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WORKING PAPER

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# 8i Ecosystem Analysis of the Pace Setter ASEAN Country – Singapore

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**Abstract**

This paper explores the factors contributing to Singapore's position as a major player in the global economy. Singapore, a small state in Southeast Asia, has experienced rapid economic growth since gaining independence in 1965. Its strategic location in the heart of Southeast Asia, along with a business-friendly environment, robust institutional governance system, sound economic policies, and world-class infrastructure, have played pivotal roles in driving its transformation from a developing country with a low-income economy into a high-income economy within less than five decades. Additionally, Singapore's emphasis on human capital development, exemplified by its robust education system and high literacy rates, has resulted in a highly skilled and innovative workforce. This, in turn, has enabled Singapore to establish a strong presence at the higher end of the global value chains, attracting multinational corporations and high-value foreign investments. Essentially, these factors are crucial in maintaining Singapore's economic competitiveness and strengthening its position as a global business hub. To delve into Singapore's success, this paper adopts the 8i ecosystem framework characterized by eight enablers, including institutions, interaction, integrity, infrastructure, infostructure, intellectual capital, incentives, and internationalization. Through a comprehensive examination of each enabler, this paper aims to shed light on Singapore's robust national ecosystem and its role in shaping its political, social, and economic systems.

**Keywords:** Singapore, the pace-setter ASEAN country, the current state of play, 8i ecosystem analysis

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## 1. Introduction

Singapore, officially known as the Republic of Singapore, consists of the main island and around 64 smaller islands situated off the coast. These offshore islands include Sentosa, Pulau Ubin, St John's Island, and the Sisters' Islands. Covering an area of 719 km², Singapore is the smallest state in Southeast Asia, with a population of about 5.4 million people (World Data, n.d.). Since gaining independence from Malaysia in 1965, Singapore has rapidly transformed itself from a developing country with a low-income economy into a high-income nation with significant GDP growth (World Bank, 2019a). One of the key factors that has contributed to the country's success is its strategic location in the heart of Southeast Asia, which helps attract foreign investors and multinational corporations, leading to a vibrant and diverse economy (U.S. Department of State, 2022). Additionally, Singapore has emerged as a global hub for trade, finance, and tourism owing to its business-friendly environment, world-class infrastructure, and sophisticated transportation systems (World Bank, 2019a; World Economic Forum, 2019). Furthermore, the effectiveness of Singapore's governance system has enabled it to successfully combat corruption and maintain a high level of transparency in its judiciary, resulting in strong political stability. This has helped create a favorable regulatory environment for business operations and foreign investments (Economic Development Board, 2023a; U.S. Department of State, 2022). Besides that, Singapore's strong emphasis on human capital development is also pivotal to its success as a pace-setter country in the ASEAN region (Quah, 2018; World Bank, 2019a). As a result of its robust education system, Singapore has a high literacy rate of 97% and a tertiary school enrolment rate of 93%, with a high proportion of university graduates (36.3%) specializing in the fields of science, technology, engineering, and mathematics (STEM) (Buchholz, 2023; Statista, 2021). This has successfully led to the creation of a pool of highly skilled and innovative workforce, which enhances Singapore's innovation capacities and enables it to maintain its economic competitiveness in the global

market (Economic Development Board, 2022a). In brief, the abovementioned efforts have expedited Singapore's socio-economic growth and strengthened its position as a major player in the global economy.

Often cited as a role model for its strength in political, social, and economic systems, Singapore's success is widely attributed to its robust and resilient national ecosystem. To examine Singapore's thriving ecosystem and how it has strengthened its position as a global hub for trade and innovation, this paper adopts an ecosystem framework characterized by eight enablers known as the "8i enablers", which are explained in detail in the section that follows.

## 2. Definitions of the Eight Enablers in the 8i Innovation Framework

The definitions of the eight enablers in the 8i Innovation Framework are provided below, and a summary of them is shown in Figure 1:

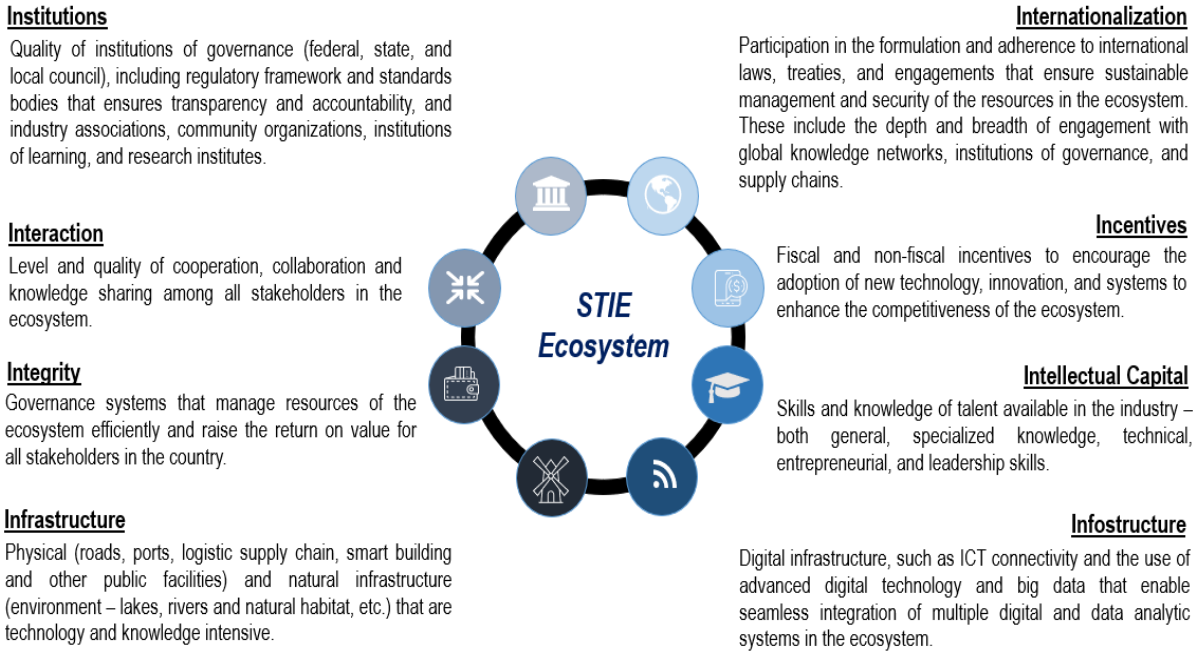
- **Institutions** refer to the quality and strength of the institutional leadership and institutions (e.g., government agencies, research institutes, higher education institutions, industry players) in managing the country's institutional governance systems. This includes the existence of effective government and strong "Champions with Clouts" in various sectors to efficiently oversee governance systems and manage the implementation of policies to enhance the country's competitiveness through the Whole-of-Nation approach.
- **Interaction** captures the state of cooperation, collaboration, and knowledge-sharing among the key stakeholders (government agencies, industry players, higher education institutions, and research institutes) in a country. These collaborations are essential to creating a knowledge- and innovation-driven economy characterized by a strong knowledge-sharing culture that fosters the adoption of best practices and innovative systems to strengthen the country's economic competitiveness.

- **Integrity** encompasses the state of the governance systems at the national, state, and local levels that ensure seamless and efficient implementation of policies, as well as regulatory frameworks that uphold transparency, accountability, and impartiality to promote political stability and socio-economic growth. This includes ensuring effective implementation and enforcement of regulations and policies, as well as establishing laws and policies conducive to business activities that promote economic competitiveness.
- **Infrastructure** captures the state of the natural infrastructure (e.g., environment - lakes, rivers, natural habitats, etc.) as well as knowledge and technology-driven physical infrastructure necessary for a country to function efficiently. Physical infrastructure encompasses both the public and private systems and services necessary for socio-economic growth and the overall well-being of the population. This includes transportation infrastructure (e.g., roads, railways, bridges, airports, seaports, etc.), energy infrastructure (e.g., physical networks of oil and natural gas pipelines, power generation, transmission, and distribution systems), water infrastructure (e.g., water supply and sanitization systems, wastewater management systems, etc.), and social infrastructure (e.g., healthcare facilities, schools, etc.).
- **Infostructure** involves the state of digital infrastructure, ICT connectivity, and the use of advanced digital technologies to promote the country's economic development and competitiveness. This includes innovative technologies such as artificial intelligence systems, big data analytics, blockchain technology, 5G technology and networks, and other digital technologies to ensure cybersecurity and drive innovation development across various industries.

- **Intellectual Capital** refers to the state of the talent stock in the country. This includes the availability and quality of the workforce with basic education and competencies, specialized knowledge, innovation capabilities, technical competencies, as well as entrepreneurial and leadership skills to enhance a country's global competitiveness by fostering a culture of creativity and innovation.
- **Incentives** incorporate the availability and quality of fiscal and non-fiscal incentives to drive the development of the country's STIE ecosystem. This includes incentives to promote knowledge sharing culture by strengthening the "quintuple innovation helix", increase local and foreign investments to nurture and develop strong local STI players, promote research and development activities, enable greater access to national research facilities, tax incentives and subsidies for STIE initiatives, as well as taxes and fines to discourage activities that are against the UN-SDG goals.
- **Internationalization** refers to the state of global outreach and international collaboration to promote technology and knowledge transfer, reduce trade barriers, increase market share, and participate in the global value chains. This includes participation in free trade agreements and economic partnerships with other countries and adhering to global standards and best practices that enable the country to move up the global value chains.

**Figure 1.**

*The 8i Ecosystem Framework to assess Singapore's current state of play.*




Adapted from Nair (2011) and Nair et al. (2022)

## 3. 8i Ecosystem Analysis of Singapore

### Institutions

Singapore's **strong institutional leadership** is a key factor in its political and socio-economic growth. The country has achieved the top rank among ASEAN countries for its **government effectiveness** and is highly regarded for its public service delivery and bureaucracy quality. Additionally, Singapore has **top-notch public research institutions and higher education institutions** that foster innovation and scientific research through collaborations. Its **industry players are strongly driven by R&D** and innovative partnerships. These strong institutions have contributed to a well-established Science, Technology, and Innovation ecosystem in Singapore.

### Interaction

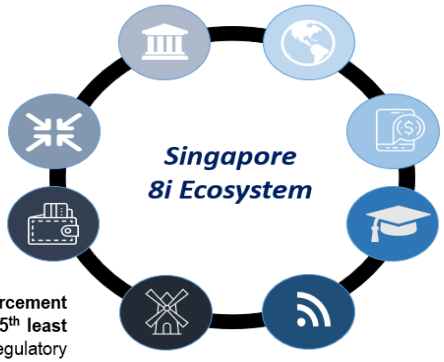
Singapore's **strong and efficient system of collaboration and cooperation** among **government bodies, industry players, academia, and research institutions** is essential for promoting political and socio-economic growth in the country. **The Research, Innovation and Enterprise (RIE) 2025 plan** by the government fosters collaboration between policymakers, universities, research institutions, and industry players, envisioning developing the country's STI ecosystem. It also **actively pursues regional and international partnerships** to establish its presence in the global market and expand its talent networks, contributing to its economic success and position as an important hub for business and innovation.

### Integrity

Singapore has a **strong national integrity system** backed by **effective law enforcement** mechanisms, ensuring zero tolerance for corruption. As a result, it is ranked as the **5th least corrupt country globally** in the 2022 Corruption Perceptions Index. Its effective regulatory frameworks and **impartial legal frameworks** create a **friendly business environment** and attract foreign direct investment, and there are **no restrictions on foreign ownership** of companies in Singapore, making it one of the **easiest places to do business** in the world.

### Infrastructure

The Singaporean government places **great importance on infrastructure development**, recognizing its crucial role in supporting economic growth and enhancing the quality of life for citizens. Singapore has earned **a high score for infrastructure quality**, with top-notch transportation systems and reliable power and water supplies. The government is also dedicated to **sustainable infrastructure development**, including promoting green buildings and reducing carbon footprints. Singapore is also known for **its top-notch healthcare infrastructure,** with top pharmaceutical and biotechnology companies setting up manufacturing hubs. These initiatives reflect Singapore's commitment to maintaining and improving its state-of-the-art infrastructure to drive economic growth and competitiveness..




### Internationalization

Singapore's government is actively developing **regional and international partnerships** to enhance its economic growth and global competitiveness. It has signed **numerous agreements with other countries** to advance development in various areas, including trade agreements such as the **RCEP**. Moreover, Singapore has the **highest level of participation in the global value chains** among ASEAN countries, specializing in **forward linkages**, which contribute to around **42% of Singapore's GDP**. As a result, the country has been able to enhance its market presence, expand its knowledge networks, and integrate into global supply chains through its active involvement in the global value chains and the establishment of agreements with multiple countries.

### Incentives

Singapore has implemented a range of fiscal and non-fiscal incentives to boost its **R&D capabilities and promote high-value economic activities**. For example, the government offers a **250% tax deduction for qualifying R&D capital expenditure** to encourage R&D activities and technology adoption by companies. Besides that, the Global Trader Program offers **tax exemptions to global trading companies**. Caregivers and persons with disabilities also benefit from **personal incentives such as the Caregivers Training Grant and Home Caregiving Grant.** These incentives demonstrate the government's commitment to promoting innovation, economic growth, and social welfare in Singapore.

### Intellectual Capital

Singapore places great importance on developing its intellectual capital to maintain its competitiveness in the global market. It possesses a **highly educated and skilled workforce**, with over 30% holding a university degree and 15% possessing diplomas or professional qualifications. Moreover, its **education system aligns well with industry demand**, scoring 92.13 out of 100. Singapore's **world-class higher education institutions, including NUS and NTU,** offer initiatives focused on data science and AI, collaborating with tech companies to cultivate skilled professionals. The universities also **work closely with industry partners** to provide real-world experience to students. These efforts have built up the country's human capital and contributed to a robust research and innovation ecosystem, essential for Singapore's economic competitiveness.

### Infostructure

Singapore **scores highly on the ICT Infrastructure Index**, indicating that it is one of the top achievers in ASEAN in various aspects of ICT infrastructure, such as **affordable mobile tariffs, widespread internet access, and high fixed-broadband subscription rates**. The government has also implemented various national programs and initiatives to promote research and innovation in digitalization and advanced technologies. The **Smart Nation initiative**, based on Digital Society, Digital Economy, and Digital Government pillars, aims to leverage technology to improve citizens' lives, businesses, and government. Singapore's success in digital initiatives has made it a world leader in the digital economy and transformed it into a Smart nation.

**Figure 2. Summary of the 8i ecosystem analysis of Singapore**

### 3.1 Institutions

Singapore's strong institutions of governance at the federal, state, and local levels, involving government agencies, industry players, higher education institutions, and research institutions, play critical roles in promoting political and socio-economic growth in the country. According to the World Bank's Worldwide Governance Indicators, Singapore has achieved the top rank among ASEAN countries for its government effectiveness[1], with a perfect score of 100 (see Figure 2) (World Bank, 2021). Besides that, Singapore ranks 3rd in the global ranking on government effectiveness in the Chandler Good Government Index[2] across 104 countries (Chandler Good Government Index, 2022). In other words, Singapore excels in its public service delivery, quality of bureaucracy, and government's commitment to policies. This achievement can be demonstrated through a study conducted by the Institute of Policy Studies (IPS) Social Lab, which reveals that more than 70% of respondents expressed "a great deal" or "quite a lot" of confidence across key institutions in Singapore, including the government, Parliament, courts, Singapore Police Force, Singapore Armed Forces and civil services (Ho, 2021). Moreover, Singapore scores 98 out of 100 on the Political Stability and Absence of Violence/Terrorism Index (World Bank, 2021), demonstrating a highly stable political environment.

In addition to being able to stay politically neutral regardless of political pressures, Singapore's civil servants are also highly competent in conducting and delivering public services (World Bank, 2021). In fact, Singapore is well-known for its highly efficient and

[1] The World Bank defines "government effectiveness" as the "perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies".
[2] Chandler Good Government Index is evaluated across seven pillars, including leadership and foresight; robust laws and policies; strong institutions; financial stewardship; attractive marketplace; global influence and reputation; and helping people rise (Chandler Good Government Index, 2022).

professional public service delivery systems, in which Singaporean civil servants are appointed and evaluated based on their performance (merit-based appointments) rather than academic results and relationships (Pennington, 2017). For example, Singapore's Corrupt Practices Investigation Bureau (CPIB) is highly competent and effective in enforcing the Prevention of Corruption Act (POCA), with an 87% clearance rate and a 97% conviction rate (CPIB, 2020). In addition, the CPIB Public Perceptions Survey 2020 reveals that 80% of the respondents perceived CPIB as an effective anti-corruption agency in Singapore (CPIB, 2020). As a result, Singapore's 5$^{th}$ ranking among 180 countries worldwide on the Corruption Perceptions Index is a testament to the agency's outstanding performance in combating corruption (Transparency International, 2022).

As a nation with a strong focus on research and development (R&D), Singapore owns top-notch public research institutions, such as the Agency for Science, Technology and Research (A*STAR). A*STAR plays an important role in moving Singapore towards a knowledge-based economy by fostering innovation and scientific research. It often collaborates with industry partners (e.g., Racer Technology, STMicroelectronics, etc.), research institutions (e.g., RVAC Medicines, Advanced Technology Research Centre [ATREC]), and higher education institutions (e.g., National University of Singapore, Nanyang Technological University, etc.) to jointly commercialize research and develop new technologies in a wide range of areas, including but not limited to biomanufacturing, engineering, food technology, robotics and automation, etc. (A*STAR, 2020b; ATREC, 2023; Compound Semiconductor, 2021; Pharmaceutical Technology, 2022).

In addition to world-renowned research institutions, Singapore also houses world-class research-based higher education institutions (HEIs), including the National University of

Singapore (NUS) and Nanyang Technological University (NTU), which were ranked 2nd (97.4/100) and 5th (96.7/100) out of 1,500 universities in the Quacquarelli Symonds (Q.S.) ranking of Asia's universities (Q.S. Top Universities, 2023). Besides that, NUS and NTU were ranked 19th and 36th (out of 1,662 universities) in the latest Times Higher Education (THE) World University Rankings 2023 (THE, 2023). These recognitions attest to the excellent performance of these HEIs in teaching, R&D, publications, knowledge transfer, and international outlook (THE, 2023; Top Universities, 2023). For example, between 2016 – 2020, NUS published more than 46,000 journal articles, secured more than S$3.74 billion of research funding, and granted more than 500 new patents, with 125 spin-off companies based on NUS technology. These achievements demonstrate that NUS has been a pioneer in pursuing impactful research that contributes to society (NUS, 2020).

As an innovation-driven and knowledge-based economy, Singapore's industry players are strongly driven by R&D and innovative partnerships to foster knowledge-sharing between different sectors (National Research Foundation, 2021). For example, Singapore Technologies Engineering Ltd. (S.T. Engineering) is a global supplier of aerospace, electronics, and defense systems. It jointly established the Research Translation @ S.T. Engineering research collaboration platform with NUS, NTU, Singapore University of Technology and Design (SUTD), and A*STAR to work together in technological areas, such as smart traffic management, 5G and future communications, digitalization and data analytics, etc. This platform allows them to leverage the knowledge and expertise of the partners to expedite the translation of research outcomes into industrial applications (S.T. Engineering, 2021).

In brief, Singapore has a well-established Science, Technology, and Innovation (STI) ecosystem attributed to its strong institutional governance, robust STI policies, investment in

R&D initiatives, talent acquisition and development, and conducive business environment (United Nations, ESCAP, 2018). Its efficient institutional governance systems have helped enhance the country's economic competitiveness and create a stable society.

### 3.2 Interaction

Singapore is known for its efficient system of collaboration among government, industry, academia, and research institutions, as well as its efforts to establish partnerships both regionally and internationally to strengthen its position in the global market. This collaborative ecosystem has played a significant role in Singapore's economic success and its recognition as an important hub for business and innovation. In fact, Singapore has been acknowledged as one of the most innovative countries in the world due in part to the strong culture of collaboration and knowledge-sharing between government, industry, and academia at national, regional, and global levels (Economic Development Board, 2023b). This can be demonstrated by the establishment of the Research, Innovation and Enterprise (RIE) 2025 plan by the government to foster collaborations between policymakers, universities, research institutions, and industry players, envision developing the country's STI ecosystem to move Singapore up the economic value chain (National Research Foundation, 2021).

Some successful partnership initiatives in Singapore can be demonstrated through the following cases. To achieve Singapore's "30 by 30" goal (to produce 30% of the country's nutritional needs locally by the year 2030), the Singapore Institute of Food and Biotechnology Innovation (SIFBI), which is a research institute under A*STAR, collaborates with government agencies (e.g., Economic Development Board (EDB), Enterprise Singapore, Health Promotion Board) and institutes of higher learning (e.g., National University of Singapore, Nanyang Technological University, Singapore Polytechnic, etc.) to develop novel technologies for

urban agriculture and aquaculture, as well as exploring alternative sources of protein, such as cell-cultured meat (A*STAR, 2020a). Furthermore, due to land scarcity in Singapore, the Economic Development Board, the Solar Energy Institute of Singapore, and Singapore's National Water Agency jointly developed floating solar photovoltaic systems at Tengeh Reservoir to harness solar energy for the national power grid (Ministry of Foreign Affairs Singapore, 2018). Besides that, to enhance Singapore's robotics ecosystem, the National Robotics Programme, which is a national multi-agency program, brings together public agencies (e.g., EDB, Enterprise Singapore, Smart Nation & Digital Government Office, National Research Foundation, etc.), universities and research institutes (e.g., A*STAR, National University of Singapore, Singapore Management University, etc.), as well as industry players (e.g., S.T. Engineering, Xnergy, HandPlus Robotics, Orinno technology, etc.) to collaboratively improve socio-economic impacts through applications of automation and robotics in various industries (e.g., healthcare, manufacturing, services, hospitality, education, etc.) (Ministry of Trade and Industry Singapore, 2023).

In terms of regional partnership, for example, Singapore's industry players (National University Hospital (Singapore) Pte Ltd (NUH) and CytoMed Therapeutics Pte Ltd.) have signed a Memorandum of Understanding (MoU) with Clinical Research Malaysia (CRM) to jointly develop clinical research capabilities on novel drug development (Business Today, 2019). This MoU enables clinical knowledge sharing between the partners, adding value to the healthcare ecosystems in both countries (Business Today, 2019). In addition, to further boost artificial intelligence (A.I.) innovation in the country, Singapore's Smart Nation and Digital Government Group (SNDGG) has entered into a global partnership with Google Cloud (a world-renowned technology company), envisioning co-developing A.I. solutions applicable in

key sectors, such as healthcare, sustainability, and finance (Smart Nation Singapore, 2022). Specifically, Singapore can leverage Google Cloud's deep tech skills (e.g., deep A.I. and machine learning training resources and programs) and cutting-edge technologies, while Google Cloud can benefit from Singapore's rich innovation ecosystem (Smart Nation Singapore, 2022). This is Singapore's first public-private partnership in the field of A.I., which is a win-win collaborative strategy.

Overall, Singapore's comprehensive and integrated collaborative ecosystem has contributed to its economic success and position as an important hub for business and innovation. In fact, Singapore has been recognized as one of the most innovative countries in the world partly due to the strong collaborations and knowledge-sharing culture between government, industry players, and academia at the national, regional, and global levels (Economic Development Board, 2023b; Low, 2022).

### 3.3 Integrity

The Singaporean government has a strict approach to upholding laws and regulations, with a zero-tolerance policy towards corruption and harsh punishments for those found guilty of corrupt acts. This has helped establish a strong national integrity system that ensures ethical behavior and accountability across all sectors of society. Such a system is vital for maintaining public trust in the government and promoting a fair and just society. In fact, Singapore has put anti-corruption measures on top of its national agenda since its independence from Malaysia in 1959. As a result, the number of corruption cases in Singapore has consistently remained low for years due to all these effective anti-corruption efforts (CPIB, 2023). Moreover, Singapore's integrity system is backed by strong enforcement mechanisms. For example, the CPIB and other law enforcement agencies have a high rate of success in investigating and prosecuting

corruption cases (with 87% clearance rate and 97% conviction rate) (CPIB, 2020). As a result, Singapore scores 83 and ranks as the 5th least corrupt country out of 180 countries globally (CPIB 2023).

Singapore is also ranked as the top country in Asia when it comes to the effectiveness of its governance and enforcement of the rule of law (World Justice Project, 2018). The country scores almost 100 in terms of its control of corruption[3], regulatory quality[4], and the rule of law[5], indicating a well-governed and stable country with strong institutions and effective legal frameworks (World Bank, 2021). Besides that, Singapore's effective law enforcement and impartial regulatory frameworks have created a business-friendly environment that attracts foreign direct investment. There are no restrictions on foreign ownership of companies in Singapore, enabling all businesses to operate and compete on a level playing field regardless of their country of origin (U.S. Department of State, 2022). In addition to transparent commercial dispute-resolving systems, Singapore's financial reporting standards are consistent with global reporting standards, such as the International Accounting Standards Board (IASB), which helps promote a level playing field among companies operating in Singapore and facilitates cross-border investments (U.S. Department of State, 2022). As a result, Singapore has consistently been ranked as one of the easiest places to do business in the world, with a transparent and predictable regulatory environment (World Bank, 2019b).

[3] Control of Corruption captures perceptions of the degree to which public authorities use their power for their own personal benefit. This includes both small and large acts of corruption, as well as situations where wealthy and influential groups take control of the government to serve their own interests.
[4] Regulatory quality captures perceptions of the government's effectiveness in creating and enforcing policies and regulations that support and encourage the growth of businesses and industries in the private sector.
[5] Rule of Law refers to how much people trust and follow the rules of society. This includes things like how well contracts are enforced, how property rights are protected, the effectiveness of the police and courts, and the level of crime and violence in a community.

In brief, Singapore's robust national integrity system and regulatory frameworks play a crucial role in maintaining transparency, accountability, and impartiality, which are fundamental to upholding the nation's political stability. These systems ensure the efficient implementation and enforcement of regulations and policies while also establishing laws and policies that support business activities and promote economic competitiveness.

### 3.4 Infrastructure

Singapore is strongly committed to developing top-quality infrastructure essential for the country's socio-economic activities, including transportation, energy, water and sanitization, and social infrastructure. In fact, Singapore's success can be accredited to its well-designed Master Plan for long-term infrastructure development, which is periodically reviewed every five years to guide the physical development of Singapore to ensure that the physical infrastructures are aligned with the evolving demands of the society (Urban Redevelopment Authority, 2023). Singapore's commitment to this initiative has resulted in an excellent score of 95.4 out of 100 on the Infrastructure Quality Index (World Economic Forum, 2019). This outstanding score is a testament to Singapore's exceptional performance in essential infrastructure such as transportation systems (including air, land, and sea infrastructure), as well as electric and water supply (World Economic Forum, 2019).

As part of the nation's initiatives to combat climate change, as outlined in the Sustainable Singapore Blueprint 2015, the government of Singapore introduced the Land Transport Master Plan (LTMP) 2040, aiming to develop a more inclusive land transport system and reduce the population's reliance on cars (Scheurer, 2020; Singapore Government Agency, 2023). Besides that, Singapore's Building and Construction Authority has also introduced the Singapore Green Building Masterplan (SGBMP) to integrate environmentally friendly design

and construction practices (e.g., renewable energy sources, use of sustainable and recycled materials, etc.) into infrastructure projects, including those related to healthcare and education. In turn, this helps expedite Singapore's transition to a net-zero country (Building and Construction Authority, 2022). In terms of energy infrastructure, Singapore is home to one of the world's largest floating solar farms, which spans 111 acres and can produce 60 megawatts of solar photovoltaic capacity. This energy infrastructure is expected to reduce carbon emissions by 32 thousand metric tons (U.S. Energy Information Administration, 2021).

Due to the lack of natural water resources, the Singapore government has developed the Changi Water Reclamation Plant to transform sewage into clean potable water. With the plant's capacity to treat up to 900 million liters of wastewater daily, Singapore is able to improve its water supply and minimize ocean pollution, ultimately promoting a sustainable future (World Economic Forum, 2022). Singapore is also widely recognized for its excellent healthcare infrastructure, boasting a state-of-the-art medical system that sets a benchmark across the ASEAN region. The country prides itself on its superior medical equipment and supplies, ensuring high standards of healthcare delivery (International Trade Administration, 2022a). In addition, top pharmaceutical and biotechnology industry leaders like Pfizer, Novartis, Sanofi, AbbVie, and Amgen have set up manufacturing hubs in Singapore to produce drug products and biomedical products, further adding to the distinction of the country's healthcare infrastructure (Economic Development Board, 2023c).

To sum up, the aforementioned initiatives showcase Singapore's strong dedication to maintaining and upgrading its cutting-edge infrastructure, thereby enhancing its economic growth and competitiveness. This, in turn, has positioned Singapore as a leading hub for business and innovation in the Asia-Pacific region.

### 3.5 Infostructure

Singapore has long recognized the importance of digital technology and has been investing heavily in developing its digital capabilities as part of its national agenda. This includes initiatives to promote the adoption of advanced digital technologies in various sectors, such as education, healthcare, fintech, smart cities, transportation, and government services, alongside efforts to improve digital infrastructure and cybersecurity (International Trade Administration, 2022b). As a result of these initiatives, Singapore earns a high score of 99.37 out of 100 on the ICT Infrastructure Index, which is a sub-pillar of the Network Readiness Index (Lanvin & Monteiro, 2022). This indicates that Singapore stands out as one of the top achievers across ASEAN in various aspects of the ICT infrastructure, including affordable mobile tariffs and handset prices, widespread Internet access, extensive 4G mobile network coverage, high fixed-broadband subscription rates, abundant international Internet bandwidth, and comprehensive Internet access in schools (Lanvin & Monteiro, 2022). Furthermore, Singapore will be among the first in the world to achieve comprehensive 5G network coverage across the nation by 2025, which is accessible even underground, with better bandwidth and security (International Trade Administration, 2022b). In addition, Singapore has set up the first physical 6G laboratory, the Future Communications Connectivity (FCC) lab, in the ASEAN region (Waring, 2022). Along with this, the government is currently developing a new national digital blueprint that outlines strategies for 6G networks development in the country, signifying Singapore's dedication to stay competitive in the global digital economy (Tham, 2023).

Singapore's efforts in developing its infostructure ecosystem have also been reflected in various national programs and initiatives, such as the Research Innovation Enterprise (RIE) plan, which is aimed at promoting research and innovation in key areas of economic growth,

including digitalization and advanced technologies (e.g., 5G, Internet of Things, etc.) (National Research Foundation, 2021). Besides that, the Smart Nation initiative is also a key part of Singapore's efforts to develop its infostructure and leverage technology to improve the lives of its citizens, businesses, and the government. This initiative is based on three primary pillars: Digital Society, Digital Economy, and Digital Government (Smart Nation and Digital Government Office, 2023). As part of the Digital Society pillar, HealthHub is a government-led digital platform encouraging Singaporeans to take charge of their health and well-being through easy access to healthcare information and services, such as health assessments and appointment booking (Telecom Review, 2020). In terms of the Digital Economy pillar, the country's Minister for Communications and Information has recently announced plans to boost broadband speeds up to 10 Gbps from 1 Gbps for both residential and business users, with the purpose of enhancing its digital connectivity and supporting the growth of its digital economy (Dominic, 2022). Under the Digital Government pillar, the Government Commercial Cloud (GCC) initiative was introduced in 2018 to migrate most of the government's IT systems to the commercial cloud, with a proposed completion rate of 70% by the end of 2023. This initiative aims to provide a secure cloud infrastructure to support the digital transformation of the public sector, seeking to enhance the efficiency of public service delivery in Singapore through digital means (Department of Commerce, 2022).

Overall, Singapore is known for its advanced digital infrastructure and early adoption of novel digital technologies. Singapore's strong commitment to developing its infostructure has enabled it to become a Smart Nation and pioneer in the global digital economy (Smart Nation and Digital Government Office, 2023).

### 3.6 Intellectual Capital

Singapore has been actively promoting the development of its intellectual capital to drive economic growth and maintain its competitiveness in the global market (Quah, 2018). This can be demonstrated through the establishment of the national RIE 2025 strategy, which aims to build a strong knowledge base for transformative innovations and enhance the innovation capabilities of local enterprises in the country (National Research Foundation, 2021). In addition, Singapore possesses a highly educated and skilled workforce attributable to its robust educational systems and workforce training programs (Quah, 2018). In fact, over 72% of its workforce had completed tertiary education (e.g., diplomas, bachelor's degree, master's degree, doctoral degree, etc.) while 37% had completed secondary education (e.g., high schools) (Lanvin & Monteiro, 2022). Moreover, over 60% of Singapore's workforce is employed in high-skilled jobs, showcasing the country's commitment to developing a skilled and knowledgeable workforce (Ministry of Manpower, 2022). As a result, Singapore earned the second spot out of 133 countries on the 2022 Global Talent Competitiveness Index for its outstanding ability to attract, develop, retain, and enable talent (Lanvin & Monteiro, 2022). Furthermore, Singapore scores 92.13 out of 100 on the relevance of the education system to the economy, indicating a strong alignment between its education system and industry demand (Lanvin & Monteiro, 2022).

Singapore is also home to several world-class higher education institutions, including the National University of Singapore (NUS) and Nanyang Technological University (NTU), which have consistently ranked highly in international university rankings (THE, 2021). These universities have introduced initiatives centered around data science and artificial intelligence, collaborating with technology corporations (e.g., Alibaba Group) to cultivate skilled

professionals in the field of big data and AI (Alibaba Cloud Community, 2022). Furthermore, to provide a pipeline of industry-ready talent, Singapore's higher education institutions have been working closely with industry partners to develop relevant curricula and provide students with real-world experience through internships and apprenticeships (Ganesan, 2022). For example, the TechSkills Accelerator program provides students with valuable practical experience by assisting them in securing internships with leading IT companies (Woo & Ranamita, 2022). As a result of these initiatives, the percentage of university graduates who secured permanent full-time employment within six months of their final exams increased significantly, rising from 69.8% in 2020 to 84% in 2021 (Ganesan, 2022).

To sum up, Singapore's intellectual capital development efforts have successfully built up the country's human capital and contributed to a robust research and innovation ecosystem, which are essential to the country's economic competitiveness in the global market.

**3.7 Incentives**

Singapore has a comprehensive set of fiscal and non-fiscal incentives aimed at boosting the country's innovation capacities and encouraging the growth of high-value economic activities. The incentives can be broadly divided into three categories: institutes, industry, and individual incentives, which include cash grants, subsidies, tax exemption, reduced tax rates, etc.

Under the institutes' category, the government offers an additional tax deduction of 250% of qualifying capital expenditure for R&D projects carried out in Singapore between 2019 and 2025, aiming to strengthen R&D activities and foster technology adoption among companies in Singapore (Inland Revenue Authority of Singapore, 2022). To further promote high-value

economic activities in Singapore, the government of Singapore has implemented two incentive programs, the Development and Expansion Incentive (DEI) and the Pioneer Certificate Incentive (PC) (Economic Development Board, 2019). By offering a 5% or 10% corporate tax exemption, the DEI and PC seek to incentivize foreign investors to establish their headquarters in Singapore, expand their operational capacities, and engage in knowledge and technology transfer initiatives (Economic Development Board, 2019). Similarly, the Global Trader Program (GTP) is another incentive designed to attract large trading companies to establish their presence in Singapore, strengthening its position as an international trading hub. Specifically, global trading companies are entitled to a 5% or 10% tax exemption on their eligible trading income for a renewable five-year period (ACCA, 2022). Furthermore, to promote sustainable and eco-friendly development in the country, the government has introduced the Green Mark Incentive Schemes (GMIS) to encourage the adoption of green building technologies and sustainable building design by developers, civil engineers, architects, and building owners (Building and Construction Authority, 2023). As part of the GMIS initiative, the GMIS - Existing Buildings 2.0 (GMIS-EB 2.0), worth $63 million, encourages energy-efficient practices in existing buildings by offering monetary grants to building owners whose buildings conform to either Super Low Energy or Zero Energy standards (Building and Construction Authority, 2023).

On the other hand, individual incentives such as the Caregivers Training Grant (CTG) provide eligible caregivers a $200 annual subsidy to encourage their participation in caretaker training programs. These programs equip them with the relevant knowledge and skills to provide care for the elderly and disabled persons (Ministry of Health Singapore, 2023a). Moreover, the government of Singapore also introduced the Home Caregiving Grant (HCG),

which provides eligible Singaporeans who suffer from chronic mild to severe disabilities with a monthly cash payment of up to $400 for caregiving costs (Ministry of Health Singapore, 2023a). In addition to caregiving grants, Singapore also offers a wide range of healthcare schemes and subsidies to enhance the health and well-being of its citizens and permanent residents (Ministry of Health Singapore, 2023b). For example, under MediShield Life, a basic health insurance scheme offered by the government, all Singaporeans, regardless of age and health conditions, are entitled to subsidized healthcare treatments in public hospitals. This health subsidy allows citizens and permanent residents to enjoy low-cost and efficient medical treatments and services (Ministry of Health Singapore, 2023b). Other than that, the government introduced the EV Early Adoption Incentive (EEAI) in 2021, aimed at promoting the purchase of electric vehicles. Under this initiative, buyers are entitled to a rebate of 45% off the vehicle's Additional Registration Fee (ARF), up to a maximum of $20,000 (Ministry of Transport Singapore, 2023). This incentive clearly demonstrates Singapore's commitment to achieving net zero greenhouse gas emissions by 2050 (Lee, 2022).

In essence, Singapore's robust incentive systems have expedited the growth of high-value-added economic activities while promoting sustainable living in the nation, contributing to a vibrant and sustainable economy. Besides that, the comprehensive set of individual incentives, such as caregiving and healthcare subsidies, has helped build citizens' confidence in the country's social safety net and economic system.

### 3.8 Internationalization

To improve its global competitiveness, the Singaporean government is actively seeking regional and international cooperation, as evidenced by its active participation in global value

chains. In addition, the government has been actively signing free trade agreements with numerous countries to boost its competitiveness in the global economy. Due to its strategic location in the heart of Southeast Asia, Singapore has become a preeminent gateway for multinational corporations to expand their presence in the ASEAN region. Besides that, Singapore's strategic approach to internationalization strategy has also enabled it to become the largest exporter among the ASEAN countries, with China, the United States, and Malaysia being its top trading partners (Department of Statistics Singapore, 2023).

Singapore's Ministry of Foreign Affairs has signed more than 80 Memoranda of Understanding and agreements with 23 countries, seeking to expand Singapore's capabilities in areas such as public health, smart cities, sustainability, green economy, cybersecurity, and digital economy (Ministry of Foreign Affairs Singapore, 2022). In addition, Singapore is also a member of numerous trade agreements (FTAs) and economic partnerships, including the Regional Comprehensive Economic Partnership (RCEP), which is the world's largest free trade agreement accounting for around 30% of global GDP and contributing to more than 30% of global FDI flows in 2020 (The ASEAN Secretariat and the United Nations Conference on Trade and Development [UNCTAD], 2021). In addition to increasing trade and investment flows between Singapore and its partner countries, the RCEP has also helped attract inward FDI, with a significant increase in its FDI-to-GDP ratio, rising from 16% in the 2000-2004 period to 25.5% in the 2015-2019 period (Matsuura, 2022). As a result, this has moved Singapore up the global value chains (The ASEAN Secretariat and UNCTAD, 2021). Singapore also signed the Digital Economy Agreement with Australia to develop a holistic digital trade ecosystem between the countries (Equinix, 2021). Besides that, the U.S. – Singapore Free Trade Agreement (USSFTA) helps strengthen the protection and enforcement

of intellectual property rights, allowing the member countries to vigorously develop their innovation capabilities in knowledge-based sectors (e.g., science and technology) (Ministry of Trade and Industry Singapore, 2020).

Singapore has the strongest level of participation in the global value chains (GVCs), specializing in forward linkages (domestic value added in the form of intermediate products that are exported to third economies to contribute to the nation's gross exports), which contribute to around 42% of Singapore's GDP (ASEAN-Japan Centre, 2018; Singapore Management University, 2018). This is primarily due to Singapore's strong R&D ecosystem and a highly skilled workforce in STI. In turn, this has attracted many multinational corporations to set up their R&D centers in Singapore, further strengthening the country's capabilities in the forward linkages of the GVC. China, Malaysia, and the U.S. are Singapore's largest trading partners, with key products such as electronics, machinery, chemical products, and refined petroleum (Department of Statistics Singapore, 2023).

Clearly, Singapore's robust internationalization strategies have contributed to its economic growth and success, enhancing Singapore's position as a regional and global hub for trade and investment.

## 4. Conclusion

In conclusion, Singapore is an exemplary country that has established itself as a global leader in various aspects, ranging from institutional leadership to infrastructure and internationalization strategy. This success can be attributed to its robust institutional leadership, where strong "Champions with Clouts" in various sectors have provided the vision and direction necessary to implement sound policies and enhance the country's competitiveness

holistically. Additionally, an efficient collaborative ecosystem that involves various stakeholders such as policymakers, industry players, research institutions, and higher education institutions has created a robust knowledge-sharing culture fostering innovation and economic growth. Besides that, a strong national integrity system with a strict rule of law, an impartial judicial system, high regulatory quality, and effective control of corruption has also been crucial in promoting a peaceful society and maintaining investor confidence. In addition to world-class sustainable infrastructure, Singapore also possesses state-of-the-art infostructure, with comprehensive 5G networks and ICT infrastructure. This has led to the rapid growth of the digital economy, enabling organizations to leverage modern technologies to drive business growth and stay agile in the global market. Moreover, Singapore's first-class education system has created a highly skilled workforce that helps drive R&D and innovation capacities, further bolstering the country's position as a global innovation hub. The country's ability to attract high-value economic activities can also be credited to its wide range of effective incentives aimed at promoting R&D initiatives and attracting foreign direct investment. Lastly, Singapore's strategic approaches to internationalization and strong presence in global value chains have also reinforced the country's position as a global hub for trade and investment. In summary, Singapore's comprehensive 8i ecosystem and its remarkable progress in a relatively short period of time serve as an ideal role model for other countries that aspire to achieve similar development goals and socio-economic growth.

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# About Sunway IGSC

Sunway Institute for Global Strategy and Competitiveness (Sunway IGSC) is dedicated to extending its research focus beyond the traditional economic boundary of competitiveness and draws into its coverage social and environmental considerations as explicit factors of competitiveness.

Based on a more inclusive and holistic consideration, Sunway IGSC identifies three primary pillars of competitiveness: Economic, Social, and Environment. The three pillars of competitiveness provide direction and focus to the type of questions asked and the work conducted within IGSC:

- **Economic health -** This pillar investigates drivers of competitiveness from the vantage point of firms, industry, and national ecosystems, with a particular focus on policies and drivers of structure and competitive strategies to create positions of sustainable advantage.
- **Social health -** This pillar focuses on issues of distribution of wealth, equity, and unity within ecosystems as a consequence of economic policies and strategies at the firm, industry, and national levels. The lens scrutinizes who creates value, for whom, and how is this value distributed among the diverse stakeholders operating within the ecosystem. It stresses the need for inclusive creation and sharing of value creation to ensure shared prosperity.
- **Environment health -** This pillar scrutinizes how actions of individuals, firms, industry, and government impact the environment and draws into explicit consideration the need to go beyond the simple mantra of firm profit maximization and short-run economic development and competitiveness by holistic consideration of the costs to the natural environment and life of species, including that of the human race over the long run.

The mission of the Sunway IGSC is to conduct meaningful fundamental and translational research exploring global strategy and competitiveness to contribute to the strategic transformation and competitiveness of governments, industries, and society in the context of rapidly changing global dynamics.

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