QTSC	80%
Cyberjaya	96.5%
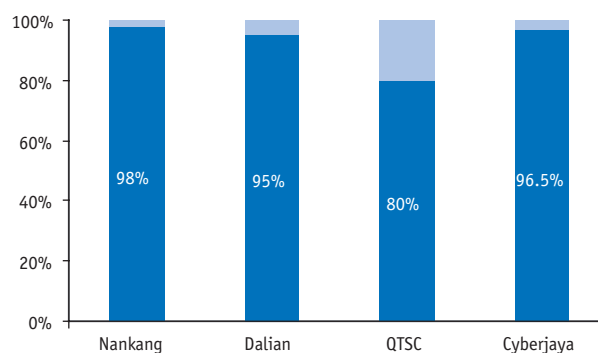
Source: Software park administrators

Conclusions:
Economic reform is the greatest lever

Our research shows that Asia's software parks do attract IT companies and generate often much needed foreign direct investment. They are effective vehicles for supporting start-ups and technology entrepreneurs with successful incubator schemes. Software park tenants rely on the low office rents and tax breaks, considering these to be central to encouraging industry development. The parks also create job markets for IT professionals and graduates.

The main failure of the parks examined for this report in terms of achieving their broader goal is that they tend to encourage mainly lower-end software outsourcing, since they are fundamentally an evolution of foreign export-processing and high-tech manufacturing zones. For environmental and cost reasons, these zones were developed in locations away from densely populated centres. However, being a knowledge-industry, software does not need to be tucked away in an industrial park. The successful development of companies on the outside of these parks is proof of this.

The incentives put in place to encourage investment and court anchor tenants have enabled Asian governments to delay tackling essential reforms to the financial and communication sectors. Deregulating, enacting data-privacy laws, strengthening intellectual property enforcement and limiting the risk exposure of VC firms may all have a greater impact on the development of a vibrant software industry.

With or without creating a specific park, the examples of Silicon Valley, Ireland, Israel and the four Asian parks studied here suggest that there are several policy steps that can be taken in order to nurture software start-ups and attract established software companies:

1. Create an attractive investment environment
Investment climates that facilitate easy access to finance benefit small entrepreneurial firms and the venture capitalists that invest in them. While some governments feel that the activities of VCs and private equity firms clash with their national interests, as the examples of Silicon Valley, Israel and others demonstrate, their involvement is essential to expanding promising businesses quickly. Regulatory structures governing foreign direct investment in developing countries were set up in an era of large-scale plant and property investments in projects of national significance. Regulations around ownership, governance and capital repatriation dissuade quick investments in the technology sector, where financiers often seek larger stakes of smaller firms. Bankruptcy laws, when they stigmatise failure, can also stifle entrepreneurialism. Governments must protect investors' money, yet in markets such as China, failed entrepreneurs are not allowed to start new companies for several years.

2. Liberalise the telecommunications sector
Most markets in Asia have made progress in liberalising their telecommunications sectors, but this process must be ongoing in order to keep pace with advances in technology. An issue currently facing policymakers in the region is the convergence of fixed and mobile platforms, or voice and data applications, and the implications of these trends. Most telecoms operations in Asia are licensed in one service class or another, whereas technology firms

require ever more multimedia approaches. Governments that seek to license carriers for unified communications, such as Singapore, and recently India, allow telecoms companies to provide the services that their customers require. In a small number of instances, governments do have to restrict the number of licences that they grant (such as spectrum for wireless services). But as a rule, market forces are usually best at correctly determining the number of competitors that should exist in a given industry.

3. Focus higher education on producing the most valuable skills

A skilled, low-cost workforce is a vital attribute for attracting investment from multinational software companies. It is also something that many Asian nations have and is not a factor that differentiates them from each other. To break away from the rest, policymakers in Asia will need to take an active role in ensuring that higher education institutions produce an adequate number of IT graduates to fuel expanding software industries and also that universities are providing the most marketable skills. In addition to technical expertise and research experience, the industry needs soft skills such as project management, critical thinking, presentation skills and cultural awareness for dealing with foreign companies.

4. Strengthen intellectual property protection

To encourage the development of high-value areas of software production such as packaged software, governments must address valid concerns about piracy in Asia. Even in markets where robust systems seem to be in place, such as Malaysia, poor enforcement in areas such as CD and DVD piracy undermines confidence. As well as discouraging foreign investment, particularly in R&D, poor IP protection can also stand in the way of skills development, technology-transfer and innovation.

5. Remain technology neutral

Governments are at their most effective when creating and enforcing a legal and policy framework that prevents anti-competitive behaviour and reduces business uncertainties. They should also promote a technology neutral development environment and avoid dictating standards or the use of some technologies over others. There are exceptions. In Taiwan's case, the government specifically encouraged development of system-on-a-chip as a commercially viable niche industry based on the previous experience it had with semiconductors. However, it is easier to get it wrong than get it right when directing development of specific technologies. Although not a software example, the lessons that China is learning through its foray into creating a 3G standard do apply more generally. By going against the global standards and pushing TD-SCDMA as its own standard, China has bound a whole industry to an isolated and rapidly outdating technology area which damages its credibility in the global IT marketplace. This type of misguided government policy is not only in fundamental opposition to the laws of innovation but potentially derails an entire industry.