Location Factors and their Importance

Germany and Singapore's Joint Path to Enhanced Competitiveness

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Foreword and Introduction

Building Bridges with the SGC between Singapore and Germany

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Over the past decades, Germany and Singapore have cultivated a robust and multifaceted bilateral relationship, navigating significant political changes and an ever-evolving global landscape. As the world faces unprecedented challenges, from political instability to disruptions in global trade, both nations have demonstrated remarkable resilience and adaptability.

While Singapore is at the forefront of innovation with its vision of Smart Nation and established itself as a business, finance and logistics hub for the ASEAN region, Germany excels with innovative engineering solutions and advanced manufacturing technology. Both countries share the goal of addressing the challenges of skilled labor shortages through innovation and education, as well as implementing sustainable energy solutions. Their collaboration has not only strengthened economic ties but also fostered cultural and technological exchanges, enriching both societies.

This paper will focus on six critical economic location factors. For each country, we will be looking at 3 factors that were found to be relevant. These factors represent the strengths of each country, highlighting areas where they excel and offer opportunities for mutual learning and collaboration.

The following economic location factors will be evaluated with a focus on Singapore:

- Smart Nation Initiative
- Digitalisation in the Administration
- Efficient Bureaucracy

For Germany, the following economic location factors will be evaluated:

- Smart Manufacturing
- GreenTech and Sustainability: Focus on Energy Efficiency
- Training and Education

The focus topics have been derived from the results of a survey which was conducted among SGC member companies, asking them which business location factors in Singapore and Germany they deem to be most important to further stimulate economic growth and stay competitive on a global scale in the next 10 years.

Therefore, this publication offers insights into current sentiments and highlights differences between the two countries, facilitating mutual learning. By understanding these differences and leveraging each other's strengths, Germany and Singapore can further enhance their strategic partnership. Through sustained collaboration and innovative strategies, both countries can continue to thrive in an increasingly complex global environment.

01

Survey Results

1. Survey Results

“From your perspective, what are the most important factors to be considered by policymakers in Singapore and Germany to further stipulate economic growth and staying competitive on a global scale as a business location for the upcoming 10 years?

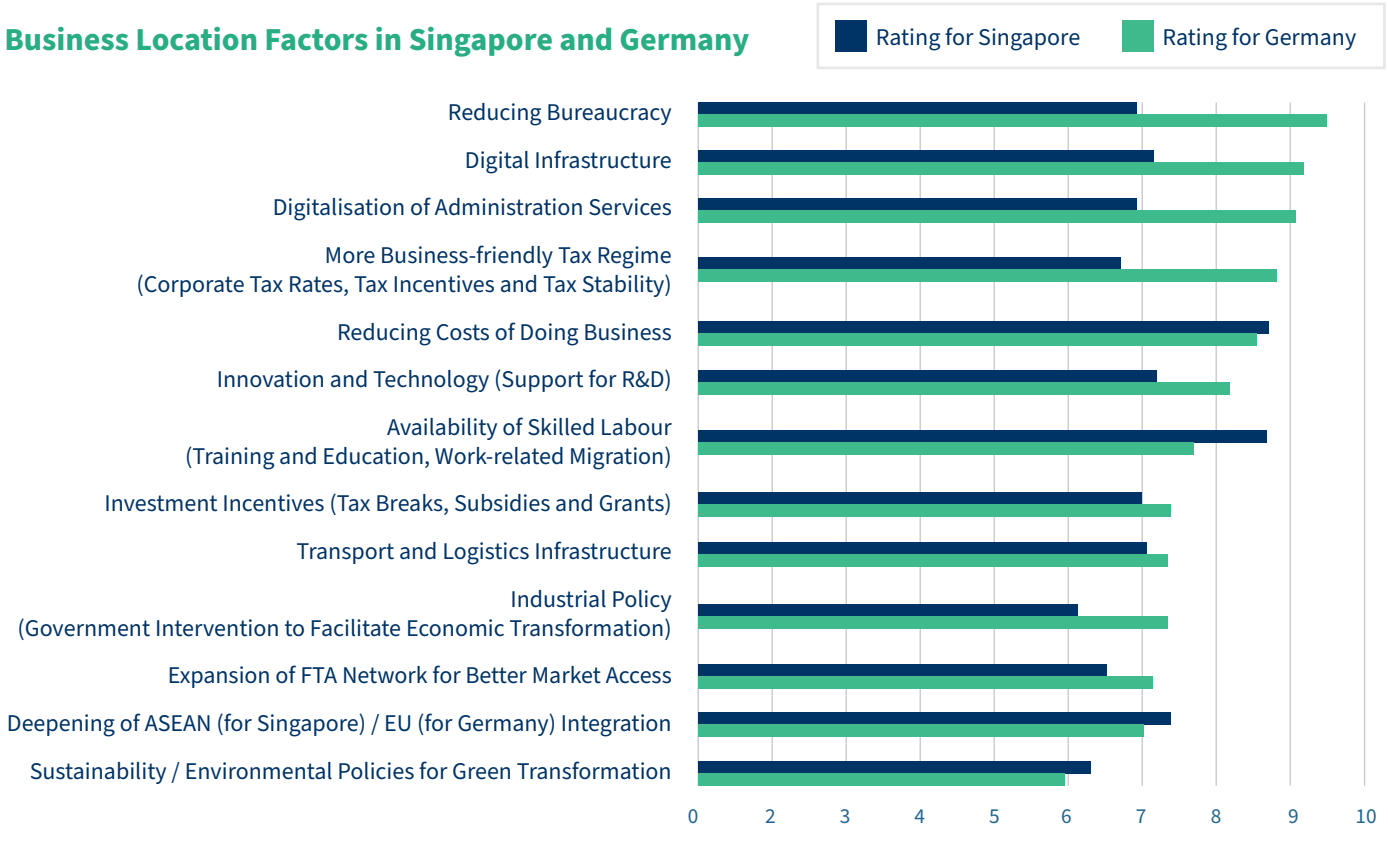
Please rate each item on a scale from 1 (least important) to 10 (most important).

In August 2024, the Singaporean-German Chamber of Industry and Commerce (SGC) conducted a survey among its members on business location factors in Singapore and Germany by asking the following question:

In total, 69 members of the SGC – equaling 12.5% of our member's base – participated in the survey.

Looking at the results, a higher value implies more urgency for policymakers to take action.

Business Location Factors in Singapore and Germany



It is evident that our members perceive a greater need for business-friendly reforms in Germany compared to Singapore. Out of 13 indicators, our members identified 9 categories where action is deemed more necessary in Germany:

1. Reducing Bureaucracy
2. Digital Infrastructure
3. Digitalisation of Administration Services
4. Innovation and Technology (Support for R&D)
5. Investment Incentives (Tax Breaks, Subsidies and Grants)
6. More Business-friendly Tax Regime
7. Transport and Logistics Infrastructure
8. Industrial Policy (Government Intervention to Facilitate Economic Transformation)
9. Expansion of FTA Network for Better Market Access

For Singapore, our member companies perceive a more urgent need for action in Singapore regarding 4 business location factors:

1. Reducing Costs of Doing Business
2. Availability of Skilled Labour
3. Policies for Green Transformation
4. Deepening of ASEAN (for Singapore) / EU (for Germany) Integration

As the survey highlighted several key trends, the results shaped the focus topics of this paper.

When looking at factors where Germany faces a greater need for reform compared to Singapore, **Reducing Bureaucracy** is identified as the top priority for Germany (9.5) (Singapore: 6.93), reflecting widespread concerns over inefficient administrative processes and regulatory burdens that can hinder business operations. Similarly, **Digitalisation of Administration Services** is a pressing issue, with Germany (9.14) scoring higher than Singapore (6.89), highlighting the need for faster digital transformation to streamline interactions between businesses and the government. **Digital Infrastructure** is another critical area, with Germany (9.18) scoring significantly higher than Singapore (7.29), further underscoring the gap in technological infrastructure that Germany must address to remain competitive in the long run. These are followed by factors that influence the overall **ease and cost of doing business,** which can play a crucial role in investment decisions. As such, Germany's relatively high corporate tax rates and complex tax structure are perceived as less business-friendly (Germany: 8.79; Singapore: 6.66) while the overall costs of doing business are identified as a pain point in both countries (Germany: 8.5; Singapore: 8.69), pointing to the need for reforms to enhance investment attractiveness.

In Singapore, the primary challenge for businesses, as identified by our members, is the shortage of skilled workers (8.66). To address this, the chapter on **Training and Education** will discuss the topic through the lens of the German dual vocational training system, which presents a practical approach to mitigating some of the key issues related to the skilled labor shortage. As already mentioned, **high business costs**, among others driven by wages, land prices, and energy costs, represent another critical issue for Singapore. In this regard, the paper explores best practices from Germany, focusing on areas where Germany is recognised as a global leader and can provide solutions for Singaporean companies to lower expenses and mitigate manpower constraints. Specific topics include **Energy Efficiency in Industry** and **Smart Manufacturing**—two critical factors affecting Singapore's business environment.

To address these challenges, this paper explores best practices from Germany, focusing on areas where Germany is recognised as a global leader and can provide solutions which offer strategies for Singaporean companies to lower expenses and mitigate manpower constraints.

02

Best Practices from Germany

2. Best Practices from Germany

2.1. GreenTech and Sustainability: Focus on Energy Efficiency

Energy Efficiency in the Industry in Germany and Singapore

Energy efficiency is a crucial factor for achieving sustainable industrial growth, reducing environmental impact, and enhancing economic competitiveness. In the face of global climate challenges, industries worldwide are under increasing pressure to adopt energy-efficient practices that lower emissions while maintaining productivity.

In Germany, the Carbon net-zero strategy is based on the premise, that the primary energy consumption will be reduced by 50% in 2050 to 1,800 TWh in comparison to 2008.[1] As the industrial sector (29%) is the biggest end user of energy, it is hence imperative for manufacturers to adopt innovative solutions to increase their energy efficiency. And indeed, when looking at primary energy consumption per capita, Germany has already been able to reduce its carbon intensity from 170.5 Gigajoule per capita (GJPC) in 2013 to 137.0 GJPC in 2023, equaling a growth rate of -2.2% per annum.[2]

Singapore is facing a similar challenge, with its industrial sector also being the largest energy consumer. However, despite clear ambitions and efforts to reduce greenhouse gas (GHG) emissions in the context of the Singapore Green Plan 2030, energy intensity further increased from an already very high value of 533.9 GJPC to in 2013 to 570 GJPC in 2023, equaling an annual growth rate of 0.8%.[2]

Also, when looking at CO2 emissions per capita, a similar trend is apparent. While Germany steadily reduced its emissions from 9.5 tons of CO2 per capita (tCO2PC) in 2013 to 7.3 tCO2PC in 2022, Singapore witnessed a slight increase from 8.1 tCO2PC in 2013 to 8.3 tCO2PC in 2022.[3]

While these numbers exemplify that both countries face significant challenges in reducing energy consumption and emissions, they also highlight key differences in their recent trajectories. Germany, particularly its industrial sector, has established itself as a global leader in energy efficiency through the implementation of innovative technologies, comprehensive policies, and collaborative industry networks. As Singapore faces limitations in utilising renewable energy sources like solar and wind due to its weather conditions and limited land availability, it stands to benefit greatly from adopting elements of Germany's expertise in energy efficiency and close collaboration with German companies offering cutting-edge energy efficiency technologies for reducing carbon emissions.

German Technology Leadership in Energy Efficiency: A GreenTech Cornerstone

While GreenTech lacks a universal definition, it is defined by its applications and impact, encompassing all technologies that contribute to national and international sustainability goals and encompasses the following categories:

Energy Sources and Energy Carriers

Energy Production, Distribution, and Storage

Energy Efficiency

Sustainable Materials and Products

Sustainable Product Design, Manufacturing, and Value-Added Processes

Circular Economy and Product Life Cycles

Among these categories, energy efficiency plays a particularly important role, forming the largest share in the global GreenTech market with a global market volume of €1,224 billion in 2020, thereby accounting for 26.4% of the entire GreenTech industry. Furthermore, businesses that are offering energy efficiency solutions are expected to achieve the strongest growth rates, with projected annual sales increases of roughly 13% from 2025 onwards. Hence, energy efficiency in industry is a cornerstone of sustainable development and economic growth.[4]

Key technologies contributing to industrial energy efficiency include:

- **Energy-Efficient Production Technologies**
  Heat pumps, combined heat and power plants, and waste heat recovery systems are critical for optimising industrial processes by reusing energy that would otherwise be lost. These technologies enable industries to achieve significant energy savings and reduce reliance on fossil fuels.

- **Advanced Machinery and Systems**
  High-efficiency electric drive systems, compressors, and heat exchangers are designed to maximise output while using less energy. These systems are integral to reducing energy intensity across manufacturing operations.

- **Digital Innovations**
  Tools like digital twins and process automation technologies are revolutionising industrial energy efficiency. Digital twins enable precise modelling of production processes, reducing resource consumption, improving throughput, and enhancing energy management. In some cases, such as pharmaceutical manufacturing, digital twins have demonstrated the potential to cut energy consumption and carbon emissions by up to 80%.

- **Control and Monitoring Systems**
  Measurement, control, and monitoring technologies, including IoT-enabled sensors, provide real-time data on energy usage, allowing manufacturers to identify inefficiencies and implement targeted improvements.

In this context, Germany has positioned itself as a global leader in GreenTech, particularly in energy efficiency. Products, processes, and services "Made in Germany" account for 14% of the global GreenTech market, despite Germany contributing only about 3% to global economic output. This underlines how German technology providers have established a strong reputation for innovation and reliability in this field.[3]

A significant proportion of Germany's GreenTech success can be attributed to its small and medium-sized enterprises (SMEs), the famous "German Mittelstand", which make up 91% of the sector's players.

Benefits of Collaboration with German Businesses

By leveraging Germany's expertise, Singapore can accelerate its energy efficiency initiatives, reducing the industrial sector's energy intensity and carbon emissions. For Germany, collaboration with Singapore provides a gateway to expanding its GreenTech solutions in Southeast Asia, a region with growing demand for sustainable industrial practices.

Therefore, energy efficiency in the industry is a critical area where Germany and Singapore can collaborate to drive sustainability, enhance industrial competitiveness, and achieve mutual benefits. Germany's expertise in advanced energy-efficient technologies and its position as a global leader in GreenTech make it an ideal partner for Singapore, which is actively seeking to improve energy efficiency in line with its Green Plan 2030.

CASE STUDY 1

Siemens Energy and PacificLight – Optimising Power Plant Efficiency

PacificLight, a leading energy provider in Singapore, partnered with Siemens Energy to enhance the efficiency of its power plant on Jurong Island.

PacificLight has operated the 800 megawatts combined cycle power plant, which meets 10% of Singapore's electricity needs, on Jurong Island since 2014. Committed to optimising operations and reducing emissions, the plant implemented Siemens Energy's Advanced Turbine Efficiency Package (ATEP) to improve performance and sustainability.

The ATEP upgrades included advanced turbine technology and digital process optimisation tools, enabling the plant to generate more electricity with the same amount of fuel. This not only reduces operational costs but also significantly lowers carbon emissions. By integrating real-time monitoring capabilities, the solution ensures that the plant operates at peak efficiency, maximising output while minimising energy losses.

Following the upgrade, the power plant's output increased by 30 megawatts, accompanied by a 3.5 percentage point improvement in heat rate. This enhancement also boosted efficiency, making it the first power plant in Singapore to surpass 60% efficiency.

CASE STUDY 2

Decarbonisation of Jurong Island – Digital Technologies to establish a sustainable Energy and Chemicals industrial park

Jurong Island is an important industrial site, located southwest off the coast of Singapore. The island is home to more than 100 companies from the energy, oil, gas and chemical sectors. Its strong industrial footprint contributed to 54% of Singapore's total carbon emissions in 2019, thus playing a considerable role in the city state's ambitions for sustainable transformation as part of the Singapore Green Plan 2030. Industry players, as well as government authorities such as the Singapore Economic Development Board have put forward initiatives and plans on supporting the transformation of Jurong Island into a sustainable energy and chemicals park, including 6 million tonnes of carbon abatement per annum from low-carbon solutions annually by 2050.

German companies like Evonik and Siemens are actively contributing to this initiative. Evonik focuses on process and plant upgrades to transform both local and global supply chains within its operations, while Siemens adopts a holistic and gradual approach to the decarbonisation of Jurong Island, engaging all relevant stakeholders in the process. Siemens is therefore looking to establish an ecosystem of partners and like-minded industrial players to establish a database from which to offer turnkey digital twin and dercabonisation technologies to plant operators.

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2.2. Training & Education

The Importance of Skilled Labour Development

Singaporean businesses are currently experiencing a significant shortage of skilled-labour. While during the past decade, roughly 40% of companies reported that limited availability of local talent was a challenge for business activities, these numbers increased sharply in recent years. In 2024, already 61% of Singaporean companies cited labour-shortage as a main challenge, making it the second most pressing issue for local businesses after rising manpower costs.

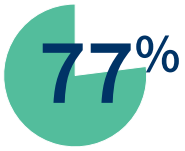
This trend is exacerbated by various factors.
First, 48% of companies reported difficulties in attracting and/or retaining younger workers.

Second, the rapid development and requirements of new technical skills continuously creates a demand for job profiles for which there is no sufficient manpower supply. These two points combined imply a partial mismatch of available skills in the workforce and training curricula compared to the needs of companies.

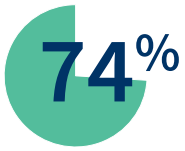
Third, many companies are increasingly looking for highly skilled professionals to maintain their innovative strength and competitiveness.

Fourth, Singapore relies on the recruitment of foreign workers to fill some of these gaps while having limited space for further growth of population and introducing stricter requirements for foreign workers to obtain work permits.

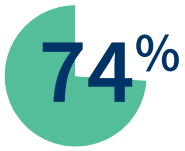
Sectors most affected by skilled-labour shortage in Singapore[5]:



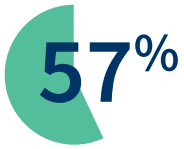
IT & Related Services



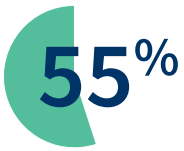
Construction & Civil Engineering



Logistics and Transportation



Manufacturing



Wholesale Trade

Dual Vocational Training in Germany

One instrument that could support Singapore's way forward in coping with these challenges is Germany's dual vocational training system, which is often regarded as the global gold standard due to its combination of theory and training embedded in a real-life work environment.

Vocational training is an educational model that integrates extensive on-the-job training with theoretical instruction to prepare skilled workers tailored to the demands of the labor market. In Germany's dual system, widely recognised for its effectiveness, training is conducted across two settings: the workplace, which emphasises practical, hands-on experience, and vocational schools, which focus on imparting the theoretical knowledge relevant to specific occupations.

This synergy allows trainees to gain valuable real-world experience while building a strong foundation of specialised expertise. Vocational training plays a pivotal role in cultivating a workforce that is directly aligned with the needs of businesses, ensuring that skills can be immediately applied. Beyond meeting labor market demands, it also strengthens the economy, fostering innovation and enhancing productivity.

Germany currently offers formal training in around 330 occupations. In Germany, the regional Chambers of Commerce and Industry (CCIs), social partners, and the government work collaboratively to ensure the framework conditions of the dual vocational training system, with each stakeholder assuming distinct responsibilities. The CCIs serve as central coordinators and are responsible for registering and monitoring training companies, training in-company personnel, and organising examinations. The chambers and social partners (employers' federations and trade unions) together define training contents and negotiate standards including the remuneration of trainees, while the government shapes the legal framework and provides the resources for the school-based part of the training.

The shared responsibility for developing and implementing nationwide standards and curricula between private and public actors, coupled with the strong involvement of companies, supported by their local CCIs, is a key success factor. This collaboration ensures that curricula remain up to date, aligned with industry needs, and enables a flexible and rapid response to emerging trends and challenges.

Hence, the dual vocational training system offers considerable advantages for companies. While generally adhering to teaching certain skillsets according to the nationwide curricula, the hands-on approach during the in-company training allows businesses to train their apprentices in a targeted manner so that their qualifications meet the company's specific requirements. Also, it is considered as a highly effective method of recruiting young personnel, since recruitment costs are reduced and misplacements are minimised, while the vocational training increases identification and loyalty among apprentices with their employer. The system also offers attractive advantages for trainees, as they already receive renumeration during their training and gain early access to otherwise highly competitive positions in SMEs and MNCs alike. Despite the renumeration, the income created by trainees for their respective company outweighs the costs, making it a business case for companies to hire apprentices.

Singapore's Current Approach to Training and Education

Singapore has established a comprehensive education system featuring world-class learning facilities, with particular strength in technical training. Institutions like the Institute of Technical Education (ITE) and the five Polytechnics provide more practice-oriented learning pathways designed to facilitate smooth transitions from school to employment or further education. However, the emphasis remains primarily on practice-oriented theory rather than the direct application of practical skills while on-the-job-experience is largely confined to internships.

The five Polytechnics in Singapore offer a wide range of over 150 diploma programmes, drawing approximately 40% of school leavers. These institutions emphasise application-oriented learning and foster intensive industry partnerships. Students have access to modern technologies and gain practical experience through internships and projects developed in collaboration with industry partners. However, despite these initiatives, the training still places a significant emphasis on theoretical knowledge.

While the technical and vocational education and training (TVET) system in Singapore is leading in the region, the lack of a continuous in-company training component limits its effectiveness for the industry.

While the SkillsFuture Work-Study Programmes (WSPs) can be seen as a first step towards a stronger integration of theoretical education and on-the-job training, the introduction of a more comprehensive dual vocational approach would complement the existing structures and bring benefits to local businesses and trainees alike. While the German model can serve as inspiration for the local vocational training sector, it is not a blueprint. It will be important to consider existing structures and strengths when it comes to cooperation between private and public actors in terms of training, skills mapping and developing of curricula in Singapore. By leveraging the strengths of both systems, robust bilateral cooperation between Singapore and Germany in this field could establish a system that responds more effectively to the rapidly changing needs of industry while producing a pipeline of young, skilled workers with greater practical experience.

CASE STUDY 1

Bosch Rexroth Implementing Dual Training in Singapore

The Bosch Rexroth Regional Training Center (BRRTC) in Singapore is a successful example of the implementation of the German dual training system in an international context. The center was set up to provide regional specialists with specific qualifications for the requirements of Industry 4.0. It combines practice-oriented learning in a modern technical environment with theoretical knowledge, similar to the dual approach in Germany. One of the main programmes is the “Industry Specialist AHK I4.0” certificate, which runs for 10 days and provides participants with practical skills to apply Industry 4.0 technologies in companies. Specialised courses are also offered, e.g. on network integration, condition monitoring and smart automation technologies. The training courses take place directly on the Bosch Rexroth site, which is equipped with state-of-the-art mechatronics and Internet of Things (IoT) systems.

The BRRTC has shown how such programmes can combat skills shortages in tech-oriented industries by combining hands-on learning with advanced technology. It also addresses challenges such as the need to convince companies of the long-term benefits of Industry 4.0 and benefits from government support, e.g. through SkillsFuture Singapore, and thereby exemplifies the compatibility of existing instruments with elements of dual vocational training.

CASE STUDY 2

Festo – Advancing Industry 4.0 and Skills Development in Singapore

Festo, a global leader in automation technology and technical education, plays a significant role in promoting Industry 4.0 and skills development in Singapore. The German company combines innovative technologies with hands-on learning solutions to meet the increasing demands of modern industry. In Singapore, Festo has not only established its technological products, but is actively involved in vocational training and collaboration with leading educational institutions under its educational branch, Festo Didactic.

One key initiative is the Competence Centre for Digitalisation, Technology, and Innovation (CDTI) in Singapore, established by Festo in collaboration with TUM Asia. Here, practical training and further education courses are offered tailored to the industry's needs. A significant focus lies in training programmes for mechatronics and robotics (MecLab), where participants not only acquire theoretical knowledge but also gain practical experience using modern equipment. This practical orientation ensures that graduates are equipped to meet the demands of high-tech industries, particularly in fields where digitalisation and automation play an important role. Additionally, Festo supports MINT (Mathematics, Informatics, Natural Sciences, and Technology) programmes through specialised laboratories, which promote STEM education by offering students hands-on experience with automation systems and modern industrial technologies.

Festo's involvement in Singapore extends to close partnerships with key higher educational institutions, including the National University of Singapore (NUS) and Nanyang Technological University (NTU). These partnerships are particularly noteworthy as they go beyond theoretical education models and integrate practice-oriented learning directly into academic curricula. At NTU, Festo has contributed to the establishment of specialised laboratories, enabling students to gain practical experience in industrial automation and to develop solutions for real industrial challenges. The collaboration with NUS, on the other hand, focuses on vocational training, where students gain valuable insights into the application of automation systems in smart factories, enhancing process efficiency. Through such initiatives, Festo enables students to engage with the cutting-edge technologies that are shaping the future of industry.

A relevant aspect of Festo's vocational training programme in Singapore is a dual training approach, which adapts elements of German vocational training to local conditions. Apprentices here not only complete technical training courses but also work actively on projects in companies. This ensures that the training is directly linked to the needs of the industry. For example, a graduate of the Festo programme could work on optimising production lines in a semiconductor company using automation technology, which is and will be an important sector for Singapore's economy.

The ecosystem in which Festo operates is particularly remarkable in Singapore. Close cooperation with industrial companies, educational institutions, and government organisations creates solutions and a thriving ecosystem that promote both technological innovation and the development of skilled workers, that can meet the demands of digital and industrial transformation.

2.3. Smart Manufacturing

The Role of Smart Manufacturing in Industrial Transformation

Smart Manufacturing, also known as Industry 4.0, integrates advanced digital technologies into industrial processes to enhance efficiency, agility, and sustainability. It leverages the intelligent networking of all components within production systems through technologies such as IoT, AI, and real-time data analytics, fostering innovation by enabling systems to adapt dynamically to real-time demands.

The term "Industry 4.0" originated from a German research project introduced at the CeBIT trade fair in Hannover in 2011. As the birthplace of Industry 4.0, Germany has established itself as a global leader in Smart Manufacturing, redefining industrial practices through cyber-physical systems, IoT, and robotics.

Singapore, as a major industrial hub with a strong export focus, is also reaping the benefits of Smart Manufacturing. With its world-class manufacturing ecosystem, Singapore consistently ranks among the top 10 nations globally for exporting high-tech goods, standing alongside industrial powerhouses such as the United States, China, Germany, and Japan.

Germany: Leadership in Smart Manufacturing

Germany has established itself as a leader in Smart Manufacturing, driven by its early adoption and promotion of Industry 4.0. A major strength of Germany's approach lies in the implementation of IoT and cyber-physical systems, which enable interconnected production environments. These systems allow machines, sensors, and networks to exchange data in real time, enabling manufacturers to monitor operations, identify inefficiencies, and optimise processes. This integration reduces downtime, improves resource utilisation, and enhances flexibility in production, addressing the evolving needs of industries.

Germany has also made significant advancements in the use of artificial intelligence for predictive maintenance and quality control. AI technologies help manufacturers analyse production data to anticipate equipment failures, optimise maintenance schedules, and ensure consistent quality in production outputs. By reducing unplanned disruptions and improving decision-making, AI has become a key component in maintaining efficient and reliable manufacturing processes.

Another important area of development is robotics and automation. German manufacturers have developed highly specialised robotic systems that are widely used in sectors such as automotive, aerospace, and electronics. These systems contribute to greater precision in manufacturing processes, while also increasing productivity and scalability. Robotics in Germany supports not only large-scale production but also adaptable solutions for smaller-scale operations, making automation accessible across various industries.

Also, German small and medium-sized enterprises (SMEs) – often referred to as German Mittelstand – play a central role as drivers of innovation. They not only promote technological development within Germany, but also the country's competitiveness on a global level. Innovations at German SMEs often arise from practical experience and through close collaboration with customers and suppliers, without always requiring formal research and development (R&D). Internationally operating SMEs must continuously improve their products and processes to remain competitive, which makes them important players in the introduction and dissemination of new technologies. The innovative strength of these companies not only secures their own market position, but also makes a significant contribution to the further development of entire sectors, including digital transformation and Industry 4.0.

CASE STUDY 1

Bosch and Aleph Alpha: Generative AI Driving Efficiency and Innovation

Aleph Alpha has introduced PhariaAI, an enterprise-grade operating system designed to facilitate the development, control, and training of AI systems within existing IT infrastructures.

PhariaAI offers ready-made components for fine-tuning, evaluation, and debugging, along with proprietary innovations that enhance the explainability and control of language models, ensuring traceability and auditability of AI systems. It supports the integration of Aleph Alpha's own language model, Pharia-1-LLM, as well as other open-source models, providing flexibility in AI deployment.

Among others, Bosch uses PhariaAI and identified more than 160 use cases for AI in its daily business operations, supporting product and software development, knowledge management and external communication. Today, Bosch is saving more than €100 Mio. per year due to AI applications.

These developments are also particularly relevant for Singapore, with the country recently announcing to establish the "Sectoral AI Center of Excellence in Manufacturing". This center, which was founded by the Agency for Science, Technology and Research (A*Star) in collaboration with various partners, aims to strengthen innovation in the field of artificial intelligence within the manufacturing industry. The center serves as a hub for research and development focused on the use of AI to improve production processes, efficiency and competitiveness. It provides an environment in which research teams, industry leaders and technology providers can work together on projects and innovative solutions. The aim is to support small and medium-sized enterprises (SMEs) in overcoming the hurdles of implementing AI in manufacturing. Pilot projects from Germany, such as the example of Aleph Alpha and Bosch and the experience of German companies in implementing AI in industrial settings could provide valuable insights for the development and implementation of AI strategies in Singapore.

CASE STUDY 2

Optimising Production Efficiency with SICK

SICK, a leading German technology company specialising in sensor solutions, has developed innovative solutions to address key challenges in production, inventory management, and resource optimisation across various industries. Through real-world applications, SICK has enabled manufacturers to enhance efficiency, reduce costs, and achieve sustainable operations.

One such challenge was faced by a beverage manufacturer struggling with inefficiencies in managing WIP (Work In Progress) Bins. Frequent delays occurred as wrong bins were collected, causing production downtime. SICK implemented a solution for real-time localisation and historical movement analysis of the bins. The outcomes were remarkable: downtime was reduced by 30%, manual search effort halved, and bin utilisation increased by up to 20%. Additionally, the solution can seamlessly integrate with the customer's SAP module to achieve further savings.

In fact, SICK has also recently signed an MoU with a Singaporean company called Aicadium, to co-create AI-powered solutions for businesses in Singapore and Southeast Asia, combining SICK's leading sensor technology with Aicadium's innovative AI software. This collaboration combines the strengths of both companies to revolutionise how the industrial sector addresses high-impact challenges through advanced AI-driven visual inspection solutions, enhancing efficiency, safety, quality, and productivity in manufacturing and logistics. By leveraging their combined expertise, the partnership focuses on developing solutions that support Singapore's Economy 2030 Manufacturing goals. These include increasing manufacturing value-add by 50% by 2030 and positioning Singapore as a global hub for business, innovation, and talent in Advanced Manufacturing.

CASE STUDY 3

DB Schenker – Smart Logistics

DB Schenker has invested in two state-of-the-art logistics facilities in Singapore, designed to enhance the company's logistics capabilities through advanced automation and sustainability.

The first facility Red Lion, started operations in August 2020, while the second facility, Red Lion2, is expected to commence operations by the first half of 2025.

Red Lion is a high-speed logistics hub located in the Airport Logistics Park of Singapore and spans 51,400 square meters. It features a next-generation Warehouse Management System and synchronised IT platform that bridges various automation technologies, significantly increasing warehouse productivity and reducing lead times for customers. The facility incorporates key innovations like an Automated Storage and Retrieval System (ASRS) to optimise storage capacity and retrieval efficiency, while the Goods-to-Person (GTP) and Pick-To-Light technologies improve picking accuracy and speed. Additionally, a robotic labelling system utilises 3D-vision technology and robotic arms to apply labels in multiple languages on products of varying sizes and shapes.

DB Schenker's second logistics hub Red Lion2 will feature more advanced automation solutions, including intelligent conveyor systems, automated storage and retrieval systems, and autonomous guided vehicles. Additionally, the facility will offer high-value-added logistics solutions tailored to Singapore's semiconductor and healthcare industries. This includes specialised handling, storage, and transportation services that meet the stringent requirements of semiconductor and healthcare products. Ultimately, RedLion2 will also create many skilled and high-value jobs as it will strengthen Singapore's position as a global logistics and supply chain management hub. RedLion2 is part of DB Schenker's larger plan to hire more than 600 people in Singapore over the next 7 years in roles such as process automation, data analytics and digital transformation.

DB Schenker selected Singapore as the optimal location for its facility, due to the continuous expansion of businesses to the island state and the broader growth of corporate operations in the region. DB Schenker's focus on logistic services for the semiconductor and healthcare industry is well aligned with Singapore's strengths as an advanced manufacturing and R&D Hub, as the city state aims to attract more leading semiconductor companies and capitalise on the growing AI sector, whilst expanding the talent pool. These investments from leading German companies in Singapore create stronger links between the two countries, more value for the industry and a multiplier effect on the economy with the addition of new jobs and expansion of technology fields in these industries.

03

Best Practices from Singapore

3. Best Practices from Singapore

3.1. Smart Nation Initiative

Smart Nation Initiative 1.0

Launched in 2014 by Prime Minister Lee Hsien Loong and updated under new Prime Minister Lawrence Wong in October 2024, the Smart Nation Initiative reflects Singapore's ambition to harness technology for societal advancement, economic growth, and government efficiency. The initiative is led by the Ministry of Digital Development and Information (MDDI).

The initiative is built on three foundational pillars: Digital Society, Digital Economy, and Digital Government. These pillars provide a coherent framework to drive collaboration across government agencies, the private sector, and the public. Through "Strategic National Projects" (SNP), the Smart Nation Initiative establishes clear priorities and facilitates resource coordination to ensure successful implementation. Some of the SNP already being implemented are:

1. GoBusiness

This platform streamlines business transactions with the government, offering access to e-services such as grants and licenses. The government has consolidated these services into two portals: the Business Grants Portal (BGP) and the GoBusiness Licensing Portal. BGP simplifies financial assistance applications by eliminating the need to approach multiple agencies or repeatedly submit the same information. Meanwhile, the GoBusiness Licensing Portal allows businesses to apply, amend, renew, or terminate licenses across various agencies quickly and efficiently.

2. Core Operations Development Environment and eXchange (CODEX)

CODEX is a shared digital platform for government agencies and the private sector, designed to deliver faster, more efficient, and cost-effective digital services. By integrating reusable components like data flows, middleware, and microservices, CODEX reduces costs, improves efficiency, and leverages commercial cloud technologies for scalability. Its impact is evident in initiatives like the Business Grants Portal, which improved service quality through agile methodologies, and the MyInfo Bank Pilot, which expedited customer onboarding with government-verified data.

3. National Digital Identity (NDI)

In line with the shift to more government services online and the need for a secure and easily accessible digital ecosystem, NDI enables secure and convenient online transactions for citizens and businesses across public and private sectors. Singpass, the cornerstone of the NDI initiative, provides access to over 700 services, streamlining interactions with government agencies and private providers. It also supports cross-border business transactions, reinforcing its role in Singapore's digital economy. Applications like the Singpass app, MyInfo, and MyInfo Business further enhance accessibility and efficiency, making NDI a key enabler of Singapore's digital transformation.

Smart Nation Initiative 2.0

In October 2024, Prime Minister Lawrence Wong announced Smart Nation 2.0. This refreshed vision paves the way forward by focusing on three core goals, labelled as “Trust”, “Growth”, and “Community”. These goals aim to enhance digital security and resilience, empower workers and businesses to participate in the digital economy, and promote digital inclusion while fostering social cohesion.

The updated strategy prioritises utilisation and investments in emerging technologies like artificial intelligence, introduces new education programmes to prepare future generations, and strengthens protections against online harms through enhanced regulations.

GovTech: Delivering Government Digital Services and Infrastructure

Established in 2016, the Government Technology Agency (GovTech) – a statutory board under MDDI – is the agency overseeing implementation of the Smart Nation initiative. GovTech focuses on leveraging advanced technologies to enhance government services, improve operational efficiency, and deliver innovative solutions that meet the needs of citizens and businesses. Hence, the target group of GovTech services and products includes citizens, businesses and government agencies alike. The work of GovTech can be classified into five capability centres:

1. Application Design, Development and Deployment:

GovTech develops public sector applications for various use cases and is also responsible for strengthening design and software engineering capabilities within the public sector. Some of the applications created by GovTech include:

- **OpenCerts:** Preventing fraud in education credentials by enabling educational institutions to issue digital certificates, allowing for cost and time savings due to ease of verification.

- **GoWhere:** Consolidates information on government services, events and initiatives, including where to find them.

- **GovWallet:** A digital wallet embedded within apps such as Singpass and LifeSG that allows all eligible citizens to manage their government payouts.

2. Cybersecurity:

GovTech contributes to securing governmental Info-Communications Technology and Smart Systems and responding to any cyberattack. It does so by monitoring, detecting and responding to cyber incidents across the whole-of-government, developing cyber capabilities by designing and implementing secure architectures, conducting, security testing and developing advanced cybersecurity products.

3. Government ICT Infrastructure:

GovTech is responsible for developing the foundational ICT layer and ICT infrastructure at scale for the public sector. The scope extends across data centres/hosting, networks, digital workplace applications, end-user devices, IT support, secure ICT infrastructure, and ICT infrastructure applications.

4. Smart City Technology:

GovTech focuses on a range of technologies, from hardware design on embedded platforms and robotics to infrastructure development on cloud management platforms. These technologies are applied in projects aimed at enhancing service delivery to better address the needs of citizens and businesses. The organisation collaborates with industry, research institutions, and government agencies to build capabilities in IoT, test new sensor technologies, and address IoT-related challenges. An example is the **Open Digital Platform (ODP),** which is the technological backbone of Singapore's Punggol Digital District (PDD), developed by JTC Corporation and GovTech (see Case Study 1 for more information).

5. Data Science and Artificial Intelligence:

GovTech applies its expertise in Data Science, Data Engineering, and Artificial Intelligence to support evidence-based policymaking, improve public service efficiency, and provide more targeted services to citizens. The agency develops platforms to assist government agencies, enabling them to build data capabilities, establish data strategies, and enhance their data infrastructure. It adopts an iterative approach to its projects, scaling successful initiatives and applying lessons from challenges to future efforts. As in other fields of expertise, GovTech applies a whole-of-government approach by offering training and programmes that encourage data-driven decision-making and collaboration across the public sector.

CASE STUDY 1

Punggol Smart District

Currently still under construction, the Punggol Smart District, also known as Punggol Digital District (PDD), represents Singapore's vision of a technologically advanced and sustainable urban space, designed to serve as a model for future developments.

Situated in the northeastern part of the island, the 50 hectares large district integrates advanced technology, sustainable practices, and collaborative spaces for businesses, academia, and the local community.

Built on an integrated master plan, PDD is designed to encourage interaction between its key stakeholders. At the heart of this vision is the co-location of the Singapore Institute of Technology (SIT) with JTC's business park buildings. This setup facilitates close collaboration between academia and industry, enabling students and professionals to exchange ideas and develop innovative solutions that can be prototyped, tested, and adopted within the district itself.

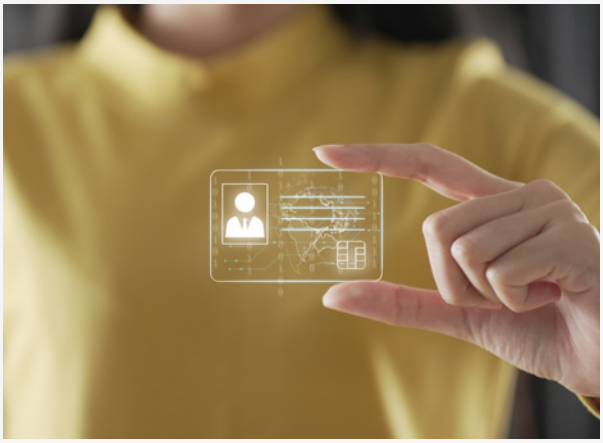
The district is expected to become a cornerstone of Singapore's digital economy, housing industries focused on key growth areas such as cybersecurity and the Internet of Things, while generating approximately 28,000 new jobs.

An integral component of the Punggol Digital District (PDD) will be the Open Digital Platform (ODP), envisioned as the digital backbone of this smart district. Developed collaboratively by JTC and GovTech, the ODP is designed to integrate various systems within PDD to optimise operations, enable seamless communication, and facilitate innovation. By acting as a "master language translator" by utilising its "Open Standard Multiprotocol Middleware", the ODP aims to connect district management systems—such as autonomous vehicles, building management systems, and district cooling technologies—that traditionally operate on separate communication protocols. This integration is expected to enhance the district's operational efficiency and enable the seamless functionality of its smart infrastructure.

One of the most anticipated features of the ODP is its digital twin, a virtual replica of the district powered by real-time data from a vast network of sensors. The digital twin is expected to allow businesses and researchers to simulate scenarios, test innovative solutions, and analyse historical data without affecting real-world operations. Future applications may include optimising energy usage, automating lighting and cooling systems, and refining autonomous delivery systems. As part of its sustainability goals, the ODP is projected to help PDD achieve a 30% reduction in energy consumption compared to standard buildings. Once fully implemented, the ODP will not only support experimentation and innovation but also position PDD as a global leader in smart and sustainable urban development.

CASE STUDY 2

Digital Transformation through Singpass and APEX in Singapore



Singapore has made remarkable progress in digital governance through the development of two pivotal platforms: Singpass, the nation's comprehensive National Digital Identity (NDI) system, and APEX (API Exchange), a centralised data-sharing platform. These initiatives form a cornerstone of Singapore's Smart Nation vision, significantly enhancing the efficiency, accessibility, and security of public services while fostering a thriving digital ecosystem for businesses and citizens alike.

Singpass, first introduced in 2003, has evolved from a basic authentication tool into a fully integrated digital identity platform. Today, the Singpass app, created by GovTech, serves as a gateway for secure access to a wide range of government and private sector services. Its features include two-factor authentication (2FA) to ensure secure transactions, MyInfo, a data-sharing service that auto-fills personal and business information, and digital signing capabilities, allowing users to electronically sign legally binding documents. These innovations streamline administrative processes and reduce the burden on both users and service providers, making Singpass a central pillar of Singapore's public service delivery. By prioritising user-centric design and robust security measures, Singpass has achieved widespread adoption, becoming an indispensable tool for millions of users. Currently, Singpass serves approximately 97% of Singapore Citizens and Permanent Residents aged 15 and above.[6]

Complementing Singpass is APEX, which facilitates seamless and secure data exchange among government agencies through standardised Application Programming Interfaces (APIs). This platform has transformed the public sector by breaking down data silos and enabling more coordinated service delivery. APEX ensures interoperability across diverse systems, maintains high standards of security, and supports scalability as the demand for digital services grows. Its implementation has allowed government agencies to work together more effectively, creating a more integrated and responsive public sector.

The integration of Singpass and APEX has had a transformative impact on Singapore's digital landscape. Services like MyInfo have drastically reduced manual data entry, saving time for users and businesses. Innovations such as digital document signing and real-time verification have further enhanced the user experience, offering seamless, efficient processes for individuals and enterprises.

3.2. Digitalisation in Administration

Singapore's Integrated Approach

Singapore's digitalisation journey is rooted in an ambitious, whole-of-government approach outlined in its Digital Government Blueprint. This strategy aims to transform public services to be both "Digital to the Core" and to "Serve with Heart," balancing technological advancements with the needs of users. The blueprint provides a unified direction for government agencies, emphasising data-driven decision-making, user-centric design, and seamless service delivery for citizens and businesses alike.

Central to this vision is the integration of data and technology into public administration to optimise policy development, operational processes, and customer-facing services. Singapore's approach focuses on breaking down silos across government agencies and fostering active collaboration with businesses, community representatives, and citizens. This inclusive method ensures that digital transformation not only enhances efficiency but also builds trust and meets the practical needs of stakeholders.

The Digital Government Blueprint establishes strategic goals that underpin Singapore's digital vision:

1. **Integrating services to meet citizen and business needs.**
2. **Strengthening connections between policy, operations, and technology.**
3. **Modernising ICT infrastructure to ensure reliability and resilience.**
4. **Enhancing system security to maintain trust and reliability.**
5. **Raising digital capabilities to drive innovation.**
6. **Co-creating solutions with citizens and businesses to promote adoption and inclusivity.**

Singapore's digital transformation reflects a commitment to redesigning public services with empathy, personalisation, and seamless delivery. It serves as a model for governments worldwide, demonstrating how technology can create user-centered, secure, and efficient systems while fostering collaboration and innovation across all sectors.

Germany, with its larger size, federal structure, and integration within the European Union, faces a more complex landscape of stakeholders than Singapore. However, it can draw valuable inspiration from Singapore's structured, user-centric approach and its strategic alignment across government agencies to advance digitalisation in public administration.

Learnings for Germany

Germany can gain valuable insights from Singapore's inclusive and user-centric approach to digitalising public administration. Singapore's success lies not only in its robust technological infrastructure but also in its belief in citizen's inherent willingness to comply when processes are simple and transparent. Key takeaways include breaking down silos across government agencies to foster collaboration, leveraging data-driven decision-making, and prioritising user-friendly processes to reduce administrative burdens for citizens and businesses. Additionally, innovations like seamless filing systems, and digital identity platforms such as Singpass demonstrate how technology can streamline compliance, improve satisfaction, and build trust in public institutions. Embracing these practices can help Germany advance its digital transformation efforts while maintaining high levels of stakeholder engagement and confidence.

CASE STUDY

Strategic Digitalisation and User-Centric Design – The Example of IRAS

Singapore's Ministry of Finance recognises digitalisation as a powerful tool to improve compliance and enhance domestic revenue mobilisation.

However, it also emphasises that technology must work alongside other critical elements, such as simplified regulations, fostering trust, and encouraging voluntary compliance. These principles are evident in the Inland Revenue Authority of Singapore's (IRAS) "Integrated Compliance and Service Framework", which seamlessly combines service facilitation and compliance enforcement.

This approach is rooted in the belief that most taxpayers are honest and willing to comply when processes are simple and transparent. This premise is based on regular surveys, which IRAS conducted to better understand the divers of compliance among taxpayers. Using quantitative research methods, the findings were consistent with international observations, showing that the attitude towards compliance is mostly shaped by the following factors:

- Taxpayers believe those around them are compliant and view the Inland Revenue Authority as effective in enforcing compliance.
- Taxpayers have trust and confidence in the integrity of the tax system.
- Taxpayers perceive the tax system to be fair.
- Taxpayers find their tax obligations straightforward to understand.
- Taxpayers find it easy to meet their tax obligations.

By embedding "compliance by design" into its systems, IRAS has reduced opportunities for errors and promoted voluntary compliance. For instance, intuitive processes, such as pre-filled tax forms and streamlined filing options, enable taxpayers to meet their obligations with minimal effort, fostering trust and fairness in the system.

IRAS employs an "outside-in" approach to service design, placing the taxpayer at the centre of every stage when developing services or systems that will affect them. This involves understanding the taxpayer's perspective through continuous engagement, including surveys, focus groups, and feedback panels. Insights gained are used to co-design processes, identify pain points, and develop systems that are intuitive and efficient. For example, the revamped Taxpayer Feedback Resource Panel allows IRAS to gather real-time input and remain responsive in a rapidly evolving environment.

Other research conducted by IRAS includes routine taxpayer surveys. The primary taxpayer survey is conducted by an external independent firm every two years, with the most recent survey carried out in 2023. Its purpose is to assess taxpayer satisfaction with IRAS's services, policies, and regulations. In the 2023 Taxpayer Survey, IRAS achieved an impressive overall taxpayer satisfaction rate of 98%.[7]

Innovations in Tax Compliance and Filing

IRAS has implemented several innovative solutions to simplify compliance for businesses and individuals:

- **Seamless Filing**
  Businesses can integrate their accounting systems with IRAS's compliance platforms, enabling direct submissions without logging into government portals. This initiative has reduced reporting times for SMEs from nine hours to just 30 minutes.

- **Simplified Returns**
  SMEs and micro-enterprises benefit from fewer reporting requirements, while eligible individual taxpayers are provided with pre-filled forms, reducing administrative burdens significantly.

- **No-Filing Service (NFS)**
  Around 70% of individual taxpayers now benefit from this system, where tax assessments are automated based on data reported by employers and other entities.

These initiatives showcase how digital technologies can streamline regulatory processes, reduce compliance costs, and improve taxpayer satisfaction.

3.3. Efficient Bureaucracy

Singapore's Efficient Regulatory Framework

Efficient regulatory processes are essential for fostering a competitive business environment. They reduce operational barriers, enhance investor confidence, and support innovation. Singapore is widely recognised for its pragmatic and streamlined regulatory framework and regularly scores top marks in international rankings evaluating ease of doing business. This is strongly connected to the regulatory environment, bureaucratic efficiency and public service quality. For instance, in the 2023 annual global business environment ranking by the Economist Intelligence Unit (EIU), Singapore secured the top spot as the world's most attractive business destination for the 15th consecutive year. According to the Business Ready (B-READY) 2024 report, published by the World Bank, Singapore achieved top ranks in categories such as 1) Business Entry (2nd), 2) Public Services (2nd) or Operational Efficiency (1st).[8]

In contrast, Germany, despite its strong economy, often faces criticism for its complex and time-consuming bureaucratic processes. Lengthy approval procedures and fragmented systems across federal, state and local authorities can create inefficiencies that can hinder business operations. By examining Singapore's approach for pragmatic regulatory structures, Germany can identify opportunities to simplify processes.

While a comprehensive examination of administrative structures and procedures is beyond the scope of this paper—and challenging due to the varied administrative setups across Germany's Federal States—it will focus on key policies and instruments that define and shape Singapore's highly efficient and effective bureaucratic system.

No Wrong Door Policy – Administration with a Customer-Centric Approach

While regulations and administrative structures are important aspects for determining the efficiency and quality of bureaucratic procedures and services, service culture within administrational units is another crucial facet. In Singapore, the public service adopts a customer-centric approach to managing external feedback and requests. To ensure prompt and effective responses, the "No Wrong Door (NWD)" policy and "First Responder Protocol (FRP)" were introduced. Under NWD, agencies receiving feedback outside their purview must identify the responsible agency, facilitate the case handover, and connect the individual with the appropriate agency. If no clear agency is responsible, the FRP requires the initial agency to assign a First Responder with relevant expertise to resolve the issue promptly while back-end policy and operational matters are addressed.

Frontline public officers are trained in these protocols through regular case simulation workshops conducted by the Civil Service College. Many large agencies incorporate these procedures into their service training and develop tools to enhance efficiency. For instance, the Central Provident Fund (CPF) Board uses an internal virtual assistant to help officers provide accurate answers and direct queries to the appropriate contacts. Agencies are regularly audited to ensure compliance with these standards and procedures. This approach not only improves the user experience by ensuring seamless and efficient service delivery but also strengthens public trust in governance, contributing positively to approval ratings and confidence in the administration.

Institutionalised Feedback Mechanisms

The Pro-Enterprise Panel (PEP) is a private-public initiative in Singapore, chaired by the Head of Civil Service, comprising business leaders and senior public officers dedicated to enabling businesses. Established in 2000, the PEP actively fosters a pro-enterprise environment by regularly reviewing rules and regulations, encouraging innovation, and streamlining processes to minimise compliance costs for businesses. It also supports regulatory innovation to accommodate emerging business models. Over its history, the PEP has received more than 2,000 suggestions, resulting in over 1,100 effective changes to rules and regulations across diverse industries and domains, significantly enhancing Singapore's business landscape.

The PEP offers businesses three channels for directing feedback and enquiries via accessible online tools:

- **PEP Suggestions** provide businesses with a platform to share feedback on government rules and regulations that may hinder their operations or propose ideas to improve regulatory frameworks. Once suggestions are submitted, the PEP collaborates with relevant government agencies to systematically review and refine these regulations, ensuring they remain adaptive, business-friendly, and aligned with the evolving needs of the economy.
- The **New Idea Scheme (NIS)** is designed for businesses with innovative proposals that face regulatory challenges, particularly those lacking a clear regulatory framework or not covered by existing sandbox programmes. It supports companies looking to develop and launch new business models or solutions within Singapore by addressing regulatory obstacles and facilitating collaboration with relevant authorities. Through the NIS, businesses can co-develop a tailored regulatory sandbox framework that enables them to test their ideas in a controlled environment.
- The **First Mover Framework (FMF)** also aims at businesses and entrepreneurs who are planning to introduce a new business model that has not been piloted in Singapore before and that is not covered by any existing regulatory frameworks. The additional value of this scheme is that First Movers under this scheme can benefit from skipping tender processes and enjoy a direct allocation of public assets, saving time spent on paperwork or waiting for tender results.

CASE STUDY 1

Simplified Business Registration and Licensing

Setting up a company in Singapore is a structured and efficient process, designed to facilitate ease of doing business. Entrepreneurs can register a private limited company in approximately 15 minutes using BizFile+, the online portal managed by the Accounting and Corporate Regulatory Authority (ACRA). The entire process, from registration to operational readiness, typically takes 1.5 days, significantly faster than the regional average. The system guides users through key steps, such as selecting a company name, filing incorporation documents, and obtaining necessary approvals, all conducted online. The costs associated with setting up a company are relatively low, with a registration fee of S$315 (€222) and a minimum issued capital requirement of S$1 (€0.71), lowering financial barriers for businesses. This approach ensures accessibility for companies of varying sizes and simplifies their entry into the market.[9]

Additional tasks, including tax registration, bank account setup, and compliance with employment regulations, are managed through platforms like GoBusiness, allowing businesses to begin operations efficiently.

Setting up a company in Singapore is a structured and efficient process, designed to facilitate ease of doing business.

CASE STUDY 2

Regulatory Sandboxes for Fintechs in Singapore

A “Regulatory Sandbox” in Singapore is a controlled framework that allows businesses to test innovative products, services, or business models in a real-world environment under the supervision of relevant regulatory authorities. These sandboxes are designed to foster innovation while ensuring that any risks, particularly those related to public safety, financial integrity, or data protection, are mitigated.

Within a Regulatory Sandbox, businesses can operate with relaxed or customised regulatory requirements for a limited period, enabling them to refine their offerings and address potential compliance challenges before launching at full scale. The sandbox approach also allows regulators to better understand emerging technologies and business models, facilitating the development of appropriate regulatory frameworks that support innovation without stifling growth.

The FinTech Sandbox, launched by the Monetary Authority of Singapore (MAS) in 2016, exemplifies this approach. It provides fintech companies with a structured environment to test innovative financial products and services using real clients and transactions. By temporarily relaxing regulatory requirements, the Sandbox supports businesses in overcoming compliance hurdles, refining their offerings, and accelerating time-to-market. This controlled environment also facilitates connections with key stakeholders, such as financial institutions, and enables businesses to align their innovations with market needs and regulatory expectations.

Through these efforts, the FinTech Sandbox has contributed to a thriving fintech ecosystem in Singapore, demonstrating how regulatory sandboxes can balance fostering innovation with maintaining public trust and safety.

The FinTech Sandbox has contributed to a thriving fintech ecosystem in Singapore.

Conclusion

This paper has explored the comparative strengths and challenges of Singapore and Germany across six critical economic location factors, offering a roadmap for mutual learning and collaboration. By drawing on insights from survey results and best practices, it becomes clear that while both nations possess unique competitive advantages, they also face distinct challenges that require targeted reforms to sustain their global competitiveness.

Singapore's streamlined regulatory framework, digitalisation, and efficient public administration, exemplify a business environment designed for growth and innovation. Its focus on digital transformation, as highlighted in its public service digitalisation and Smart Nation initiatives, provides a model of how governments can leverage technology to enhance efficiency and service delivery.

Germany, on the other hand, excels in advanced manufacturing, GreenTech, and vocational training—areas where its leadership can offer valuable learnings to Singapore. Germany's Industry 4.0 innovations and its dual vocational training system are benchmarks of excellence that can help address critical issues such as energy efficiency for reducing business costs and skilled labour shortages. However, challenges in regulatory complexity, digital infrastructure, and digitalisation of public administration services, as highlighted by our survey results, present a possibility for Germany to take Singapore's pragmatic and streamlined approach into consideration.

A recurring theme throughout this paper is the importance of adaptability and innovation in addressing future challenges. For Germany, considering elements of Singapore's customer-centric administrative practices could simplify processes and enhance investment attractiveness. Similarly, Singapore can benefit from Germany's expertise in energy efficiency and industrial innovation to address its own challenges, such as high operational costs and labour shortages.

Ultimately, the findings underscore the value of the strategic partnership between Germany and Singapore. By leveraging each other's strengths, both nations can craft policies and initiatives that not only address their respective challenges but also set new benchmarks for competitiveness in a rapidly evolving global landscape. Through sustained collaboration, innovation, and mutual learning, Germany and Singapore can remain at the forefront of economic growth and technological advancement, forging a resilient and prosperous future together.

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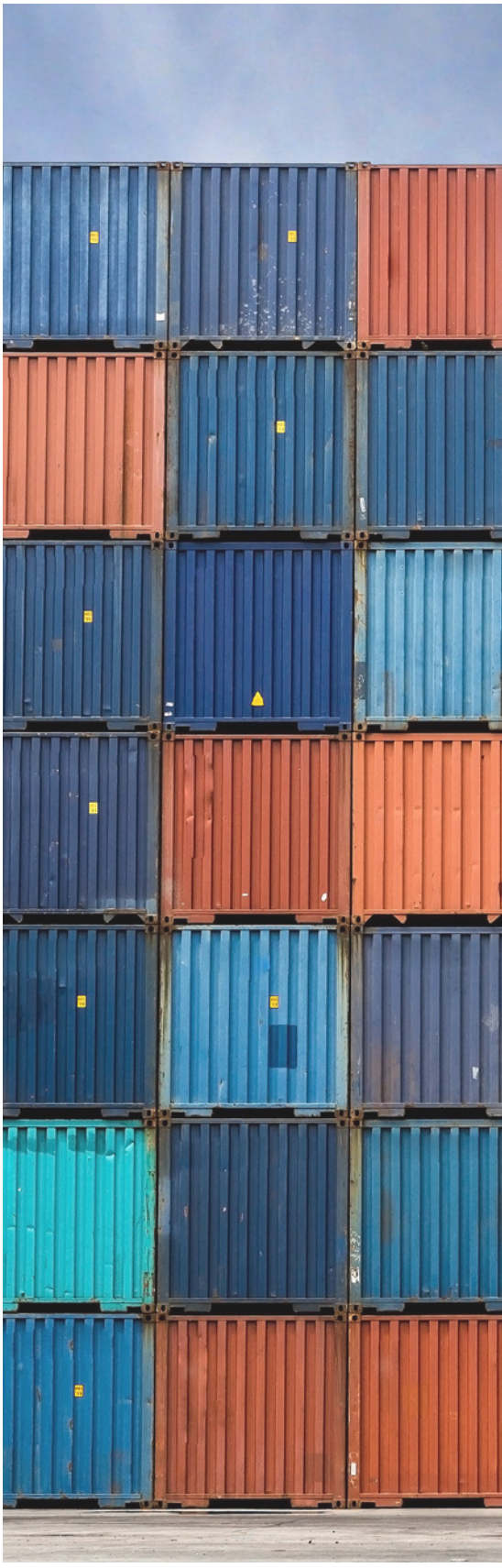

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