THE FUTURE OF MANUFACTURING WORK IN SINGAPORE'S SMART NATION INITIATIVE: IMAGINATIONS, REALITIES, AND (DIS)CONTINUOUS INEQUALITIES

Gayathri Haridas and Thijs Willems

Postdoctoral Research Fellows at the Lee Kuan Yew Centre for Innovative Cities,

Singapore University of Technology and Design

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Introduction

Speaking at the launch of Smart Nation, on 24 November 2014, PM Lee of Singapore said:

> "*Smart Nation is not just a slogan. It is a rallying idea for us all to work together, to transform our future together……………there are endless possibilities waiting to be dreamed of*[1]"

In this paper, we take a closer look at Singapore's Smart Nation strategy. Identifying Singapore Smart Nation as a national sociotechnical imaginary, being and to be realized in the future, this paper questions these 'dreams' and asks who the 'dreamers' are.

Jassaanoff & Kim defined national sociotechnical imaginaries as ''collectively imagined forms of social life and social order reflected in the design and fulfilment of nation-specific scientific and/or technological projects'' (2009). Although the smart nation strategy in Singapore has clearly identified policy agendas, we argue that this vision of a smart nation is the result of imaginaries the state has carried around for the last fifty years and that has seeped into the norms and discourses of Singapore. The smart nation policies of Singapore, launched in 2014 and being implemented in five key strategic areas since then, assume a future for the nation that is technologically driven. We argue that this national S&T project should not be understood as a standalone plan that neutrally describes the future. Rather, it is closely connected to the historical development of Singapore and is thus an extension of numerous other projects, documents, and transformations through which the State, since its independence from Malaysia in 1965, has aimed to *create* a desirable future.

Focusing on two key policy instruments used to operationalize the smart nation strategy, Industry Transformation Maps and SkillsFuture, we discuss the evolution of the manufacturing industry and technical education in Singapore, how the two have developed hand in hand, and how future changes may bring about new and reinforce existing social inequalities.

Tied to this is also the question of what smart is. In trying to understand the notion of 'smart', employing the notion of sociotechnical imaginaries comes in handy. While a number of scholars and private sector entities have defined the concept of a smart city (e.g. Albino et al., 2015; Batty, 2013), there exists no consensus on who or what smart is.

The future as imagined and as lived

Singapore's visions of a utopia fuelled by *digital* technology started in the early 1980s, and the latest instalment of it is the Smart Nation initiative which was launched in 2014. There were seven masterplans released by the government between 1981 and 2016 covering a range of technologies and means to shape and improve Singaporean lives and society. From modest goals of computerizing the civil service and professionals with the National Computerization Plan of 1981 to the highly "inter-connected computers in every house, school, and factory" of the IT2000 report of 1992, every decade

[1] Read more at https://www.channelnewsasia.com/news/singapore/pm-lee-outlines-the-smart-nation-vision-meaningful-lives-enabled-8286672

saw a change in vision which was in line with other national aspirations (NCB 1992, 19–20). The Infocomm Media 2025 report, released in 2015, expands this to encompass a Heterogenous Network (HetNet) to "connect everyone and everywhere, all the time" (IMMSC 2015a, 22). In our view, although each era may have been fuelled by different technological developments affording different social changes, they should not be interpreted as so technologically deterministic. Rather, the different imaginations of Singapore as a state are better understood in succession and as being sociotechnical, with each new initiative contributing something to the larger 'project' of Singapore.

For instance, the Smart Nation initiative has a related, but also slightly different vision of a Singapore "where people are empowered by technology to lead meaningful and fulfilled lives" (Singapore Smart Nation, 2018)[2]. Staying close to the rhetoric of economic development and retaining competitiveness, this plan stresses the need to "harness the power of networks, data and infocomm technologies, to improve living, create economic opportunity and build a closer community" while bringing a distinct focus on 'people' (Singapore Smart Nation, 2018). The ushering in of Industry 4.0 (i4.0) related technologies is a prime feature of Singapore's Smart Nation strategy to, amongst others, automate and digitalize a broad range of work related activities. Yet, they do so non-deterministically and, rather, the Smart Nation initiative should be regarded as 'sociotechnical imaginaries' (Jasanoff, 2015), which are the "collectively imagined forms of social life and social order reflected in the design and fulfilment of nation-specific scientific and/or technological projects" (Jasanoff and Kim, 2009: 120). In other words, in this paper we perceive automation and digitalization within the context of Singapore's Smart Nation initiative as a sociotechnical system, thereby highlighting the duality of technological innovation and social change as an ongoing and co-constructed process that is, moreover, a highly politicized one. We aim to explore this in the context of the manufacturing industry, as this industry is, arguably, one that is most likely to be affected by automation and digitalization in the near future.

Manufacturing accounts for almost 20% of Singapore's economy and has been a backbone of Singapore's development story since the 1960s. Regional competition, domestic restructuring, and a lack of local labour has exerted pressures on this sector and it is gearing up to transform itself through digitization, specifically automation. Providing more than 400,000 jobs in the country, most companies in the sector will embrace nine types of technologies as part of the i4.0 strategy viz. autonomous robots, big data and analytics, augmented reality, additive manufacturing, the Industrial Internet of Things, horizontal and vertical system integration, simulation, the Cloud, and cyber security (MCI, 2016). Numerous books, both (science-)fiction and academic, are written about the future – some with a distinctive utopian and others with a predominantly dystopian flavour – , and these usually focus on the advent of The Singularity, the rise of robots or Artificial Intelligence, or the incremental erosion of expertise and professionalism in a digital age (e.g. Ford, 2016; Susskind and Susskind, 2015). Whilst these are all topics that may have strong social consequences and certainly need to be examined, we contend that these approaches do not fully capture technological innovations as being sociotechnically constituted, that is, as not only shaping but themselves being shaped, designed, appropriated and perhaps even transformed by human beings and from within the already existing logics of everyday life. Therefore, rather than focusing on these technologies, it may be more realistic to be concerned about how their potential consequences – e.g. automation – are played out and

[2] Retrieved from the Singapore Smart Nation website on 28 February 2018: https://www.smartnation.sg/

negotiated in practice and how this is perceived, experienced, and acted upon by social actors and the workforce (Urry, 2016; Wajcman, 2017).

At the same time, however, we should also be aware of the fact that such technologies are always already political in nature, building upon and extending existing inequalities (Magnet and Rodgers, 2012). This is especially the case with digital technologies, which by their virtue are often, erroneously so, understood as 'neutral' as they operate independently from human bodies and judgement (Sterne, 2003). Yet, literature exists on how race and ethnicity (Mesch & Talmud, 2011), gender (Ono & Zavodny, 2008), and socio-economic status (Witte & Mannon, 2010) all have an impact on internet usage and subsequent benefits (Stern, Adams, & Elsasser, 2009). Digital inequality is a much-discussed phenomenon within this context, but what is less addressed is how this intersects with other forms of inequality that already exists within society or how other technologies that go in hand with the advent of internet impact lives (Robinson et al, 2015).

To address this gap in the literature, we aim to study Singapore's manufacturing industry from the 1960s until today through a historical analysis of policy instruments and media outlets. Moreover, we take this as a starting point to understand how one can think of the future of manufacturing, especially within the context of Singapore's Smart Nation Initiative. Throughout our narrative, we look at the role that technical education and training has played in the transformation of Singapore's manufacturing industry. As becomes apparent, education has crucially shaped the success and shape of industrialization in Singapore while, in turn, the way that technical education has transformed has been highly contingent upon the manufacturing industry. This paper is thus an attempt to situate the history and future of manufacturing within larger sociotechnical discourses in which, indeed, a specific and preferred 'version' of a nation is imagined and realized. Moreover, looking at the role of education allows us at a later stage to answer the question of what 'smart' is and who this is for. Students as well as those entering the manufacturing workforce will at one point inevitably be confronted with automation and digitalization. We may thus dig deeper in understanding these transformations by questioning who will reap the benefits of a 'Smart Nation', how workplaces are and will be transformed, how this informs the choices of the youth and how notions of 're-skilling' or 'up-skilling' become ever more important in becoming 'smart'[3].

History and Future of Manufacturing in Singapore

Singapore labelled itself as an Intelligent Island sometime in the mid-1990s, which was then aspirational. This was Singapore's entry into the smart city discourse and this was identified as a development trajectory to be taken. The geography of the nation as well as its politics are contingent factors on the development of the manufacturing sector and the course of its future development. To situate the history and future of manufacturing in Singapore within this smart nation discourse, we now embark on a journey both backwards and forwards in time. On the side we also focus on how ideas of automation have been enmeshed in this development and how it is currently imagined, following how the state has transformed the educational system accordingly in order to realize such visions.

[3] The current version of the paper will not answer these questions into detail, but we hope that we can explore these issues further during the workshop.

Singapore's economic development and creating an appropriate workforce through education

The early politics of Singapore played a big role in the industrialization of the nation. It was in 1959 that Singapore became self-governing, still under British rule. The ruling party, People's Action Party, under the leadership of Lee Kuan Yew chartered out a pragmatic plan for the economic growth of the little island, which was very different from its neighbors. As Singapore separated from the Malaya Federation, it lost a common market as well as natural resource rich land. Once the British troops retreated, the economy came to a halt and thousands were left without a job. The welfare-oriented state programs of the region were shunned, and a principle of survival was adopted to create a market-oriented society but with the state's hand playing a dominant role in driving economic progress. At that time, the educational system that the British had left behind was still structured to serve colonial needs and not apt to help Singapore face the impending economic development and industrialization. The British had not seemed keen to introduce any solid technical education as they denied the existence of relationships between high unemployment rates on the one hand and a lack of manual crafts and trading skills on the other. Rather, as can be read in the 1925 Windstedt report and reflecting the colonial attitude towards the local population and the importance of education and training, Singaporeans were stereotyped as being less inclined to follow higher technical education as 1) certain subjects – such as applied mathematics, drawing, manual instruction and elementary science – were not already regarded as basic subjects in primary schools, and 2) parents seemed not willing to exercise 'self-sacrifice' in letting their children devote unpaid time to study (Varaprasad, 2016: 3). With the self-government of Singapore, however, the realization that technical education was key to reap the benefits of an industrializing country led to the establishment of Singapore Polytechnic in 1954 which was officially opened in 1959.

Singapore's entrepot trade supported the economy of the nation historically and it has always been a commercial city in South East Asia (Krause, 1988). The entrepot activities that Singapore has been engaging in, mainly due to the development of rubber estates and tin mining in Malaysia, gave the right impetus for further development. The development of a fully functional and modern port, skilled labor, and entrepreneurship propelled Singapore forward and this remains to be an important source of economic clout, only to be challenged by the development of manufacturing (Krause, 1988).

Despite the developments, the nation was still poor, and unemployment was rampant. To alleviate this, the government made two decisions in the 1960s. An export-led industrialization strategy was adopted thereby reducing reliance on imports and global multinational corporations (MNCs) were used as vehicles to attract investments into the nation. The Economic Development Board (EDB) was created to facilitate this process. EDB was the primary enabler that worked to bring in foreign direct investments (FDI) as well as create infrastructure in Singapore. The development of the Jurong Industrial Estate (JIE) kickstarted the manufacturing production and thereby innovation. Reformation of labor laws were done to protect the infant industries and basic education became a priority with emphasis on technical skills to aid in the nations industrialization. Education and training emphasized the expected need for the mass-employment of many semi-skilled laborers, which was a response to the governments fast job-creation strategy. Several commissions and decision-makers proposed, unsuccessfully, measures to stimulate the majority of primary school cohorts to follow up their studies on a vocational path (65% to be exactly) and only 20% on an academic path (Varaprasad, 2016: 19).

From 1960 to 1965, manufacturing production increased by 20% every year, and by 28% per year after that through 1973 (Krause, 1988). Between 1973 to 1979, manufacturing increased by 16.7% and by 11.6% between 1979 to 1984 (Singapore Department of Statistics, 1984, 1985, 1986; see Table 1 below). There were also changes in composition throughout these years in the manufacturing sector. The early year, in the 1960s, labor-intensive industries thrived, and this included matches, fish hooks and mosquito coils as well as food and beverage, textile, apparel, and wood-based production. This accounted for 45% of manufacturing output in the 1960s while the rest was accounted for by low value-added chemical and petroleum and electronics (Toh, 1998). Much of the production in the early years happened in the JIE helmed by the Finance Minister, Dr. Goh Keng Swee (EDB, 2014). The National Iron and Steel Mills was created in 1963 and by 1968, there were more than 300 factories in the estate with around 21,000 workers.

Year	Manufacturing Sector Output (%pa)	Total GDP Growth Rate (%pa)
1960-1970	13.7	9.1
1970-1980	10.1	9.0
1980-1985	1.6	6.2
1985-1990	12.5	8.1
1990-1996	7.3	8.3

Table 1. Singapore's manufacturing performance (Reproduced from Toh, Mun Heng. Competitiveness of the Singapore economy: A strategic perspective. World Scientific, 1998)

Despite the push from the government, the majority of school-leavers still pursued the academic path which would inevitably lead to a shortage of manpower. As a preventive measure, technical education became more institutionalized in Singapore. The Ministry of Education (MOE) formed the Technical Education Department (TED) in 1968, centralizing all vocational and technical education initiatives. Moreover, the tripartite relations were strengthened, meaning that the government, labor (through the unions), and the employers and industries together became involved in the development of education and training. For instance, a uniform system of certification to recognize diverse levels of skills was developed. This move towards the industry has characterized Singapore's educational system ever since. Employers, for example, were stimulated to become actively engaged in the skill development of the workforce by sponsoring students for vocational training, offering employees opportunities to upgrade their existing skillsets, and to set up programs to take up students aboard early as part of an apprenticeship-scheme. Similarly, the government set up programs to make technical education more industry-relevant, so that employers would eventually reap the benefits by having access to an adequately skilled pool of laborers (Varaprasad, 2016). To spearhead industrialization, the EDB also became more centrally involved in developing technical education and training. In the JIE, where companies from all over the world were now established, the need for a higher level of technical skills emerged in the form of supervisors or managers. Thus, the EDB opened several training centers to serve these needs. Moreover, the EDB offered MCN's land, buildings and subsidies so companies could start their own training centers and create a workforce they deemed necessary. As a caveat, these companies were only given these incentives if their training centers would train an equal number of technicians for other companies. In this way, the EDB assured that "a whole new generation of trainees would be industry-ready, trained in state-of-the art equipment by company instructors" (Varaprasad, 2016, p. 46).

These labor-intensive industries declined through the 1970s and more skills-based and higher value-added industries began to develop especially in component and precision engineering, petrochemicals, and electronics. The petrochemical sector increased outputs to over 41% by the 1980s while the labor-intensive industries dropped to just over 5% by 1990 (Toh, 1998). It was the electronics sector that saw most growth from 4% in 1960s to 17% in 1980 and 39% by the end of 1990 (Toh, 1998).

By mid-1990s, electronics had assumed more than 50% of the total manufacturing outputs. A few hallmarks of the 1970s were the establishment of the Beecham (now part of GSK) amoxycillin manufacturing plant which recommenced pharmaceutical manufacturing; Hewlett Packard producing the first pocket calculator; and Hamilton Sundstrand creating an aircraft parts manufacturing plant which ushered in more investments in the aerospace sector (EDB, 2014). By the end of 1970s, JIE had 1400 factories employing more than 112,000 workers (EDB, 2014). Singapore's manufacturing for the most part has been driven by MNCs, as opposed to local firms (Low, 1993) and by the 1980s the share of local firms dropped to less than 30%. Education, once again, followed accordingly and training was aimed at providing a higher skilled workforce apt for the new demands in the now high-tech manufacturing industry. In 1978 Dr. Goh Keng Swee, then Deputy Prime Minister, investigated and wrote a report – the Goh report – on the Singaporean education system with a focus on primary and secondary schools. They came with several issues and recommendations, mainly in terms of school performance, cohort attrition, and the low percentage of students passing both English and their mother tongue language at O-level. It was recommended to start the streaming of students, that is, to diversify the system to such an extent that the diversity in students – the academically bright and the average student – could be catered. Moreover, the acquisition of English was further stimulated across all levels. This would enable more students to progress to secondary school and complete at least 10 years of education, something that would prepare them to make the final step to higher vocational and technical education (Varaprasad, 2016, pp. 33-34). Moreover, streaming students would better cater the industries' demands for both semi- and high-skilled workers.

The 1990s and beyond saw two financial crises in the nation. The regional crisis of 1997 and succeeding one in 2001 that hit regional as well as global players, especially in the electronics industry affected growth in Singapore to fall by 1.2% (MTI, 2011). To recover, the taxes were kept as low as possible while the wage structures as well as production pricing was restructured. Entrepreneurship and domestic companies were promoted, and emphasis was placed on innovation. The manufacturing sector was identified as needing an upgrade by developing new capabilities, industries, as well as skills. In the last two decades, higher technical and vocational education also saw their coming of age. Several other polytechnics were established over the years to include, besides Singapore Polytechnics, Ngee Ann, Temasek, Nanyang, and Republic. Moreover, their campuses were upgraded and facilities, subsidizes by the government, were considered as state of the art and rivalling overseas universities. With increasingly growing numbers of students, the polytechnics are now Singapore's premier post-secondary path (see chart 1). Moreover, after creating a semi-skilled workforce through education in the 60's and 70's and responding to the high-tech impetus in the 80's and 90's by creating a high-skilled workforce, the current focus is to teach students qualities that prepare them for today's knowledge economy, including entrepreneurship, creativity and innovation. With this last phase, Singapore's education system at large (i.e. both polytechnics and universities) has moreover entered the global arena on (foreign) 'talent' hunt and 'centres of excellence'. Education and knowledge, hitherto understood as an expenditure, have now become lucrative and money-generating resources in and of themselves (Ng, 2013).

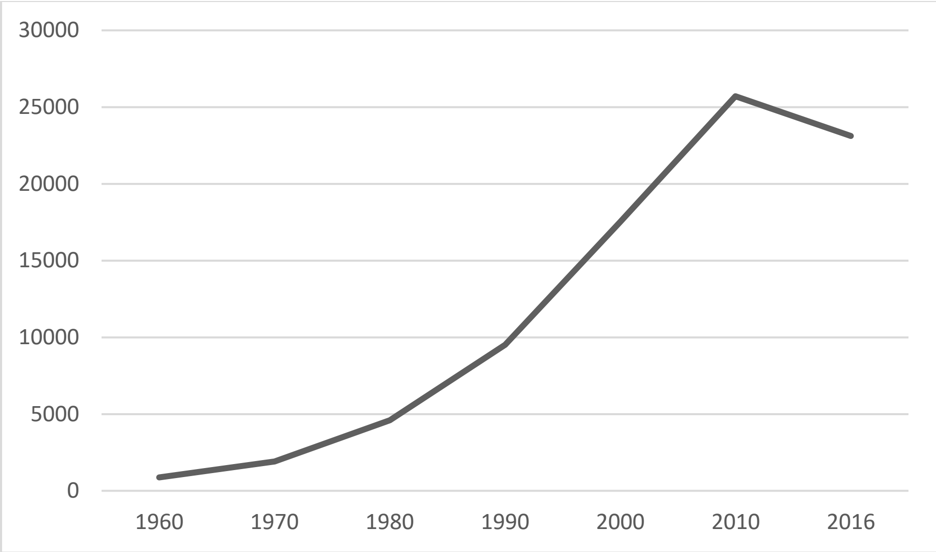

Chart 1. Intake figures of students at all polytechnics combined (adapted from MOE, 2017)

The future of manufacturing and education within Singapore's Smart Nation discourse

It is at these crossroads that we will now take stock of how the manufacturing industry and technical education in Singapore have shaped each other and have emerged hand in hand. We do so specifically by focusing on how we can understand the future of manufacturing and education, looking at how social and technical forces co-construct in how Singapore imagines this future through the Smart Nation discourse. As becomes clear in one of the Smart Nation masterplans, a document titled 'InfoComm Media 2025 – Creating connections, inspiring innovation', a smart nation is a nation that is build on an takes full advantage of technologies that are part of industry 4.0. Looking ahead, the country imagines "a Singapore transformed for the better by Infocomm media [where] people live meaningful and fulfilled lives enabled by technology" (MCI, 2015: 8). Throughout the document it becomes clear that the manufacturing industry, amongst other industries, is seen as a key sector that will be changed by and reap the benefits of these technologies. Moreover, the idea that the education and creation of an appropriate workforce remains crucial to these developments. Digital technologies, for instance, will have to be used to generate data through which the nation can generate insight on what skills in specific industries can be expected, thus identifying "urgent training needs" (2015: 36). What is more, it is deemed important to equip the future workforce with the necessary and expected skills and capabilities, and this can be reached through education and training, a support network for startups growth companies, and to build on the idea of Singapore as a Living Lab where innovation is continuously stimulated (MCI, 2015; see also Clancey, 2012). Below we will further elaborate how this future is imagined in the case of the manufacturing industry. We first zoom in on Singapore's Industry Transformation Maps to analyze how the government sees changes in this industry and how it hopes to accomplish this, after which we focus on the SkillsFuture program where we can see how Singapore aims to reach these industry transformations through a specific use of education and training.

Manufacturing and the Industry Transformation Maps

In Budget 2016, the government launched the S$ 4.5 billion Industry Transformation Program to achieve maximum synergy between government, firms, industries, trade associations etc. to aid the transition of Singapore into a smart nation. This encompasses an integrated approach to combat challenging economic conditions, rising competition, as well as impending disruptions from new and emerging technologies of industry 4.0. This program hinges on cooperation from multiple stakeholders, upgradation of industry sectors, and for organizations and individuals to take ownership of the transformation process and not rely on the state completely. The Future Economy Council (FEC) led by Minister of Finance, Heng Swee Keat, oversees the implementation of Industry Transformation Maps (ITM) under this program to transform six clusters in the nation. One of the main clusters undergoing transformation is manufacturing, and this transformation will be characterized by the blurring of the physical and digitals worlds in industry 4.0 with automation and robotics powering the sector forward. Each ITM has a growth and competitiveness plan which has a four-pronged focus: strategies to improve productivity of companies by moving up the value chain; matching jobs and skills for individuals; strategies to improve innovation; and expansion of trade and internalization (MTI, 2016). The manufacturing cluster has ITMs for five distinct sectors viz. precision engineering, energy & chemicals, marine offshore, aerospace and electronics.

The Precision Engineering ITM (PE ITM) released in October 2016 is set to grow the industry's value-added from S$ 8.8 billion in 2014 to S$ 14 billion by 2020 (MTI, 2016). It currently holds 15% of Singapore's manufacturing value added outputs and the aim is to grow robotics, additive manufacturing, sensors, advanced materials, lasers and optics with a budget of S$ 3.2 million under the Research, Innovation, Enterprise (RIE) 2020 plan. A National Robotics Programms (NRP) was launched to enhance local adoption of robotics as well as a National Additive Manufacturing Innovation Cluster (NAMIC) was established to increase uptake of technology and additive manufacturing by SMEs. Two key initiatives are also launched to encourage innovation in manufacturing. Model Digital Factories where factories can test and develop digital solutions and Digital Championing of companies (e.g. Meiban) where government (EDB) will aid companies in transforming through digitalization.

The Energy & Chemicals ITM is expected to increase value-added by S$ 12.7 billion and create 1400 new jobs by 2025 (MTI, 2016) from S$ 78 billion and 28,400 jobs in 2015. It's the fifth largest refinery hub in the world today and at least 20 plants are set to adopt innovative advanced manufacturing technologies by 2020. Emphasis is also placed on linking MNCs with SMEs as well as research institutions. Systems level digitalization efforts will be undertaken to improve logistics and productivity across the sector.

The Marine & Offshore Engineering ITM (M&OE ITM) provides the roadmap to create a value-added output of S$ 5.8 billion and 1500 jobs by 2025. Currently the M7OE sector contributes S$ 12.6 billion to Singapore's total manufacturing. Additive manufacturing, robotics and automation will be adopted as part of the ITM for the M&OE sector to improve competitiveness. Local, in-house R&D will also be supported while improving collaborations between various institutions. Transition to a local carbon economy will be aided while pursuing alternate uses for liquified natural gas and offshore wind market.

The Aerospace ITM (A ITM) is expected to achieve a value added of an additional S$ 4 billion and 1000 new jobs by 2020 from S$ 3.5 billion in 2016 with 21000 existing jobs. Majority of the jobs in this sector is high skilled and Singapore is Asia's leading Maintenance, Repair and Overhaul (MRO) hub for aviation (MTI, 2016). Operational excellence, innovation, and re-skilling will be done to transform the industry sector.

Through ITM efforts, the Electronics sector, which is a key sector to Singapore's economy, is expected to achieve a value added output of S$ 22.2 billion and introduce 2100 PMET jobs by 2020. In 2016, this sector accounted for S$ 90 billion of total outputs and employed around 70000 workers. The new areas of opportunity are autonomous vehicles, artificial intelligence and electronics-enabled healthcare. Although these transformations in the ITMs are approached from a largely technological perspective, the reality is more complex. During the launch of the ITM for the electronics sector, Singapore's minister for Trade and Industry, Mr. Iswaran, emphasizes these complexities in the following ways, hinting at the fact that technological and social transformation need to go hand in hand. Firstly, the electronics market is growing due to recent advances in technology while simultaneously the growth in, for example, the production of semiconductors makes possible these technological advances such as automation, smart factories, robotics, or artificial intelligence. Secondly, to remain competitive in an increasingly global market, this requires Singapore to tap and invest into this industry so that it can explore new growth opportunities and change accordingly. Part of this relies on providing and constructing the appropriate infrastructure "to better support electronics-related SMEs and startups" (MTI, 2017) that can help materialize these changes.

Yet, thirdly, mere technological transformation is not enough. With an expected growth of $90 billion in manufacturing output the necessary workforce within this industry is expected to grow with an employment of about 70,000. This future workforce will need requisite skills to be able to thrive and maintain being employed within this changing industry, a daunting task which Singapore has rolled out nation-wide through its SkillsFuture program. During the launch of the ITM for electronic manufacturing this is envisioned as follows: "[SkillsFuture] identifies emerging skills and competencies for the sector in the areas of Robotics and Automation, Artificial Intelligence and Data Analytics, which the local workforce in the electronics sector would need to acquire to be future-ready" (MTI, 2017). In sum, industry transformations in which automation, amongst others, seem key, emerge from the complex interplay between technological and social processes and have a strong future-oriented outlook. Moreover, SkillsFuture is aimed at equipping the workforce with skills and capabilities to be able to work with, for example, automation or digitalization; something which ironically will affect the ways in which humans will still be involved in manufacturing.

SkillsFuture is part of a nation-wide trend that seeks to change education in order to prepare for a skills-based future. This entails a greater emphasis on STEM-related studies, which sees a continuation of Singapore's belief that technical education is crucial to growth, economic development, and to prepare for the future ahead. Moreover, higher education should be designed in such a way that it comes with a skill; theoretical knowledge alone is not enough but Singaporeans should be able to make such knowledge practically relevant. This implies, moreover, that notions of lifelong learning, 'up-skilling' or 're-skilling' have come to the fore: a skill is not a ready-made product but something that has to be fostered, actively achieved and continuously improved in order to stay relevant in a changing economy. SkillsFuture is seen as important to these changes:

> "*In our next wave of development, we will build a first-rate system of continuing education and training: learning throughout life. It will intertwine education and the world of work in ways that strengthen and enrich both. It will make the workplace a major site of learning. It will enable every Singaporean to maximise his or her potential, from young and through life. It will build an advanced economy and ensure us a fair society"* (Mr. Shanmugaratnam in Varaprasad, 2016: 154)

We can understand SkillsFuture better in the context of our earlier historical analysis of manufacturing and education: the two have always responded to each other and this time is no different. Thus, although 'lifelong learning' is fostered through SkillsFuture, it also promotes a specific kind of learning, namely one that is of direct added value to the economy.

Part of SkillsFuture is that specific education and training courses are subsidized. A digital account for every Singaporean has been created with an initial credit of $500, topped up annually. This credit can be used to follow courses through which workers can 'deepen' their skillset (i.e. improving or existing skills) or to 'broaden' their skillset (i.e. taking up new skills that fall outside of their current field or occupation). Courses that students as well as employees, for instance, can follow with this credit are Data Analytics, Finance, Tech-enabled Services, Digital Media, Cybersecurity, Entrepreneurship, Urban Solutions, and Advanced Manufacturing. As becomes apparent, certain issues emerge from SkillsFuture, which we will discuss below and hope to enrich empirically and discuss further during and after the workshop in Hong Kong.

Discussion

At least four concerns can be raised in concluding this paper. First, as can be read on their website (e.g. "you can own a better future with skills mastery and lifelong learning. Your skills. Your asset. Your future"[4]) SkillsFuture seems to promote ideas that in first instance can hardly be seen different than benevolent. Yet, although using empowering discourse and talking about 'owning the future', the future has already been imagined by Singapore. This future is a future that is best capable of keeping Singapore an economically rich country in which the right skills are available in a workforce to attract foreign investment. Second, the SkillsFuture is more than an addition to the already existing educational systems. For polytechnics and universities alike it is now mandatory to offer courses that fall under the predefined categories. Moreover, in conjunction with SkillsFuture the idea of Skills Frameworks have been rolled out. These frameworks identify for specific sectors, which skills at which level are necessary to take up a certain position or occupation. This is a clear example of how the government imagines what, for instance, an 'Assistant Process Engineer' is, what she does and which skills are necessary to do so with competence. Although these frameworks describe each of these occupations into the greatest detail, they are simultaneously generalizing. They show, in short, what is the most productive and value-added 'type' of this occupation; it is a utilitarian approach to skill development which is strongly directed at not just reacting to an impending future but, in fact, creating this future. The courses and programs offered at institutes of higher education, and this is our third concern, have to follow these very detailed frameworks. Courses are evaluated by external parties, and if they do not effectively build upon the framework for a specific occupation (i.e. if they do not follow how the government imagines a future 'version' of this occupation), the courses will not be taken up in the SkillsFuture portal, which is seen an important way of ensuring a steady intake of students. Fourth, although at first sight these courses seem to be within a hand's reach for the Singaporean society at large and thus, in a sense, contribute to more equity within this society, it remains to be seen whether this is indeed the case. Arguably, a number of skills exist that are not deemed important in the SkillsFuture framework. How can we ensure that also these people will reap the benefits and maintain relevant in the future? In other words, in describing and creating a desirable future, Singapore has also described and created a part of society that in this imagined future may seem less so desired. Rather than offering equal opportunities for each and everyone, it may very well be the case that existing inequalities will be reinforced in Singapore as a Smart Nation, or that new

[4] http://www.skillsfuture.sg/AboutSkillsFuture

inequalities will arise. In further developing this paper, we hope to come back to these four concerns and elaborate their possible impact.

Conclusion

Imaginations play a crucial role in social and political life (Jasanoff & Kim, 2009). They are valuable cultural resources which enables the achievement of national goals. As the history of Singapore reveals, the polytechnics and the skilled talent produced by this group of institutions were necessary for the development of the country. It was labor-intensive production that allowed Singapore to achieve rapid industrialization as well as rising literacy (Vogel, 1991; Chowdhury and Islam, 2005). Along the course of development however, these specific set of skills and their place in society has been questioned. In visions of a future Singapore there seems to be no need for it. The society that is imagined conclusively envisions a set-up where citizens and graduates have to 'upgrade' themselves in order to thrive. In becoming a Smart Nation, Singapore thus clearly identifies what constitutes 'smart' and what not, who is deemed 'smart' and who is not. These issues need to be better addressed, should smart city initiatives all over the world indeed deliver on their promises that a smart city is a good city for each and every one of us.

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