

Going Beyond Comparative Advantage: How Singapore Did It

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Singapore has been transformed economically, socially, and politically since independence in August 1965. The country's industrial development strategy evolved from labor intensive in the 1960s, skill intensive in the 1970s, capital intensive in the 1980s, and technology intensive in the 1990s to knowledge and innovation intensive from the 2000s onward (Figure 3.1). Four industries—electronics, precision engineering, chemicals, and biomedical sciences—have anchored the city's approach to industrial development.

1960S: LABOR INTENSIVE

GDP was S\$2.2 billion (US\$0.7 billion) in the 1960s, and by 2013 had expanded to S\$372.8 billion (US\$298.0 billion). Income per capita had reached US\$54,662 from US\$428 in the span of about 50 years (Singapore Department of Statistics 2014a). This phenomenal growth can be attributed to an economic transition through different industrial phases (as shown in Figure 3.1).

Marked by high unemployment, Singapore focused on labor-intensive industrialization in the 1960s. The Jurong Industrial Estate, transformed from a mangrove swamp in the west of the island, initiated the country's industrialization program with factories producing garments, textiles, toys, mosquito coils, wood products, and hair wigs (EDB 2014a). The overriding strategy at that time was to spearhead rapid industrialization that would urgently create new jobs and promote economic development.

Industrialization was a new experience for independent Singapore, as the economy had been wholly dependent on the *entrepôt* trade since the British founded it in 1819. Hence, active leadership and timely execution by the fledgling Singapore government was needed to promote industrialization. The Economic Development Board (EDB) carried out industrial planning, development, and investment promotion, while Jurong Town Corporation, spun off

Research and assistance in the preparation of this chapter were provided by Dr. Yew Kwan Choong, Economic Development Innovations, Singapore.

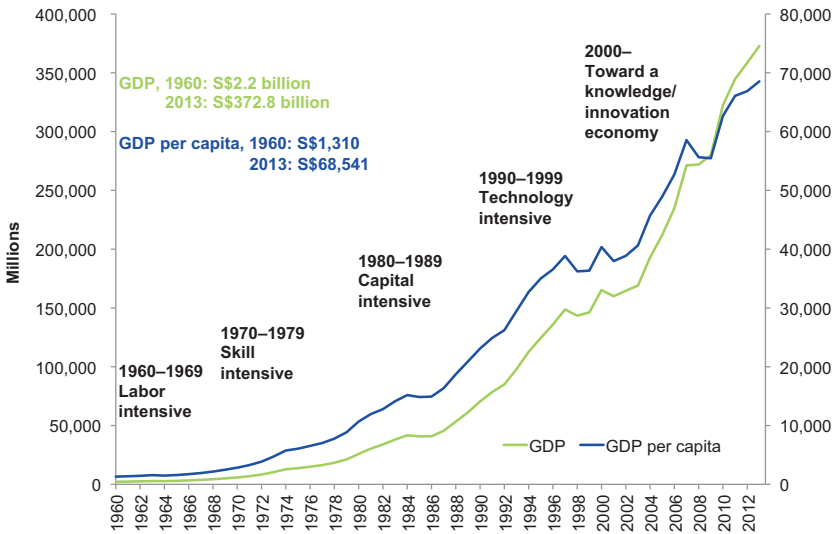


Figure 3.1 Five Phases of Singapore’s Economic Development, 1960–2013 (Singapore dollars)
 Source: Singapore Department of Statistics.

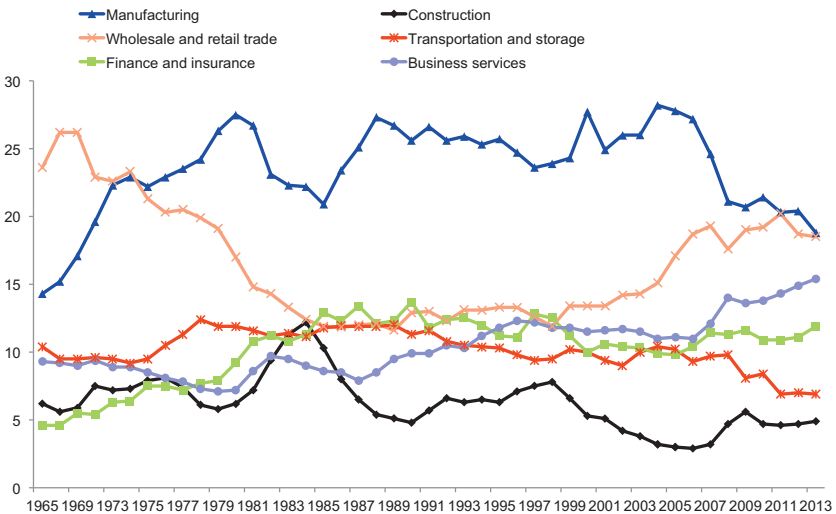


Figure 3.2 Share of GDP by Industry at 2013 Market Prices (Percent)
 Source: Singapore Department of Statistics (2014b).

from the EDB’s Land Department, focused on the development and management of industrial estates.

By the mid-1970s the manufacturing sector contributed a significant share of GDP, solidifying the successful transition from an entrepôt into an industrialized economy (Figure 3.2). Realizing the limitations of the domestic

market to support local industries and the lack of raw resources, the government proactively went to the global marketplace to engage and attract foreign investors.

Singapore accompanied industrialization in its economic development with early social investments. The evidence of 50 years of growth is clearly reflected in the transformation of the Singapore River itself, a cornerstone of the city state's modern history. Located within the central region and acting as an economic lifeline, it was originally a busy—and polluted—port, earning it the nickname “Dead Chicken River” in the 1970s for the proliferation of poultry farms along its banks.

Various government departments embarked on a 10-year program to clean it up. Riverside squatters were resettled in public housing and hawkers in hawker centers. And with completion of the cleanup in the 1980s, the Urban Redevelopment Authority embarked on a comprehensive long-term plan to transform the river precinct. The plan covered the length of the river all the way to its mouth at Marina Bay, where the downtown area now sits, anchoring the city's competitive edge as a premier financial and business hub. Planned as early as the late 1960s, land was reclaimed as part of the new downtown area for a seamless extension of the central business district. Today, the Singapore River is an aesthetically pleasing, functional reservoir supporting tourism and commercial activity.

The social needs of the population included infrastructural investment and housing development. To address these priorities, the country established the Housing and Development Board in 1960 to build low-cost housing. At its inception, only 9 percent of residents lived in public housing; today more than 80 percent do (Housing & Development Board 2014).

The Urban Redevelopment Authority¹ was set up to redevelop the city area into a vibrant modern commercial center. Among its key tasks in the early 1960s was to resettle residents living in slums and move industries to new locations. Once land was amalgamated and parceled, the government started the sale of sites for modern commercial development.

Authorities drew up the first Concept Plan in 1971 and laid the foundation for the physical landscape, such as housing developments outside of the city and developing key transport infrastructure, with the first mass rapid transit lines and expressways, as well as Changi International Airport.

The Urban Redevelopment Authority also started conserving historical buildings as physical anchors to Singapore's past and social memories. Close to 7,200 buildings have been conserved so far. As Singapore's national land use planning authority, the Urban Redevelopment Authority works with other government agencies such as the National Parks Board to “green” Singapore's urban environment through parks, park connectors, and “vertical greenery,” incorporating plants within buildings' vertical surfaces.

¹ Initially known as the Urban Renewal Unit of the Housing Development Board.

1970S: SKILL INTENSIVE

As industrial development gathered momentum, the government saw an opportunity to upgrade the economy from low-cost, labor-intensive industries to higher-value-added skilled jobs and businesses by developing technical and business skills and expertise.

Significant effort was made to attract foreign investment from Europe, north Asia, and the United States into Singapore by positioning the country as a global business hub for a company's entire value chain of activities. Investments poured into an emerging electronics industry, in particular high-tech products, including computer parts, peripherals, software packages, and silicon wafers. Multinational companies were encouraged to relocate to Singapore or develop research and development activities locally as an extension of their manufacturing operations. Many showed their willingness to make such long-term investments. Texas Instruments set up manufacturing operations in Singapore to produce semiconductors and integrated circuits, a major investment highlight in the coordinated push to develop a local electronics industry. Other firms followed, including Hewlett Packard of the United States, SGS (now ST Microelectronics, Europe), and NEC (Japan). The continued success of the manufacturing industry was proven when, in the late 1970s, it surpassed the trading sector for the first time.

Recognizing the need to upgrade the local workforce to support this economic growth, efforts were made to train skilled technicians, engineers, and managers from the local population. This started with the EDB's establishment of the Singapore Institute of Management and of various industrial training institutes, including the French-Singapore Institute, German-Singapore Institute, and the Japan-Singapore Institute, which were combined into the country's third polytechnic institute, Nanyang Polytechnic, in 1993.

To cope with the immediate shortfall in skilled professionals resulting from accelerating economic growth, Singapore took the radical step of liberalizing its immigration and work permit systems for foreign professionals to be employed by foreign firms, solving a potential squeeze in human capital in the operations of multinational corporations (Mathews and Cho 2007).

1980S: CAPITAL INTENSIVE

In response to rapid globalization in the 1980s, Singapore introduced a new national economic strategy, the Second Industrial Revolution: The Economic Development Plan for the Eighties (Parliament of Singapore 1981). The manufacturing sector's focus under the plan was on transitioning toward capital-intensive operations, as emphasized in the 1980 budget (Parliament of Singapore 1981, paragraph 24):

Our industries will require more land as they become more capital intensive. On the other hand, the large claims for land for social and recreational purposes will continue unabated. The Ministry of National Development

must accord higher priority to industrial land and set aside more land in or near housing estates for the clean and higher value-added industries.

In 1985, Singapore's growth was interrupted by its first recession. The government realized the need to diversify economic activities, and a second engine of growth in exportable services was initiated by positioning the city state as a "total business center"—a methodology combining industry and technical know-how with the strategic formation of business relationships. It did this to attract international service corporations in the financial, educational, lifestyle, medical, information technology, and software sectors (EDB 2014a). Greater emphasis was put on higher value-added industries at all levels. Among the large-scale initiatives launched was the establishment of Science Park next to the National University of Singapore to spur research and development by the private sector. In addition, local enterprises were encouraged to grow through loans and incentives.

1990S AND 2000S: A TECHNOLOGY-INTENSIVE AND KNOWLEDGE- AND INNOVATION-BASED ECONOMY

The government's Strategic Economic Plan (Singapore Ministry of Trade and Industry 1991) in the 1990s focused Singapore's efforts to "attain the status and characteristics of a first league developed country within the next 30 to 40 years."

A key initiative was the building of a research and development environment to create a knowledge-based and innovation-driven Singapore. The National Science and Technology Board was established in 1991 to focus on applied research, and transformed into the Agency of Science, Technology and Research (A*STAR) in 2002 to focus on research and development and human capital training through local and overseas PhD scholarships. Two research-oriented councils were created: the Biomedical Research Council, which supports, oversees, and coordinates public sector biomedical sciences research and development activities in Singapore; and the Science and Engineering Research Council, which fulfills similar functions in physical sciences and engineering.

SINGAPORE TODAY

In 2013, as Singapore's GDP reached S\$373 billion, 70 percent of nominal value added was generated by the service industries, and close to 25 percent by goods-producing industries (Singapore Department of Statistics 2014b). Manufacturing, which includes major industry sectors such as chemicals, electronics, precision engineering, transport engineering, and biomedical science, accounts for 19 percent of total GDP (Figure 3.3 and see Annex Table 3.1.1).

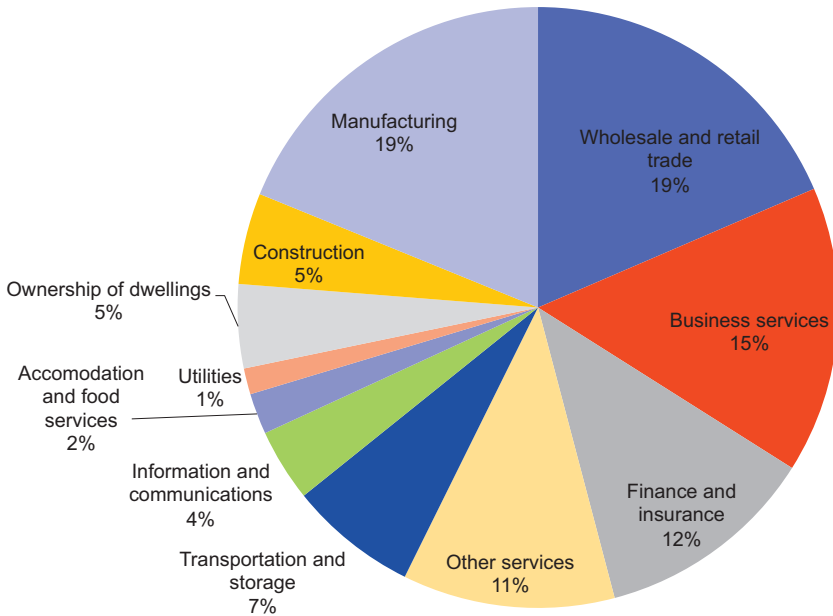


Figure 3.3 Share of Singapore GDP by Industry, 2013

Source: Singapore Department of Statistics.

A key item to note is the value added achieved in each sector.² As a country with no natural raw materials, Singapore has to import raw supplies needed for the chemical industry; hence the value added achieved was only 6.9 percent, in contrast with the biomedical sciences industry, where a significant 20.5 percent value added was achieved through the high-value proprietary products manufactured. This was made possible by heavy investment in research and infrastructure, and foreign investment in the development of the biomedical sciences industry.

The path taken to achieve high, long-term growth rates despite the lack of natural resources and a large domestic market enabled Singapore to become one of the four Asian Tiger economies, along with Hong Kong Special Administrative Region, Korea, and Taiwan Province of China. In 1992 the Economic Development Institute of the World Bank attributed Singapore's remarkable success largely to sensible and effective policies and early attention to infrastructure and manpower resources.

Accompanying this economic growth was a tangible transformation in the infrastructure and social make-up of its people. Urban redevelopment proceeded

²The value added equation used is as follows: value added = labor cost to employees + interest to lenders of money + depreciation for reinvestment in machinery and equipment + profits retained by the organization + other distributed costs (for example, tax) (Spring Singapore 2011).

at a very rapid pace to cope with the expansion of the population from 1.6 million in 1960 to 5.4 million in 2013.³

THE DEVELOPMENT THEMES OF THE SINGAPORE APPROACH—EXAMPLES OF FOUR INDUSTRIES

Singapore was forced to focus its efforts on specific industries for development, precisely because it had no domestic market and no natural resources. It started with the electronics industry in the 1970s, precision engineering in the 1980s, and chemical and biomedical industries in the 1990s.

It took an *investment promotion* approach to build and solidify its position as a “total business center.” Through each decade of change, the country took a prioritized approach when selecting an industry to develop. Following research on that industry, international companies were identified as foreign investors and partners, and relationships formed with key executives of those companies. This proactive approach to building an international network of business relationships allowed it to search out foreign direct investment opportunities across all continents.

Singapore today has garnered investments from 37,400 international companies, including 3,200 from China, 4,400 from India, and 7,900 from the Association of Southeast Asian Nations (excluding domestic companies). In addition, some 7,000 multinational corporations (60 percent of which have regional responsibilities) have made Singapore their home base.

The Electronics Industry—Creating Value Added

Electronics manufacturing is the backbone of the Singapore economy, contributing 30 percent of total manufacturing value added (see Figure 3.3 and Annex Table 3.1.2). According to the EDB (2014b), Singapore’s electronics industry, in 2013, attracted numerous investment projects, totaling S\$3.3 billion of fixed assets investments, and S\$0.6 billion of total business expenditure. These projects are expected to contribute S\$1.8 billion in value added per year to GDP and create 1,310 skilled jobs when they are fully implemented.

Electronics was the first industrialized manufacturing industry developed in the 1960s that benefited from the availability of low-cost labor. This industry is still relevant today because further investment was made during the capital-intensive phase of the 1970s to enable electronics manufacturing to progress up the value chain. Process-intensive semiconductor fabrication complemented by assembly and testing activities, which require high-cost skilled labor, still comprises a significant share of Singapore’s electronics industry. Through this phase, a development theme of *creating value added* can be identified.

³The number of citizens increased from 1.9 million in 1970 to 3.3 million in 2013, while permanent residents rose from 0.14 million to 0.53 million in the same period (Singapore Department of Statistics 2014c).

The Precision Engineering Industry—Building around the Value Chain

The precision engineering industry emerged in response to the need to grow the support infrastructure for the electronics industry. Its development was capital intensive, and considerable investments were made in the development of infrastructure and skills.

Alongside the electronics industry, the precision engineering industry today is a core enabler of associated industries, including marine, aerospace, oil and gas, and medical devices. Precision engineering skills and products also support the manufacturing of semiconductor chips and the large drill bits for oil exploration. In 2013, the industry contributed 11.4 percent, S\$33 billion, to manufacturing GDP, or 2.2 percent to Singapore's GDP (see Figure 3.3 and Annex Table 3.1.2).

The precision engineering industry can be divided into two categories that, combined, create a self-sustaining cycle in the sector: precision modules and components, and machinery and systems (equipment). Companies in the first category produce specialized components, some of which then supply companies in the second category to build equipment. Companies can then use this equipment in the precision modules and components category. The developments within this industry bring a second developmental theme of *building around the value chain*.

The Chemicals Industry—Developing Clusters

In 2013 the chemical industry contributed 33 percent, S\$97 billion, to Singapore's manufacturing output, and it has been the largest contributor to the country's manufacturing output since 2006 (Annex Table 3.1.2; Singapore Department of Statistics 2014d).

The chemical industry started with oil, an integral part of the country's economic history. Oil trading began in 1891, and the three main activities were refining, trading, and logistics (EDB 2011). Today, Singapore is recognized as one of the world's top three export oil refining centers, even though it has no oil reserves of its own. Investment, moving to higher-value-added production in developing the chemical industry, follows the two economic development themes of *creating value added* and *building around the value chain*.

A game changer for Singapore's chemical industry was the development of 3,000-hectare Jurong Island, through a S\$7 billion land reclamation of seven smaller islands, which became the heart of the chemical industry. Besides clustering chemical suppliers, producers, and service providers, Jurong Island segregates the more polluting manufacturing processes from the main island. Jurong Island has attracted more than S\$40 billion of investments with over 100 companies across the entire chemical production value chain, and some 40,000 people commute to it daily.

Jurong Island provides a “plug-and-play” capability to its clustered stakeholders, such as oil refineries, crackers, gas synthesis, petrochemicals, and specialty chemicals. It does this by developing infrastructure that allows access to feedstock and simplified logistics through co-location, reducing the cost of production for companies operating there. Singapore had effectively taken a proactive step to undertake the cost of infrastructure development in Jurong Island. Emphasis on *cluster development* can be seen as the third economic development theme.

Following the successful development of Jurong Island, Singapore turned to the next phase of growing its chemical industry, through the so-called Jurong Island Version 2.0 initiative and development of research activities. This was launched in 2010 to seek out investments to increase optimization, robustness, and options for resources. One of these was the Jurong Rock Caverns liquid hydrocarbon storage facility, located 130 meters under the Banyan Basin on Jurong Island. It is Southeast Asia’s first underground liquid hydrocarbon storage facility, and was developed for liquid hydrocarbons such as crude oil, condensate, naphtha, and gas oil. Phase One has a storage capacity of approximately 1.47 million cubic meters (Energy Market Authority 2011). Other key infrastructure developments include a gasification plant, a liquefied petroleum gas terminal, and a multiuser product grid.

Research activities under Jurong Island Version 2.0 were executed through joint industry scholarship programs and the creation in 2002 of a public research institute, the Institute of Chemical and Engineering Sciences. From these endeavors, a fourth economic development theme emerges: *research and development*.

The Biomedical Sciences Industry—Focusing on Research and Development

The biomedical sciences initiative was launched in June 2000 to develop this industry cluster as a new, knowledge-based and knowledge-intensive pillar of the economy. In 2013, the biomedical sciences industry contributed 8.2 percent to GDP and, more importantly, contributed a value added of 20.5 percent (second only to the electronics industry, at 30.3 percent).

The two key sectors of Singapore’s biomedical science manufacturing industry are pharmaceuticals and medical technology. Pharmaceuticals manufacturing investments were enabled by the establishment of a reclamation project at the western tip of the country to form the Tuas Biomedical Park. As of 2013, the park is home to seven of the top 10 international pharmaceutical companies, including 29 commercial-scale manufacturing plants for active pharmaceutical ingredients, biologics, cell therapy, and nutrition. The medical technology sector, meanwhile, is made up of 30 manufacturing plants, more than 10,000 employees, and six research and development centers in Singapore.

In addition to attracting manufacturing investment in the pharmaceutical and medical technology sectors, the biomedical sciences initiative included a

bold plan to attract industry research and seed start-up ventures to cover four biomedical sciences industries (pharmaceuticals, medical technology, health care services and delivery, and biotechnology and biologics) from bench (research) to bedside (service delivery to patient). To support industry research and commercialization, publicly funded research institutes were created to build up capabilities in areas spanning bioprocessing to genomics and cell biology.

This initiative was implemented in three distinct phases. In the first (2000–05), Singapore invested in public research institutes that covered core research capabilities, including bioprocessing, chemical synthesis, genomics and proteomics, molecular and cell biology, bioengineering and nanotechnology, and computational biology. The second phase (2006–10) focused on strengthening translational and clinical research with the aim of translating basic discoveries from the lab into clinical applications to improve health care. The third phase (2011–15) aims to achieve commercialization, research partnerships with industry, and spin-offs. An essential aim of the third phase is the availability of financing and support, and one such approach is through co-investment with strategic partners for capital and value added, or commercialization grants. Some 40 local medical technology start-ups are currently in this program (the Agency for Science, Technology, and Research Biomedical Sciences Initiative).

The development of the biomedical sciences industry follows the four development themes of creating value added, building around the value chain, utilizing a cluster development approach, and making investments in research and development (Figure 3.4).

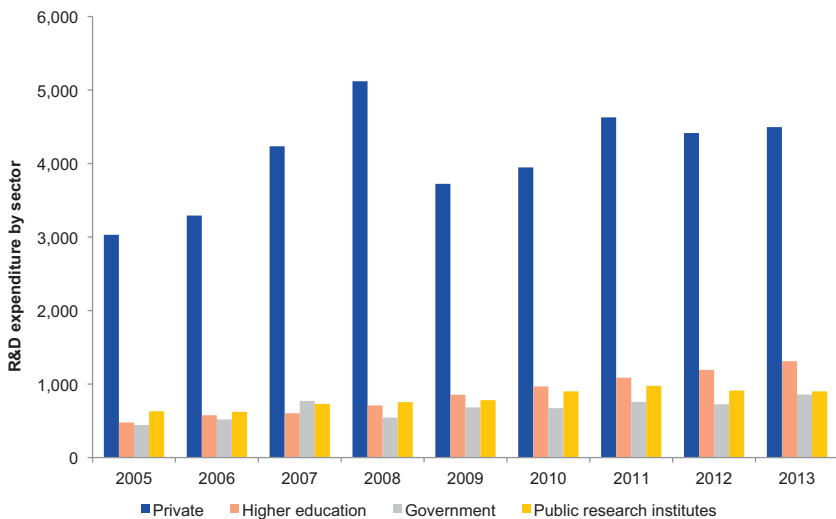


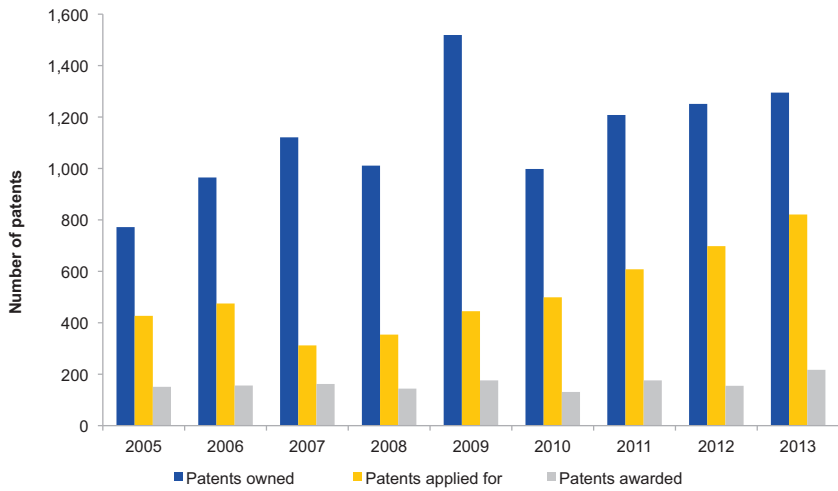
Figure 3.4 Research and Development Expenditure by Sector (\$\$, millions)

Source: Singapore Department of Statistics (2014e).

GOING FORWARD AS A KNOWLEDGE- AND INNOVATION-BASED ECONOMY

Significant investments have successfully transitioned Singapore’s economy from a dependence on manufacturing and services to one based on knowledge and innovation, through investments in knowledge, innovation, and human capital. Evidence of its success is in the rise in publications, patents, and licensing revenue arising from research in Singapore during the 2000s (Figure 3.5).

1. Public Sector



2. Private Sector

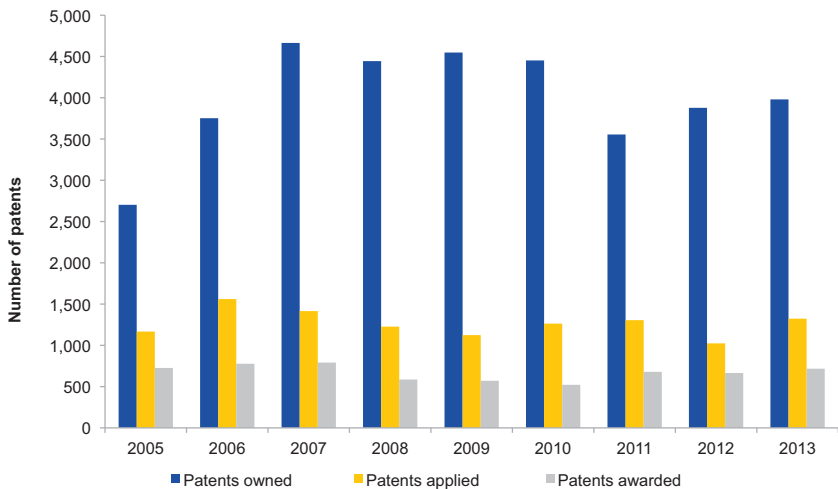


Figure 3.5 Patents Applied for, Awarded, and Owned in the Private and Public Sectors, 2005–13

Source: Singapore Department of Statistics (2014e).

Long-term human capital development remains a priority and senior figures from the international scientific community are invited to Singapore to lead research institutes and teams and to develop local talent (Figure 3.6). New scholarships were introduced to encourage Singaporeans to pursue PhDs, and more than 1,200 PhD scholarships have been awarded to develop research and development talent since 2001. Some 350 scholars have completed their PhD studies and are contributing to the research, innovation, and enterprise development environment (Figure 3.7).

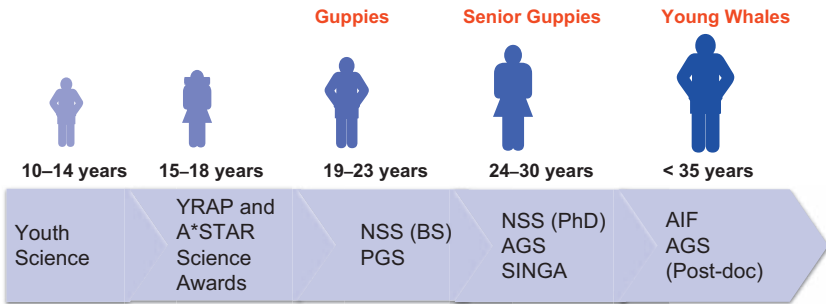


Figure 3.6 Long-Term Human Capital Investment Pipeline

Source: Agency for Science, Technology and Research (A*STAR).

Note: AGS = A*STAR graduate scholarship; AIF = A*STAR international fellowship; NSS = national science scholarship; PGS = pre-graduate scholarship; SINGA = Singapore international graduate award; YRAP = young researchers attachment programme.

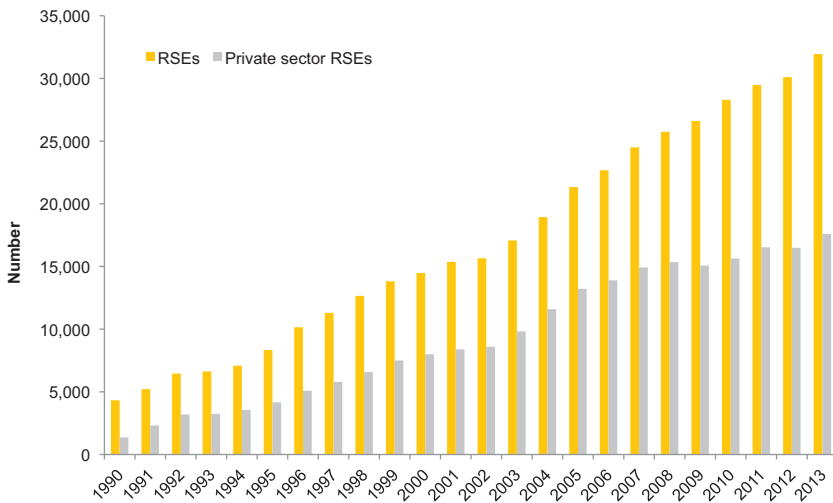


Figure 3.7 Research Scientists and Engineers, 1990–2012

Source: Agency for Science, Technology and Research (2014).

Note: RSE = Research scientists and engineers.

Infrastructure development is a cornerstone in Singapore's move to become a knowledge- and innovation-intensive economy, as shown by the 200-hectare purpose-built, high-tech zone known as the "one-north" development. Here, hubs such as Biopolis and Fusionopolis house public and private institutes and organizations. The one-north differentiation is in its integrated work-live-play-learn concept. The co-located work facilities the hubs provide are close to public amenities and residences to stimulate an exchange of ideas and to create a holistic environment. In essence, one-north has comprehensively captured the four economic themes of *creating value added*, *building around the value chain*, *cluster development*, and *research and development*.

Biopolis is the hallmark of Singapore's biomedical research and development. Construction of the seven buildings in Biopolis Phase 1 began in December 2001 and was completed in 18 months. Biopolis colocates public sector research institutes with corporate laboratories to facilitate a collaborative culture while providing access to state-of-the-art facilities, shared infrastructure, and specialized services. It is also strategically located near the National University of Singapore and National University Health System to facilitate translational and clinical research. Fusionopolis is an integrated urban development that is dedicated to research and development in information and communication technology, media, physical sciences, and engineering industries. It serves as a platform to fuse and synergize knowledge from different scientific domains, bringing together the public and private sectors.

Having started its development ascent as a poor island in the 1960s and possessing no comparative advantage in any specific industry, Singapore has transformed itself from a labor-intensive economy to a knowledge- and innovation-based one within a few decades. It has established international partnerships and industrial parks to share knowledge and explore opportunities in China, India, Indonesia, and Vietnam. Yet the city state cannot rest on its achievements—it must continue to learn and adapt to remain relevant in the face of increasingly complex global economic challenges.

ANNEX 3.1. SINGAPORE'S MANUFACTURING INDUSTRY

ANNEX TABLE 3.1.1

Value-Added of Singapore Manufacturing Industry, 2013

	Employment		Remuneration		Total Output		Value Added		Remuneration per Worker	Value Added per Worker
	Number	Percent	Million S\$	Percent	Million S\$	Percent	Million S\$	Percent	Thousand S\$	Thousand S\$
Electronics	76,402	18.4	4,271.0	21.1	80,860.0	27.8	17,469.0	30.3	55.9	228.6
Semiconductors	40,659	9.8	2,468.0	12.2	46,260.0	15.9	10,861.0	18.8	60.7	267.1
Computer peripherals	10,170	2.4	494.0	2.4	8,195.0	2.8	2,188.0	3.8	48.6	215.2
Data storage	9,645	2.3	394.0	1.9	4,877.0	1.7	1,744.0	3.0	40.8	180.9
Infocomms and consumer electronics	9,129	2.2	602.0	3.0	19,510.0	6.7	2,010.0	3.5	66.0	220.2
Other electronic modules and components	6,799	1.6	312.0	1.5	2,018.0	0.7	665.0	1.2	45.9	97.9
Chemicals	24,909	6.0	2,362.0	11.7	97,114.0	33.4	3,977.0	6.9	94.8	159.7
Petroleum	4,087	1.0	740.0	3.7	51,316.0	17.7	72.0	0.1	181.0	17.6
Petrochemicals	5,577	1.3	539.0	2.7	34,581.0	11.9	1,015.0	1.8	96.6	182.0
Specialty chemicals	10,291	2.5	803.0	4.0	9,369.0	3.2	2,377.0	4.1	78.0	231.0
Others	4,954	1.2	281.0	1.4	1,848.0	0.6	513.0	0.9	56.7	103.6
Biomedical Manufacturing	16,704	4.0	1,098.0	5.4	23,677.0	8.2	11,793.0	20.5	65.7	706.0
Pharmaceuticals	6,272	1.5	608.0	3.0	18,593.0	6.4	9,795.0	17.0	96.9	1,561.7
Medical technology	10,432	2.5	490.0	2.4	5,085.0	1.8	1,998.0	3.5	47.0	191.5
Precision Engineering	89,682	21.6	4,227.0	20.9	33,143.0	11.4	7,508.0	13.0	47.1	83.7
Machinery and systems	42,173	10.1	2,336.0	11.5	22,367.0	7.7	4,192.0	7.3	55.4	99.4
Precision modules and components	47,509	11.4	1,891.0	9.3	10,777.0	3.7	3,316.0	5.8	39.8	69.8
Transport Engineering	111,404	26.8	4,890.0	24.1	32,172.0	11.1	9,772.0	16.9	43.9	87.7
Marine and offshore engineering	85,378	20.5	3,089.0	15.2	21,080.0	7.3	5,939.0	10.3	36.2	69.6
Aerospace	19,856	4.8	1,424.0	7.0	8,749.0	3.0	3,046.0	5.3	71.7	153.4
Land	6,170	1.5	376.0	1.9	2,343.0	0.8	787.0	1.4	61.0	127.5
General Manufacturing Industries	96,740	23.3	3,415.0	16.9	23,509.0	8.1	7,144.0	12.4	35.3	73.8
Food, beverages, and tobacco	28,181	6.8	947.0	4.7	8,492.0	2.9	2,300.0	4.0	33.6	81.6
Printing	14,882	3.6	683.0	3.4	2,279.0	0.8	1,168.0	2.0	45.9	78.5
Miscellaneous industries	53,677	12.9	1,784.0	8.8	12,739.0	4.4	3,677.0	6.4	33.2	68.5
Total manufacturing	415,841	100.0	20,262.0	100.0	290,476.0	100.0	57,661.0	100.0	48.7	138.7

Source: Singapore Department of Statistics (2014f).

Note: Refers to all manufacturing establishments. The industries are classified according to SSIC 2010.

ANNEX TABLE 3.1.2

Manufacturing Sectors, 2013

	Total Output		
	Million S\$	Percent	Percent of Manufacturing GDP
Electronics	80,860.0	100.0	27.8
Semiconductors	46,260.0	57.2	15.9
Infocomms and consumer electronics	19,510.0	24.1	6.7
Computer peripherals	8,195.0	10.1	2.8
Data storage	4,877.0	6.1	1.7
Other electronic modules and components	2,018.0	2.5	0.7
Precision Engineering	33,143.0	100.0	11.4
Machinery and systems	22,367.0	67.5	7.7
Precision modules and components	10,777.0	32.5	3.7
Chemicals	97,114.0	100.0	33.4
Petroleum	51,316.0	52.8	17.7
Petrochemicals	34,581.0	35.6	11.9
Specialty chemicals	9,369.0	9.6	3.2
Others	1,848.0	1.9	0.6
Biomedical Manufacturing	23,677.0	100.0	8.2
Pharmaceuticals	18,593.0	78.5	6.4
Medical technology	5,085.0	21.5	1.8

Source: Singapore Department of Statistics (2014d).

ANNEX 3.2. SINGAPORE OUTPUT BY INDUSTRY

ANNEX TABLE 3.2.1

Share of Gross Domestic Product by Industry at 2013 Market Prices (Percent)

Year	Manufacturing	Construction	Wholesale and Retail Trade	Transportation and Storage	Finance and Insurance	Business Services
1965	14.3	6.2	23.6	10.4	4.6	9.3
1967	15.2	5.6	26.2	9.5	4.6	9.2
1969	17.1	5.9	26.2	9.5	5.5	9.0
1971	19.6	7.5	22.9	9.6	5.4	9.4
1973	22.3	7.2	22.6	9.5	6.3	8.9
1974	22.9	7.3	23.3	9.2	6.4	8.9
1975	22.2	7.9	21.3	9.5	7.5	8.5
1976	22.9	8.1	20.3	10.5	7.5	8.1
1977	23.5	7.4	20.5	11.3	7.2	7.8
1978	24.2	6.1	19.9	12.4	7.7	7.3
1979	26.3	5.8	19.1	11.9	7.9	7.1
1980	27.5	6.2	17.0	11.9	9.2	7.2
1981	26.7	7.2	14.8	11.6	10.8	8.6
1982	23.1	9.4	14.3	11.2	11.2	9.7
1983	22.3	11.3	13.3	11.4	10.8	9.5
1984	22.2	12.2	12.4	11.1	11.3	9.0
1985	20.9	10.3	11.9	11.8	12.9	8.6
1986	23.4	8.0	11.8	11.9	12.3	8.5
1987	25.1	6.5	12.0	11.9	13.4	7.9
1988	27.3	5.4	12.1	11.9	12.1	8.5

(Continued)

ANNEX TABLE 3.2.1 (CONTINUED)

Year	Manufacturing	Construction	Wholesale and Retail Trade	Transportation and Storage	Finance and Insurance	Business Services
1989	26.7	5.1	11.6	12.0	12.3	9.5
1990	25.6	4.8	12.9	11.3	13.7	9.9
1991	26.6	5.7	13.0	11.6	11.8	9.9
1992	25.6	6.6	12.3	10.8	12.4	10.5
1993	25.9	6.3	13.1	10.5	12.5	10.3
1994	25.3	6.5	13.1	10.4	12.0	11.2
1995	25.7	6.3	13.3	10.3	11.2	11.8
1996	24.7	7.1	13.3	9.8	11.1	12.3
1997	23.6	7.5	12.6	9.4	12.8	12.2
1998	23.9	7.8	11.9	9.5	12.5	11.8
1999	24.3	6.6	13.4	10.2	11.2	11.8
2000	27.7	5.3	13.4	10.0	10.0	11.5
2001	24.9	5.1	13.4	9.4	10.6	11.6
2002	26.0	4.2	14.2	9.0	10.4	11.7
2003	26.0	3.8	14.3	10.0	10.3	11.5
2004	28.2	3.2	15.1	10.4	9.9	11.0
2005	27.8	3.0	17.1	10.2	9.8	11.1
2006	27.2	2.9	18.7	9.3	10.4	11.0
2007	24.6	3.2	19.3	9.7	11.4	12.1
2008	21.1	4.7	17.6	9.8	11.3	14.0
2009	20.7	5.6	19.0	8.1	11.6	13.6
2010	21.4	4.7	19.2	8.4	10.9	13.8
2011	20.3	4.6	20.2	6.9	10.9	14.3
2012	20.4	4.7	18.7	7.0	11.1	14.9
2013	18.8	4.9	18.5	6.9	11.9	15.4

Source: Singapore Department of Statistics (2014b).

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