

## Singapore's Role as a Regional ICT Hub

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### I. Introduction

Singapore is a small city-state of 650 square kilometres and a population of only four million. Despite possessing no natural resources it has become one of East Asia's miracle economies, achieving a per capita income level that is among the highest in the world. It has successfully overcome its small size by leveraging on the region and the world. It is a manufacturing base producing skill-and technology-intensive goods for regional and global markets. It is also a services hub, producing exportable services largely for markets in the region.

Singapore's latest strategy is to position itself as a regional information and communications technology (ICT) hub as part of its overall strategy to develop as a knowledge-based economy in the 21st century. The paper describes the aspirations, the competitive advantages, and the weaknesses of Singapore as a hub for ICT.

### II. A Theoretical Framework

The paper introduces two models of the new economic geography—one quantitative (Fujita, Krugman, and Venables) and one qualitative (Porter). The quantitative model is centred on increasing returns from positive externalities due to agglomeration and it introduces a world with trade costs, while the second introduces concepts of cluster analysis and builds a conceptual model that focuses on competitive advantages in cluster location.

#### A Seamless World with Trade Costs

Fujita, Krugman, and Venables argue that agglomerations are the result of equilibrium between two opposing forces.<sup>1</sup> The centripetal force of forward and backward linkages among firms creates forces that support agglomeration, and the centrifugal forces due to trade costs between regions work against agglomeration.

The number and spatial distribution of agglomerations are due, *inter alia*, to the presence of specific factors and trade costs. Industry-specific factors make it more likely that an intermediate number of agglomerations will form and that these will increase in size. This is intuitively tenable. Where there are no specialised factor inputs, it is possible for an industry to locate in many different regions (which leads to any possible number of clusters); but where inputs are specific to the industry, there is greater motivation to pool resources in a few locations.

Trade costs influence the location in space of agglomerations. As trade costs fall, the frequency of agglomeration declines. At the same time, higher cost industries will move from the core toward the periphery to take advantage of lower costs, as the increasing returns from agglomeration become negligible. This frequency change is characterised by significant changes in the economic landscape.

#### Cluster Analysis and Competition Effects

By concentrating on the agglomeration economies of linkages these quantitative models neglect several important qualitative variables. Porter discusses these additional influences in the context of competitive advantages gained through location in industrial clusters.<sup>2</sup> The analytical framework for which location influences productivity and productivity growth includes factors such as factor input conditions, the context for firm strategy and rivalry, demand conditions, and the presence of related industries, which encourages cluster formation and growth.

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<sup>1</sup> M. Fujita, P. Krugman, and A.J. Venables, *The Spatial Economy: Cities, Regions and International Trade* Cambridge, MA: MIT Press, 1999.

<sup>2</sup> M.E Porter 'Clusters and the New Economics of Competition'. *Harvard Business Review*, November 1998a and 'Clusters and Competition: New Agendas for Companies, Governments, and Institutions'. In *On Competition*. Boston, MA: Harvard Business School Press, 1998b.

Cluster theory rests on a broad, dynamic view of competition that emphasises growth in productivity. It advocates the development of *all* existing clusters, not just selected ones. This stance implies that foreign imports and firms are important contributors to agglomeration externalities and therefore it results in a positive sum view of competition and trade. The role of government is summarised in [Figure 1](#).

### III. The Role of Singapore as a Regional Hub

Hubs are geographical concentrations of economic activities that arise due to particular conditions such as the parameters of the location and its qualitative characteristics. As the economic landscape changes in response to dynamic forces, and sometimes policy developments, hubs can wane and new hubs emerge in new geographical locations. Singapore is a regional hub for Southeast Asia and sometimes for the broader East Asia/Asia-Pacific region.

- It is the regional entrepot and Southeast Asia's intra-regional trade is largely with/through Singapore.
- It is the major shipping and air transport node of the region, linked by sea and air to all parts of Southeast Asia and beyond (as well as by land to Malaysia).
- It is a regional financial centre.
- It is a regional telecommunications hub.
- It is a regional production base for manufactures.
- It serves as the regional headquarters for many European, Japanese, and US MNCs. Some 6,000 foreign MNCs and international companies carry out not only manufacturing but also service, and headquarters functions in Singapore.
- Singapore's outward direct investments are mainly regional and are concentrated in Malaysia, Hong Kong, and Indonesia and to a lesser extent in the other ASEAN economies.
- Singapore increasingly plays the role of intermediary for Southeast Asian trade in machinery and equipment and in industrial parts and components.

### IV. ICT Industry Development in Singapore and its Links with the Asia-Pacific

The ICT goods sector is a major contributor to Singapore's GDP, amounting to S\$26 billion in 1996 or 20% of GDP. The main sub-sector is manufacturing (12.3%), followed by wholesale and retail trade (3.2%), telecommunications (2.1%), business information and technical services (1.4%), and computer-related services (0.8%).

#### ICT Goods Production and Trade

The main ICT goods manufactured in Singapore are computers and electronic office equipment and electronic components. Singapore is an East Asian production centre for electronics products and parts and components. It is also a marketing and distribution hub for ICT products, particularly office machinery and telecommunications equipment. Production of electronics has been characterised by dominance of foreign MNCs, concentration in industrial electronics and electronic component sub-sectors, strong export orientation, and rapid industry restructuring and relocation of labour-intensive processes and lower-end product lines to neighbouring countries. The Singapore electronics industry has gone through several phases of development.<sup>3</sup>

- *Late-1960s to late-1970s*: The Singapore industry was established in the late 1960s with the initial influx of MNCs from the US followed by ones from Europe and Japan. To these foreign MNCs, pushed into offshore production by maturing product cycles and rising domestic labour costs, Singapore offered a combination of central geographic location and a productive labour force.
- *Late-1970s to late-1980s*: The earlier American-dominated investments in semiconductor assembly plants were followed by largely Japanese investments in

<sup>3</sup> Chia Siow Yue, 'Singapore: Advanced Production Base and Smart Hub of the Electronics Industry'. In Dobson, W. and Chia, S.Y. (eds.). *Multinationals and East Asian Integration*. Canada and Singapore: International Development Research Centre and Institute of Southeast Asian Studies, 1997.

consumer electronics. Singapore became a major manufacturing site for computers and peripherals as its labour cost advantage eroded and competitiveness depended increasingly on its skilled workforce, invested capital in electronics production, and excellent infrastructure.

- *Late-1980s to mid-1990s*: Rapid technological change and shortening product cycles intensified global and regional competition. Operations became more technology-intensive through automated manufacturing, shifting to higher-end products, as well as relocating labour-intensive operations and mature and lower-priced product lines to neighbouring countries with greater availability of low-cost labour.
- *Since late 1990s*: Singapore's diverse production fronts in the electronics industry are all human resource-intensive, leveraging computer science, engineering, and artificial intelligence research. The Industry 21 Master Plan has identified electronics as a key cluster in positioning Singapore as a world-class electronics hub by bringing in global leaders with the latest product design, manufacturing, and applications.

In the Krugman-Fujita-Venables model, the presence of a specific industrial factor is central to the existence and maintenance of an industrial cluster. In Singapore's case the economic landscape of the ICT goods industry evolved along with Singapore's ability to provide such specific factors. Initially, the factors were productive labour combined with a central geographic location attractive to foreign MNCs. These factors were replaced by a skilled labour force coupled with electronics hardware production, and these were subsequently replaced by high-level technology. Most recently, human capital, in the form of ICT engineers and scientists, has been the specific input that Singapore has provided.

#### **ICT Services, Human Capital, and Infrastructure**

The ICT services industry, including software, content, and ICT services, comprises so-called 'weightless' economic items that involve little or no trade cost. The ICT services industry did not feature prominently in the early stages of Singapore's industrial development, but by the early 1990s there was a growing recognition of its importance. The Singapore government actively promoted the development and use of ICT services in five phases.<sup>4</sup>

- *1981-85*: A national information technology drive, embodied in the National Computerisation Plan launched in 1981 outlined 3 objectives: computerisation of the civil service, training of software professionals, and building the local IT industry to expand software and services.<sup>5</sup>
- *1985-92*: The National IT Plan (NITP) introduced in 1985 outlined a 7-pronged approach to ICT strategy in Singapore: developing IT professionals and experts; improving the information and communication infrastructure; promoting the ICT industry; co-ordinating and collaborating between various ICT-promoting organisations; establishing a culture that welcomes ICT; encouraging creativity and entrepreneurship; and increasing ICT application in workplaces.<sup>6</sup>
- *1992-97*: The IT2000 Plan released by the National Computer Board (NCB) in 1992 provided the vision of an 'Intelligent Island' based on an advanced National Information Infrastructure (NII), which would interconnect computers in virtually every home, school, and workplace. IT2000 set out an ambitious plan to intensify development of ICT-related manpower; improve quality of life; improve personal and community

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<sup>4</sup> Chia Siow Yue and Jamus J. Lim, 'Singapore's ICT and SME Policies for the New Millennium'. Paper presented at the Conference on the New Euro-Asia Pacific Partnership: Challenges of Integration, ICT and SMEs, Singapore, November 14-15, 2000.

<sup>5</sup> *IT2000 Plan*. Singapore: National Computer Board, 1992.

<sup>6</sup> C.N.Tan, S.K. Goh, S.T. Chua, J. Montiwalla, and S.M. Sung. *National IT Plan: A Strategic Framework*. Singapore: National IT Plan Working Committee, 1985.

communications; use the NII to establish a competitive advantage within and beyond Singapore; and position Singapore as a regional hub by plugging into international business networks.

- *1997-2000:* Both the ICT industry and ICT policy in Singapore changed in this period, with the acceleration of the scheduled telecommunications consolidation and the convergence of information technology, broadcasting, and communications media. Convergence occurred not only in the private sector (Pacific Internet, an ISP, began to offer Internet telephony services) but also in the public sector, with the merger of NCB and Telecommunications Authority of Singapore (TAS) to form the Infocommunications Development Authority (IDA) to spearhead the drive to make Singapore a vital global ICT centre. The legal and regulatory framework was made more ICTfriendly and brought into line with international standards and models.
- *Infocomm 21:* Singapore entered the new millennium with the Infocomm 21 Masterplan, a strategic framework to guide the further development of ICT, encompassing ICT goods, services, human resources, and infrastructure. Key components are a fully liberalised telecommunications market to develop Singapore as a telecommunications hub and a clear legal and policy framework, especially concerning security and privacy in e-commerce, mainly through fine-tuning existing laws. Manpower strategies for the infocomm sector are to enhance the environment to nurture a net-savvy workforce by providing world-class education, training, and recruitment.

#### **Developing the Infocomms and Media Cluster**

To achieve the vision Singapore as a regional hub for the digital economy, there are three key focus areas for the Infocomms and Media cluster: to strengthen the total e-business framework, to grow Singapore as a content hub, and to develop an interactive broadband and multimedia (IBBMM)/mobile wireless infrastructure

- *e-Business Framework:* An e-commerce master plan was launched in September 1998, starting a campaign to bring e-commerce to mainstream businesses and the general public and to attract international e-commerce activities. Singapore is also a regional telecommunications hub, hosting the regional headquarters of many global telecoms players. The human capital development policy increasingly favours recruiting ICT service professionals as well as electronic methods of training and education.
- *Content hub:* Singapore launched Technopreneurship 21 (T21) in an effort to foster creativity, innovation and entrepreneurship. T21 covers the four key areas of education, financing, facilities, and regulations.
- *IBBMM/Mobile Wireless Infrastructure:* This was to piggyback on the mainly narrowband network of the national information infrastructure (NII). The development of the broadband infrastructure, broadband industry, and broadband user base progressed steadily in 1999-2000, and the wireless broadband market is also expected to grow rapidly.

The exposition above shows that in Singapore the quantitative condition favouring industrial agglomeration, the provision of industry-specific factors, has been supplemented by qualitative factors, as advocated by Porter (1998b). Both the government, through active utilisation of ICT services, and the financial services industry, which is an intensive user these services, provided positive demand. Indeed, the financial services industry has become so ICTheavy we could possibly identify ICT services and financial services as a wider, self-reinforcing cluster of related and supporting industries. Likewise, through the stance of ICT manpower development policy as well as the policy towards the infocomm service industry in general, Singapore enjoyed favourable factor input conditions. The narrow and broadband aspects of the NII provided excellent support for clusters, and a sound legal system and a deregulated ICT scene created a positive context for firm strategy and rivalry.

### **The e-ASEAN Initiative**

In November 1999, the ASEAN Informal Summit established the e-ASEAN Task Force to develop a broad and comprehensive action plan for an ASEAN e-space and to develop competencies within ASEAN to compete in the global information economy. The Task Force proposed to improve the physical, legal, logistical, social, and economic infrastructure for ASEAN. The integration of national information structures through the AII is expected to increase knowledge spillover, increased the depth of markets for factor inputs such as labour and foreign capital, and internal and external demand (through increased intra-ASEAN e-commerce and stronger ties with extra-ASEAN networks).

Increased economic integration through the e-ASEAN agreement and the expected liberalisation of trade in ICT products and services are likely to cause trade costs to fall, and the economic geography of the ICT goods industries might change in consequence. In order for Singapore to remain an ICT hub it needs to enhance the supporting institutions and general infrastructure for ICT service delivery. Beyond the clear need to invest in a national information infrastructure that would accommodate any future moves in this direction, governments need to ensure that R&D capabilities as well as S&T policy are flexible enough to play a larger role in the economic activities of the country. The most crucial function of government is to create a favourable policy framework for enhancing comparative and competitive advantage. Historical fact and recent economic analysis have consistently shown that the right policy framework *does* matter.

### **V. Conclusion**

The ICT revolution is spurring a new economic geography in East Asia. The flying geese model of vertical production networks and hierarchical diffusion of production is rapidly being displaced. The new typology is a series of growth poles and clusters inter-linked through trade, capital, investment, and people flows. These flows are no longer uni-directional but multi-dimensional, reflecting supply and demand complementarities.

The New Economy is characterised by increasing returns to scale and spillover externalities; information is characterised by high fixed costs, low marginal costs, and high barriers to entry inherent within networks. There is a tendency for agglomeration and benefits from concentration and specialisation. Dynamism will come from specific nodes and growth centres, which will be linked to other nodes and growth centres rather than to national economies. Simultaneously these nodes must serve the hinterland economies to which they are inextricably linked.

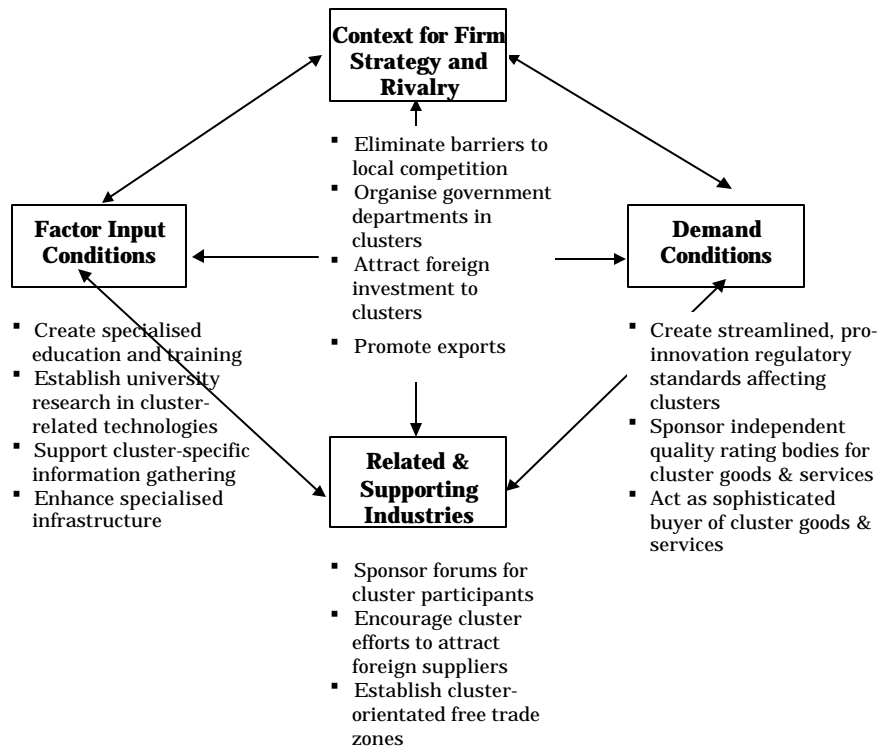
With increasing returns, there are benefits to being the first mover. With a host of quantitative and qualitative factors continuing to work to Singapore's advantage, the new theory of economic geography suggests that Singapore should remain a hub for the ICT goods and services industry, at least in the short- to medium-term. Singapore's solid legal framework and supporting ICT infrastructure—both the physical IBBMM network and the knowledge-based S&T environment—will be attractive to large multinational corporations as well as to smaller domestic (and possibly regional) technopreneurial start-ups. These key institutional and environmental factors generate positive externalities through static productivity gains and dynamic innovation benefits that encourage new business formation so that the cluster becomes self-reinforcing.

Competition for ICT leadership in the region is heating up. Singapore has to strive hard to move into the knowledge-based economy as it can no longer compete in the old economy. Human resource development is problematic because of Singapore's small population base and the long gestation period for education and training. Efforts to expand ICT-related education and training supplemented by aggressive recruiting of international talents are progressing well to create the specific factor of ICT human resources. It will be more difficult to build a factor of creativity and entrepreneurship.

To be a regional ICT hub Singapore must be competitive vis-à-vis existing and potential hubs in the region and beyond. But Singapore must also engage in political diplomacy and economic co-operation within the region, so that the hub and the 'hinterland' can mutually benefit. As the

most ICT-ready economy and society in the ASEAN region, Singapore can help its neighbours overcome the digital divide region and to take advantage of the ICT revolution.

**Figure 1 Role of Government in Porter's model**



Source: M.E. Porter. 'Clusters and Competition: New Agendas for Companies, Governments, and Institutions'. In *On Competition*. Boston: Harvard Business School Press, 1998.