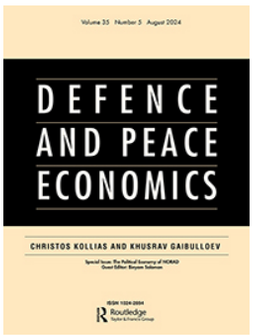

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Singapore's 'Total Defence' Strategy

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ABSTRACT

Singapore launched its Total Defence strategy in 1984. It was one of the first countries in the modern era to enact such a policy based on an expanded interpretation of national security. Conventionally defence equates to military security, but for Singapore this approach was too limiting. There was a recognition that defence and development were intertwined and accordingly the authorities sought to exploit the synergies from adopting an integrative security approach. Total Defence thus emerged, manifesting itself as a blend of soft 'social resilience' elements designed to foster collectivism and national identity, and the harder industrial and technological dynamics of 'defence capability'. The resulting civil-military overlay, along with the government's imperative to push the boundaries of innovational endeavour, has enabled Singapore to achieve a remarkable cultural, economic and military transformation. In the process, it has achieved rapid expansion of both defence 'and' development, leaving most other contemporary post-colonial states in its wake. Yet, the uncertain and turbulent global environment over recent years has revealed possible emerging fault lines in the Total Defence model that the Singaporean authorities would be well advised to heed, and, if possible, resolve.

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Singapore; Total Defence; social resilience; defence-ecosystem; Comprehensive Security

Introduction

Singapore represents a remarkable case study of defence economic transformation. In less than three decades, it has progressed from strategic dependence on its former colonial power, Great Britain, to Southeast Asia's most formidable defence player. Although a small island state of less than six million people, its impressive military capability reflects the crafting and effective implementation of a judicious defence strategy that has included the leverage of military technology multipliers (Bitzinger 2021). There has also been the important role played by an acquisition mix of sophisticated foreign platforms and the impressive capability derived from the island state's indigenous defence industry. Singapore's principal prime-contractor, ST Engineering (STEngg), is a success story in its own right, as reflected in its 55th ranking in the world's top 100 defence companies (Defense News, 2022) Yet, the Singaporean 'defence' phenomenon goes well beyond a single-lens focus on one company, and embraces more broadly the synergistic fusion of civil-military relationships across society (Neo 2020). This can be studied by reference to six distinct but interrelated defence policy pillars. These include the formal military domain, comprising Singapore's Armed Forces (SAF) and also its sovereign military-industrial complex within a broader 'defence ecosystem'. This system

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importantly encapsulates the broad canvas of universities, supply chains, R&D networks, defence industry and digital infrastructure that reflects the breadth and depth of Singapore's technological absorptive capability (Matthews and Koh 2019). Additionally, adopting a whole-of-society approach, there are wider socio-economic, civil and psychological defence dimensions incorporated into what the Singaporean authorities describe as 'Total Defence'.

Singapore's Total Defence model has been in place since 1984 (Singapore Ministry of Defence 2004), and appears to have worked well, though with emerging challenges in recent years – as will be discussed later, providing policy-relevant lessons for effective harnessing of resources alongside the cultivation of a broad-based commitment towards collective defence. Singapore has attracted interest from developing states, which are interested in emulating its success (Quah 2018). Thus, it will be useful from a comparative perspective to understand in what ways Singapore's Total Defence strategy can similarly act as a benchmark for other states keen to pursue a broader-based interpretation of national security. In an under-researched field, then, the aim of this paper is to identify, explain and analyse the principal components of Singapore's Total Defence Strategy, with a view to determining its putative success. The paper begins by identifying and assessing the derived origins of Singapore's Total Defence paradigm through critical analysis of the concept's application elsewhere in the world. It then moves on to appraising the specific empirical context of Singapore. This involves a focused examination of the six constituent pillars of Total Defence Strategy, including also critical evaluation of the civil-military, socio-cultural and psychological relationships that underpin the model. The paper will close by offering conclusions derived from the findings of the analysis.

Historical Evolution of Total Defence

The notion of Total Defence originally surfaced as 'comprehensive security' in 19th Century Japan (Akaha 1991), and evolved as a cultural attribute of Japanese society that was never formalised into official policy. During that era, Japan sought rapid industrialisation as a means of militarisation, with Tokyo viewing civil-military synergy as the cornerstone of the country's multidimensional approach towards securing both development and defence. Indeed, throughout Japan's contemporary history, civil-military integration proved a constant theme in its security framework (Samuels 1994). Following the end of WWII, a swathe of newly independent but relatively poor Asian states, began to pursue developmental strategies influenced by the region's common cultural characteristics of long-termism, collectivism and patriarchal government interventionism. The dual imperative of defence and development prompted a recognition of the appropriateness of comprehensive security, leading to Singapore's 1984 Total Defence concept, the Malaysian 1986 equivalent, also called Total Defence, and Indonesia's 1945 National Defence Law. Additionally, the Philippines evolved its own unique security paradigm, embracing a diverse spectrum of national security threats. This broad-based security approach extends well beyond the military domain and conforms to the conventional Asian emphasis on wider societal security rather than an exclusive focus on defence. The Total Defence model enables responses not only to traditional external threats, but also to non-traditional internal security concerns. Simultaneous resolution of both defence and development challenges is viewed as mutually reinforcing, leading to de-escalation, if not eradication, of terrorism, insurgency, secessionism, transnational crimes, at the same time as promoting economic development, human rights, humanitarian operations and disaster relief (Avila and Matthews 2022).

Non-traditional threats have brought to the fore the promulgation of comprehensive security solutions. Yet, the 1990's conceptualisation of comprehensive security proved dissimilar to the original Japanese model, particularly with respect to the attention given to how 'defence' should be redefined to adapt to the new and evolving security scenarios (Baldwin 1995). For instance, Walt's traditionalist realist perspective ignited controversy because it associated security with peace and the prevention of conflict through military means, e.g. deterrence and non-offensive defence (Walt 1991; Kolodziej 1992b, 1992a). A more nuanced perspective was offered by Ayoob (1997), who argued that national security represents a function of nation building, requiring both 'security

hardware' (control of coercive force) and 'security software' (integration and legitimacy). Buzan contributed to the debate by deftly steering discussion away from the purely military sphere to instead emphasising the multi-dimensional context of comprehensive security, especially its connectivity between political, military, economic, societal and environmental considerations (Buzan 1990, 1991b, 1991a).

These contemporary perspectives of comprehensive security emerged from the post-Cold War discourse on the dynamics of security as an interdisciplinary field of inquiry (Szymanski 2020). This encouraged the essentiality of focusing on the wider global community of interests, in which environmental and globalisation pressures coalesce to constrain the ability of governments to control externally induced non-traditional threats that do not respect national borders, such as the SARS, H1N1 Bird Flu, Ebola, AIDS and Coronavirus epidemics (Hsiung 2004). Additionally, there has been a transition towards a human-centric form of security, defined by the United Nations (UN) in its epochal (Human Development Report 1994) as 'safety from chronic threats, such as hunger, disease, and repression, as well as protection from sudden and harmful disruptions in the patterns of daily life' (Laird 2020).

The debates about broader non-military threats are of increasing relevance in a 21st century global environment plagued by environmental catastrophes, which have largely been driven by climate change. However, as the Russia-Ukraine war powerfully demonstrates, the traditional military component cannot be detached from the broader interdisciplinary security paradigm affecting, for instance, global supply chains, and energy, food, as well as environmental security. Indeed, it is in the Northern hemisphere, where contemporary security models have evolved to reflect the unique military and security challenges faced by small states. Switzerland, for instance, has pursued 'armed neutrality' since the early 19th century, and, as a result, successfully avoided occupation during both the 20th Century's World Wars. Yet, paradoxically, the experience of these wars, especially WWII, highlighted the 'fantasy' of small nation neutrally in the absence of adequate defence forces (Spillmann 1986) Indeed, the Commander of the Swiss armed forces, pointed out the necessity to include economic, technical, administrative and many more precautions in a network of 'comprehensive preparations' in order to cope with future contingencies (Spillmann 1986). The experience of WWII as a 'Total War' demonstrated that the Armed Forces can no longer operate in a compartmentalised environment, and that all sectors of society are impacted by conflict. While Switzerland's armed forces would remain the principal and most powerful instrument in the country's defence, it can no longer remain the exclusive 'defence' domain. An integrated 'comprehensive' defence response, including specifically psychological defence, is required, an approach the Swiss describe as 'General Defence' (Fischer 1982). This is once again evidenced by the Russian-Ukrainian war in which Moscow has launched indiscriminate missile attacks against Ukraine's civil infrastructure.

Non-NATO Nordic states, Sweden and Finland (albeit that both gained NATO accession in July 2022 after Russia's invasion of Ukraine) follow similar integrative comprehensive security defence paths as Switzerland. Sweden's model came to prominence during WWII following the appointment of a Commission on 'Total Defence in Transformation', representing an acknowledgement of the blurring of external and internal security components. As with the Swiss Model, the Swedish approach possesses two core constituents. The first is armed neutrality, characterised by Stockholm's aim of neutrality in war and non-alignment in peace. The traditional view espoused was that instead of joining strategic alliances, like NATO, Sweden should encourage a cultural and collectivist attitude of self-preservation in parallel with 'credible' neutrality, via a near-autonomous domestic arms industry to reduce foreign defence dependency through sovereign capability and mass conscription. The latter enabled mobilisation into military service of all abled-bodied males between 18 and 47 years of age, contributing to a national defence organisation that is conceived as an enterprise with shareholders consisting of Sweden's entire population (Sydow 2018).

The second core constituent of Sweden's comprehensive security model is the pursuit of a 'whole-of-society' approach to national security as reflected by a deeply embedded civil defence

architecture. It is a model that resonates with the principles of resilience found in Article 3 of NATO's founding Treaty, which were further elaborated through the seven baseline requirements set out in the Resilience Commitment agreed by Allied leaders at the 2016 NATO Summit in Warsaw (NATO Warsaw Summit 2016). This Swedish comprehensive security narrative is backed up by the law of 'civil defence duty' (*tjänsteplikt*), obliging every civilian between 16 and 70 years of age, every registered household, and even private property, such as buses or trucks, to fulfil a specific function in the fortification of Sweden (Larsson 2020). Stockholm has recently reinstituted its cold war era term, 'Total Defence', based on the principle that all functions of society are engaged in the defence effort (Szymanski 2020), including psychological defence (Sweden Government 2020). In the current deteriorating security environment facing Sweden, Total Defence is intended to provide a balanced approach to both enhancing warfighting capability and increasing societal resilience (Sydow 2018).

Finland's comprehensive security framework dates back to 2008 when it adopted the 'all-hazards' principle, in which central responsibility rests with the competent authority, and all other relevant security actors in supporting roles. The notion of all-hazards means there is a response to all discernible threats, including security of supply. This is a broader concept than in other countries, where the focus is solely on the provision of energy resources. Essentially, an all-hazards approach covers two kinds of tasks: firstly, the security of critical infrastructure, concerning energy (production, transmission, and distribution), communication systems, financial services, transportation and logistics, water supply, maintenance and construction of infrastructure and waste management; and, secondly, the security of crucial branches of production and services, covering food supplies, medical care, industrial manufacturing and the production of goods and services supporting the armed forces. A further distinguishing characteristic of Finland's security model is the development of a cultural and psychological mind-set termed *Sisu*, reflecting fortitude, will-power, courage, perseverance, endurance and tenacity (Szymanski 2020).

In the late 1970s and early 1980s, Scandinavian defence analysts began to argue that globalisation's encouragement of societal openness and rapid technological development was heightening sensitivity to non-military disruption through terrorism, sabotage, and, more recently, cyberattacks (Larsson 2020). This began to change the risk spectrum whereby the principal threat was no longer postulated to be from military technology scenarios but rather through asymmetrical and 'grey' destabilising threats. In turn, the process of globalisation was rationalized according to neoclassical strictures, encouraging individual pursuit of wealth, but at the cost of weakening commitment to collective responsibility, hastening the loss of national identity. The danger for small states, such as Switzerland, Sweden, and more so, Singapore, is that necessarily they pursue an 'open' economic model, but it means potentially falling prey to becoming a victim of their own success. In other words, subscription to neoclassical individuality arguably threatens the community ideals of Total Defence, undermining national identity and solidarity.

Singapore's Total Defence Model

Origins

Singapore's Total Defence Model did not derive from the Japanese experience but rather from the national defence and resilience strategies of the similarly small states of Sweden and Switzerland (MINDEF 2019). As with the latter models, Singapore's contemporary version adopts a 'whole-of-society' approach towards uniting all the country's sectors – including government, business and the people. February 15th every year is known as Total Defence Day in Singapore. It represents the annual celebration of both Total Defence and the SAF, which together are viewed as the cornerstone of national security. The event commemorates the loss of life when Singapore fell to the Japanese during World War II, and reminds all citizens of their collective responsibility to defend the nation. Following Singapore's independence, security was solely viewed from the perspective of protecting the country from external military aggression via conventional warfare. However, it was soon

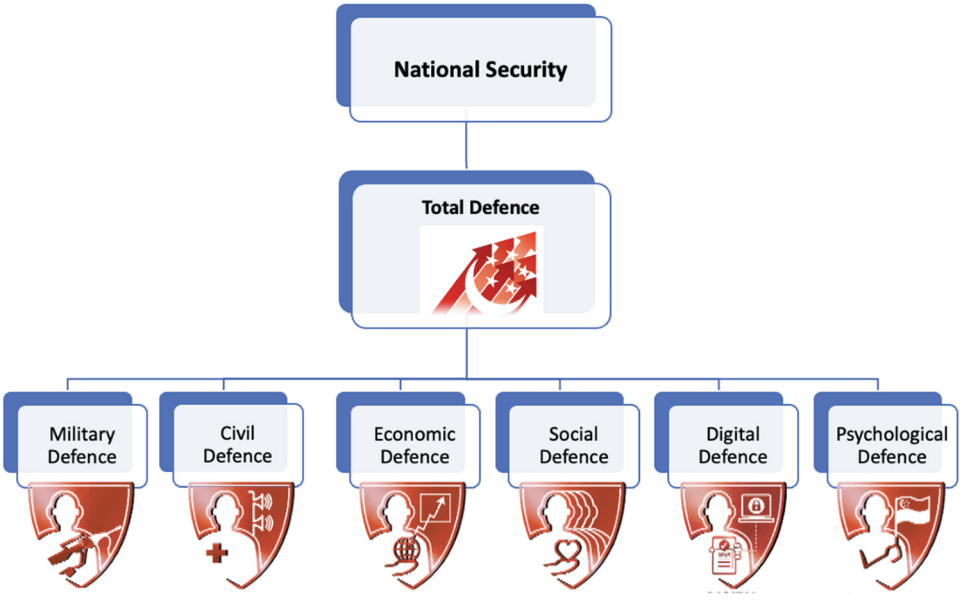

Figure 1. Singapore Total Defence paradigm. Source: Adapted from Singapore Ministry of Defence, *Fact Sheet: Total Defence Logo* (2019), https://www.mindef.gov.sg/web/portal/mindef/news-and-events/latest-releases/article-detail/2020/February/15feb20_fs

recognised that non-traditional threats from 'within' might also disrupt the nation's solidarity, given that the multi-racial and multi-religious Singaporean society is vulnerable to segregationist elements. Therefore, a defence strategy was required which would address both traditional and non-traditional security threats, but for this to happen there would need to be a cultural acceptance of this multi-faceted security approach. Accordingly, public campaigns became a constant feature of the communications strategy conducted to inculcate Total Defence into the people's psyche. The strategy was targeted on adults, but it also sought to influence the development of responsible societal values in children.

Initially, Total Defence consisted of five Pillars, but in February 2019, a sixth was added to address the threats arising from the digital revolution. There have recently also been calls to create a seventh pillar, 'climate' defence, reflecting Singapore's vulnerability to climate change through especially rising sea levels (Ong 2021a). Each of the Pillars is subordinated to the overarching goal of uniting all stakeholders in the 'defence' of Singapore, and justified on the grounds of Singapore's small size, lack of national resources and a racially and religiously diverse population (MINDEF, undated). These conditions potentially make Singapore prone to economic slowdowns as well as the emerging international threats of terrorism, natural disasters, pandemics and disinformation campaigns (Today, 2017). Total Defence has been the rallying cry of successive People's Action Party (PAP) governments, invoked during several threats, including the respective 2003 and 2019 H1N1 and COVID-19 pandemics, the 1997, 2008 and 2022 economic turbulence and the annual Southeast Asian haze incursions (Baharudin 2019; Lim 2021). Figure 1 offers a diagrammatic schema for examining Singapore's Total Defence paradigm.

Military Pillar

The Military Defence Pillar represents Singapore's conventional security component. Traditionally, military defence equates to national security, and, indeed, Singapore has invested heavily to ensure it has the capability to deter threats. In evaluating the Military Pillar, three perspectives will be

addressed, namely, Singapore's strategic context, the evolution of its sovereign military-industrial complex and the role of National Service in reinforcing the Total Defence concept.

Strategic Context

The evolutionary nature of Singaporean defence capability has been shaped by the country's 'small state' strategic landscape, with MINDEF implementing strategic policies reflecting the island state's constrained land mass, military size and operational scale. Technology multipliers are thus emphasised to compensate for smallness and to underpin the country's 'Shrimp-Porcupine-Dolphin' deterrence strategy. The analogy with the ascending size and power of marine life appears to implicitly reflect sequential stages in the technological sophistication of Singaporean military capability, as well as associated changes in operational and doctrinal concepts and force structures. During the initial post-independence 1st generation phase, Singapore's strategic posture was characterised as a 'poisonous shrimp' (easy to swallow, impossible to digest), and accordingly the SAF's first line of defence would be at the waterfront, followed by the 'Stalingrad' model of urban close combat. Siege relief would potentially come via the other four partner countries of the Five Power Defence Arrangement (FPDA), namely the Armed Forces of Australia, Great Britain, New Zealand, and the United States. However, such assistance could not be guaranteed, as the FPDA is far removed from NATO's Article 5 'Collective Defence' Arrangement. Member states would engage in consultations, but there was no cast-iron guarantee that military aid would be granted to fellow FPDA partners under attack. In any case, during the late 1970s, linked especially to the withdrawal of allied forces from Vietnam, FPDA capability was scaled back, leaving Singapore no choice but to assume a more self-reliant and offensive strategic posture. In turn, this necessitated a switch in emphasis from quantitative platform-centric competence to instead a focus on qualitative system-level capability, reflecting the country's growing technological maturity, especially regarding aerospace capability.

The switch to systems capability heralded the 1980's pre-emptive strategic doctrine, and was symbolised by the 'porcupine' analogy (small, but with painful spines offering protection from a distance) (Ng 2005). Then, into the 1990s and beyond, the SAF began transitioning to what was termed the 'Dolphin' deterrence posture, representing (smart, agile and maneuverable) Armed Forces, capable of moving quickly from danger, yet armed with sharp teeth and thus possessing an ability to defend itself (Loo 2004). The precepts of the so-called Revolution in Military Affairs proved a decisive factor influencing the SAF's push for military technological innovation. During the post-Millennium decades, MINDEF continued to expand and deepen SAF technological and operational advantage in pursuit of 3rd Generation command and control, as well as systems integration capability. MINDEF's acquisition strategy accommodated this transition, but it was not focused on the development of final platforms. Rather, it reflected Singapore's limited size and scale, with the strategy emphasising: 1) acquisition of foreign off-the-shelf systems, such as F-15E fighters; 2) indigenous development of basic platforms, including Bionix II Infantry Fighting Vehicles and the Terrex AV-81 Armoured Personnel Carriers; 3) development of niche defence systems capabilities, such as systems integration and electronics; 4) and broad-based specialisation in the maintenance and upgrade of weapon systems, evidenced by the technology upgrade of A4 Skyhawk fighters (Palavenis 2022; Matthews and Zhang 2007; Manohara 1998). As a consequence, Singapore's military capability was transmogrified from a 1980's second-generation SAF, characterised by 'force modernisation', to a third-generation SAF, focused on expeditionary warfare and force projection.

Singapore's expanding military capability was supported by a robust defence economy, which in turn was supported by a strong economy, as evidenced by the data in Table 1. When measured against the economic performance of other Association of South East Asian Nations

(ASEAN), Singapore's progress is remarkable: a country of less than six million people, it has a GDP per capita income that is higher by a factor of 10 than the next highest nation, Malaysia; it has the highest defence budget, giving it the second highest defence spend in relation to national income;

Table 1. ASEAN member state defence statistics, 2021.

	GDP (current US$bn)	Population (mn)	GDP/ Popn (US$)	MILEX (US $mn)	MILEX/ GDP (%)	Defence firms in global top 100	Total AFs (active, reservists, paramilitary - thousands)
Brunei	14.0	0.44	31,723	453	3.3	-	8
Cambodia	26.9	17.05	1,591	643	2.3	-	191
Indonesia	1,186.0	276.36	4,292	8,259	0.7	-	1,076
Lao PDR	18.8	7.38	2,551	-	-	-	129
Malaysia	332.7	32.78	11,371	3,830	1.1	-	188
Myanmar	65.1	54.81	1,187	2,108	3.3	-	468
Philippines	394.1	111.05	3,549	4,091	1.0	-	288
Singapore	397.0	5.45	72,794	11,115	3.0	Rank 55 (ST)	312
Thailand	506.0	69.95	7,233	6,605	1.3	-	655
Vietnam	362.6	98.17	3,694	-	-	-	5,522

Source: GDP, Population, GDP/Popn from World Bank Data https://data.worldbank.org/; all MILEX and MILEX/GDP% data sourced from SIPRI https://www.sipri.org/databases/milex and Defence Firms in Global Top 100 sourced from Defense News https://www.defensenews.com/top-100/. The value (*) indicates uncertainty by SIPRI; Vietnam's MILEX is sourced from CEIC (2021). Total Armed Forces (AF) data sourced from the International Institute for Strategic Studies, *Military Balance 2022*.

and possesses the biggest defence company, ST Engg, in Southeast Asia, and the only one in ASEAN that is ranked among the world's top 100 defence enterprises. A further measure of ST Engg's success is its emergence as a defence exporter. In 2020, Singapore's defence exports were valued at US $202mn, giving it a ranking of 41st amongst global exporters, but with a product complexity of 0.7, equating to a ranking of 6th amongst the 21 arms exporting states that were surveyed (OEC, 2022). Historically, most of Singapore's exports have been in the maritime area, including, for example, the Endurance-Class Landing Platform Dock (HTMS *Ang Thong)* built for the Thai Navy. However, in 2008, Singapore achieved a break-through in land-systems exports when the *Bronco* all-terrain tracked vehicle was sold to the UK Armed Forces for deployment in Afghanistan. Moreover, under open competition, Singapore has won contracts for the upgrading of Turkish and New Zealand C130J heavy lift aircraft and Brazilian and Turkish F-5 fighters (Sobie 2004).

Military-Industrial Complex

MINDEF's continuous push for frontier defence-related innovation has propelled Singapore's military-industrial capacity to reach ever higher technological levels, providing what the country's former President S. R. Nathan termed the 'secret-edge' of its military technology capability (Nathan 2002). However, this secret-edge heavily depends on a dynamic indigenous defence industry, described by Bilveer Singh (1990) as the additional (though formally unrecognised) 'Defence-Industrial' Pillar of Total Defence. The process of defence industrialisation began in 1967, and through a series of consolidations culminated in the 1994 establishment of the state-owned ST Engg. This industrial conglomerate comprises four divisions, ST Aerospace, ST Marine, ST Electronics and ST Kinetics; the latter being the only dedicated defence operation. ST Engg is a success story: in 2021, it employed 25,000 workers globally, with 17,000 of them working in engineering and technology, and generating S$7.7bn in revenue and S$1.5bn in profit (ST Engineering Annual Report 2021). The company has played a pivotal role in Singapore's defence-industrial strategy. At the military-industrial level, it has been the motive force of external technological partnerships with foreign defence contractors. This is crucially important, because although the value of MINDEF's acquisition budget has never been revealed, there is no question that the biggest proportion of funds is directed towards overseas acquisition of major weapons platforms, such as Type 218SG submarines (Germany) and planned F-35B Lightning-2 fighters (US) for 2026 delivery (SIPRI 2022). Singapore simply does not possess the scale to affordably design, develop and produce complete systems.

To facilitate technology transfer, Singapore has consistently demanded offset, and ST Engg has been the biggest beneficiary. The offset policy goes back to the beginnings of defence

industrialisation in the early 1970s, but there has never been a published set of offset policy guidelines. It is an untypical approach, and means that offset agreements are determined through negotiation on a case-by-case basis. This degree of flexibility contrasts with the prescriptive model adopted by most other states, where offset policy is characterised by inflexibility and penalties. Singapore's offset model appears to have worked well, with one observer arguing that offset has been a major contributor in the rapid build-up of defence-industrial capacity (Bitzinger 2013). The offset-related technology transfer process follows the conventional pattern, whereby major overseas acquisitions commence with ST Engg staff embedded in the 'first of series' production located at the overseas contractor's manufacturing/integration facility. The learning process enables acquisition of essential skill sets that can be applied in the integration of Singaporean designed systems in subsequent local ST Engg series production, as occurred, for instance, in the naval programme to build six *Formidable* class stealthy frigates based on the French *La Fayette* design. Moreover, offset deals have occasionally been arranged to facilitate training, as in the case of the F-16A fighter transfer to Thailand that afforded Singapore access to Thai training areas for 15 years (Palavenis 2022).

In 2017, Singapore's Defence Minister Ng argued that . . . 'Singapore can lead in defence technology, even though we are small' (Singapore Ministry of Defence 2017). In pursuit of this goal, ST Engg is critically engaged in sponsoring the evolutionary incubation and maturity of leading-edge defence systems, and does so in cooperation with its technology partners, home and abroad. ST Engg contributes to the internal dynamics of the domestic defence ecosystem, by reference to the interdependency of SAF users, technology agency developers and supply chain producers. However, as has been argued elsewhere, perhaps a more 'inclusive' rubric is of a defence-industrial ecosystem, reflecting on the one hand, the network of overseas trading partners and collaborators, and, on the other, domestic stakeholders, embracing policymakers, funders, producers and defence-related R&D organisations (Matthews and Koh 2019). Supporting the intense institutional R&D effort, ST Engg spends between 4-5% of its revenue on R&D and 75% of that is focused on digital technologies (Lee 2017, 2021).

National Service

According to MINDEF, 'Deterrence is provided by developing a strong and capable SAF . . . through the institutions of National Service and Total Defence' (Loo 2019). Yet, while National Service (NS) has been the cornerstone of Singapore's defence and security since independence, its origins predate 1965 given that conscription was first introduced by the British colonial power through the 1954 National Service (Amendment) Bill. It led to rioting by Chinese students, who were against enforced conscription, but newly independent Singapore continued with the policy, launching the March 1967 National Service (Amendment) Bill. Since then, more than a million male Singaporean and permanent residents have served National Service, and in 2022 full-time National Servicemen numbering around 350,000 and serving two years over a 10-year cycle (up to 40 days per year), formed the bulk of the Armed Forces when fully mobilised (Lim 2022). While enlistees can serve in the military, police and the Singapore Civil Defence Force, most are deployed to the SAF.

Although conscription is now a rarity in many western nations, in Singapore it is viewed as an essential component of national security, providing rapid and robust responses to external and internal threats. As with fellow small states, Sweden, Switzerland and Israel, conscription is viewed as the mechanism for quickly building up a large military force necessary for deterrence. However, it also contributes to the creation of a national identity that cuts across ethnic, class, religious and ideological fault lines, bolstering social resilience against instabilities (Neo 2020). MINDEF applies the concepts of universality and equity to ensure that no liable male citizen is exempted from conscription to secure public acceptance of National Service as a valuable national institution (Lau 2019). Application of this rule is rigorously implemented and monitored: initially, exemption from NS was allowed for working males who were sole 'breadwinners' and students awaiting university

enrolment, but this was later amended to selectively capture graduating students; exemption for males reaching 18 years old through overseas study was disallowed in 1970; there are also no grounds for conscientious objection; and strong penalties are imposed on defaulters (Lau 2019). Women are welcome to become part of the SAF as volunteers and regulars, but there is hesitancy to enlist women into NS, as according to Defence Minister Ng Eng Hen, the societal cost 'would far outweigh any benefits', this judgement being rationalised on the basis that it would delay women's entry into workforce, reduce household income and worsen human resource shortages going forward (Kok 2022). Similarly, transgender women (transitioning from men to women) who declare themselves to be 'trans' before enlistment, will not be required to serve in NS (MINDEF 2016). By contrast, transgender men (transitioning from women to men) who have legally changed their sex will automatically receive an enlistment letter in the mail and can serve if they so wish; there, nevertheless, remains concern that usage of male barracks and common showers may allow sexual assault (Transgender SG 2022). Meanwhile, there is no published protocol on dealing with homosexuality or sexual orientation on the websites of MINDEF and the SAF.

Economic Pillar

Singapore's ability to grow its defence capability rests on the health and vibrancy of its economy. In terms of resilience, the Economic Pillar is critical in order to create and sustain the wealth required to achieve high levels of prosperity. However, Singapore is a small island state, lacking self-sufficiency, and therefore has no choice but to be integrally networked into the global economy. This dependence means that the authorities must stockpile essential supplies of food, medication and personal protective equipment to protect against international supply chain fragility. Indeed, since independence, of even greater concern has been the critical scarcity of water resources, with the principal supplier, Malaysia, repeatedly threatening to cut-off Singapore's vital water supply (Long 2001; Chakraborti and Chakraborti 2018). Water security has thus become a fundamental component of economic security, and, in turn, national security. There remains a heavy reliance on imported water from Malaysia, but the latter's monopoly position has lessened due to Singaporean efforts to conserve and diversity, principally via desalination.

The economic pillar also supports military capability. Indeed, one of the enduring lessons of war is that it revolves around three things: money, money and more money (St Clair 2008). Singapore subscribes to this view, espousing the virtues of a strong economic foundation, built upon sound policies and practices, to encourage the search for competitiveness and withstand financial shocks. Therefore, as with Japan's historic thesis: 'Rich nation, Strong Army', there is a recognition that economic strength depends on military power and vice versa (Samuels 1994). Since independence, therefore, the Singaporean government has adopted an interventionist and non-dependent approach to economic, industrial and technological development. The government has proactively sought to evolve dynamic comparative advantages, moving the economy from the initial cash-crop agricultural stage, through manufacturing to specialisation in services. Singapore has now entered the fourth knowledge-intensive stage, focusing on R&D, STEM activities, bio- and nano-technology, cyber, Artificial Intelligence, Space and the broad span of digital systems.

Dynamic economic growth and development represents the catalyst for successful attainment of social cohesion, resilience and the smooth functioning of the defence ecosystem. During the early post-independence period, Lee Kuan Yew's government adopted a 'developmental' approach to macroeconomic management, investing heavily into human capital. As people represent Singapore's sole natural resource, there was/is a recognition that ingenuity and creativity represent the principal mechanisms for generating value added. As far back as 1991, Singapore's Strategic Economic Plan was structured around eight strategic thrusts, including a major focus on human capital, Research and Development (R&D) and the fostering of indigenous supply chains through industrial and technological clusters. Policy initiatives to create and support development of specified 'strategic' industries were prioritised, including, for instance, the high technology aerospace,

maritime and electronics industries. The Strategic Plan was implemented in concert with a Science and Technology Plan to ensure that elevated R&D investment, quantitatively and qualitatively, enhanced the intensity of local research and scientific capability. Undoubtedly, Singapore's push for technological advancement was influenced by fellow small nation, Israel, where 'National Security through economic means' has long been viewed as a critical component for enhancing educational opportunity and strengthening social cohesion in the pursuit of technological innovation (Eisenkot and Siboni 2019).

To foster and, indeed, accelerate indigenous technological progress, Singapore established the Economic Development Board (EDB) in 1961. Its purpose was to identify and orchestrate the development of strategic industries. Defence and aerospace were interpreted as strategically integrative industries, enjoying technological synergies that straddle the civil-military divide. EDB was thus instrumental in establishing an advanced aerospace industrial cluster at the old WWII Seletar Park airfield. EDB's 'visible hand' market intervention was aimed at facilitating capability development, through government funding and business incentives in the form of concessionary loans and training grants. An interventionist approach was adopted to ensure that major overseas players, such as Rolls-Royce, Airbus, Boeing and Thales, along with local contractors were attracted to this dynamic aerospace cluster. Presently, the EDB supports next-generation aerospace capacity enhancement, including the creation of a future Advanced Air Mobility hub at the Seletar Aerospace complex. With EDB support, Singapore gained the distinction of becoming the 2019 World Economic Forum's first ranked Globally Competitive nation and second ranked Advanced Manufacturing Readiness nation (EDB Singapore 2020). Moreover, in terms of cutting-edge dual-use technology development that contributes to both civil and military development, Singapore's Defence Science and Technology Agency (DSTA) has invested in 'deep' technology companies through CapVista, its strategic investment arm, and has an enterprise portfolio which includes, for example, Atomionics, a start-up enterprise developing quantum sensors that allow navigation without GPS (Prime Minister's Office of Singapore 2021).

Civil Pillar

Civil defence is the umbrella term covering the front-line activities of Singapore's Police Force and Civil Defence Force when addressing national crises, especially the provisioning of safety and basic needs, enabling the population to quickly return to normalcy. Civil defence provides training to support the civilian population in rescue work, evacuation procedures, shelter management, first-aid, damage control and the management of blood, water and food resources, all aimed at instilling confidence and resilience in times of national crisis (Singapore Ministry of Defence 2004). The population is encouraged to contribute to civil defence through good citizenship activities that include blood donations and broader medical voluntary work, providing a second line of support in the defence of Singapore. There is a civilian-led Advisory Council on defence-related Community Relations to help build public awareness and devise a media strategy delivered by Members of Parliament and community leaders. Civilian leadership is held to be critical, not only in promoting the Total Defence Strategy, but also as a means of boosting local and community ownership.

Social Pillar

Singapore's numerous diverse ethnic groups and multi-religious communities provide a possible breeding ground for disruption to national unity, particularly if social 'alienation' is left to fester. Thus, the purpose of social defence is to maintain social cohesion, harmony and tolerance among Singapore's different ethnic communities, as means of facilitating national unity and stability. The government defines social defence as an 'effort to understand differences between distinctive races and cultures, so that all segments of society are united under the same flag' (Singapore Ministry of Defence, 2021a). The authorities prioritise racial and religious harmony by aiming to treat all ethnic

groups fairly, not just because it is morally correct, but because it represents a political, economic and foreign policy imperative to ensure continued prosperity and survival. Singapore engages religious leaders in interfaith sessions and encourages the presence of inter-religious organisations. There are also activities designed to promote the sharing of kindness in society and neighbourhood meal-sharing (Teo 2016). Importantly, such policy efforts look to be working, as evidenced by an IPSOS survey conducted in 2020, which asked the question: what is considered to be important in establishing a Singaporean identity? Three in five respondents highlighted the key determinant to be cultural pluralism through a tolerant multiracial and multi-religious society (IPSOS 2020). Indeed, Singapore seeks to maintain internal stability within the boundaries of national security through policies aimed at promoting social cohesion and harmony, as a means of underpinning conventional military defence.

These social integration policies are laudable, but mask what appears a growing undercurrent of discontent arising from the evolving contradictions between Singapore's defence pillars. For instance, since independence, the economic pillar has delivered stellar results, achieving high and sustained economic growth, full employment, rising skill-intensity and competitive output that combined have acted to keep a lid on inflationary pressure. The continuous growth and prosperity afforded PAP its governing legitimacy, with no other party gaining power since 1959 (Jayakumar 2022). The concern, however, is that the model's success was a 'child of its time'. According to Krugman, Singapore's economic growth between 1966 and 1990 was driven not by efficient resource utilisation but rather by resource mobilisation through expansion of employment, increases in education levels, and, above all, massive investment in physical capital (Peng and Phang 2018). As the effects of mobilisation began to dissipate in the early years of the Millennium, the government prioritised investment to promote compensatory productivity. While this approach proved resilient during the late 1990's Asian economic crisis, subsequent external shocks have revealed cracks in the economic model, undermining social cohesion. Growth continues to be positive, but anaemic – and not because of external demand constraints, but rather because low growth has become the 'new normal' (Sheridan 2015). The enduring economic malaise has given rise to criticism that the social compact is broken; that the system has become ossified, calcified and atrophied, where internal debate has sclerotised in the absence of flexibility and energy to challenge the core ideologies (Guest 2020).

The economic problems, moreover, continue to mount, externally, in the aftermath of the COVID-19 pandemic and the Russian-Ukraine war, leading to the breakdown of the global trading system and the disintermediation of global manufacturing chains, and, internally, through declining fertility rates and an ageing population. Government efforts to recruit migrant labour to maintain employment levels commensurate with growth have ignited anti-foreigner sentiment, the antithesis of national unity. Foreign workers are accused of exacerbating the accommodation shortage and depressing wages, creating social unease which has been driven by a surge in Singapore's immigrant population, such that between 2000 and 2010, it nearly doubled from 755,000 to 1.3 million, not counting foreign-born citizens given permanent residence status; and, as of June 2019, it had reached 3.5 million citizens, comprised of 530,000 permanent residents and 1.7 million foreign workers, students and dependents (Guest 2020). The consequent social resentment that has erupted found expression at the 2020 general election, when the PAP was returned to power but with a nearly 10 percent reduction in vote share compared to 2015 (Jayakumar 2022). Voters appear to be turning away from traditional stoic acceptance of their collective lot, and in the face of economic hardship and social challenges are increasingly demanding fairness, transparency and a democratic voice (Barr 2016)

Psychological Pillar

The principal aim of psychological defence is to create a collective will and commitment among Singaporeans to protect independence. The Psychological Pillar is focused on the need to strengthen

the resolve and resilience of Singapore's citizens in the face of unexpected crises, and in this regard appears to emulate Finland's psychological defence framework (Aw 2018). Singapore's Second Minister for Defence Ong Ye Kung described Psychological Defence as the most important pillar of peacetime defence because it strengthens the ability of people to trust each other, have faith in societal and government institutions and be resilient in the face of discontents sowing discord and causing fissures in society (Zhang 2018). He later described the concept as a 'well-established social compact, which forms the bedrock of social cohesion and psychological resilience of the people . . . a cultural ballast, arguably stronger than military defence' (Zhang 2018). The official website of the Singaporean government identifies 'pride in being a Singaporean' as the principal tenant of psychological defence, and the main enabler to understanding the island state's historical struggles, its leadership and the constitutional principles and cultural mores that have helped Singapore to achieve defence, development and diplomatic success (Singapore Ministry of Defence, 2021b). The aim is to nurture a sense-of-belonging and nationalism so if a threat jeopardises Singapore's national interests, the people will have the confidence, courage and collective will to counter that threat. This resilience is deemed essential in supporting rapid resource mobilisation as a means of overcoming crises (Nair 1995; Kong 1995; and Ho et al. 2020). Minister Ong Ye Kung broadens the approach by asserting that psychological defence is necessary to suppress the fast spread of fake news influencing public opinion and the national interest, jeopardising both government legitimacy and national identity (Zhang 2018).

In a bid to strengthen the country's psychological resolve, the government has launched two key laws in recent years: the 2019 Protection from Online Falsehoods and Manipulation Act (POFMA) and the 2021 Foreign Interference (Countermeasures) Act. This legislation followed a heated domestic debate over Singapore's national identity built on a multi-ethnic and multi-cultural society. The event which triggered this bout of serious introspection was the Island state's squabbles with China during the 2016-17 South China Sea dispute. The debate centred on the role of Singapore, given its majority ethnic Chinese population, when addressing Asia-centric Chinese geopolitics. Singapore's prime minister Lee Hsien Loong gave a speech in September 2017 that specifically touched on race and multiculturalism in the country, with the plausible intention of signalling to both domestic and external audiences that the country's sovereign identity reflected a multi-ethnic and multi-cultural society, and should not be construed as a 'Chinese society' (Singapore Ministry of Defence 2017).

As mentioned, Singapore's Psychological Defence Pillar mirrors the Finnish Total Defence model. Yet, emulation of Finland's cultural and psychologically cohesive 'Sisi' attitude will only work in the Singaporean context if there is trust in government policymaking. Singapore's changing political landscape, and, particularly, the PAP government's seeming inability to push through unpopular policies without backlash (Peng and Phang 2018), is due to a fracturing of consensus as national identity dilutes. Lee Kuan Yew's post-independence economic model was initially forged from a mixture of socialist nationalism and paternalistic authoritarianism (Guest 2020), but this gave way in the 1990's to right wing neoliberal policies based around individuality and materialism. The legitimacy of this approach was uncontested when growth was robust but the present era of occasional recessionary and generally lower growth conditions is potentially leading to a questioning of Total Defence precepts, including: the process of HDB homes in lieu of pensions losing value as leasehold life declines and values erode, leaving owners in retirement with a depreciating asset and a diminished pension pot (Guest 2020); rising individualism, consumerism and nonconformity to authority, especially among younger citizens (Ng 2014), accelerating the family's diminishing status; and the serious impact of both declining birth rates and historically high death rates due to an ageing population, exerting further inward migration pressures to maintain output (Tan 2021).

The resultant increased dependence on 'foreigners' to fill jobs amid population shortfalls appears to be leading to divisions within society, and as numbers grow, inevitably their share of socio-economic assets and resources will expand, causing further resentment and heightened calls of 'Singapore for Singaporeans' (Han 2013). This anti-foreigner sentiment has even touched the Military

Pillar through the so-called 'jobs for foreigners, national service for locals' debate (MINDEF 2022; Ng 2022; Ong 2021b). In short, Singapore appears a victim of its own success. Subscription to the neoclassical model has encouraged individual pursuit of wealth that has weakened commitment to collective responsibility, leading to the consequent loss of national identity. This threatens societal consensus, community ideals, strong national identity and a sense of belonging and patriotism to Singapore, on which the integrity of the Psychological Pillar and Total Defence depends. Thus, if consensus crumbles, then the tenure of the ruling 'elites' is threatened, with only greater political liberalisation offering a solution (Ortmann 2009).

Cyber (Digital) Pillar

Singapore's sixth defence pillar is Digital Defence, and this addresses the population's 'post-truth' awareness of the full gamut of digital and hybrid cybersecurity threats, including misinformation, phishing scams and cyberattacks. Singapore has invested heavily in technically complex information systems that are ubiquitous in the commercial sector, but have vulnerabilities, and these may be exploited to threaten Total Defence. This may happen in a number of ways, such as cyberattacks by political opposition groups aimed at weakening the fabric of psychological defence by using social media to distort narratives and undermine trust in government. Similarly, social defence may be threatened if a false picture of reality is communicated, threatening multicultural consensus, harmony and community cohesion; civil defence may crumble in the face of cyberattacks aimed at disrupting civil infrastructure, including energy, water, food, transportation and fuel. Economic defence might also suffer through economic cyber espionage and attacks on the country's financial system. Finally, military defence will be impacted if operational readiness is impaired by cyberattacks on the SAF's C4ISR capabilities (Raska 2016).

The priority accorded to digital defence is evidenced by mandatory cybersecurity training for all civil servants, and is additional to regular cybersecurity audits of state infrastructure, affecting all segments of Singapore's emerging digital economy. With the ever-growing pressure of global connectivity, the need for building a strong digital security architecture and an increased awareness of online threats is urgently needed as the nation advances towards a digital future. During the launching of Digital Defence, the Minister-in-Charge, S. Iswaran, explained that Singapore is an open and connected city-state, which is relentlessly exploring new ways of improving the quality of lives through creating opportunities in the digital economy for businesses and people (MINDEF 2019). The aim is also to transform Government into a digital organisation, delivering better services for citizens, and encouraging digital readiness of Singaporeans in order to exploit opportunities associated with technological advancement. However, pursuit of the vision to become a smart digital nation comes with increased vulnerability. This includes cyberattacks to disrupt entire systems and hostile information campaigns that can sow seeds of distrust and division in the community, thus weakening social cohesion (Singapore Ministry of Defence 2021b). The government also consistently promotes awareness of phishing attacks and internet scams, responsible social media usage, robust cybersecurity practices to protect personal data and systems, and the construction of effective recovery plans for resilient responses to cyber catastrophes.

Notwithstanding the above cybersecurity measures, cyber threats are expanding. As a result, Singapore's Cyber Security Agency (CSA) has recently launched Cybersecurity Strategy 2021, outlining the country's updated goals and policies toward addressing rapidly evolving strategic and technological challenges, including future pandemic crises similar to that of COVID-19. The approach emphasises the importance of three primary enablers, building resilient infrastructure, enabling a safer cyberspace and enhancing international cyber cooperation. Additionally, there are two foundational enablers, namely, development of a vibrant cybersecurity ecosystem and creation of a robust talent pipeline. The government plans to take a more proactive stance towards addressing cyber threats, as well as advancing international norms and standards on cybersecurity (CSA Singapore 2021). Singapore is not immune to global 5 G competitive pressures, and has therefore

issued Guidelines for Critical Information Infrastructure Owners to identify threats that may be introduced into systems connected to 5 G services along with recommendations to mitigate the risks of such threats. Finally, citing the cyber-attacks linked to the Russia-Ukraine War, and as part of 'SAF 2040' (the city-state's vision for its armed forces in 2040), Singapore plans to establish a 'Fourth Service' (digital security), aptly named the Digital and Intelligence Service (Palanisamy 2022).

Future Development Trajectory . . .

Singapore's future development imperative is to aggressively pursue dynamic technological comparative advantages in knowledge-intensive capability domains. It is intended that the process will exploit civil-military synergies, and induce technology multipliers that will prove difficult for commercial competitors and military foes to easily duplicate. The strategy will overcome manufacturing limitations imposed by smallness and constrained scale, and strengthen Singapore's international reputation and 'brand' in the high-end engineering, science and technology space. Indeed, the specific focus on cyber security reflects a Singaporean acknowledgement that the future will be grounded on the evolution of 4th Industrial Revolution (4iR) technologies. This will be supported by the 5,000-strong community of defence engineers and scientists, along with the preparedness of government to expand defence scholarships and awards by 40 percent over the coming years to 2025 (MINDEF 2017). One such 4iR technology is Artificial Intelligence (AI), which features prominently in Singaporean high technology planning. Two new laboratories have been established: the first is the DSO robotics laboratory and the second is the DSTA lab, with both aimed to exploit AI and data analytics (MINDEF 2017). Singapore has developed a National AI Strategy that aims to propel the country to the forefront of developing and deploying scalable and impactful AI in high value sectors. The government has committed to investment of S$680mn in this field, with the first S $500mn funded through the Research, Innovation and Enterprise 2025 Plan for AI research and development, and the remainder through the National AI Programme in Governance and Finance (Spencer 2021). These investments support studies to address the challenges of AI adoption, transnational research in key sectors and industry-research collaboration to accelerate the adoption of such technology.

Another 4th generation technology domain exemplifying the brave new world of futuristic dual-use technologies is space. Singapore is a late entrant into the space sector, only engaging in 2003, attracted not only by security imperatives but also by the high skill and capability spin-offs. EDB established the Office for Space Technology and Industry (OSTIn) in 2013 and was the principal sponsor of investment into the industrial and technological infrastructure of space, aimed at attracting foreign expertise as well as cultivating local endeavour. The space programme was kick-started by an initial modest investment to develop a locally built satellite X-SAT, and a subsequent range of small satellites, ranging in weight from 1 kg to 400 kg (Low 2017). Singapore's space industry now employs 1,000 people across 30 companies, and has launched 13 satellites since 2013 (EDB Singapore 2019). In 2022, the Singaporean government announced it had signed an Artemis Accord of shared vision into space exploration, the first Southeast Asian state to sign such an agreement (NASA 2022). Additionally, the National University of Singapore's Centre for Quantum Technologies, and its spin-off company SpeQtral, have leveraged quantum cryptography to explore its application in secure communications of sensitive data, including space satellite systems (SpeQtral 2022).

To achieve its ambitious next-generation technology policy goals, the government intends to maintain this high investment tempo in R&D-intensive capabilities. A trend of remarkable progress has already been achieved. For instance, between 1998 and 2020, the number of Singaporean researchers per 1,000 of the labour force has doubled; over the past five years, 19% of the country's scholarly papers are in the top 10 percent of the world's most highly cited publications, on par with Switzerland and Holland; business expenditure on R&D has grown from S$1.5bn in 1998 to S$5.6bn in 2018; and, partially as a consequence of the aforementioned achievements, the island-state has

become the top innovative nation in Asia-Pacific, according to the World Intellectual Property ratings compiled by Cornell University and INSEAD (National Research Foundation 2020). Going forward, there is evidence to suggest that this momentum will be maintained. The UNESCO Institute for Statistics estimated Singapore's 2019 R&D investment was 1.89 percent of GDP, which is just below the world average of 1.93 percent (UNESCO, 2022).

The aim is to intensify efforts and further entrench a research culture into the economy. This is reflected in the December 2020 announcement by Mr Heng Swee Keat, Deputy Prime Minister and Chairman of the National Research Foundation (NRF), of enhanced funding for the Research, Innovation and Enterprise (RIE) 2025 Plan (Research 2020). The Singaporean Government aims to invest about 1 percent of GDP, or S$25bn across 2021-2025 solely in RIE programmes (National Research Foundation 2020). The 2021-25 RIE budgetary plan will comprise the following allocations: S$7.5bn to strengthen core research capabilities in universities and A*STAR research institutes; S $6.5bn for mission-oriented research; S$5.2bn to establish new I&E platforms, strengthen innovation capabilities and develop entrepreneurial talent; S$2.2bn for postgraduate programmes and I&E talent development; and S$3.75bn to support prospective future emerging opportunities (National Research Foundation 2020). A related policy dimension of Singapore's institutional research agenda is CREATE. The acronym stands for the 'Campus for Research Excellence and Technological Enterprise', representing what the government terms Singapore's international research 'collaboratory' (National Research Foundation 2020). CREATE is home to research projects, established in cooperation with leading global universities and research institutions, to tackle common priorities. Existing CREATE partnerships embrace organisations from ETH Zurich (Switzerland), Cambridge University (UK), Shanghai Jiao Tong (China) and MIT (US). Much of the above investment is focused on civil science and technology endeavours, but because of the interlay of civil-military industrial and knowledge structures, beneficial technology 'spin-ons' are inevitable.

From the defence perspective, Singapore's defence R&D spending recorded a steep 98 -percent year-on-year growth, from US$215mn in 2020 to US$425mn in 2021 (Asia Pacific Defence Reporter 2021). As with CREATE, the defence research emphasis is on high level international cooperation initiatives. A major player is DSO National Laboratories, Singapore's largest defence R&D organisation, with a critical mission to develop technological solutions necessary to sharpen the cutting edge of Singapore's national security. In this regard, international collaboration forms a strong foundation in the cross-pollination of knowledge and ideas for innovative research and development. DSO collaborates with renowned research institutions and defence industries in Australia, France, Germany, India, Italy, Sweden, South Korea, the UK and the US. For example, a major DSO research collaboration is termed the Centrale-Supélec ONERA NUS DSO Research Alliance (SONDRA), which conducts research in areas important to Singapore's national defence and national security. This multi-alliance collaboration focuses on high tech projects, including electromagnetic signal propagation modelling, compact antenna design, radar concept studies, Advanced Radar Detection in Urban Terrain, Ricin Diagnostics and Fibre Laser projects conducted through French doctoral research programmes. The priority that Singapore attaches to innovation-inducing cooperation with overseas high tech companies is reflected by the fact that 80 of the world's top 100 technology companies have established a presence on the island-state (National Research Foundation 2020). More specifically, in 2020, SIPRI ranked Singapore's defence industry as one of the most globalised in the world (in terms of numbers of overseas defence companies operating onshore) (Béraud-Sudreau et al. 2020).

These future-oriented initiatives essentially come under the harder-edge Military, Economic and Digital Pillars of Total Defence. The Civil, Social and Psychological dimensions will also require strengthening going-forward, especially with regard to lessons learned during the recent COVID-19 crisis. From the civil perspective, the concept of 'partnership' through inter-agency support teams will likely endure, with personnel from Singapore's Civil Service Defence Team, supplemented by uniformed officials from the Prisons Service, Immigration and Checkpoints Authority, Narcotics Bureau and the Singapore Police providing a fast response to emergencies (Soh 2023). However,

the pandemic's challenges were also addressed by a deepening social consensus across Singaporean society that went beyond the coordinated actions of the uniformed services. Government provided the necessary adaptive leadership, emphasising the importance of regular and clear communications to reassure an anxious population. The greater inter-agency engagement, reflected a 'joined-up -whole-of-government' approach, especially in the provision of effective support for the vulnerable segments of society.

Moreover, Singapore's Total Defence Pillars are not mutually exclusive, and while there might be contradictions between economic and social outcomes, there can also be positive reinforcement effects through flexible contingency responses (Soh 2023). Panic-buying of food/energy, for example, can be reduced through economic foresight planning. Singapore is a small state where local scalability of vital resources is not feasible, and dependence on overseas supply is thus unavoidable. The problems are compounded by the present fragility of global supply chains, obliging the government to 'red team' creative solutions to reduce dependence and seek greater supply diversity. An example of such forward thinking is the initiative to reduce dependence on food imports through a new '30 by 30' policy framework. The aim is to develop a R&D-intensive high-tech agri-food hub as the motive force to drive the development of a local and sustainable agri-food industry producing 30 percent of the country's nutritional needs by 2030 (Singapore Food Agency 2022). Additional complementary plans have been instituted to diversify foreign food supply sources and improve domestic logistical efficiencies in warehousing, stockpiling and port distribution procedures (Singapore Government 2022).

There is no doubt that such strategic planning will deepen trust in the far-sightedness of government, and its commitment to deliver on Social and Psychological Defence. Its plans to strengthen resilience are focused on achieving a return to a long-term trend of economic growth to ensure greater, more equal and more inclusive opportunities for all sectors of society, including women (Singapore Government 2022/23). Finally, given increasing global concern over environmental sustainability, alongside Singapore's reputation for pro-active thought-leadership, it is likely there will be a 7th Climate Pillar in the not too distant future; indeed, the policy foundations to promote the country's environmental security credentials have already been laid through the government's 2021 launch of Green Plan 2030 (Singapore Government 2021).

Conclusions

The purpose of this paper has been to evaluate Singapore's 'Total Defence' strategy. The model was launched in 1984 and was framed by reference to the Swiss and Swedish models, and to some extent also the Finnish approach. All refer to the importance of civil and psychological defence and all have recently added digital/cyber security to their respective Total Defence frameworks. The concept of Total Defence resonates with contemporary policy emphasis on broadening the definitional scope of national security by providing a template for the pursuit of national unity, social cohesion, civil resilience, economic strength and military power. The Singaporean strategy is formulated around six distinct but interrelated 'defence' pillars that reflect the island state's collectivist and consensual civil-military development approach. To this point, the social attributes of the strategy have acted to support and strengthen advances in both traditional defence and the broader economy. Technology has been the common thematic in the development process, and, from the paper's analysis, it is clear that the policy priority accorded to R&D and technological innovation has proved pivotal in evolving dynamic civil-military comparative advantages. This is important, because knowledge-intensive civil-military development will overcome the lack of critical mass and scale, and leverage global high tech economic and defence partnerships. Government-sponsored investment guided through a long-term strategy is directed towards ensuring continuation of this dynamism into the future, projecting Singapore into next generation higher value technological fields of endeavour.

Yet, the resilience of the Total Defence model is dependent on the sum of its parts. The separate pillars do not operate in isolation and weaknesses emerging in one domain will impact on others.

Singapore's strong economy, which has assumed almost mythical status among foreign observers since the 1960s, is now faltering. Economic growth is slowing, there is a cost of living crisis and asset values are eroding. Economic headwinds have made the other pillars less stable. The social compact is under threat, with trust in government seemingly waning, following contentious decision-making, especially in the demographic and immigration spheres. There is a danger of knock-on impacts affecting the Psychological Pillar through the fracturing of cultural consensus and national unity. The societal ties that bind together the diverse elements of community life, including ethnic minorities, may potentially be starting to unravel. Singapore's present turbulent environment begs the policy question as to whether 'Total Defence' strategy has worked to this point simply because of conducive politico-economic and cultural conditions. The changing global and national context is creating a broad range of security pressures, and government policymaking is responding with positive responses, but there will need to be a continuum of nimble, reflexive and balanced measures to ensure that the reservoir of trust is maintained and the integrity of the Total Defence Pillars endures.

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References

Akaha, T. 4 April 1991. "Japan's Comprehensive Security Policy." *Asian Survey* 31 (4): 324–340. doi:10.2307/2645387.

Asia Pacific Defence Reporter. 21 October 2021. "Singapore Defence Spending to Grow at 10.77% CAGR Through 2026." Accessed 13 July 2022. https://asiapacificdefencereporter.com/singapores-defence-spending-to-grow-at-10-77-cagr-through-2026/

Avila, A., and R. Matthews. 2022. "The Philippine Defence-Development-Disaster Security Paradigm." *Defence and Security Analysis* 38 (3): 269–283. JuneJuly Accessed 13 2022. doi:10.1080/14751798.2022.2085538.

Aw, C. W. 15 February 2018. "Drive to Build-Up Social, Psychological Defences." *The Straits Times*. Accessed 10 November 2022. https://www.straitstimes.com/singapore/drive-to-build-up-social-psychological-defences

Ayoob, M. 1997. "Defining Security: A Subaltern Realist Perspective." In *Critical Security Studies*, edited by K. Krause and M. C. Williams, 130. Minneapolis, MN: University of Minnesota Press.

Baharudin, H. 14 February 2019. "Digital Defence to Be Sixth Total Defence Pillar, Signalling Importance of Cyber Security." *The Straits Times*. Accessed 10 November 2022. https://www.straitstimes.com/singapore/digital-defence-to-be-sixth-total-defence-pillar-signalling-the-importance-of-cyber

Baldwin, D. A. 1995. "Security Studies and the End of the Cold War." *World Politics* 48 (1): 122. doi:10.1353/wp.1995.0001.

Barr, M. D. 2016. "Ordinary Singapore: The Decline of Singapore Exceptionalism." *Journal of Contemporary Asia* 46 (1): 1–17. doi:10.1080/00472336.2015.1051387.

Béraud-Sudreau, L., A. Marksteiner, D. Lopes da Silva, N. Tian, A. Kuimova, P. D. Wezeman, and S. Wezeman. December 2020. *International Presence of the World's Largest Arms Companies* 22. Stockholm, Sweden: SIPRI Insights on Peace & Security. 2020/12.

Bitzinger, R. 2013. "Revisiting Armaments Production in Southeast Asia: New Dreams, Same Challenges." *Contemporary Southeast Asia* 35 (3): 369. doi:10.1355/cs35-3c.

Bitzinger, R. A. 2021. "Military-Technological Innovation in Small States: The Cases of Israel and Singapore." *Journal of Strategic Studies* 44 (6): 873–900. doi:10.1080/01402390.2021.1947252.

Buzan, B. 1990. *The Case for a Comprehensive Definition of Security and the Institutional Consequences of Accepting It*. Copenhagen: Centre for Peace and Conflict Research.

Buzan, B., edited by. 1991a. *People, States and Fear: An Agenda for International Security Studies in the Post-Cold War Era*. Boulder: Lynne Rienner.

Buzan, B. 1991b. "New Patterns of Global Security in the Twenty-First Century." *International Affairs* 67 (3): 431–451. doi:10.2307/2621945.

Chakraborti, T., and M. Chakraborti. 2018. "Water-Sharing Saga Between Singapore and Malaysia: A Historical Discord Revisited." *Asian Politics & Policy* 10 (1): 36–55. doi:10.1111/aspp.12373.

CSA Singapore. 2021. *The Singapore Cybersecurity Strategy 2021*. Accessed 16 July 2022. https://www.csa.gov.sg/News/Publications/singapore-cybersecurity-strategy-2021
Defense News. 2022. Accessed 22 July 2022. https://people.defensenews.com/top-100/
EDB Singapore. 2019. *Office for Space Technology and Industry*. Accessed 16 July 2022. https://www.edb.gov.sg/content/dam/edb-en/our-industries/aerospace/OSTIn-brochure.pdf
EDB Singapore. 2020. *Singapore Asia's Aerospace Hub*. Accessed 16 July 2022. https://www.edb.gov.sg/content/dam/edb-en/our-industries/aerospace/EDB-Aerospace-Industry-Brochure.pdf
Eisenkot, G., and G. Siboni. 2019. "*Israel's National Security Strategy*. The Washington Institute for Near East Policy." *Policy Focus* 160: vii. (October).
Fischer, D. 1982. "Invulnerability Without Threat: The Swiss Concept of General Defense." *Journal of Peace Research* 19 (3): 205–225. doi:10.1177/002234338201900301.
Guest, P. 22 January 2020. "Is Singapore's 'Perfect' Economy Coming Apart?" *Asia Nikkei*. Accessed 10 November 2020. https://asia.nikkei.com/Spotlight/The-Big-Story/Is-Singapore-s-perfect-economy-coming-apart
Han, K. 18 February 2013. "Singapore's Population Debate Grows Heated." *The Diplomat*. Accessed 11 November 2022. https://thediplomat.com/2013/02/singapores-population-debate-grows-heated/
Ho, C. S. H., C. Y. Chee, and R. C. M. Ho. 2020. "Mental Health Strategies to Combat the Psychological Impact of COVID-19: Beyond Paranoia and Panic."*Annals Academy of Medicine* 49 (1): 1–6.
Hsiung, J. C. 2004. *Comprehensive Security: Challenge for Pacific Asia*, 3. Indiana: University of Indianapolis Press.
Human Development Report. 1994. "New Dimensions of Human Security." *UNDP*. Accessed 21 November 2022. https://hdr.undp.org/content/human-development-report-1994.
IPSOS. 2020. *Singaporeans on National Values and Identity*. Singapore: IPSOS. Accessed 13 July 2022. https://www.ipsos.com/en-sg/singaporeans-national-values-and-identity
Jayakumar, S. 3 March 2022. "Singapore's PAP: The Politics of Dominance." *The Diplomat*. Accessed 10 November 2022. https://thediplomat.com/tag/peoples-action-party/
Kok, Y. 2 August 2022. "Cost of Enlisting Women into NS, Even in Non-Military Roles, Far Outweighs Benefits: Ng Eng Hen." *The Straits Times*. Accessed 17 December 2022. https://www.straitstimes.com/singapore/politics/cost-of-enlisting-women-into-ns-even-in-non-military-roles-far-outweighs-benefits-ng-eng-hen
Kolodziej, E. A. 1992a. "Renaissance in Security Studies? Caveat Lector." *International Studies Quarterly* 36 (4): 421–438. doi:10.2307/2600733.
Kolodziej, E. A. 1992b. "What is Security and Security Studies? Lessons from the Cold War." *Arms Control* 13 (1): 1–31. doi:10.1080/01440389208403977.
Kong, L. 1995. "Music and Cultural Politics: Ideology and Resistance in Singapore." *Transactions of the Institute of British Geographers* 20 (4): 447–459. doi:10.2307/622975.
Laird, R. 20 April 2020. *Norway Releases Its Long-Term Defence Plan, 2020: Resilience as a Core Defense Capability*. 5, 16–17 and 31. Accessed 7 December 2021.https://sldinfo.com/2020/04/norway-releases-its-long-term-defence-plan-2020-resilience-as-a-core-defense-capability/
Larsson, S. 2020. "Swedish Total Defence and the Emergence of Societal Security," In *Nordic Societal Security*, edited by M. Rhinard, 45–67. London: Routledge.
Lau, A. 2019. "National Service and Citizen Soldiers: The Singaporean Experience of Military Conscription." In *National Service In Singapore*, edited by H. S. Huang and G. Ong-Webb, 3–34. Singapore: World Scientific Publishing .
Lee, H. L., 23 September 2017. "Race, Multiracialism and Singapore's Place in the World." *Prime Minister's Office*, Singapore. Accessed 16 February 2023. https://www.pmo.gov.sg/Newsroom/pm-lee-hsien-loong-pa-kopitalk-ci-yuan-cc
Lee, S. L., 16 November 2021. *ST Engg Technology and Innovation*. Accessed 23 May 2022. https://www.stengg.com/media/1318056/technology-innovation-by-group-chief-digital-technology-officer.pdf
Lim, M. Z., 14 February 2021. "Covid-19 Pandemic Reaffirmed Total Defence as Vital to Singapore: Ng Eng Hen." *The Straits Times*. Accessed 10 November 2022. https://www.straitstimes.com/singapore/covid-19-pandemic-reaffirmed-total-defence-as-vital-and-necessary-ng-eng-hen
Lim, M. Z., 20 March 2022. "What is the Future of Singapore's National Service as It Turns 55?" *The Straits Times*. Accessed 11 November 2022. https://www.straitstimes.com/singapore/a-look-at-the-future-of-national-service-as-it-turns-55
Long, J. 2001. "Desecuritizing the Water Issue in Singapore—Malaysia Relations." *Contemporary Southeast Asia* 23 (3): 504–532. doi:10.1355/CS23-3F.
Loo, B. 2004. "Explaining Changes in Singapore's Military Doctrines: Material and Ideational Perspectives." *Asia in the New Millennium: APISA First Congress Proceedings*. Singapore: Marshal Cavendish. 27–30.
Loo, B. 2019. "Goh Keng Swee and the Policy of Conscription." In *National Service in Singapore*, edited by H. S. Huang and G. Ong-Webb, 35–56. Singapore: World Scientific Publishing.
Low, K. S. 8 October 2017. "Commentary: How Singapore Can Be a Space Power, with Small Satellites." *Channel News Asia*. Accessed 24 May 2022. https://www.channelnewsasia.com/singapore/commentary-how-singapore-can-be-space-power-small-satellites-1001271
Manohara, C. 1998. "Defence Procurement and Industry Policy - a Singapore Perspective." *Defence and Peace Economics* 9 (1–2): 119–136. doi:10.1080/10430719808404897.

Matthews, R., and C. Koh. 2019. "Singapore's Defence-Industrial Ecosystem." In *The Economics of the Global Defence Industry*, edited by K. Hartley and J. Belin, 527–546. London: Routledge.
Matthews, R., and N. Zhang. 2007. "Small Country 'Total Defence': A Case Study of Singapore." *Defence Studies* 7 (3): 385. doi:10.1080/14702430701559289.
MINDEF. 1 May 2016. "Reply to Media Queries on Transgender Individual Serving NS." *Reply to Media Query*, https://www.mindef.gov.sg/web/portal/mindef/news-and-events/latest-releases/article-detail/2016/may/2016may01-media-queries-00035.
MINDEF. 3 Mar 2017. *Fact Sheet: Defence Technology is Key Enabler for Next Gen SAF*. https://www.mindef.gov.sg/web/portal/mindef/news-and-events/latest-releases/article-detail/2017/march/03mar17.
MINDEF. 15 February 2019. *Total Defence Strengthened with Addition of Digital Defence as the Sixth Pilllar*. Ministry of Communications and Information. Accessed 22 November 2022. https://www.mci.gov.sg/pressroom/news-and-stories/pressroom/2019/2/total-defence-strengthened-with-addition-of-digital-defence-as-the-sixth-pillar?category=Libraries&page=3
MINDEF. 2 August 2022. "Ministerial Statement by Minister of Defence Dr Ng Eng Hen to Clarify Liabilities and Contributions of New Citizens to National Service for Parliamentary Sittings." *Parliamentary Statements*. https://www.mindef.gov.sg/web/portal/mindef/news-and-events/latest-releases/article-detail/2022/August/02aug22_ps
Nair, E. 1995. "Conscription and Nation-Building in Singapore: A Psychological Analysis." *Journal of Human Values* 1 (1): 93–102. doi:10.1177/097168589500100109.
NASA, 29 March 2022. "Singapore Signs Artemis Accords." Accessed 22 July. https://www.nasa.gov/feature/singapore-signs-artemis-accords
Nathan, S. R. 2002. *Creating the Technology Edge, Singapore 1972–2003*. Singapore: DSO Laboratories.
National Research Foundation. 2020. "Research, Innovation and Enterprise 2025 Plan." *Prime Minister's Office*. Accessed 21 November 2022. https://www.nrf.gov.sg/
NATO Warsaw Summit. 8-9 July 2016. *Commitment to Enhance Resilience*. Accessed 10 November 2022. https://www.nato.int/cps/en/natohq/official_texts_133180.htm
Neo, I. 2020. "The Management of Threats in Singapore: Civil-Military Integration." *Singapore Policy Journal*. Accessed 29 July 2022. https://spj.hkspublications.org/2020/01/03/the-management-of-threats-in-singapore-civil-military-integration/
Ng, Y. Y. 31 December 2014. "Singapore's Biggest Test: Dilution of National Identity." *Today*. Accessed 10 November 2022. https://www.todayonline.com/voices/singapores-biggest-test-dilution-national-identity
Ng, P. S. 2005. "From 'Poisonous Shrimp' to 'Porcupine': An Analysis of Singapore's Defense Posture Change in the Early 1980s." *Working Paper*, 397. Strategic and Defense Studies Center: Canberra.
Ng, W. K. 2 August 2022. "Statements About NS Exemptions for New Citizens Misleading: Ng Eng Hen." *The Straits Times*. Accessed 11 November 2022. https://tnp.straitstimes.com/news/singapore/statements-about-ns-exemptions-new-citizens-misleading-ng-eng-hen
OEC database: Weapons in Singapore. 2022. Accessed 24 July 2022. https://oec.world/en/profile/bilateralproduct/weapons/reporter/sgp#:~:text=About&text=Exports%20In%202020%2C%20Singapore%20exported,most%20exported%20product%20in%20Singapore.
Ong, J. 30 January 2021a. "First Climate Change Motion to Be Debated in the House Next Week." *The Straits Times*. Accessed 10 November 2022. https://www.straitstimes.com/singapore/politics/first-climate-change-motion-to-be-debated-in-the-house-next-week
Ong, J. 24 September 2021b. "NCMP Leong Mun Wai Maintains Job Losses, Displacement are Due to Foreigners." *The Straits Times*. https://www.straitstimes.com/singapore/politics/ncmp-leong-mun-wai-maintains-job-losses-displacement-are-due-to-foreigners
Ortmann, S. 2009. "The Politics of Inventing National Identity." *Journal of Current Southeast Asian Affairs* 28 (4, December): 23–46. doi:10.1177/186810340902800402.
Palanisamy, B. 10 March 2022. "Singapore's Military Modernisation Program is Ambitious but Feasible." *The Diplomat*, Accessed 25 July 2022. https://thediplomat.com/2022/03/singapores-military-modernization-program-is-ambitious-but-feasible/
Palavenis, D. 2022. "Critical Factors Influencing the Development of Singapore's Defence Industry." *Security and Defense Quarterly* 38 (2). Accessed 28 July 2022. https://securityanddefence.pl/Critical-Factors-Influencing-the-Development-of-Singapore-s-Defense-Industry,149996,0,2.html.
Peng, N., and S. Y. Phang. 2018. "Singapore's Economic Development: Pro- or Anti-Washington Consensus?" *Economic and Political Studies* 6 (1): 30–52. doi:10.1080/20954816.2018.1426364.
Prime Minister's Office of Singapore. 2021. *Keynote Speech by Deputy Prime Minister and Coordinating Minister for Economic Policies Heng Swee Keat at the 3rd Singapore Defence Technology Summit on 13 October 2021*. Accessed 16 July 2022. https://www.pmo.gov.sg/Newsroom/DPM-Heng-Swee-Keat-at-the-3rd-Singapore-Defence-Technology-Summit.
Quah, J. S. T. 2018. "Why Singapore Works: Five Secrets of Singapore's Success." *Public Administration and Policy: An Asia-Pacific Journal* 21 (1): 5–21. Accessed 21 November 2022. doi:10.1108/PAP-06-2018-002.

Raska, M. 2016. "CO16156: Cyber Conflicts and Singapore's Total Defence Strategy." *RSIS Commentary*. 23 June. Accessed 29 July 2022. https://staging.rsis.edu.sg/v3/rsis-publication/rsis/co16156-cyber-conflicts-and-singapores-total-defence-strategy/#.YdWNxy-I1QI

Research,Innovation and Enterprise 2025 Plan. 2020. National Research Foundation, Singapore. Accessed 25 July 2022. https://www.nrf.gov.sg/docs/default-source/default-document-library/rie_booklet_fa2021_pages.pdf

Samuels, R. 1994. *Rich Nation, Strong Army: National Security and the Technological Transformation of Japan*. Ithaca, New York: Cornell Studies in Political Economy.

Sheridan, G. 20 November 2015. "Lee Hsien Loong's Lessons in Leadership from Singapore". *The Australian*. https://www.theaustralian.com.au/nation/inquirer/lee-hsien-loongs-lessons-in-leadership-from-singapore/news-story/2de91992d97fd7f5d0f599021d11b1e8

Singapore Food Agency. 2022. A Sustainable Food System for Singapore and Beyond. 11 November. Accessed 20 February, 2023. https://www.sfa.gov.sg/food-for-thought/article/detail/a-sustainable-food-system-for-singapore-and-beyond

Singapore Government. 2021. *Green Plan 2030*. Accessed 16 February 2023. https://www.greenplan.gov.sg/

Singapore Government. 2022. Food Supply Chain Resilience During and Beyond the Pandemic." 6 July. Accessed 16 February 2023. https://www.psd.gov.sg/challenge/covid-19/stories/stronger-together/food-supply-chain-resilience-during-and-beyond-the-pandemic

Singapore Government. 2022/23. White Paper on Singapore Women's Development. Accessed 16February 2023. https://www.scwo.org.sg/wp-content/uploads/2022/03/White-Paper-on-Singapore-Womens-Development.pdf

Singapore Ministry of Defence. Undated. "Factsheet –About Total Defence," *News Release*. Accessed 10 November 2022. https://www.nas.gov.sg/archivesonline/data/pdfdoc/MINDEF_20040207001_2/MINDEF_20040207003.pdf

Singapore Ministry of Defence. 2004. *News Release: Factsheet - About Total Defence*. Accessed 13 July 2022. http://www.nas.gov.sg/archivesonline/data/pdfdoc/MINDEF_20040207001_2/MINDEF_20040207003.pdf

Singapore Ministry of Defence. 2017. *Speech by Minister for Defence Dr Ng Eng Hen at the Committee of Supply Debate 2017 on 3 March 2017*. Accessed 13 July 2022. https://www.mindef.gov.sg/web/portal/mindef/newsandevents/latestreleases/articledetail/2017/mrch/03mar17speech1/ut/p/z0/04_Sj9CPykssy0xPLMnMz0vMAfljo8zizf1dnD0MTIz8_E1DDA0cw0JCfEydDxDzc30vfSj8CsAmmBU5Ovsm64fVZBYkqGbmZeWrx9hZGBorh-Rm1iUnKEfYWAMZBiaxxcXpKYmZxjqF2RHRTo6KioCAAKhBTc!/

Singapore Ministry of Defence. 15 February 2019. *Fact Sheet: Evolution and History of Total Defence Over the Past 35 Years*. Accessed 10 November 2022. https://www.mindef.gov.sg/web/portal/mindef/news-and-events/latest-releases/article-detail/2019/february/15feb19

Singapore Ministry of Defence. 2021a. *Total Defence*. Accessed 13 July 2022. https://www.mindef.gov.sg/web/portal/mindef/defence-matters/defence-topic/defence-topic-detail/total-defence

Singapore Ministry of Defence. 2021b. *Total Defence: What is Total Defence?* Accessed 13 July 2022. https://www.mindef.gov.sg/oms/imindef/mindef_websites/topics/totaldefence/about.html

Singh, B.1990. "Singapore's Defence Industries." *Canberra Papers on Strategy and Defence*, 49. Australian National University.

SIPRI. 2022. *SIPRI Arms Transfers Database*. Accessed 15 July 2022. https://sipri.org/databases/armstransfers

Sobie, B. 2004. "Building a Future." *Flight International* 165: 42–47. 24 February/1 March.

Soh, S. 10 February 2023. "CO23022 | Total Defence in Action – Singapore's Response to the COVID-19 Pandemic."|"CO23022 | Total Defence in Action – Singapore's Response to the COVID-19 Pandemic." *RSIS Commentary*. Accessed 16 February. https://www.rsis.edu.sg/rsis-publication/nssp/total-defence-in-action-singapores-response-to-the-covid-19-pandemic/#.Y-3mN3ZBxPY

Spencer, L. 9 November 2021. "Singapore Bolsters National AI Effort with $180M Funding Injection." *Channel News Asia*, Accessed 16 July 2022. https://www.channelasia.tech/article/692911/singapore-bolsters-national-ai-effort-180m-funding-injection/

SpeQtral. 9 February 2022. "SpeQtral Quantum Satellite Mission for Ultra-Secure communications', PRnewswire, Accessed 25 July 2022. https://speqtral.space/speqtral-announces-speqtral-1-quantum-satellite-mission-for-ultra-secure-communications/

Spillmann, K. R. 19-21 November 1986. "Beyond Soldiers and Arms: The Swiss Model of Comprehensive Security Policy." *Conference on "Stability and Assessing Europe's Neutrals*, The Woodrow Wilson Washington D.C.

St Clair, W. 2008. *That Greece Might Still Be Free: The Philhellenes in the War of Independence*, 228. United Kingdom: Open Book Publishers.

ST Engineering Annual Report. 2021. Accessed 15 July 2022. https://www.stengg.com/en/investor-relations/annual-reports/

Sweden Government. 2020. *Objectives for Swedish total defence 2021–2025 - Government bill 'Totalförsvaret 2021–2025.'* Accessed 10 November 2022. https://www.government.se/government-policy/defence/objectives-for-swedish-total-defence-2021-2025—government-bill-totalforsvaret-20212025/

Sydow, B. V. 4 April, 2018. "Resilience: Planning for Sweden's Total Defence." *NATO Review*. Accessed 10 November 2022. https://www.nato.int/docu/review/articles/2018/04/04/resilience-planning-for-swedens-total-defence/index.html

Szymanski, P. 2020. "New Ideas for Total Defence - Comprehensive Security in Finland and Estonia', *OSW Report*, Centre for Eastern Studies, Warsaw, 12. Accessed 6 December 2021. https://www.osw.waw.pl/sites/default/files/OSW-Report_New-ideas-for-total-defence_net_0.pdf

Tan, T. 14 March 2021. "Births in Singapore Hit Decade Low as Deaths Climb to Historic Peak." *The Straits Times*. Accessed 11 November 2022. https://www.straitstimes.com/singapore/births-in-singapore-hit-decade-low-as-deaths-climb-to-historic-peak

Teo, D. 2016 "Boosting Social Bonds 'Vital Part of Total Defence." *The Straits Times*, 15 February. Accessed 13 July 2022. https://www.asiaone.com/singapore/boosting-social-bonds-vital-part-total-defence

Today. 15 February 2017. "Total Defence Vital to S'pore's Wellbeing: Ng Eng Hen." Accessed 10 November 2022. https://eresources.nlb.gov.sg/newspapers/Digitised/Article/today20170215-1.2.21.2.3

Transgender SG. 2022. *National Service*. https://transgendersg.com/ns/

UNESCO Institute of Statistics. 2022. *UIS Releases New Data for SDG 9.5 on Research and Development*. Accessed 13 July 2022. http://uis.unesco.org/en/news/uis-releases-new-data-sdg-9-5-research-and-development.

Walt, S. M. 1991. "The Renaissance of Security Studies." *International Studies Quarterly* 35 (2): 211–239. doi:10.2307/2600471.

Zhang, L. M. 2018. "Psychological Defence Vital During Peacetime: Ong Ye Kung." *The Straits Times*. 29 January. Accessed 13 July 2022. https://www.straitstimes.com/singapore/psychological-defence-vital-during-peacetime-ong-ye-kung