

THE FUTURE OF THE SINGAPORE ECONOMY – STRATEGIES TO INCREASE MANUFACTURING CONTRIBUTION OF THE SINGAPORE ECONOMY

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INTRODUCTION

1. Global Shifts – Vulnerabilities of Reliance on a Single Source for Production of Goods.

One of the most significant realisations of the impact of Covid-19 has been the overreliance of the world on China as a manufacturing base. Countries were comfortable in accepting China as the factory of the world but when China went into lockdown and factories shuttered, the world suffered as supplies of goods dropped drastically, and logistics were disrupted.

While the trade war between China and USA highlighted this overreliance as an issue, Covid-19 drove home the reality. Needless to say, businesses around the world will now need to rethink their strategy of depending on the most cost-effective suppliers vs diversified supply chains.

Herein lies an opportunity for many countries including Singapore to again consider manufacturing as a larger contributor to our economy. While we can never realistically compete with China or India or Vietnam based on cost and labour availability, we need to look for areas where we can be competitive, perhaps in higher valued added processes? Are there ways for us to have a footprint both in Singapore and in China, so that we can access their market while at the same time maintain supremacy back home?

Covid 19 has shown that economies of scale alone should not be the driving force in deciding which sectors of our economy are best anchored home. Cost aside, we need to retain what's of strategic interest to us.

2. Industry 4.0 and Disruption and Future Job Losses

The trends towards I4.0 were already taking shape before Covid-19 struck. De-globalization, new technologies, AI, automation, business models disruptions were creating greater efficiencies and eliminating jobs. While some new jobs were also being created, it did not keep pace with job losses.

Covid-19 has accelerated the urgency for a relook. Being a small and vulnerable economy, we have to reinvent or become irrelevant. The greatest priority for government is to create meaningful jobs for Singaporeans that will grow our economy.

Manufacturing happens to be our best chance of creating and retaining a sizable stable base of meaningful jobs onshore. If we keep manufacturing and technology expertise in Singapore it will also enable us to manage supply chains better. When we control supply chains, all other service sectors can be better retained too. We lessen our dependence on foreign enterprises as when big MNCs move out of Singapore, service sector jobs get lost too. The key is to be in control of some major parts of the supply chains, like manufacturing, like Taiwan has done.

THE CASE FOR GROWING THE MANUFACTURING SECTOR IN SINGAPORE

3. How Manufacturing has Changed over the Years

Singapore was once one of the four “Tiger Economies” in Asia, together with Hong Kong, South Korea and Taiwan. These were all emerging economies that did very well from the 1980s to 1990s. The “Tiger Economies” were defined as those countries that had rapid economic growth; were major production and manufacturing hubs that produced goods locally and shipped globally; had a growing educated and skilled workforce; and a rapidly improving standard of living.

Manufacturing’s share of Singapore’s economy is about 21% in 2018 and 18.6% in 2019. It peaked at around the early 2000s at around 28% before declining again over the years.

Taiwan’s manufacturing share of the GDP is around 30% in 2019¹. It peaked at around 35% sometime in the 1980s and remained stable at around 30% till today.

For South Korea, in 2019, manufacturing contributed to 29.6% of the GDP. It was around 30% in the mid 1980s and peaked at 31% in 2011.

Hong Kong is mainly a service based industry today but with its hinterland in Shenzhen, perhaps we can count that as a strong manufacturing base too, but data is hard to find.

So, I would say we focus on the 2 “Tigers” that remain strong and show a great potential for sustainable growth driven by a robust locally driven manufacturing sector. Both South Korea and Taiwan’s share of manufacturing of their GDP remains at around 30%.

For Singapore, I think we can continue to grow a strong service sector, and we will benefit from the recent Hong Kong fall out. I do not expect us to bring manufacturing back to 30% of the GDP as that is going to be tough, but I suggest we target 25% to 30% of our economic contribution the years ahead. Achieving 25% in 5 to 10 years will be a good target. It will contribute to a steady base for employment.

4. Why Should Manufacturing Remain a Key Pillar of Singapore’s economy

In an article I read in 2018², written by a research associate from University of Cambridge, this was one of the observations made “Every economic activity stimulates another economic activity. So, just as manufacturing stimulates the provision of services, services stimulate manufacturing production. But evidence shows that manufacturing has a stronger “multiplier effect” than services.”

¹ <https://www.nationmaster.com/nmx/ranking/contribution-to-gdp-of-manufacturing>

² <https://aspioneer.com/why-manufacturing-is-essential-for-economic-growth/#:~:text=Manufacturing%20helps%20services,%E2%80%9Cmultiplier%20effect%E2%80%9D%20than%20services>

So, for example in Singapore, every 100 new manufacturing jobs are also create 27 new services jobs. However, every 100 new services jobs stimulate the creation only three more manufacturing jobs.

It is also a well-known fact that productivity in all sectors of an economy are mainly driven by innovations in the manufacturing industry. The same article also concluded that in the USA, companies that are still active in manufacturing still employ 64% of all scientists and engineers. Also, it is important to view the manufacturing sector in the broader sense – not just the direct production activities but also the overall support activities that are needed to successfully produce, deliver and supply globally. So, for example, industrial R&D, product design, and engineering services needed to keep the factory going are also jobs that can be counted as manufacturing jobs. And we should not forget the supporting industries that have to be located close the mass production factory and the whole range of logistics like warehouse and transportation that are needed to move the products manufactured.

Bottomline is that having a larger manufacturing sector will catalyse other sectors but more importantly will be capable of creating far more jobs than most of the other sectors of the economy.

If we look at the employment trend by industry sector over the years, the share of people employed in the manufacturing sector has been steadily declining in the last 25 years³. In 1994, the manufacturing sector employed around 25% of people and this has been steadily declining since then to around 13% in 2019. While for South Korea, the manufacturing sector continued to employ around 25% through the last 10 years.

So not just from a strategic point of view, of having the ability to pivot and manufacture critical goods during emergencies, having a robust and significant manufacturing sector will allow Singapore to also keep employment high, do more R&D and Innovation that can help all other sectors of the economy, and also catalyse other industries and hence create jobs including in the service sectors.

5. Singapore's Strengths and Weakness to Benefit from Shifting Trends

Our biggest strength in manufacturing is trained manpower. Many PMETs have lost their jobs in this sector as companies relocated out of Singapore over the last decade. We should take stock of this residual capability base and develop a strategy to choose those areas where we can quickly gain a competitive advantage. Retraining displaced skilled PMETs does not require a complete change of skills but a refresh and extension of their current skill sets. This is easier to do than to learn a completely new skill. For example, it is easier to get a product engineer in a disk drive industry to learn process engineering in a semiconductor industry than for that product engineer to learn about pharmaceuticals.

Our other strength lies in our intellectual property (IP). How can we reap the investments from research given that the government has spent billions of dollars in Research, Innovation and

³ <https://www.tablebuilder.singstat.gov.sg/publicfacing/mainMenu.action>

Enterprise (RIE) funding in the many 5 year RIE plans over the last 30 years. What does the IP stock of our universities and research institutes look like? How can that be translated quickly and efficiently? Can we overcome our inability to innovate and create new businesses? Or to use the knowledge and skills to help us design a predefined need, for example a more effective manufacturing system. We have to ask this question - How can we reap even more from \$61 billion invested from 1991-2020 in Research, Innovation and Enterprise (RIE) funding? The answer lies in our ability to commercialize as much as possible, of the research we had done in the last 20 to 30 years.

Our third strength is our great infrastructure, and regional and global connectivity which will allow Singapore to anchor some key industries in Singapore.

Our biggest weakness is the cost of doing business which went out of control because the government refused to focus on cost over the last 2 decades. There are two main contributing factors to the cost of doing business in Singapore. The first, real estate or land cost can be easily be solved by government by pricing industrial land differently. The second, labour cost and availability is an old argument that technology has already solved using AI and robotics and other forms of technology.

6. Should Singapore Focus only on Manufacturing Medical Goods and Food?

I look at our potential manufacturing strategy differently. We do not have to jump into making medical masks and ventilators just because a health emergency required us to do so this time round. Many others around the world are also getting into this area so the long term sustainability may not be viable. Instead, we should choose industries where we had the competitive edge before and make them competitive again. We were very strong in semiconductors before and we lost that edge the last 10 years. We were also very strong on contract manufacturing and disk drives before but also lost the edge because of cost and lack of government support. If we can bring back manufacturing expertise, in times of emergencies, we can quickly turn around some manufacturing lines to produce products we cannot source in an emergency, like masks and medical products.

Other areas that we can focus on and which will be critical and where I believe we have the technologies and capabilities to do are food production and precision engineering. Re-growing these sectors should allow us to develop greater capabilities and sufficiency to produce critical goods during an emergency.

STRATEGIES FOR GROWING SINGAPORE'S MANUFACTURING SHARE OF THE ECONOMY

7. Strategies for Singapore's Refocus on Manufacturing

So how can we rebuild the manufacturing sector as an important pillar of Singapore's Future Economy? While we cannot possibly compete in every area of manufacturing with vast countries that have cheaper land, abundant skilled workers and big local markets, there are some things we can do.

7.1 Prototyping Factory of the World

With intellectual property, technology and robotics, we may have a competitive edge if we focus on productivity and efficient operations, are flexible with labour policies, and have the capital to invest.

But one area that Singapore can definitely lead is to become the prototyping factory of the world. What do I mean by this? Well before products go into mass production, they need to make the transformation from design to productization. Initial production of new designs of any products requires skilled workers to understand the product design and find the right manufacturing processes to ensure cost effective, high quality and high yielding production.

Any new design needs to be checked for manufacturability and this is another skill that will remain important for a long time. If Singapore can be the prototyping place for all new products, then we can also determine how mass production can be done and we can help design and transfer capabilities to do mass production in any part of the world. We will remain relevant for a long time to come.

Mass production facilities have to be upgraded all the time and being the prototyping factory of the world, Singapore will be called upon to design future production lines and upgrade existing ones to become more efficient. The test runs for such lines can take place in Singapore before being adopted in any part of the world. As the prototyping factory of the world, we can also invest in mass production factories outside Singapore. Finally, in times of an emergency like Covid-19, Singapore can quickly use our understanding and capabilities in manufacturing to set up factories to meet our local needs. And guess what, we have may displaced PMETs who can do this work, based on their past experience in working in factories in Singapore – factories that left Singapore and retired them early.

- **Infiniti's experience**

Can this be done? Is there such a thing as a prototyping factory? Can this model work? Well I have personally done this before. My third major start-up, Infiniti Solutions was Singapore based. However, I set up a prototyping factory not a cheaper place than Singapore but in more expensive Silicon Valley where we had 3 factories – doing semiconductor prototyping and initial production testing, design and initial assembly of systems, and transfer of successful products to mass production sites – in our case to our factory in the Philippines. We had many customers who we served for their prototyping needs and later they transferred their working prototype to mass production factories of their own. We ran Infiniti Solutions till 2014, after which we exited our business in a trade sale. So, the model has been proven and can work in expensive Singapore.

- **Mobile Eye Start-up**

Last year I visited a start-up that spun off from NTU. The technology developed by the professors replicates the functions of a retina. What this means is that instead of capturing images which require high storage and a long time to process, data will be

captured in pixels. Processing pixels is much faster (I believe 100 times faster and requires much less processors and memory storage). If this works, it will easily replace the Mobile Eye that is in most cars today that help detect closeness of a vehicle in front (the Mobile Eye technology was developed by professors in an Israel university and later sold to Intel for US\$8b or so!) This pixel-based system will be faster, cheaper and will be a huge advantage for autonomous cars that need to house very large electronics. This technology can reduce the electronics to less than 10% of space that currently is needed with old technology.

The professor who spun off the company licenced IP developed at NTU to start his prototyping facility to productize his technology. But guess what? He started this in Shanghai and not in Singapore. He hired PhDs who trained at NTU and they were all based in Shanghai. Now Shanghai is as expensive as Singapore. He had around 30 engineers and staff when I visited him last year. When asked him why he did not do his prototyping in Singapore, his reply was that he could not find funding support in Singapore. All he raised was around \$10m and he got it in Shanghai. This is a huge opportunity loss for Singapore. We could have done the prototyping in Singapore and still do the mass production and sell in China later.

- **Prototyping Other Technologies**

I would urge that the government makes this a national priority – to fund and support and encourage productization and commercialization of technologies that are developed in Singapore’s universities and research institutions. Having a prototyping centre will enable us to capture some value from our IP, instead of them being licensed directly to entities abroad, for which the returns to us become substantially diluted. With the China US trade war, an allegations of IP theft, Singapore would become an important source of IP for China.

I know of many great technologies that are being sought after and already being licenced by Chinese investors who then bring all the work to China, bypassing Singapore. When I speak with some of the researchers and professors on why they did not consider Singapore, I get the same answer each time – they could not find the money in Singapore. Of course, the other important reason is the market size in China. I say by all means go for the China market but do your initial productisation and prototyping in Singapore and then expand in China or in any other part of the world.

7.2 Strengthen Current Strong Industries – Complement with Local Companies – acquire some MEs from Germany and other parts of the West

Singapore already has strengths in a few areas. Precision engineering is one strength. Chemical and Biotech is another. Oil refining and related industries, Shipbuilding, offshore equipment, are others. It is always easier to succeed when we are already leading in an area. We can develop strategies to strengthen these sectors where we already have a strong competitive advantage. The precision engineering industry is important because they can help design, develop and produce production machines and systems that are needed for many manufacturing industries.

As the world is in turmoil today, many companies around the world will struggle to stay afloat. I suggest economic agencies like EDB look at attracting some of the SMEs from countries like Germany, Sweden and other western countries. Asia is attractive and with the right incentives, we can attract some of them to come here. I suggest some of our sovereign funds take stakes in some of these strategic companies so that we can have some control. Germany in particular has excellent medium sized companies (their SMEs are in fact Medium to Large companies in Singapore's definition).

7.3 Re-start Industries where we had the Competitive Edge and Skills Sets

Because of past economic strategies, we placed less emphasis on some industries as Government wanted to focus on other new more sexy industries. This economic strategy was a very disruptive one (I covered this in a paper I wrote in 2018 – The Future of the Singapore Economy), prematurely giving up on industries where we were globally competitive. When Government's focus changes, funding becomes difficult as incentives shift to newer and not older industries (older and getting outdated as judged by Government and civil servants).

I suggest Government be prepared to pump in money to buy over some existing companies which we can revive in Singapore and bring back the skilled PMETs and workers to work in these industries again. Here are some industries where were strong but today do not have any local ownership.

7.3.1 Semiconductors – buy some of the existing players throughout the semiconductor industry supply chain, e.g

- i. Waferfabs,
- ii. Semiconductor Assembly and Test (SAT) companies,
- iii. Design Houses, and
- iv. Invest in some Integrated device manufacturer (IDM) (IDMs - company which designs, manufactures, and sells integrated circuit (IC) products)

Semiconductors will continue to be a valuable part for the whole supply chain, powering all the electronics and devices of the world. Semiconductors are in every possible device and home appliances, cars, anything that works on energy. So, let's get back to this industry as owners, not just depending on MNCs.

Singapore once owned wafer fabs, assembly and testing lines and even design houses. Due to wrong strategies, we sold these assets to foreign buyers and hence lost the competencies and capabilities that could have still been valuable today. Just look at Taiwan, their economy continues to be powered by the semiconductor industry with gems like TSMC.

So, let's use the vast reserves we have to reinvest by buying up some strategic companies in the Semiconductor industry. We have enough people who can head up these

companies. Many who spent a lifetime in the semiconductor industry had a premature end to their careers because we decided not to focus on this industry.

7.3.2 **Contract Manufacturing** – Acquire Companies in this Downturn

We had many contract manufacturers based in Singapore, MNCs and local companies. Today, Venture Corp still remains strong. All others are in foreign hands. I believe we can purchase a couple of these companies and hopefully become like Foxconn of Taiwan (Foxconn is the world's largest contract manufacturer of electronics and the biggest assembler of Apple products). And recently I read somewhere that Foxconn is moving their huge factories from China back to Taiwan, because with robotics and automation, they can again be cost effective in Taiwan. The Taiwanese government is giving great incentives to bring back such manufacturing companies to Taiwan. I see a huge potential for Singapore through to tap on our sovereign funds to acquire and convert such companies into Singapore companies.

7.3.3 **Other Industries** that we can revive

There may be other industries where we had past glories that we may be able to revive. Disk Drives comes to mind. There may be others. Someone needs to study if there are some that are worth reviving.

7.4 **New Industries that Will Grow**

Looking at the trends around the world and the new trends that are caused by the Covid-19, we can spot a few areas where we can see potential for Singapore to adopt for future manufacturing industries.

7.4.1 **Robots, AI and Automation**

This is clearly a bright spot and there is room for new leaders to emerge. Remember during the gold rush years, many speculators lost money but those who supplied equipment, chemicals and materials to help in gold prospecting made a lot of money. Similarly, if we can develop an industry that supports the rush for new manufacturing around the world as companies exit China, we may be able to grow a significant manufacturing industry. So, instead of rushing for “gold”, we could focus on what will support and lower the cost of the “gold” (manufacturing) rush.

In 2016, a Chinese consumer electronic company, Midea, bought over a German robotics company, Kuka through a hostile takeover, for USD5b. Located in the southern German city of Augsburg, about 40 kilometres northwest of Munich, Kuka employs a total of 13,710 people. Now that quite a good number of employees, most of whom are skilled workers. Singapore should position herself to get into this industry while it's still in the early stages of growth.

7.4.2 3D Manufacturing – to support customized mass production

Customized mass production will be the future for manufacturing. In the past, it was standardized mass production where products were manufactured to one standard for all consumers – one size fits all. With changing consumer demands, a standard product that the rest of the world buys will no longer be attractive, they will want customisation to meet their preferences. And with technology we can today provide customized mass production, closer to home. 3D manufacturing will play a big role in this. The good news is that Singapore has one of the best capabilities in the area of 3D manufacturing or additive manufacturing. NTU has one of the best research centres in the world. We should start building a manufacturing base around the 3D technology. I see many of the contract manufacturers needing to get into 3D manufacturing to meet their customer needs in the near future.

7.4.3 Food Production and Preservation

Food technology will be another great area to get into. This should include water technology to support both the food industry and also to supply drinking water for the future. I see future global tensions revolve around food and water security. In water, we have many strengths and it is worth saving some of the struggling water industries in Singapore. Also, a lot of research is going on in the universities around the areas of water technology and we should look out for opportunities to strengthen our water industries.

Let me focus on Food Technology. This has been not well focused in the past but now that we have our Food strategy 30/30 (Singapore to provide 30% of basic nutrient supply by 2030), this is one area where there is great potential.

There are two big areas where we can focus:

- (i) First is food production – the vertical and urban farms and the supporting industry of IOTs and systems integration are industries we can do well in. I know for example in NTU we have great work done in the food technology areas, but I don't see a great level of focus in commercializing the many great ideas.
- (ii) Next is packaging, storage and transportation, in relation to spoilage and waste reduction- Do we should just produce more food or also work on technology to keep food fresher and available for a longer period of time? There is significant innovation in food packaging and transportation. These will require specialized equipment that Singapore could manufacture for the rest of the world. (Data from FAO, Annex 2, show that the extent of food waste. The numbers are huge and if we preserve food better, we could add another 20% to 25% to food availability without new production!).

7.5 Productize technology that will solve industry problems

While I have suggested a few industries that Singapore can immediately get into to boost our manufacturing sector (and I think if we do some or most of what I have suggested, we can easily bring the total manufacturing contribution to our economy to around 25% in

the next 10 years), we need to keep looking for new future areas where we can add to the manufacturing sector of the Singapore economy. For this we will need someone and some specialized agencies in Government to constantly scan the emerging technologies. Some immediate areas that I can think of are;

- Solve limitations for semiconductor speed (e.g. carbon nanotube)
- Cyber-Physical-Biological integration
- IOT

HOW TO MAKE IT HAPPEN

8. Recommendations on Implementation

As I mentioned earlier in the paper, Singapore already has many strengths. We should build on the strengths and address the weak areas mentioned earlier too and we have the chance to quickly catch up and fill the gaps that we will soon see as a result of this Great Disruption caused by the Covic-19. Companies will realign their supply chains, companies will become distressed (and form good targets of acquisition), new areas of technology will get productize that needs to make that transition from lab to factory (and we can play the role as a prototyping factory of the world). So, while things look depressing, I believe these are also time to spot the opportunities and act quickly to the lead in some areas of manufacturing so that we can secure a stronger future for Singapore. Some of the recommendations are;

8.1 Infrastructure and Cost

Singapore already has good infrastructure to support a larger manufacturing base. But cost remains an issue. An immediate priority is to lower the cost of operations to sustain a healthy manufacturing base. With rising costs of rentals, infrastructure, utilities and labour costs, companies will find it less feasible to invest in capex and up-scaling. Companies can only re-deploy surpluses if productivity goes up and costs are kept down.

So, one way we can make manufacturing competitive in Singapore is to have a strategy of differential pricing of industrial land for manufacturing. The current market driven pricing of land makes it difficult to price manufacturing land competitively when we compare to how such land is priced in Taiwan or South Korea or even in USA. Land pricing for manufacturing therefore needs to be relooked at. This is not difficult to do as pricing of land depends on how land is classified. Real manufacturing real estate should be priced to match those in Taiwan and South Korea. This is what I mean by differential pricing of land.

Similarly, we need to look at utilities and water prices that are heavily used by the manufacturing sector. Differentiated pricing should be also looked. After all, the cost of production of these utilities are not that high although these are being sold at very high prices. In any case, there is enough technology today to optimize energy and water usage to keep the cost manageable.

We need an integrated strategy to manage land costs, utilities and labour that constantly adjusts to benchmarks with leading manufacturing centres such as South Korea, Taiwan, China, India and even USA. With this baseline, we can offer differential pricing of industrial land,

rentals and utility rates to stay competitive. On balance, a package of right incentives and differentiated pricing will encourage companies to invest and stay anchored in Singapore.

There is an argument that labour cost in Singapore is just too high for a manufacturing sector to thrive. This is now an old argument because through automation, robotics and AI, labour cost will be just a small fraction of the total manufacturing cost. Our existing trained talent can continue to upskill to handle highly automated factories. Our output per capita will rise and we will be creating meaningful jobs for Singaporeans.

So, the biggest worry for us will be real estate and utility costs. Once we can optimize these cost factors by policy changes, we don't have to worry too much about labour cost or availability because technology can help us solve those problems with many Singaporeans doing more value-added jobs.

8.2 Develop Regional Supply Chains

We have a huge opportunity to develop regional supply chains managed from Singapore.

Singapore can play a dominant role in developing and managing regional hub supply chains, connected to all regions globally. Coupled with a strong trade financing and logistics services, a broader hinterland, well beyond former PM Goh Chok Tong's concept of "Growth Triangle" formed by Singapore-Johor-Batam, may be considered. We can cover the whole of South East Asia as our Growth Triangle.

South East Asia can be our hinterland for manufacturing supporting Singapore based manufacturing companies. Many cities in Vietnam, Indonesia and Thailand are ready for development as mass production or assembly bases. Progressively, we must create enough local industries that initiate their prototyping and initial manufacturing in Singapore and then move into the region and these can become Singapore's future MNCs, and with control of supply chains firstly across the region, then extending to China, India, the West and Africa. By being integrated, we can help and lead the development of South East Asia's growth concurrently while procuring many advantages for Singapore:

- a. **Cost.** Best sourcing to provide cost effective mass production;
- b. **Co-Development** of the Region. To accelerate regional growth by sharing the technology and capability advances;
- c. **Captive Market.** To tap the natural market of 500m people;
- d. **Connectivity.** To increase its trading hub status with unprecedented connectivity via an intense matrix of market players.
- e. **Confidence.** To build a class of industrialists with the confidence to prototype, produce and sell high quality products, and mindset to increase speed to market and promote the Singapore brand.

We can play a big role to bring economic development to the region.

8.3 Innovation

Singapore's other strength lies in intellectual property ("IP"). Singapore stayed on the course of investment in research through billions of dollars in Research, Innovation and Enterprise ("RIE") funding. How can it reap even more from the approximately \$61 billion invested from 1991-2020 in RIE funding?

The answer lies in its ability to commercialise the research done. The time has come for more RIE money to be allocated to innovation. This means setting a new set of KPIs (such as time to market, marketable applications, new start-ups, regional reach).

In an earlier article I wrote about preparing for the New Normal post Covid-19, I suggested that in addition to basic research we focus equally on applied research (innovation). While basic research remains important for us to develop future capabilities and be ahead of curve on the latest developments, innovation is important to bring IP and knowhow to industry and support enterprise creation. This has been underfunded for the longest time.

It is time that more of our RIE money be allocated to innovation⁴. Currently most research grants focus narrowly on domain subject matters for knowledge creation. The researchers develop great in depth understanding which may take a very long time to become useful to the economy but otherwise remain useful research papers.

For innovation, the starting point would be defining an industry or economy or society problem that needs to be solved. So for example, if we say we need to create 30% food sufficiency for Singapore, then this is the problem statement and this will require cross-disciplinary research bringing together subject matter experts from food science, engineering, chemistry, biology and perhaps humanities. And the grant can be given with the goal of solving that predefined problem. Along the way, subject matter experts will develop new technologies and capabilities that over time will add to helping solve the problem at hand.

Aligning to this goal, grants can then be awarded to produce promising solutions, held in Singapore companies, and nurture them into industry leaders. Think Nestlé, Singapore-style.

8.4 National Innovation and Enterprise Champion

Today all the Innovation and Enterprise Budget is managed through the National Research Foundation (NRF), So far, Singapore has done well in the "R" (research) but lags behind the "I" (Innovation) and "E" (Enterprise) part. We have to separate the management of the "R" from the "I & E".

I suggest we form a new foundation to champion manufacturing as a stronger pillar of the economy. Modelled after the NRF for basic research, where Singapore has excelled, we can

⁴ Innovation is defined as the conversion of knowledge to practical applications

extend this to a National Innovation and Enterprise Foundation (“NIEF”). Or we can call this the National Manufacturing Foundation (“NMF”)

It is evident that within the budgets already available, a decisive shift towards more funding for innovation and enterprise will create the impact to uplift manufacturing. The exact form of such an organisation can be explored further in consultation with stakeholders. Involve practitioners (experts), policy makers and researchers.

8.5 Funding – A New Venture Builder

Singapore’s old venture builder, Temasek Foundation, had created success stories like Singtel, DBS, Singapore Technologies. Since then, Temasek’s mindset has shifted towards being a largely a fund manager, whose role is more to spot winners, maximise IRR returns, rather than build a venture from 0 to 1, and then overcome the challenges. A Fund Manager and a Venture Builder require different skills, different mindsets, and different focus. It is futile to keep asking Temasek to play a part-time venture builder role. Instead we need a new entity to be created as Singapore’s future Venture Builder, which we so critically need now, its mission must first be to reboot manufacturing in Singapore.

9 Call for Debate – Make Manufacturing Sexy Again

We see a very exciting future for manufacturing, build on a more competitive and digitally connected supply chain landscape, bringing in the latest 3D and automation, design, advanced prototyping with new product development in Singapore.

The creation of a NIEF, with a decisive funding shift towards product development and shorter time-to-market, will lead towards a rapid reboot of manufacturing. While the Covid-19 world is still at semi-lockdown, Singapore is best placed to cast a wider net, attract growing global and regional players, and acquire meaningful stakes and concentrate the resources and networks here.

I believe this current crisis represents an immense opportunity for Singapore to relook and reboot her economy. I invite debate on the merits proposed. Let’s not dismiss this dream that Singapore can excel in manufacturing again. It is definitely to our national interest to re-fire manufacturing as a stronger pillar of our economy, one that can create many more meaningful jobs for Singaporeans. Let’s just do it. I know we can succeed.

Annex 1 – Successful Industries in the Other Tiger Economies

South Korea Industries

South Korea's largest industries are **electronics**, automobiles, telecommunications, **shipbuilding**, chemicals and **steel**. The country is among the largest manufacturer of electronic goods as well as semiconductors, with globally popular brands such as Samsung **Electronics Co. Ltd.** and Hynix Semiconductor (SK Hynix Inc.).

Taiwan Industries

The major industries in Taiwan are electronics, petroleum refining, armaments, chemicals, textiles, iron and steel, machinery, cement, food processing, vehicles, consumer products, pharmaceuticals. In semiconductors, close cooperation among diverse yet essential elements in the value chain, ranging from IC design and manufacturing to packaging and testing.

The county is currently among the top 10 nations in the world in the manufacturing of robots. Taiwan's main exports in 2016 were machinery, electrical machinery and equipment, plastics, optical, technical, & medical apparatus, mineral fuels (such as oil), vehicles, and organic chemicals

The Food Preservation Industry

Food Security is one of the most pressing issue facing most countries. As agricultural land become less due to urbanization and as food demand explodes rapidly as societies become more affluent, supply is starting to lag demand. Food production technology has however been rapidly improving to increase food production across the board. From vegetables, fruits, grains, meat and other produce, new techniques and methodologies have improved the yields of food production.

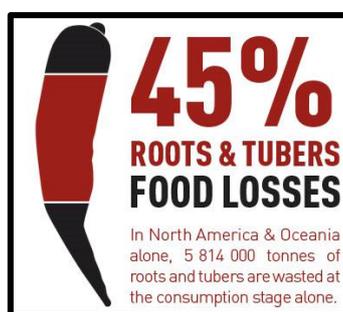
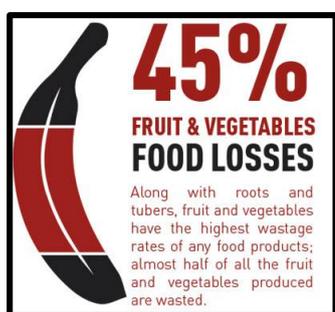
However, one problem that continues to plague the food industry is food waste. If we can reduce food waste, significantly, we may be able to improve supply without significant improvement in production of food. In addition to food wastage, food waste also add to the Climate Change problem by generating greenhouse gas emissions.

According to the Food and Agriculture Organization (FAO) of the United Nations, the Global food waste generated is very high. The data is alarming as follows:

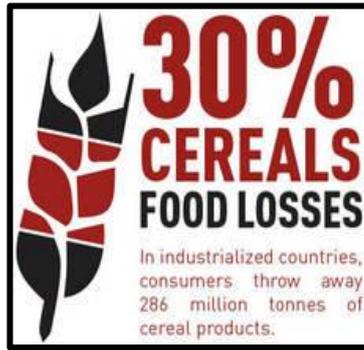
- Every year approximately one third of the food produced in the world for human consumption (1.3 billion tons) are wasted.
- Food losses and waste amounts to roughly about US\$ 680 billion in industrialized countries and US\$ 310 billion in developing countries.
- Fruits and vegetables, plus roots and tubers have the highest wastage rates of any food.
- Global quantitative food losses and waste per year are roughly 30% for cereals, 40-50% for root crops, fruits and vegetables, 20% for oil seeds, meat and dairy plus 35% for fish.
- Australians alone throw away 3.1 million tons of food a year resulting in 6.8 million tons of greenhouse gas emissions.

The Data from FAO can be summarized below:

A. Fruits, Vegetables, Roots and Tubers



Almost half of fruits and vegetables go to waste because of the short life time after harvest.



B. Meat and Seafood



Seafood and Fish waste are very high because once caught, storage becomes a challenge. Meat waste is around 20% mainly because of storage issues. Once meat is defrosted, it cannot be frozen again.

C. Cereal, Pulses & Dairy

In most developed and Industrialized countries, the cereal and dairy waste is at 30% and 20% respectively. Oil seeds and pulses also decay at about 20% losses yearly, due mainly to decay at storage.

Many techniques have been used to help prevent food waste over the year, by prolonging the life of food after harvesting and after cooking.