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COMPARATIVE ANALYSIS OF SMART STRATEGIES IN STATE POLICIES

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Abstract. The contemporary advancement of digital technologies presents a transformative opportunity for the transition to the concept of smart development. The integration of digital, physical and human systems, which occurs as part of the process of smartification, gives rise to intelligent ecosystems that create distinctive conditions for sustainable and efficient growth, process optimisation, productivity and new opportunities for businesses and individuals. The objective of this study is to provide a systematic and analytical framework for understanding the processes through which countries around the world are developing smart economies. The study focuses on the state smartisation policy in Singapore and Brazil, analysing the organisational and legal framework of smartisation, the ways and tools for the formation of a smart economy, approaches to promoting sustainable development, and the international and regional aspects of national smartisation policy. The research indicated that the foundational components of the smartisation strategy in these countries are the digitalisation of the economy, government, and society. Both countries allocate significant resources to the digital transformation of the economy, the requirements of Industry 4.0, and the instruments that facilitate the innovation ecosystem. The promotion of innovation development in Singapore is evident through a variety of mechanisms, including innovative tax incentives, the commercialisation of intellectual property derived from R&D, and the cultivation of an extensive startup ecosystem. In Brazil, noteworthy initiatives that facilitate innovative development include the establishment of the National Research Infrastructure Platform, AI Applied Research Centres, the Human Resources in Strategic Areas Program, and the Startup Support Program. The study indicates that Brazil's primary focus is on the development of smart cities and the introduction of new technologies that enhance the urban environment and reduce environmental impact. Brazil's digital transformation strategy, in conjunction with a number of programs and initiatives to "smarten" cities, provides the foundation for modern changes throughout the country. Singapore is developing and implementing a comprehensive strategy to construct a society and economy that is adequately prepared for emerging challenges and capable of leveraging the opportunities presented by innovative development and digitalisation for sustainable and inclusive growth as part of its large-scale Smart Nation initiative. It is imperative to examine global experiences in the development of a smart economy, as this facilitates the optimisation of smartisation strategies at the national level, the implementation of superior foreign practices, and the formulation of efficacious mechanisms for smart development, particularly in the context of Ukraine's post-war recovery.

Keywords: smartisation, smart economy, smart city, digitalisation, innovation, and sustainable development.

JEL Classification: O2, O38, Q01, R11

1. Introduction

The philosophy of economic development has undergone significant rethinking in recent decades, leading to the emergence of the concept of the smart economy. The smart economy can be delineated as an advanced and interconnected economic system driven by innovations in technology, data, and automation. The notion of the smart economy is predicated on the promotion of efficiency and sustainable growth. The objective of optimising processes, increasing productivity and creating new opportunities for businesses and individuals has been achieved.

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The concept of the smart economy is no longer confined to theoretical discourse and long-term planning; it is now being implemented in practice at both the regional and national levels. Numerous examples of smart cities already exist, including Barcelona, Copenhagen and Dubai. Singapore has been implementing the ambitious Smart Nation initiative for 10 years. In the context of the ongoing military aggression by the Russian Federation and the extensive destruction of industrial facilities, infrastructure, housing, educational and medical institutions in Ukraine, the question of rebuilding the national economy on the basis of smartisation has become particularly pertinent. Against this background, the aim of this study is to provide a comprehensive and systematic account of the approaches adopted by countries around the world in the pursuit of a smart economy.

There is a considerable body of academic literature on the subject of smart economic development. Most studies focus on the concept of smart cities. For example, the work of Quélin V. and Smadja I. (2021) focuses on the most famous smart cities in the world and their long-term vision, the participation of companies in providing solutions and sharing values, and the interaction with different stakeholders. In his 2017 work, T.M. Vinod Kumar (Vinod Kumar) addresses the issues of sustainable development of smart cities, the system of standards and institutional support. In a recent contribution to the field, Fachinelli and Yigitcanlar (2023) propose a system for assessing the smartness of cities. The study of smart projects in cities is the subject of research by Richard Florida (Vergara-Perucich F.; Florida R., 2019). The role of technology in the formation of smart cities is explored in the work of Carlo Ratti and Matthew Claudel (2016). A study of the modern concept of smart cities and the key principles that underpin it can be found in the work of Srivastava and Sharifi (2022). The potential for the development of smart cities in the modern world is explored in the work of Wipraechtiger and Peter (2021). At the same time, the process of "smartification" extends beyond individual cities and communities. In the contemporary era, the discussion surrounding the formulation and implementation of a national smartisation policy has become a prevalent subject in numerous countries worldwide. Consequently, the smartisation process necessitates a comprehensive examination of the broader context. According to commonly accepted definitions, the smart economy is an economic system that uses advanced technologies such as artificial intelligence, the Internet of Things (IoT) and big data analytics to increase productivity, competitiveness and sustainable development. It is important to emphasise that the smart economy goes beyond automation and digitalisation and seeks to create value through the use of analytical data, enabling the creation of smart infrastructure and innovative business models.

2. Experience of Singapore

At the national level, Singapore was one of the first countries to start building a smart economy. The Smart Nation Initiative (SNI) was officially launched in 2014, and three years later received substantial financial support from the government, amounting to 2.4 billion SGD (equivalent to 1.73 billion USD or 1.51 billion EUR) (Quélin, Smadja, 2021). The overarching objective is to harness the potential of information and communication technologies (ICT) on a large scale in order to address the challenges confronting the country and to enhance the quality of life of citizens in a tangible manner. The Republic of Singapore has commenced extensive utilisation of technological devices and innovations to address the issues of scarcity of natural resources, elevated reliance on exports, and high population density. The country has become an attractive centre for business, attracting international workers and demonstrating leadership in the practical implementation of policies to promote sustainable development at the state level.

To realise the vision of a Smart Nation, Singapore has developed a comprehensive strategy to develop a digital economy, digital government and digital society. This strategy involves the public, private and human sectors. All industries, businesses and government agencies are intensifying their digitalisation efforts and developing the capabilities and solutions that will drive the country forward. To facilitate this transformation, the Singapore government has outlined a series of comprehensive plans, namely the Digital Economy Action Framework, the Digital Government Plan and the Digital Readiness Plan. The Digital Government concept is predicated on the premise that it can provide the necessary conditions for the development of a digital economy and digital society. The digital economy is understood to operate in conjunction with the digital government, providing support for the digitalisation of public service delivery and the development of sectoral capacity to meet future transformation requirements. Furthermore, the country is adopting a comprehensive strategy for the development of a digital society that can effectively utilise the full range of opportunities presented by digital technologies. In October 2024, a decade after the inception of the Smart Nation initiative, an updated vision was presented. This new vision, entitled Smart Nation 2.0, is a policy document that outlines the planned transformations and changes in Singapore (Smart Nation 2.0, 2024). Singapore's strategic focus on digital inclusion, leveraging

technology to strengthen its partnership with citizens, empowering businesses and workers, and enhancing digital infrastructure security and resilience, is particularly noteworthy.

In particular, the digital government allocates resources to the development of infrastructure and the establishment of shared, open platforms for the training and development of businesses and citizens. The digital economy fosters the investment of companies in technology and talent, thereby supporting efficient growth. The digital society offers individuals the opportunity to cultivate their talents and to utilise the latest digital technologies with confidence, thus facilitating the realisation of human potential and paving the way for a higher quality of life (Singapore Smart..., 2024).

The digitalisation of Singapore is seen as a critical factor in creating new economic opportunities, expanding business activities and creating better employment prospects. The Singapore Digital (SG:D) movement has been launched to drive the digitalisation effort. The Republic of Singapore is endeavouring to consolidate its position as a pioneering digital economy, adept at perpetual reinvention in the context of the Fourth Industrial Revolution. The Digital Economy Action Framework has been meticulously crafted with the overarching objective of expediting the digital transformation of prevailing economic sectors, fostering the emergence of novel digital ecosystems and cultivating the next generation of digital industries, including cybersecurity.

The Singapore government has articulated a comprehensive and well-defined vision for the digitalisation of various industries. As a result, the Committee on the Future Economy developed 23 industry transformation maps (ITMs) in 2017. The transformation maps are complemented by sectoral digital plans, which aim to facilitate the digitalisation of specific industries. Small and medium-sized enterprises are an important pillar of Singapore's economy. The SME Digital Transformation Programme is a scheme designed to provide assistance to small and medium-sized enterprises (SMEs) in the process of digital transformation. The sector-specific SME Digital Plans, which are aligned with the Industry Transformation Maps, provide SMEs with a detailed, step-by-step guide to the digital technologies that they should adopt at each stage of their growth. SMEs can assess their own digital readiness, seek advice on their digital journey, implement curated solutions, participate in industry-led pilots and engage project management services to implement their digital initiatives.

Concurrently, the digitalisation of Singapore is precipitating the dissolution of traditional industry boundaries. The country's economic competitiveness is being enhanced by the creation of novel integrated ecosystems that converge around customer needs. The advent of digital platforms has resulted in an increased level of influence being exerted by customers over the design and delivery of products and services. This has, in turn, precipitated the emergence of novel business ecosystems and market intermediaries. These novel ecosystems have the potential to become the foundation of future industry. The city-state of Singapore is establishing an environment conducive to the growth of integrated ecosystems, and providing support for businesses to innovate, develop their own business models and enhance their international competitiveness. In particular, the Open Innovation Platform (OIP) was established with the objective of providing support to the innovation ecosystem in Singapore.

A number of key initiatives have been implemented with the objective of fostering a culture of innovation in Singapore. Among these is the following:

– The advent of open data, whereby government agencies' collected datasets are now accessible to the public via online portals, has had the effect of facilitating the co-creation of digital solutions by developers for the benefit of society.

– The Living Lab initiative, in conjunction with other research and innovation programmes such as Research, Innovation and Entrepreneurship and AI in Singapore, facilitates the utilisation of technological advancements to attain the objectives of the Smart Nation.

– The Singaporean startup ecosystem is currently undergoing a period of significant growth and prosperity, largely due to the presence of a robust network of venture capital funds, multinational corporations, and startup accelerators such as SGInnovate. Initiatives such as LaunchPad provide an optimal environment for startups and entrepreneurs to engage in collaborative endeavours, pursue innovative strategies, and expand their business operations. These initiatives offer a comprehensive array of bespoke resources and opportunities to facilitate this growth.

– With regard to the digital economy, the country provides resources to assist both individuals and businesses in acquiring the necessary skills to participate in this sphere.

As previously stated, the objective of the Republic of Singapore is to cultivate a cutting-edge digital industry that will serve as a catalyst for economic expansion and facilitate digitalisation across all sectors. The establishment of digital enterprises and prospective opportunities is actively encouraged, with specific focus directed towards the advancement of data science and artificial intelligence (AI), cybersecurity, immersive media, in addition to the Internet of Things (IoT) and the future communications infrastructure. The primary

objective of the Accreditation@SG:D programme is to establish a level playing field for Singaporean technology companies demonstrating potential, with a view to enabling them to secure projects, expand their operations and compete effectively in the global market. Accredited companies are afforded the opportunity to enhance their international visibility through the utilisation of a robust Singaporean brand identity. Enterprise Singapore, a government agency, facilitates the expansion of Singaporean companies abroad through the implementation of targeted programmes. The Economic Development Board of Singapore, Enterprise Singapore and the Infocomm Media Development Authority are the primary entities responsible for the attraction of leading digital companies on a global scale, as well as the provision of support to digital companies based in Singapore. The overarching objective of this undertaking is threefold: firstly, to facilitate the creation of high-quality employment opportunities; secondly, to accelerate the development of human capital; and thirdly, to encourage technological collaboration within the national ecosystem.

The establishment of a smart economy in Singapore is contingent on the consideration of several pivotal elements. These include the continuous upskilling, retraining and digitalisation of the workforce, as well as the utilisation of intellectual property and the capabilities of the national research and innovation community by firms in order to gain a competitive advantage. The formulation of competitive policies, standards and regulatory environments for data innovation is a key objective. Furthermore, the establishment of contemporary physical and digital infrastructure is a priority, with the aim of ensuring that connectivity, platforms, data and other infrastructure support the growth of the digital economy.

A close examination of the experience of Singapore reveals that information technology and a range of applications serve as the primary instruments for the country's smartification. To illustrate, citizens are able to utilise mobile applications to report municipal issues, access unmanned vehicles, receive environmental notifications regarding air quality, temperature and precipitation, monitor energy consumption and employ apps tailored to the specific needs of young families or the elderly.

Singapore's Smart Nation vision is driven by the country's ambition to maintain a leading position in the global urban landscape and become one of the world's premier cities. Singapore is undergoing a process of urban transformation, with a particular focus on improving the mobility of its citizens. Notable among these is the use of sensor technologies and open data. This is helping to optimise traffic and improve transport planning. It is estimated that in excess of five thousand vehicles are engaged in the collection of data from sensor-enabled fare cards, with the real-time tracking of buses undergoing constant analysis. Contactless payment technology is employed to enhance the mobility and financial transactions of the 7.5 million individuals who utilise public transportation on a daily basis. Moreover, the city is implementing the Smart Mobility 2020 initiative, which has resulted in the establishment of a joint venture between the Land Transport Authority (LTA) and the Intelligent Transport Society (ITS). The objective of this venture is to enhance the passenger journey experience by developing intelligent transport mechanisms.

As part of its Smart Nation initiative, Singapore has embarked on a digital transformation of its healthcare system. The country has an ageing population. It is estimated that by 2050, 47% of Singapore's population will be aged 65 and above. To help ease the burden of an ageing population on the city's care services, Singapore's smart healthcare system includes home-based exercise programmes for patients and Internet of Things (IoT) devices that monitor patients' progress and transmit data to their caregivers.

It is important to note that the provision of business support was identified as a key priority in the development of a smart economy. Emphasis was placed on the integration of industry and academia, the development of cybersecurity technologies and the Internet of Things, and the establishment of co-operation in data exchange with the aim of promoting transparent business interaction. The process of "smartification" in economic development involves harnessing the opportunities presented by the Fourth Industrial Revolution. Singapore offers a range of fiscal and non-fiscal incentives to promote high-value economic activities and encourage companies to enhance their capabilities and expand their operational scope in the context of Industry 4.0 (Singapore Incentives..., 2024).

In order to qualify for the various incentives on offer, businesses must meet the requisite standards. These standards include commitments to specified levels of investment, the introduction of advanced skills and technologies, and the promotion of research and innovation capabilities.

It is noteworthy that Singapore's industry-specific tax incentives deviate from the prevailing system of incentives for the advancement of high-value activities. The administration of business and tax incentives for Singaporean organisations in specific areas is the responsibility of four main government agencies. The Economic Development Board of Singapore (EDB) is responsible for developing and implementing strategies that promote investment in the country's industries. The Inland Revenue Authority of Singapore (IRAS) is the national tax regulator. Enterprise Singapore (ESG) assists Singaporean companies

in expanding on a global scale and promotes local exports. The Monetary Authority of Singapore (MAS) is the central bank and financial services authority. A number of industries and activities are eligible for tax incentives, including financial, insurance and banking services; fund management; tourism; shipping; global retail chains; research and development; legal services; e-commerce and others.

In the Singaporean context, a range of tax incentives are employed with considerable frequency, including those designed to encourage manufacturing and service activities. To illustrate, organisations engaged in the production of high-value added products or services may apply for a pioneer certificate, which entitles them to a tax exemption or a reduced tax rate of five per cent or 10 per cent for a period of five years. The aforementioned period may be extended, contingent upon the company's demonstrated commitment to further expansion.

It is also worthy of note that the Republic of Singapore implemented a 100% investment allowance scheme, which was in effect until 2021. The administration of the investment allowance incentive was the responsibility of the Economic Development Board (EDB) of Singapore. In the case of projects that met the criteria of the aforementioned scheme, the EDB bestowed upon the companies in question the privilege of exemption from taxation for a period of up to 100% of the fixed capital expenditure incurred.

The approved projects covered a range of activities, including the production of new products or an increase in the output of existing products, the promotion of the country's tourism industry, research and development activities, energy efficiency projects, construction projects, projects to reduce water consumption, the provision of specialised engineering or technical services, and maintenance, repair and overhaul services for the aviation industry. The investment allowance was applicable to expenditure relating to the acquisition of new production equipment, the construction of factories in Singapore and the acquisition of patents and know-how.

Among the preferential incentives for the development of higher value-added activities, the Land Intensification Scheme (LIA) is worthy of mention. The programme, which was introduced in 2010, is targeted at promoting the utilisation of industrial land for higher value-added activities. The LIA is available to companies in the manufacturing and logistics sectors that possess extensive land holdings. Recipients of the scheme are entitled to the following allowances on qualifying capital expenditure incurred in the construction or alteration of an approved LIA building: an initial allowance of 25 per cent; annual allowances of five per cent until the total amount of the allowance reaches 100 per cent of the qualifying expenditure.

It is also important to note that the Republic of Singapore offers a range of incentives to encourage innovation, research and development, and capacity building. In January 2020, the Singaporean government launched the Tech@SG programme, which aims to help Singaporean technology companies recruit highly skilled foreign professionals and facilitate their expansion into the regional market. Companies that meet the eligibility criteria may submit an application for a maximum of 10 new Employment Passes (EPs), which permit the hiring of foreign nationals for a duration of up to two years. Subsequent to this initial period, EPs can be extended for a period of up to three years through the Tech@SG programme, with subsequent renewal being facilitated through the Ministry of Manpower.

The EP is primarily targeted at expatriate managers, executives and professionals in Singapore. To qualify for Tech@SG status, a company must meet the following criteria: it must be registered in Singapore with the Accounting and Corporate Regulatory Authority (ACRA); it must have a digital or technology offering as part of its core business, product or service. This includes the provision of hardware or software technology, e-commerce, digital gaming, digital media, cybersecurity, data science and fintech, among many others. In addition, the company must have secured more than 10 million USD in total investment funding over the past 36 months and received funding from one of the Tech@SG investment firms within the same period.

In January 2021, the Republic of Singapore introduced a new work permit, designated as the Tech.Pass, with the stated objective of attracting a cohort of highly skilled individuals in the technology sector, including entrepreneurs, experts, and business leaders. In contrast to the Employment Pass, the Tech. Pass scheme does not necessitate sponsorship from a local employer. This provision confers a greater degree of flexibility on the professional, enabling them to engage in a wider range of activities, including assuming roles as an employer, investor, entrepreneur, or director or consultant in one or more technology companies based in Singapore.

The Intellectual Property Development Incentive, which was introduced in 2018, was designed to encourage the commercialisation of intellectual property arising from research and development activities. Eligibility for this incentive is contingent on meeting specific criteria, including a reduced corporate tax rate of either five or 10 percent on income derived from intellectual property. The incentive period is limited to an initial period of no longer than ten years. Thereafter, the tax rate is increased by 0.5 percent for each subsequent year of the incentive period, beginning with the eleventh year.

Moreover, the Singaporean government has introduced an additional tax credit amounting to 250% of eligible expenditures on research and development (R&D) projects conducted within the country, applicable to assessment periods between 2019 and 2025. In order to qualify for this incentive, companies are required to demonstrate that they have effective ownership of and the capacity to commercially exploit the intellectual property or other outcomes of their R&D activities.

Additionally, Singapore actively fosters financial and treasury activities, which are subject to a reduced tax rate of eight percent. Approved activities encompass the management of international treasuries and funds, investment analysis and economic research, and corporate finance and advisory services.

Incentives are also available for the financial sector. Income derived from high-value activities, such as operations and services related to the stock market, derivatives market, and bond market, may be subject to a reduced rate of five percent. Other activities are subject to a standard rate of 13.5 percent.

Furthermore, a programme has been initiated with the objective of fostering technological advancement and innovation within the financial sector. The scheme provides co-financing for the development of financial technologies that enhance the capabilities of the Singaporean banking industry. The scheme provides financial assistance up to a maximum of 70% of eligible costs, including intellectual property rights, technical software, workforce skills and professional services.

It is also useful to look separately at Singapore's system of incentives for headquarters internationalisation. To illustrate, the Headquarters Award offers a preferential tax rate of 5 or 10 per cent of income to companies that engage in core headquarters activities, such as managing, coordinating and controlling their regional operations from Singapore. The Mergers and Acquisitions (M&A) Scheme provides an M&A allowance, which is equivalent to 25 percent of the acquisition cost, with a cap of 10 million SGD (7.3 million USD) per valuation year. This allowance is granted to the acquiring company and is limited to 40 million SGD (29.5 million USD) per valuation year. Additionally, the M&A allowance is exempt from the following: The exemption from stamp duty is limited to 80,000 SGD (59,000 USD) per valuation year, while the transaction costs associated with the double tax deduction are limited to 100,000 SGD (70,700 USD).

In addition, Singapore has introduced a double tax deduction mechanism to facilitate the process of internationalisation. Under the terms of this incentive, companies can claim a tax deduction of up to 200% for expenses incurred in pursuing international expansion. Most of the deductions are subject to the approval of Enterprise Singapore (ESG) and the Singapore Tourism Board. However, certain activities are exempt from the approval requirement for the first 150,000 SGD (equivalent to 111,000 USD) of eligible expenses.

3. Experience of Brazil

While Singapore is undertaking a significant and far-reaching transformation through its Smart Nation initiative, Brazil is prioritising the development of smart cities that will facilitate positive change across the country. Brazil has implemented a number of initiatives and strategies to facilitate the smart transformation of urban areas and infrastructure, with the aim of promoting sustainable development and improving the quality of life for its citizens. These include the Smart Cities Strategic Plan, the National Smart Cities Policy, the Smart Cities Programme and the Cities Transforming Brazil initiative.

The country has adopted the Smart Cities Charter, which aims to integrate digital transformation into sustainable urban development policies, programmes and actions. This is to be achieved in a manner that respects diversity and takes into account the inequalities that exist in Brazilian cities. Additionally, the charter seeks to ensure quality, equitable access to the Internet for all people, and to establish data and technology management systems that are transparent, secure and private. The text introduces innovative and inclusive models of urban governance, thereby strengthening the role of public authorities in managing the impact of digital transformation. The objective of this study is to stimulate the development of models and tools for financing sustainable urban development in the context of digital transformation. Furthermore, it is essential to promote a significant and innovative public educational and communication movement with the aim of increasing public involvement in the process of digital transformation and sustainable urban development (Fachinelli A. at al, 2023).

One of the fundamental principles underlying the development of smart cities in Brazil is the large-scale digitalisation of the country. In 2018, the country's digital transformation strategy for the period 2018-2022, entitled E-Digital, was adopted with the aim of implementing the aforementioned principles. Taking into account the achievements and challenges of this period, a strategy for continued digital transformation has also been developed for the following four-year period (2022-2026) (Brazilian Digital..., 2022). It is worth noting that in recent years, Brazil has made significant progress on numerous fronts related to digital transformation. These include the adoption of amendments to the Information and Communication Technology Law (ICT Law), the introduction of the Brazilian Artificial Intelligence Strategy, the creation of the National Data Protection

Authority, the launch of the Brazilian Instant Payment System (Pix) and the unification of public services on the gov.br platform. As previously stated, the E-Digital strategy is the identification of the principal elements that will constitute the foundation of digital transformation. These elements are comprised of the following key components: infrastructure and access to ICT; research, development and innovation; trust in the digital environment; education and training; and the international dimension.

In particular, with regard to the development of infrastructure and the enhancement of access to information and communication technologies (ICT), the strategy places emphasis on the introduction of a high-capacity data network to all Brazilian municipalities; the expansion of mobile and fixed broadband networks in both urban and rural areas; and the promotion of digital inclusion. The strategy posits the integration of favourable instruments for the promotion of research and development (R&D), as well as research infrastructures with the objective of developing digital technologies. Furthermore, the strategy proposes enhancements to the legal framework governing science, technology, and scientific and technical production, innovation (ST&I).

A significant objective within the strategy is to enhance the mechanisms that safeguard rights in the digital domain, encompassing elements pertaining to privacy and personal data protection. The strengthening of the country's cybersecurity is planned to be implemented through the creation of mechanisms for co-operation between government agencies, federal institutions and the private sector. These mechanisms will facilitate the adoption of best practices, the coordination of incident response and the protection of critical infrastructure. A significant aspect of Brazil's cybersecurity strategy is to reinforce international collaboration mechanisms between governmental agencies and private sector entities in diverse jurisdictions, with the objective of guaranteeing effective digital law enforcement.

A further objective of the digitalisation strategy is to prepare society for the digital world, equipping it with new knowledge and advanced technologies. It is intended that digital technologies will be introduced into school practice on a more extensive basis, that technical capabilities will be provided to facilitate improved access to the Internet for schools, and that teachers' skills in using digital technologies in the classroom will be enhanced.

The Brazilian Digitalisation Strategy for 2022-2026 has been devised to consolidate Brazil's status as a leader in global digital forums, facilitate regional integration in the digital economy, and enhance the competitiveness and international presence of Brazilian companies operating in digital sectors. The strategy aims to promote the expansion of exports through e-commerce and to facilitate the inclusion of small and medium-sized Brazilian companies in this sector.

The digitalisation of Brazil's economy is principally intended to foster a robust ecosystem conducive to the flourishing of the data economy. This objective is to be achieved through the provision of incentives to develop telecommunications infrastructure and to attract data centres to the country. It is anticipated that the technical and human capabilities associated with the utilisation and processing of substantial quantities of data will be enhanced. It is imperative to establish a legal and regulatory framework that fosters investment and innovation, thereby ensuring the security of the data processed and the appropriate protection of personal data.

In conclusion, the digital transformation of the Brazilian economy is predicated on the promotion of novel business models. The government's objective is to facilitate a more robust performance of Brazilian companies in the digital business environment. This will be achieved by encouraging and supporting technology-based startup companies and developing a flexible regulatory environment that allows for experimentation with innovative business models.

The Brazilian government is undergoing a digital transformation, which is characterised by the expansion of digital public services that are consolidated on a single platform. The overarching objective of this transformation is to facilitate broad access to government information and open data. Additionally, it is intended to encourage the integration and interoperability of government databases, advance data-driven public policy, guarantee the security of digital government platforms, and equip government teams with digital competencies.

In the contemporary context of digitalisation and smartification of development, Brazil must prioritise the expansion of research, development and innovation, including in the field of ICT. The nation is devising mechanisms to address the inadequate levels of public and private investment in research and development (R&D) in the information and communication technology (ICT) sector. This is a matter of significant concern, as it poses a threat to the productivity and competitiveness of the Brazilian economy in relation to global trade. Additionally, the Brazilian government is obliged to address the paucity of qualified scientific personnel, particularly in comparison to leading countries.

It is imperative to acknowledge that the implementation of the E-Digital Strategy 2018-2022 has already taken significant steps that have contributed to the advancement of research and development in Brazil. Of particular note is the launch of the National Research Infrastructure Platform (PNIPE). As of October 2022, the platform had registered 317 institutions, 3,023 laboratories and 15,989 pieces

of equipment. The RNP Testbed Service was introduced with the assistance of private sector entities, offering educators, students, researchers, and startups access to experimental environments (testbeds) for the purpose of conducting experiments, research, and testing scientific hypotheses related to networking and distributed computing. The Brazilian Agency for Industrial Development (ABDI) has launched the Sandbox Guide for Smart Cities and, in collaboration with various partners, is implementing experimental environments in Brazilian cities, such as Foz do Iguaçu in Paraná, for the testing and improvement of solutions in real-world contexts (Brazilian Digital..., 2022).

The initiatives already underway include the following (Brazilian Digital…, 2022):

1. In 2022, a budget of 80 million BRL was allocated to provide financial assistance to startups engaged in the development of artificial intelligence solutions. The objective of this initiative is to facilitate the advancement of technology by addressing various technical challenges.

2. The creation of eight Applied Research Centres in Artificial Intelligence to facilitate collaboration between researchers and industrial partners to develop research and development projects focused on addressing challenges through the application of AI. Six of the centres will be active in environments that have been identified as priorities for the ST&I policy, namely healthcare, industry, cities and agriculture. The remaining two centres will focus on artificial intelligence research applied to information security and cybersecurity. This will encompass the research and development of algorithms, mechanisms and systems for cyber defence. Furthermore, a comprehensive programme of artificial intelligence research will be conducted, encompassing machine learning, natural language processing, security and ethics, computer vision and image recognition, neural networks, autonomous systems and robotics, among other areas.

3. The RHAE (Human Resources in Strategic Areas) programme has been developed to attract postgraduate students and doctoral candidates to private companies, with a particular emphasis on micro-, small- and medium-sized enterprises. The programme is designed to provide training and qualifications in the domain of applied research and technological development, while also facilitating interaction between academic institutions and the business sector. To support research, development and innovation (RDI) projects, a public competition was held to select projects proposed by innovative companies and startups. A total of 104 million BRL in grants was made available through the call, and 473 proposals were ultimately approved.

4. The "The Future of Work? Work of the Future!" programme, administered by MCTI, was conceived with the objective of augmenting the ranks of professionals engaged in digital ecosystems, digital transformation projects and research, development and innovation (RD&I). Additionally, the programme seeks to facilitate the qualification and attraction of talent to work in the field of information and communication technologies. In this context, the project, entitled "ICT Residency and Digital Literacy".

5. A number of National Priority Programmes and Projects have been identified, namely: (a) National Microelectronics Programme – Design NPM; (b) National Teaching and Research Network Programme – RNP; (c) National Software for Export Programme – SOFTEX; (d) Programme for the Production and Qualification of Electronic Products with Information and Communication Technologies – HardwareBR; (e) Internet of Things/Manufacturing 4.0; (f) Digital Health.

The overarching objective of the E-Digital 2022-2026 strategy is to further develop research, development and innovation (RD&I) in Brazil, including through government technology orders, in strategic digital transformation topics such as the Internet of Things (IoT), artificial intelligence, robotics, automation, cloud computing, blockchain, privacy, information security, cybersecurity, cryptography, data science, wearables, connectivity technologies, and technologies that enable a circular economy of used electronic products and components. The objective is to promote the advancement of technology and the production chain of software and electronics, computer and mechanical components, with due consideration for the production cycle, operation and maintenance of robots. This objective will be achieved through the establishment of public-private co-operation platforms and the structuring of special or export processing zones (Brazilian Digital..., 2022).

The objective of this strategy is to encourage public and private investment in research and development activities that address the priority needs of Industry 4.0, Cities 4.0, Healthcare 4.0, Agro 4.0, Tourism 4.0, and cybersecurity. The strategy proposes the expansion of access to small and medium-sized enterprises (SMEs) and startups, with the objective of stimulating innovation in strategic areas of digital transformation. Moreover, the strategy is intended to encourage the specialisation of research and postgraduate centres in priority technologies by ensuring the provision of adequate resources, including those derived from the ICT Law. This is with a view to promoting regional development and deconcentrating and optimising scientific production and innovation. In order to guarantee the scale and strategic direction of the technologies to be developed,

it is necessary to integrate enabling instruments for R&D promotion, as well as research infrastructures aimed at the development of digital technologies. Such infrastructures may include international technology hubs and examples of experimental environments (testbeds) in innovative technologies. In order to identify research and development priorities that will have a positive impact on income, job creation, productivity, and competitiveness, it is recommended that scenario studies be conducted. It is imperative that this encompasses forecasting and forecasting methodologies, expert consultations (e.g., Delphi, panel, and survey methods), technology scenarios, and roadmaps. It is of the utmost importance to facilitate an ongoing dialogue between representative institutions from government, academia, and industry with the objective of ensuring that RD&I policies and initiatives related to digital transformation are comprehensive, convergent, and coordinated.

Table 1
A comparative analysis of the state policies of smartification in Singapore and Brazil

Components of state policy and its features	Singapore	Brazil
Organisational and legal framework for smartisation	Smart Nation Initiative; Digital Economy Action Framework; Digital Government Plan; Digital Readiness Plan.	E-Digital digital transformation strategy 2018-2022; E-Digital Transformation Strategy 2022-2026; Brazilian artificial intelligence strategy; ICT Law; National Data Protection Authority; Smart Cities Charter; National Policy on Smart Cities; Smart Cities Programme; Cities Transforming Brazil Initiative.
Vision, ways and tools for the formation of a smart economy	A comprehensive understanding of the digitalisation of each industry, in conjunction with the formulation of industrial transformation maps, is imperative. The implementation of a system of fiscal and non-fiscal incentives is pivotal for the stimulation and development of high-value economic activities, as well as the capitalisation of opportunities presented by Industry 4.0.	The digital transformation of the economy is predicated on the creation of a robust ecosystem for the development of the data economy. New business models are to be supported, and a flexible regulatory environment is to be created for experimentation with innovative business models. Incentives are to be provided for the development of telecommunications infrastructure and the attraction of data centres to the country.
Tools to support the innovation ecosystem	Open data; 'Living Lab'; Startup ecosystem; Innovative tax incentives; Incentives for innovation, research, development, capacity building; Stimulating the commercialisation of intellectual property arising from R&D; Scheme to support technology and innovation in the financial sector.	National platform of research infrastructure; Centres of applied research in the field of AI; Human Resources in Strategic Areas programme; Startup support programme (subsidies for the development of AI-based solutions); National priority programmes and projects (National Microelectronics Programme, National Teaching and Research Network Programme, ICT Electronic Products Manufacturing and Qualification Programme, National Export Software Programme, Internet of Things/Manufacturing 4.0, Digital Health).
Promoting sustainable development	A wide-ranging policy framework promotes sustainable development, including through the development and implementation of Singapore Sustainable Development Plan (adopted in 2015), the Sustainable Development Framework. Significant achievements in the implementation of sustainable development approaches in practice.	A comprehensive approach to sustainable development, development and adoption of a number of documents, including, National Strategy for Sustainable Development National Policy on Sustainable Urban Development. The implementation and effectiveness of these initiatives are contingent on the prevailing political and economic circumstances of the country.
International aspect	Attracting international companies; Attracting international employees; Creating an attractive centre for doing business; Financial and organisational support for the international activities of promising Singapore technology companies.	Stimulating the competitiveness and foreign presence of Brazilian companies operating in digital segments; Engage small and medium-sized Brazilian companies in e-commerce export activities; Supporting smartisation initiatives in the G-20.
The regional aspect	Active co-operation with Southeast Asian countries on the development of smart cities (ASEAN Smart Cities Network, ASEAN Smart Cities Framework).	Promoting regional integration in the digital economy of Latin America.

Brazil's strategic approach to digital transformation has had a favourable impact on the implementation of the concept of smartification, as evidenced by its achievements in this domain. These achievements have been acknowledged on the global stage, as demonstrated by the designation of Curitiba as the world's smartest city at the World Smart City Awards in Barcelona in November 2023. The city was recognised for its integration of public policies, programmes and innovative initiatives for urban planning, with a particular focus on environmental sustainability and socio-economic development.

Brazil serves as a case study that illustrates how a nation can proactively leverage international experience and collaboration at the global level to drive forward progressive reforms and foster intelligent development. As is widely known, a plethora of initiatives to support the development of smart cities are being implemented on a global scale under the auspices of the G-20, which brings together the world's leading economies, including those in the developing world. Brazil, which has held the G-20 presidency since January 2024, has identified the advancement of collaborative initiatives pertaining to the development of smart cities within the G-20 countries as a principal objective. This is particularly evident in the context of the Urban 20 (U20) initiative.

It is evident that the establishment of international initiatives and global alliances on the subject of smartisation is of significant value in the promotion of such approaches and the sharing of experiences. This is particularly important for countries in the Global South, where such initiatives could have a particularly beneficial impact.

4. Comparative Analysis of National Approaches to Smartisation

The present study employed a comparative analysis of Singapore and Brazil's smartification policies for socio-economic development, thereby facilitating an evaluation of the approaches, tools and components of the respective public policies. The findings of the comparative analysis are presented in Table 1.

A comparative analysis of the respective government policies in Singapore and Brazil shows that the digitalisation of the economy, government and society is a fundamental aspect of the smartisation strategy in both countries. At the state level in both Singapore and Brazil, considerable attention is being paid to the digital transformation of the economy, the demands of Industry 4.0, tools to strengthen the innovation ecosystem, and the promotion of sustainable development. Countries use a variety of instruments and incentives to encourage innovation. Singapore, for example, has introduced a range of tax incentives, including those aimed at encouraging the development of higher value-added industries. In terms of the international dimension of national smartification initiatives, Singapore focuses on attracting international companies, including those in the IT sector and those that employ highly skilled workers. Conversely, Brazil's economic diplomacy prioritises the internationalisation of Brazilian companies, with a specific focus on augmenting the export activities of small and medium-sized enterprises, notably through the digitalisation of their operations.

5. Conclusions

The notion of the smart economy is one that is exerting a profound influence on a global scale, impacting not only industries and businesses, but also societies in their entirety. Propelled by advancements in technology and connectivity, this novel economic paradigm is enabling innovation, efficiency and sustainable growth. Fundamentally, the pursuit of a smart economy can facilitate a more optimal allocation of resources, enhanced competitiveness and a more inclusive society. A comparative analysis of the respective government policies in Singapore and Brazil indicates that the principal elements of the smartisation strategy in these countries are the digitalisation of the economy, government and society. Both countries demonstrate a high level of attention to the digital transformation of the economy, the requirements of Industry 4.0, and the tools that facilitate the innovation ecosystem. Brazil employs a range of strategies to develop smart cities and integrate new technologies with the objective of enhancing the urban environment and reducing environmental impact. It is important to note that the implementation of such strategies is frequently dependent on local governments and may vary depending on the specific needs and capabilities of each city. The country's digital transformation strategy, in conjunction with a number of programmes and initiatives to "smarten" cities, provides the foundation for the current changes taking place. Conversely, Singapore has set an ambitious objective of becoming a "Smart Nation," and is developing and implementing a comprehensive strategy to ensure that its society and economy are fully prepared for the challenges of the future and able to capitalise on the opportunities presented by innovative development and digitalisation for sustainable, inclusive growth. It is imperative to persist in the investigation of international experiences in the establishment of a smart economy. This facilitates the enhancement of smartisation approaches at the national level, the implementation of the most effective foreign practices, and the formulation of effective mechanisms for smart development, particularly in the context of Ukraine's post-war recovery.

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