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Developing Digital Business Ecosystem in Singapore

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Abstract

In recent years, the aim to transform into a smart nation together with the drive towards ubiquitous digitalization of the economy has provided the hope and conduit to launch the economy into a new phase of growth and sustain competitiveness. In this paper, we trace the evolution of Singapore's journey in digital transformation of the economy. Starting from encouraging greater use of ICT in industries and computerization drive in the civil services to increase labour productivity and service quality, the many national IT plans launched over the years had laid a solid foundation for the establishment of a SMART nation and digital economy. The paper considers the challenges faced in digitalizing the economy and developing the digital business ecosystem to sustain economic vibrancy and competitiveness. In particular, we consider the various schemes, incentives and action plans that are crafted to help the small and median enterprises which made up 99% of total enterprises in the economy, to transform their business models into one that make best use of digital technologies. Digitalization is part of Singapore game plan to be a Global-Asia node for technology, innovation and enterprise.

Key Words: Smart Nation; digital transformation; e-commerce; artificial intelligence (AI); Automation; SME; business ecosystem; global value chain; Singapore.

Developing Digital Business Ecosystem in Singapore

1. Introduction

The publication of the Strategic Economic Plan (SEP) by the Ministry of Trade and Industry in 1991 marks the beginning of a new development philosophy in Singapore. Singapore has adopted the cluster-based approach in economic development, and has strived to maintain its relevance and usefulness in the global value chain. This new approach to economic development has provided an improved framework for fostering industrial growth and development based primarily on trade and foreign investments. It has enabled better planning in terms of strategic choice of industries for development and promotion; capitalising on the interdependence of the industries, and investing in appropriate infrastructure, technologies and institutions to achieve better outcome and higher returns. The cluster approach is very often discussed in terms of establishing an ecosystem around a specific industry or sector. For instance, in the cluster of electronics and electronic related companies – an ecosystem can be established. There is co-dependence and co-existence of among these companies. The relationship among the companies are synergistic giving rise to positive spill-over externalities or agglomeration effects for promoting further growth (Toh, 2015; Enterprise Singapore, 2019). This is the adopted development philosophy that has remained unaltered till present as the digital era unfolds.

The revision of the development approach is not independent of international event and economic environment. The buoyant international economy after the fall of Berlin Wall in 1989 as a consequence of international trade liberalization, and domestic deregulation and structural reform in many countries, had spurred growth and development in Southeast Asia, including Singapore. Willingness of emerging economies like India and China with large markets and populations to adopt capitalistic market principles in development, had fostered notable growth in their economies by embracing export promotion and foreign investments. This has also challenged the continued growth of the Newly Industrializing Economies (NICs) economies like Singapore, Hong Kong and South Korea, and somewhat dampened the rise of a new batch of NICs like Indonesia, Malaysia and Thailand. International economic environment began to dip into more uncertainty and volatility amidst international terrorism and pandemics from early 2000s. Just before the decade ends, the world was struck by the Great Recession which was sparked off by the housing loan financial crisis in the United States.

Since the Sub Prime Financial Crisis in 2008, Singapore's economic growth declined by almost half, from an average 5% per annum to slightly more than 3% per annum. Concurrently, productivity growth had also stuttered despite several public schemes implemented to uplift the performance. In recent years, the aim to transform into a smart nation together with the drive towards ubiquitous digitalization of the economy has provided the hope and conduit to launch the economy into a new phase of growth.

In this paper, we begin with a review of the concept of the digital business ecosystem (DBE) and traced the emanation of the digitalization drive as a continuation of the momentum of industrialization started more than two centuries ago. The main features and the benefits that

can be derived from digitalization of the economy are discussed. Following that, we investigate how Singapore began its digitalization journey with the objective of using technology, especially information technology, to computerize public services and support economic growth. We review the IT plans were put forth by the government at regular interval, that help to digitalize the various economic clusters, to become digital business ecosystems powering the economy into a new phase of growth. The next section considers the digitalization of small and median enterprises (SMEs) in Singapore. In particular, we consider the various schemes, incentives and action plans that are crafted to help the SMEs which made up 99% of total enterprises in the economy, to transform their business models into one that make best use of digital technologies. We report on the progress of digitalization bas on the surveys done recently before concluding the paper with some remarks on the challenges faced in digitalization of the economy.

2. Review of Digital Business Ecosystem

2.1 What is digital business ecosystem?

A business ecosystem is an economic community of loosely-coupled interacting organisations and individuals who produce valuable goods and services (Moore, 1993). It is the network of organizations—including suppliers, distributors, customers, competitors, government agencies, and so on—involved in the delivery of a specific product or service through both competition and cooperation[1]. A digital business ecosystem (DBE) is an extension of Moore's business ecosystem for which digital technology plays a dominant role. Digital ecosystem is a group of interconnected information technology resources that can function as a unit that creates, disseminates and connects digital services over the Internet. We can view DBE as an integration of the digital and business ecosystems and thus define DBE as a socio-technical environment of individuals, organisations and digital technologies with collaborative and competitive relationships to co-create value through shared digital platforms (Senyo, Liu & Effan, 2019).

2.2 Main Features of Digitalization

Digitalization can be considered as the continuation of the momentum of industrialization that first started around 1760. This was epitomised by the harnessing of steam power for production and transportation. This era lasted for about a hundred years till 1870, when the second industrial revolution is said to begin with a collection of innovations related to railroads, telecommunication, electric lighting, internal combustion engines, and all types of electro-mechanical machinery including road vehicles, aircraft, radio and televisions, washing machines, industrial chemicals as in fertilizers and plastics. Manufacturing of such products forms the basis of industrialization program in many aspiring developing economies. This

[1] For a more extant discussion on the genesis of digital business ecosystem (DBE), and its use as a framework for research in business and economic transformation, see report by European Commission (2007).

lasted for another hundred years till 1970 when the era of Industry 3.0 emerged with the use of electronic and IT systems that automate production and other processes becomes increasingly pervasive in industries. With the advent of the internet, advancement in data processing power, machine learning, data analytics, automation and artificial intelligence, another industrial shift, Industry 4.0 is reckoned to have evolved. Businesses of different industries are connected via Internet, and expanded the business outreach and prospects significantly. The availability of automation technologies, communication, artificial intelligence, and accessibility to BIG data greatly facilitate the adaptation (digitization) and creation of the products that offer disruptive competitive advantage and higher returns (Baldwin, 2019).

It is important to make a distinction between digitization and digitalization (Leinwand and Mani, 2021). The two terms are not synonymous. Digitization is creating a digital copy of an object. For instance, a handwritten tennis-court booking form can be converted into editable digital document using an optical character recognition (OCR) software. The booking form is being digitized and the digital document forms the basic building blocks for digitalization. With digitalization online forms are created, filled up and submitted within the Electronic Document Management System (EDMS). EDMS is the digital technology that come with scripts to check form fields in real-time ensuring that all necessary fields are filled correctly. Once submitted, the system will route the digital form from one approving party to the next based on the pre-set workflow of the form. The information capture can also allow the tennis organization to improve scheduling and to decide on investing in more tennis courts and sales of ancillary equipment and services.

From the perspective of the business environment, digitalization is connected with the use of technologies, products and data in order to maximize revenue, improve business models, replace/change business processes. It creates an environment for digital business. Digitization is a process of converting information into digital form which facilitates the ease of interconnection of digitized units, IOT (Internet of Things), collection and transfer of data that can have beneficial opportunities for individuals and businesses. From practical point of view, different companies apply various approaches to digitize business:

- digitizing products;
- digitizing processes when implementing diverse business management systems/online platforms/applications;
- combining both approaches (using the products of data science, cognitive technology and processing power to create ‘intelligent enterprises’).

Digitalization affects entire ecosystems, their business models and the underlying business functions of a company’s value chain. By digitalizing business functions, data can be provided to enhance and develop each of these functions - and thereby the entire value chain. The well-known online book seller, Amazon, digitizes by launching the Kindle e-book reader at the expense of its physical books sales. It basically digitizes the content. Meanwhile Whats-App used a lean operating model approach in digitization of its business processes. Hospitals are collaborating with IT companies to build platform that will transform and optimize the way healthcare is delivered. It will help to set up a new ecosystem of developers with healthcare

applications that will support collaboration between patients, doctors and pharmaceutical companies.

Digital products, digital services and digital solutions are becoming common and penetrating markets and production space associated with many industries. Businesses have to rise up to the challenge and adapt to the change. In the new digital business ecosystem, the relations between companies (competition/cooperation) increasingly depend on this decision. According to the report by McKinsey, in 2017 Europe was a net importer of US digital services, running a digital trade deficit amounting equal to nearly 5.6% of total services trade between the EU and the US. However, if its laggards double their digital intensity, EU can add €2.5 trillion to GDP in 2025, boosting GDP growth by 1% a year over a decade.

Many scholars have reported that new digital technologies often facilitate changes in products and processes and thereby reshape business models or even entire industries (Porter and Heppelmann, 2014, Digital Vortex, 2015; Björkdahl, 2009). Software platform is considered as one of the important precursors to intensive adoption of digitalization in business. Using a case-based analytical approach, Evans, Hagiu and Schmalensee (2006) investigated the economic role of software platforms. Platform technologies can help to transform industries and how to develop the strategies that will create value and drive profits**.** Digitalization is currently frequently reported as an enabler for various changes in company operations, offerings and the overall competitive landscape, for example (Rymaszewska et al. 2017; Porter and Heppelmann, 2014; World Economic Forum 2016). Companies can use digital technologies to change a business model and provide new revenue and value producing opportunities. Digitalization induces transformation rather than supporting and developing traditional ways of working (Treutiger et al. 2017). Matt et al. (2015) share the same view. They noted digitalization may affect large parts of the organization by impacting "products, business processes, sales channels, and supply chains." Very often, digitalization in manufacturing companies leads to an increased emphasis on services, an aspect worthy of attention by the management. A well known example is the case of Rolls Royce company famed for its sale of aero-engines, has turned into a service company that leases engines to airlines. By embedding sensors and other digital assets right across its product lines and manufacturing facilities, Rolls Royce becomes a data-rich company with data capability ranging from predicting equipment issues and maintenance requirements to showing airlines how to optimize their routes to minimise operation cost.

Internet has promulgated e-commerce, starting with B2B transactions before the proliferation and popularity of B2C transactions in recent years. Dinlersoz and Pereira (2009) discuss the viability of adoption of e-commerce by retailers. They analyse and identify how consumer loyalty, differences in firms' technology and consumers' preferences can affect the timing and sequence of adoption by firms, as well as the post-adoption evolution of prices. A more recent study by Amormkitvikai and Lee (2020) reports that social media and website are significantly drivers of e-commerce utilisation levels, and smartphones are found to be a cost-effective tool for e-commerce transactions. New, scalable, digitally networked business

models—for example those of Amazon, Google, Uber, and Airbnb—are impacting on growth, scale, and profit potential for companies in every industry (Aagaard, 2019; Libert et al. 2016).

2.3 Benefits of digitalization

The benefits of digital transformation are many. Firstly, it can help companies to increase profits. In a recent Gartner survey, 56% of CEOs said that digital improvements have already led to increases in profits (Gartner, 2017). In another study of companies that undergo digital transformation, the SAP Center for Business Insights and Oxford Economics reported that 80% of organizations that have completed digital transformation report increased profits. Secondly, efficiency of companies is increased with main benefits of digital transformation is the streamlining of business operations and processes. This leads to increased efficiency is many aspects of business.

Digital transformation can help business maintain a lead over competitors and stand out amongst the rest with unique offerings. A digitalized business can reach wider markets, and even launch new business models. For businesses that are facing rising labour cost, pursuing digital solutions and modification to production function and processes can increase the productivity and efficiency of employees to increase the value and production of manpower and allow business to remain competitive and stay one step ahead of the curve. Digitalizing the business may not be costly, especially when the government of the country is investing resources and providing financial grants and loans to businesses for digital transformation.

3. Singapore Digitalization Journey

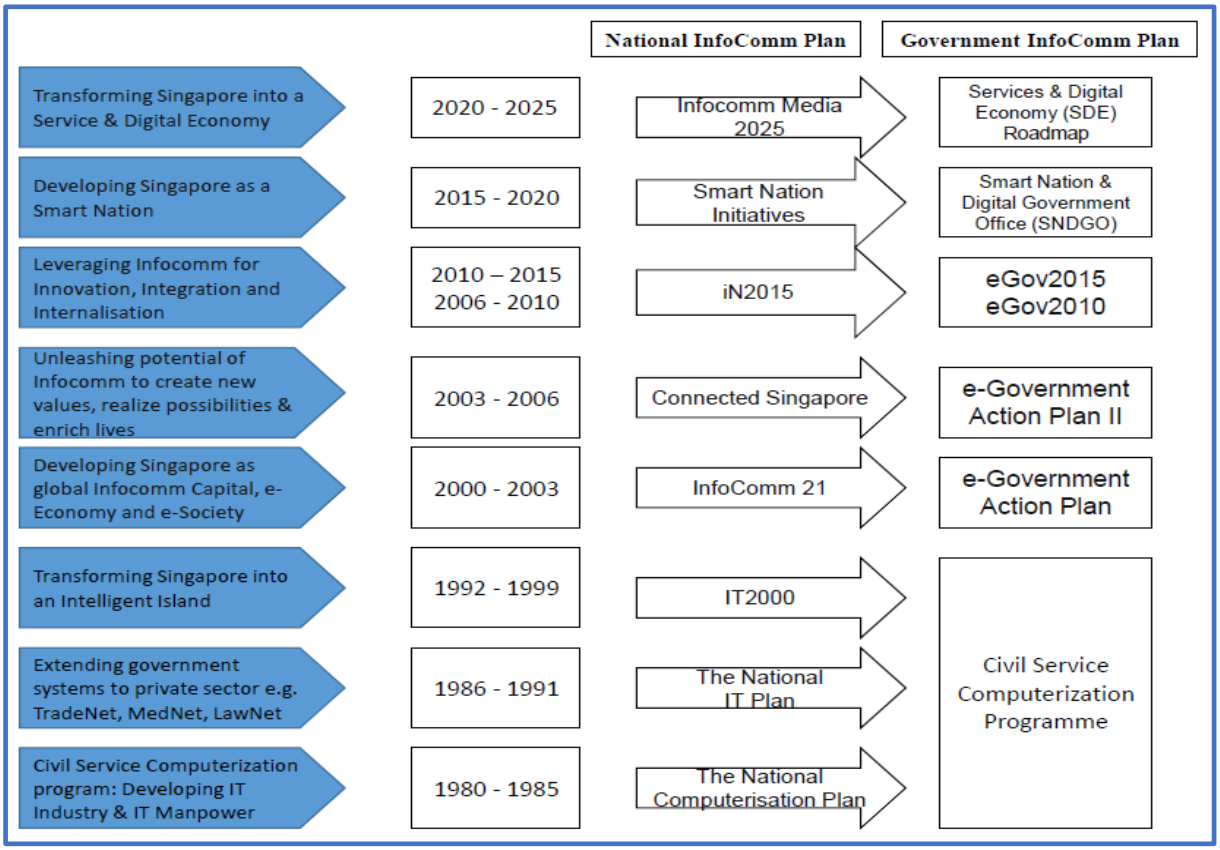
3.1 National IT Plans

The successful industrialization program that started in the 1960 powered by low cost labour began to experience manpower shortage and limited scope for further growth by the late 1970s amidst rising competition from larger regional economies. In response the government leveraged on initial economic gains to deepen the industrial based by attracting more capital and technology intensive foreign investments that can produce higher value-added commodities for export. At this point the government also began to focus on technological innovation i.e., the application of technology, especially ICT to solve problems, increase efficiencies, develop new products and services, and create new knowledge. Thus, began Singapore's infotech journey which has closely mirrored international eco-techno trend, domestic economic development and social needs.

National infotech masterplans and capabilities over 40 years (1980–2020) not only focused on leveraging ICT as an enabler of economic competition and social development but also on building a globally competitive infotech industry and a knowledge-based economy. Such an economy will thrive with talented manpower and creative enterprises in various digital business ecosystems. Coordinated efforts arising from these masterplans have also emphasised infotech manpower development, infotech awareness and literacy of the populace and

businesses, domestic and international infotech infrastructure and connectivity, efficiencies in government agencies, as well as business transformation (Figure 1).

Figure 1 Singapore InfoTech Plans,



Source : IMDA Singapore

Between 1980 and 2000, there were three national ICT master plans: National Computerization Plan (NCP), National IT Plan (NITP), and IT 2000: The Intelligent Island. The aims of the first master plan, NCP, were (a) to initiate the computerization of major functions in all the government ministries to deliver better and efficient services to the public, (b) to facilitate the development and growth of local ICT industry, and (c) to develop a pool of ICT professionals to meet the needs of the ICT industry (Committee on National Computerisation, 1980). The second master plan, NITP, opened up the computerized government systems to the private sector to enable electronic data interchange across government departments, industry, and the public (National IT Plan Working Committee 1985). One prominent example of use of IT in business economics and helps Singapore maintain its premier port status is the TradeNet. Launched in 1989, TradeNet is Singapore's National Single Window for trade declaration. It allows various parties from the public and private sectors to exchange trade information electronically. It integrates import, export and transhipment documentation processing procedures and enables trade and logistic communities to fulfil their trade formalities efficiently. This sort of one-stop services portal has also been extended to the legal and health sectors with LawNet and MedNet. The idea of organizing the manufacturing sector into different cluster of industries was formalised. There were 5 clusters: electronics, chemicals, precision engineering, marine & offshore engineering and aerospace.

The adoption of cluster approach is extended to the rest of the economy by the third master plan. The aim of the third master plan, IT2000, was to develop a national information infrastructure to transform Singapore into an "intelligent island" where ICT is available everywhere-in the home, offices, schools, and factories (Cordeiro and Al-Hawamdeh 2001).

For the next 15 years from 2000 to 2015, three plans were launched. They are Infocomm 21, Connected Singapore, and iN2015. With the ICT infrastructure generally in place, the fourth master plan, Infocomm 21, was targeted at nurturing an environment to develop a sufficient pool of high calibre ICT manpower and Net-savvy users to sustain the growth of the economy as well as to deliver as many integrated public sector services online as possible to increase public access to e-government services (Infocomm Development Authority 2000). The fifth master plan, Connected Singapore, extended the broadband capabilities to provide an infrastructure that supported wireless and wired networks and value-added mobile services (Infocomm Development Authority 2003). The sixth plan, iN2015, aims to develop Singapore into a global ICT capital e-economy, and e-society. To achieve the latter, an ultra-high-speed network on the order of one gigabit per second was developed to link every home and office. This had included a wireless broadband network throughout the island to further improve the ability of all Singaporeans to stay connected at all times (Koh and Lee, 2008).

Launched in 2014, the Smart Nation initiative aims to "support better living, stronger communities, and create more opportunities, for all". The Smart Nation Initiative has the dual goals of improving citizens' lives and allowing them to connect with each other through the use of sensors and smart devices, as well as enhancing economic productivity and exploring new opportunities through such technology. The Smart Nation initiative built on the Singapore government's earlier efforts to digitise public service delivery through its 'e-government' drive that began with a 'Civil Service Computerisation Programme'. While these earlier e-government initiatives tended to focus on increasing efficiency in public service delivery, the Smart Nation initiative was much more comprehensive, reflecting a broader 'digital transformation' that aimed to digitise the all aspects of urban life in Singapore, often through collaborations with non-state actors such as businesses, citizens, and NGOs (Woo, 2017)

Infocomm Media 2025 (MCI, 2015) is a 10-year plan released in August 2015 aims to create a globally competitive infocomm media ecosystem that enables and complements Singapore's Smart Nation vision. This ecosystem supports people and enterprises in tapping on infocomm media to effect economic and social transformation and foster a common identity.

The Services & Digital Economy (SDE) Technology Roadmap (IMDA, 2018) was officially launched in 2019. The Technology Roadmap has identified nine key trends[2] that will

[2] The nine key trends are: Pervasive adoption of AI; More empathic, cognitive and affective AI; Greater human-machine collaborations; More natural technological interfaces; Greater use of codeless development tools; More seamless services enabled by everything-as-a-service (XaaS); Cloud deployment matures with hybrid and multi-cloud; Blockchain decentralizes trust; and Application Programming Interfaces (API)economy takes off.

move the digital economy significantly over the next three to five years. They may be viewed either as challenges or opportunities. The biggest impact will be on the services sector as it forms the bulk of the global economy and Singapore's GDP.

Services 4.0 was identified through the SDE Technology Roadmap as a potential growth engine for Singapore's digital economy. Services 4.0 is the vision that will guide Singapore's response to capture opportunities for the economy. In Services 4.0, businesses will need to meet changing customer needs quickly, innovate and create new value in order to differentiate themselves from competitors. Emerging technologies will make it possible for businesses to automate repetitive tasks and achieve higher productivity. However, as customers still demand human interactions, businesses should unlock growth by offering customer-centric services enabled by emerging technologies. Both worker augmentation and automation will ultimately lead to the creation of new and enhanced job opportunities.

3.2 Digitalization Challenge

Singapore has been through many changes in the past, be it industrialisation, automation, internationalisation. As a small, open economy, Singapore has nurtured the instincts to be flexible, adaptable and stay relevant. It is not abandoning the development philosophy based on having Singapore as an important node in the global value- chain (GVC). Digital transformation is considered as a means to strengthen the function of the GVC and enable Singapore continue to be a relevant node in the GVC. Nonetheless, digitalisation poses fundamental and far-reaching challenges.

Singapore government has decided to transform the economy by strengthening the digital ecosystem in conjunction with developing the industries; identifying new areas of growth; investing in infrastructure; enhancing our regulations; setting up relevant promotional institutions, and forging international partnerships. Leading the charge in transformation is the Infocomm Media Development Authority (IMDA), a statutory board under Ministry of Communication and Information, has laid out plans to anchor global technology leaders, build local champions, spawn start-ups, and nurture future-ready talent in the country. Singapore intends to build deep capabilities and stay at the forefront of global technology trends, so that she can tap into growing markets and build new solutions that are globally scalable and exportable.

To facilitate that objective to be achieves, a new **Digital Industry Singapore, or DISG**, office had been established. DISG will work with private companies to address issues on needs for securing talent and market access, building capabilities, and internationalising. An example to illustrate this is DISG's collaboration with SAP, one of the world's largest providers of enterprise application software. Singapore is home to the first SAP Leonardo Centre in Southeast Asia, a digital innovation platform focusing on areas such as AI, analytics, the IOT and blockchain to help their customers to innovate and scale their businesses. Through the centre, SAP collaborates with Singapore-based small and medium ICT enterprises to develop solutions based on SAP technology which they can also scale and sell internationally. DISG is

also working with other companies to capture opportunities in areas like ride-hailing, e-commerce, fintech, cybersecurity, AI and cloud. A holistic approach is used in engaging the foreign tech companies and, bringing them into Singapore to create a vibrant ICT ecosystem and exciting job opportunities for Singaporeans. As many as ten thousand new jobs are expected to be created over the next three years.

Within the tech space, 5G technology is a critical component of a digital transformation strategy. 5G is the fifth-generation of mobile internet connectivity, making better use of the radio spectrum and enabling far more devices to access the mobile net at the same time. According to the study by Capgemini (2019), 75% of industrial companies' executives mentioned 5G as a key enabler. Singapore is tapping the full potential of 5G technology to spearhead new areas of growth. 5G technology is widely touted to enable the development of new business models and advanced applications, fostering business innovation and spurring economic growth. Communities, businesses and industries are expected to benefit from the transformative impact that 5G enables. It is reckoned that Singapore need to move decisively, both on the infrastructure supply side and also the industry use-case demand side, to capture opportunities in 5G applications and services.

To catalyse 5G development and adoption in the economy, Singapore has identified six strategic clusters which are believed to have the potential to generate the most value for Singapore[3]. One of the clusters is the maritime sector, which IMDA is working on together with the Maritime and Port Authority of Singapore, PSA, and telcos (Singtel and M1) to conduct 5G trials for Smart Port operations. The trials will allow our ports to experiment with cutting-edge technology in areas such as remote crane operations, tele-operations of port equipment and automated ground vehicle port navigation.

In the annual budget statement of the government in 2021, digital transformation of the economy is again a key concern. The Singapore government has set aside S$1 billion for a string of new schemes and enhanced support to co-fund mature enterprises' adoption of digital solutions and new technologies. Singapore is allocating more than SG$500 million (US$352.49 million) to support local businesses in their digital transformation efforts. Specifically, the funds will go towards facilitating companies in their adoption of e-payments, e-invoicing, as well as more advanced digital tools. Half of the SG$500 million has also been earmarked to help businesses digitalise alongside with digital platform application providers.

In addition, some SG$285 million will be set aside in venture capitalism, to provide financial support for promising startups to sustain innovation. This is in addition to an earlier SG$300 million committed to help deep tech startups gain access to capital, expertise, and industry networks. Singapore government will also enhance the Productivity Solutions Grant (PSG) - Job Redesign by raising the government co-funding ratio to 80 per cent, from 70 per cent previously, till end-March 2022. This is to help businesses redesign jobs. PSG Grant is a

[3] These are: maritime operations; urban mobility; smart estates; Industry 4.0; Government applications; and consumer applications.

Singapore government subsidy to encourage SMEs in Singapore to take on IT solutions costs and solutions to streamline business operations. A new Emerging Technology Programme will therefore co-fund the costs of trials and the adoption of frontier technologies such as 5G, artificial intelligence and trust technologies.

Overall, the government has set aside $40m to grow the 5G ecosystem in Singapore. That includes developing open 5G test beds, and conducting R&D for 5G in Singapore. Other than enhancing its digital infrastructure and cybersecurity environment[4] , Singapore has also investing significantly in R & D in frontier technologies, targeting areas like AI and cybersecurity. AI Singapore (**AISG**) is a national AI programme launched by the National Research Foundation (NRF) in 2019. It is public-private partnership to anchor deep national capabilities in AI, grow local talent, and build the AI ecosystem in Singapore by looking at actual use cases and application for AI.

There is also an international dimension of digitalization that cannot be ignored. Singapore is a strong proponent of an integrated, global digital economy. Indeed, a strong domestic digital business ecosystem will help to attract investment from abroad. It can help in elevating an industry's digital standards and practices which can possibly replace legal requirements of physical documentation, and increase the velocity and volume of trade. For example, Hong Kong Shanghai Bank (HSBC) has worked on digitalising the letter of credit process using blockchain technology and has managed to reduce transaction times from 5 to 10 days to under 24 hours. The same technology can be applied to other trade processes heavily reliant on paper and couriers. Across the border, Singapore has teamed up with Indonesia to build the Nongsa Digital Park (NDP) on Batam Island which is just 40 minutes ferry ride from Singapore (Goh, 2021). In fact, plan had already been made to expand NDP into a Digital Town that includes a residential village, tech campuses, a town plaza, and a commercial centre and is set to house 8000 tech talents when completed. There are currently about 1000 tech talents at the existing NDP working for tech companies and start-ups from Singapore and Indonesia.

Singapore has participated in several regional and international initiatives, to raise awareness of and build consensus on the rules of Responsible State Behaviour in cyberspace. The ASEAN Digital Integration Framework Action Plan and the ASEAN Framework for Digital Data Governance are two examples of platforms which, if implemented, could bring about greater ease of business in the region. Singapore has concluded negotiations on two Digital Economy Agreements (DEA): one with Chile and New Zealand, and the other with Australia[5]. A DEA is a treaty that establishes digital trade rules and digital economy collaborations between two or more economies. DEA fosters interoperability of standards and systems and support businesses, especially SMEs, engaging in digital trade and electronic

[4] The Cybersecurity Act was passed in 2018 in tandem with the Cybersecurity Code-of-Practice governing protection of **Critical Information Infrastructure (CII).** CII Owners are also required to submit their cybersecurity risk assessment reports and perform detailed cybersecurity audits once every two years.

[5] Ministry of Trade and Industry (2020) *Digital Economy Agreements* https://www.mti.gov.sg/Improving-Trade/Digital-Economy-Agreements

commerce. It encourages cooperation between Singapore's economic partners in nascent areas such as digital identities, Artificial Intelligence (AI) and data innovation. This gives organisations the scope to trial use-cases and technologies across different countries.

4. Digital Transformation of SMEs in Singapore

Digital transformation provides hope for a new path of economic growth and development. More importantly, it will help to create more interesting careers and job possibilities for Singaporeans, and exciting opportunities for our businesses big or small. Singapore want the digital transformation to be inclusive, and to ensure that all individuals and companies are well-equipped to participate in and benefit from Singapore's digital transformation. Singapore's goal is to be a leading digital economy that continually reinvents itself.

Singapore has rolled out a slew of initiatives and programs to quicken the pace of digitalisation of companies, especially the small and medium enterprises (SMEs). SMEs account for 99% of enterprises, contribute 50% of GDP, and provide jobs for two-thirds of the workforce.

SMEs should strive to be a part of a digital ecosystem, where companies, people, data, processes and things are connected by the shared use of digital platforms. In a nutshell, such digital ecosystems are created through the business relationships one company has with another. When a company develops a suite of flexible services and resources which can be managed in an agile manner, it is then able to meet its evolving business needs.

4.1 Government Grants and Initiatives to help digitalization of SMEs

Launched in April 2017, the SMEs Go Digital programme by the Infocomm Media Development Authority (IMDA) aims to make going digital simple for SMEs. Digitalization initiatives (listed in Table 1) in the program help SMEs use digital technologies and build stronger digital capabilities to seize growth opportunities in the digital economy. The digitalization initiatives include Industry Digital Plans, Pre-Approved Solutions and Digital Consultancies.

Table 1: Initiatives under SMEs Go Digital Programme

	Initiatives	**Description**
1	Digital Resilience Bonus https://www.imda.gov.sg/DRBonus	The Digital Resilience Bonus provides additional support to Food Services and Retail enterprises seeking to uplift their digital capabilities to emerge stronger after the circuit breaker period.
2	InvoiceNow	Grow your business with InvoiceNow — a nationwide E-invoicing method that facilitates the direct transmission of

	https://www.imda.gov.sg/programme-listing/nationwide-e-invoicing-framework/InvoiceNow	invoices in a structured digital format across finance systems
3	Digital Solutions For Safe Reopening https://www.imda.gov.sg/programme-listing/smes-go-digital/Digital-Solutions-For-Safe-Reopening	This Directory of Digital Solutions is specially curated to help businesses use digital solutions to implement safe management measures for safe reopening.
4	Industry Digital Plans https://www.imda.gov.sg/programme-listing/smes-go-digital/industry-digital-plans	Identify digital solutions for each stage of your growth, with this step-by-step guide. IMDA works with industry leads to develop Industry Digital Plans (IDPs) that will make it easier for SMEs to adopt digital technology to boost growth and productivity.
5	Pre-Approved Solutions https://govassist.gobusiness.gov.sg/productivity-solutions-grant/	Visit GoBusiness Gov Assist for pre-approved solutions that improve productivity and are supported under the Productivity Solutions Grant (PSG). Applicants should consider their business needs to select relevant and right-sized PSG support packages.
6	Start Digital Pack https://www.imda.gov.sg/programme-listing/smes-go-digital/start-digital-pack	Start your business right with these foundational and competitively-priced digital solutions. Start Digital was launched in January 2019 to help newly incorporated SMEs and those that have not adopted any digital solutions before.
7	Grow Digital https://www.imda.gov.sg/GrowDigital	Connect to Business-to-Business (B2B) and Business-to-Consumer (B2C) e-commerce platforms that have regional or global reach, to sell overseas without a physical presence there.
8	SME Digital Tech Hub https://www.imda.gov.sg/programme-listing/smes-go-digital/sme-digital-tech-hub	Established by IMDA and operated by the Association of Small and Medium Enterprises (ASME), the SME Digital Tech Hub is a dedicated hub that provides specialist digital technology advisory to SMEs with more advanced digital needs, such as data analytics and cybersecurity.

9	Advanced Digital Solutions https://www.imda.gov.sg/programme-listing/smes-go-digital/Advanced-Digital-Solutions	Connect multiple firms digitally and enable advanced capabilities in the ecosystem.

As at March 2021, more than 63,000 SMEs have adopted digital solutions from the programme, with around 40,000 signing up in 2020. More than 2,000 enterprises have gained access to overseas market through e-commerce platforms under the Grow Digital initiative.

Of particular relevance to the digitalization push is the sector-specific Industry Digital Plans (IDPs). IDPs provide SMEs with a step-by-step guide on the digital solutions to adopt and relevant training for their employees at different stages of their growth. The IDPs serve as a common reference for SMEs and they are aligned with the Industry Transformation Maps (ITMs)for each sector[6]. To date, IMDA has rolled out IDPs for the following 14 sectors – Retail, Logistics (including Air Transport), Environmental Services, Security, Food Services, Wholesale Trade, Media, Land Transport, Sea Transport, (Bunkering, Harbour Craft and Ship Agency), Accountancy, Hotel, Construction and Facilities Management, Early Childhood as well as Training and Adult Education.

To make it easy for SMEs to adopt digital solutions recommended in the IDPs, IMDA provides a list of pre-approved solutions assessed to be market-proven, cost-effective and supported by reliable vendors. SMEs interested in adopting these solutions can start by visiting the website, GoBusiness Gov Assist[7] and applying for the Productivity Solutions Grant (PSG) through the Business Grants Portal[8] . PSG can help to offset up to 80% of the costs of adopting these solutions.

4.2 Manpower Training – Digital Skills

Emphasis on technology is important for digitalization. However, the best digitalization plan will not succeed if the workers are deficient in skill and knowledge required in the new digital economy. People need to have the requisite skills to take full advantage of the new jobs that are being created. Singapore government is working with industry partners to enhance training and placement opportunities for ICT jobs across the economy via the SkillsFuture[9] initiative known as TechSkills Accelerator (TeSA)[10], launched in April 2016. The Infocomm

[6] See Annex A for list of ITMs assigned to 6 clusters consisting of 23 industries.
[7] For more details, please refer to https://govassist.gobusiness.gov.sg/productivity-solutions-grant/
[8] For more details, please refer to www.businessgrants.gov.sg
[9] Skillsfuture is a national movement to provide Singaporeans with the opportunities to develop their fullest potential throughout life, regardless of their starting points. Through this movement, the skills, passion and contributions of every individual will drive Singapore's next phase of development towards an advanced economy and inclusive society.
[10] For more details, please refer to https://www.imda.gov.sg/imtalent/about-us/national-talent-development-initiatives/techskills-accelerator--tesa

Media Development Authority (IMDA), which drives TeSA for ICT professional development, takes an integrated approach/framework to ICT skills acquisition and practitioner training - in core ICT skills and in sector-specific ICT skills - and enhance employability outcomes through place and train programmes, and career advisory services. The skills identified in the framework can support emerging areas such as cyber security, Internet of Things (IoT), immersive media, artificial intelligence and data analytics. More than 80 ICT skillsets and more than 100 job roles have been identified. Interest in TeSA, has been very encouraging. Since April 2016, over 74,000 training places have been taken up or committed.

Another programme that can help companies to upgrade and reskill the workers under their payroll is the SkillsFuture Funding Support for Employers[11]. Eligible companies can receive up to 90% subsidy on training fees and absentee payroll while attending courses.

.In August 2020, AISG launched two new initiatives (AI for Everyone; AI for Industry) in partnership with the IMDA targeted at enabling 12,000 more people to acquire AI knowhow, under the TechSkills Accelerator (TeSA) initiative. The latter aims to develop a pipeline of skilled tech professionals to drive Singapore's local tech ecosystem, especially in the AI space. It helps to ensure that businesses and workers can effectively use AI to be more competitive.

Beyond the ICT sector, IMDA is collaborating with the Singapore Computer Society (SCS) to reach out to non-ICT Trade Associations and Chambers (TAC) to equip their businesses with digital skills and prepare them for a digital economy. For a start, IMDA and SCS are working with TACs in the Legal, Accountancy and Manufacturing sectors on an action plan to upskill professionals in these sectors with digital capabilities. Effort is also made to excite young Singaporeans about the new opportunities in the digital economy. All upper primary school students will go through a 10-hour programme, to develop an appreciation of the core computational thinking and coding concepts through simple visual programming-based lessons co-developed by MOE and IMDA. They will also be exposed to emerging technologies such as AI as part of the programme.

4.3 Progress of Digitalization so far

In a 2020 *SME Digital Transformation Study*[12] produced jointly by the Association of Small & Medium Enterprises (ASME) and Microsoft Singapore, reports that 83 percent of small and medium enterprises (SMEs) in Singapore have digital transformation strategies in place, more

[11] For more details, please refer to: https://www.ssg.gov.sg/programmes-and-initiatives/funding/funding-for-employer-based-training.html

[12] *SME Digital Transformation Study*: Accessible at: https://news.microsoft.com/en-sg/2020/10/22/over-80-of-singapore-smes-embrace-digital-transformation-more-than-half-report-slowdowns-due-to-covid-19-asme-microsoft-study-2020/

than half (54 percent) reported delays in their digitalisation plans due to COVID-19. Also, despite higher adoption of digital transformation, only two in five SMEs perceive their efforts to be successful. SMEs also faced barriers in their digital transformation journey. The barriers include high cost of implementation (56%), lack of digitally skilled workers (40%), low awareness of government support (30%) and not having the right technology partners (28%).

On a more positive note, the 2020 study also found that that more than three-quarters (80 percent) of Singapore SME leaders are now aware of the term 'digital transformation' – up from 57 percent since 2018. Overall, the adoption rate of digital technology has also risen, as nearly all companies (99 percent) surveyed have adopted at least the most basic level of digital technologies such as office productivity tools and web-based email.

In a more recent survey involving 782 SMEs, conducted between November to December 2020 by the United Overseas Bank (UOB)[13], small businesses are lagging behind their larger peers in digital transformation. The survey found that 41 per cent of SMEs that implemented digitalisation initiatives last year recorded revenue growth. Among SMEs that had not digitalised, only 24 per cent saw their revenue improve. Those that had digitalised their entire business reported better revenue growth than those that digitalised only one area.

SMEs in business services, manufacturing and engineering, community and personal services, technology, media and telecommunications as well as consumer goods sectors saw the highest year-on-year percentage increases in productivity and efficiency, ranging from 42 per cent to 49 per cent. Study demonstrates that close to **one in two SMEs** that proactively took steps to adopt digital tools last year are already seeing benefits, such as greater productivity and efficiency gains, improved customer experience and higher revenue, even in a volatile business environment.

In the area of government support, the study revealed that majority of respondents were unaware of government schemes and initiatives available to SMEs, such as the Productivity Solutions Grant[14] and Start Digital Pack[15]. However, it found that despite low levels of awareness of such initiatives, more than 3 in 5 SMEs would be keen to leverage these grants and schemes to support digital transformation in the next year. Existing government support also tends to benefit larger firms, with medium and medium-large companies stating that they are more likely to find government support useful (60 percent and 73 percent respectively).

As at March 2021, more than 63,000 SMEs have adopted digital solutions from the programme, with around 40,000 signing up in 2020. More than 2,000 enterprises have gained access to overseas market through e-commerce platforms under the Grow Digital initiative.

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[13] *Digitalisation efforts pay off for Singapore SMEs with rise in revenue*. Accessible at: https://www.uobgroup.com/web-resources/uobgroup/pdf/newsroom/2021/Digitalisation-efforts-SMEs-revenue-rise.pdf

[14] This is one of the initiatives in the SMEs Go Digital program. See Table 1.
[15] This is one of the initiatives in the SMEs Go Digital program. See Table 1.

5. Conclusion

Singapore has successfully ridden consecutive waves of digital transformation, starting from the national computerisation efforts of the 1980s. This latest digital transformation will open up opportunities on three fronts: new industries, new markets and new jobs. New industries will be formed even as older ones start to evolve and transform. Technologies such as AI have the potential to completely rewire whole industries, from finance to shipping and manufacturing. Singapore's scarce land resources and limited population have been the main constraints to growth. Digitalisation provides new options to overcome these constraints.

SMEs surveyed in the ASME-Microsoft study in 2020 alluded in other section, also indicated that high implementation cost was the biggest barrier they faced when it comes to digital transformation – a similar observation from the 2018 iteration of the study. Other significant factors include the lack of a digitally-skilled workforce, uncertain economic environment, low awareness of government support as well as the lack of appropriate technology partners.

Singapore government is always very good in pushing out schemes, grants and programs, but the take up rate is not spectacular. Even with 63,000 signing up for government program by the end of March 2021, that is only about 23% of all SMEs. Though it is reckoned that some SMEs proceeded to digitalize without utilizing government schemes or grants. The take up rate is still low for an urgent nation-wide campaign. Some would blame it on application procedures that involve too complicated instructions and qualification criteria, or simply ignorance or low level of awareness of SMEs bosses. Nonetheless suggestions can be made to help the SMEs on their digitalization journeys. Easier access to funding or grants can be made available so that financial constraint less binding and budgeting for digitalization can be facilitated via deferred principal payment, bridging loan, and tax rebates on investment in digital equipment and software. A directory of accredited technology and solution providers can be compiled by the leading government agency such as IMDA, and this is made available to SMEs planning their technological solutions and digitalization journey. It will be very useful if digital 'shepherd' can be assigned to companies to help them to navigate the plethora of government initiatives, schemes and grants, to achieve the desired outcome faster.

Singapore aspires to be a Global-Asia node for digital technology and innovation. It aims to be a choice destination where entrepreneurs consider their start-up projects, and where innovators will experiment with their latest ideas. The congregation of start-ups and interaction of innovation endeavours will help to establish an ecosystem for digital business. An enterprise is strengthened by having a vibrant and conducive start-up ecosystem in the country. Startups play an increasing role in driving innovation, especially as growing markets demand new solutions. The OECD predicts that Emerging Asia (i.e., ASEAN, China and India) will grow by an average of 6% over the next five years. With Asia poised to account for more than half of global GDP by 2050, Singapore can be the gateway for start-ups to develop, test-bed solutions and expand into the region. Enterprise Singapore, a government agency, helms the Startup SG program that helps start-ups build track record, and provide access to mentors,

funding and workspaces. Through close to 100 partners, Startup SG programmes supported the growth of over 3,690 start-ups across key sectors such as health, urban solutions, fintech and digital services in March 2020.

Digital transformation is not necessarily an easy experience. Some companies may encounter difficulties in the transformation process. One commonly cited difficulty is how to get employees digitally ready. Companies will need to pay attention to hiring the right people and making sure existing employees are trained for using new digital tools. Important to have patience in identifying who needs more help in the transition, and set aside time for training. While government can made available the grants and training schemes for training, the success of reskilling and upgrading workers still depend very much on the willingness of employers allowing their employees time-off to attend courses and training.

Going digital can open gaps in cyber security. Getting the advice of security consultants when implementing wide ranging digital solutions can help businesses understand risks and adopting appropriate mitigating measures. It can be very expensive in terms of tools and training to get everyone in the company up to speed. Hence government grants will helpful to offset some of the costs. The long term benefits can more than outweigh the short term costs.

While the pandemic has accelerated the adoption of digital technology, it has also highlighted the gap in skill and literacy across people and countries. The risk is that individuals who lack the necessary financial or digital literacy may fall behind. From the perspective of the society, there is a risk that digitalization is a blocker rather than an enabler of prosperity. Government, the education sector and companies must work together to address the challenge and prevent a growing skills gap which creates greater inequality that is inimical to social stability. To get digital transformation right, the focus should not be solely on technology, attention has also to be paid to inculcating a progressive mindset – an attitude of unlearning, relearning and adapting to the changes.

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ANNEX A

Singapore Government announced the S$4.5b Industry Transformation Programme at Budget 2016. The programme will integrate different restructuring efforts, taking a targeted and industry-focused approach to address issues and deepen partnerships between Government, firms, industries, trade associations and chambers.

Under the programme, there will be Industry Transformation Maps (ITMs) developed for 23 industries under 6 clusters. The Future Economy Council (FEC) established in 2017 takes overall responsibility for the implementation of the ITMs.

LIST OF ITM CLUSTERS AND INDUSTRIES

S/N	Cluster	Sector	Lead Agency
1	Manufacturing	Energy & Chemicals	EDB
2		Precision Engineering	EDB
3		Marine & Offshore	EDB
4		Aerospace	EDB
5		Electronics	EDB
6	Built Environment	Construction (incl. Archi & Engineering services)	BCA
7		Real Estate	CEA
8		Cleaning	NEA
9		Security	MHA
10	Trade & Connectivity	Logistics	EDB
11		Air Transport	CAAS
12		Sea Transport	MPA
13		Land Transport (incl. Public Transport)	LTA
14		Wholesale Trade	IES
15	Essential Domestic Services	Healthcare	MOH
16		Education (Early Childhood and Private Education)	MOE
17	Professional Services	Professional Services	EDB
18		ICT and Media	MCI
19		Financial Services	MAS
20	Lifestyle	Food Services	SPRING
21		Retail	SPRING
22		Hotels	STB
23		Food Manufacturing	SPRING

Source: Media Factsheet – Industry Transformation Maps, Annex A
https://www.mti.gov.sg/-/media/MTI/ITM/General/Fact-sheet-on-Industry-Transformation-Maps---revised-as-of-31-Mar-17.pdf