IPS-Nathan Lectures

The Challenges of Governance in a Complex World
Lecture II: Governing in the Anthropocene: Risk & Resilience, Imagination & Innovation

Peter Ho
2016/17 S R Nathan Fellow for the Study of Singapore

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Welcome to the Anthropocene

We live in the Anthropocene. Preceding epochs, like the *Holocene* and the *Pleistocene* – more commonly called the Ice Age – were all periods in the earth's long geological history that dates back four and a half billion years.

Humans have only existed in the last 200,000 years or so, from sometime in the late Pleistocene. This is just a blink of an eye in geological terms.

A view that is gaining currency in the scientific world is that human activity has begun to have a significant impact on the geology and the eco-systems of our earth. This is now often referred to as the Anthropocene, and many date its origin to the Industrial Revolution.

But what does the Anthropocene have to do with governance?

The Great Acceleration

In the Anthropocene, human activity is the prime driver of change of the earth's eco-system. What is most striking is that since the 1950s, after the end of the Second World War, change caused by human activity has actually started to accelerate. This phenomenon is sometimes called the *Great Acceleration*. Changes are now taking place at a pace and on a global scale that is unprecedented in history. The evidence is made visible in a spectrum of global indicators – including greenhouse gas levels, ocean acidification, deforestation, and loss of biodiversity.

It is not difficult to understand why. Today, increasing urbanisation is driving up consumer demand. Globalisation has taken off because of airline travel, container shipping, telecommunications and the Internet. Tourism is booming, and even the number of McDonald's restaurants increasing. As a result, the global economy is expanding, and the demand for infrastructure is growing. These combine to create a spiralling demand for resources – food, water and energy – that is straining the earth's eco-system. Climate change is one major consequence, but it is only one of many dangers that lie ahead as the Great Acceleration continues unabated.

Technology is a major factor in propelling the Great Acceleration. Moore's Law says that computing power doubles every two years. It is still holding more than fifty years after Gordon

Moore, the co-founder of Intel, made the observation. But it is not just computing power that is growing at an exponential rate. In his latest book "Thank You for Being Late", Tom Friedman presents evidence that other technologies are also changing at a similar breath-taking rate, and he writes of "simultaneous accelerations in technology, globalisation, and climate change, all interacting with one another."

The Fourth Industrial Revolution

If the Anthropocene started with the Industrial Revolution, Klaus Schwab, the founder of the World Economic Forum, argues that there have actually been three industrial revolutions since the 18th century, and a fourth is upon us. He explains thus,

> "The First Industrial Revolution used water and steam power to mechanize production. The Second used electric power to create mass production. The Third used electronics and information technology to automate production. Now a Fourth Industrial Revolution is building on the Third, the digital revolution that has been occurring since the middle of the last century. It is characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres."

But he goes further to argue that the Fourth Industrial Revolution has no historical precedent because,

> "When compared with previous industrial revolutions, the Fourth is evolving at an exponential rather than a linear pace. Moreover, it is disrupting almost every industry in every country. And the breadth and depth of these changes herald the transformation of entire systems of production, management, and governance."

Singapore and the Great Acceleration

Singapore has experienced its own version of a Great Acceleration. In less than half a century, we moved out of the Third World and entered the First World. Furthermore, by most indicators, we are now in the top rank of the First World. Life expectancy has shot up, from 65 years when we gained independence after Separation, to around 83 years today, an astonishing achievement given that it happened within less than two generations. No other country has achieved so much in so short a time.

But an implication of this remarkable transformation is that change in Singapore has not occurred at a sedate pace. Unlike most countries that have tracked a more gradual path to the top, change in Singapore during this period has the *lurch of an acceleration*, rather than the *gentle sensation of a velocity*.

Within less than two generations, societal demands have moved from the basic needs at the bottom of Maslow's hierarchy – such as food, shelter, water and security – towards the more complex psychic needs at the top of the hierarchy, such as self-esteem, self-actualisation and transcendence, which are needs that governments find very difficult to service.

One could argue that this is a happy problem to be tackling, instead of dealing with a hardscrabble existence as a Third World country. But acceleration gives little time for government and society to adapt. Decision cycles are compressed within shorter and shorter time frames. But it is a treadmill from which we cannot get off, unless we are prepared to give up the quality and way of life that we enjoy today.

Consequences of the Anthropocene for Governance

Among other things, the Great Acceleration increases the complexity of our world, a challenge that I discussed in my first lecture two weeks ago. As a result, the Anthropocene today is characterised by growing Volatility, Uncertainty, Complexity, and Ambiguity – or VUCA – leading to an increase in the frequency of black swans and unknown unknowns. In other words, we will face bigger shocks, more often, but with less time to discern causes and respond.

With increasing VUCA, governments face two particular challenges:

- The first challenge is how to deal with inevitable *disruptions* that are the effect of rapid change. New technologies can disrupt, massively. Such disruptions could be black swans, but mostly – and luckily – they are not. Instead they are disturbances to the normal flow of life – a terror attack, a cyber-hack, a new virus, a flood, civil unrest, economic turbulence, and so on. They have a disruptive effect because we live in a highly interconnected and complex world. As the Great Acceleration causes interconnections to intensify, the frequency of disruptions will increase and the amplitude of their impact will grow.

- The second challenge is how to *manage risk*, which is the effect of uncertainty, and in particular, how to manage its impact on national aims and objectives, plans and policies.

I will now deal with each of these challenges, and how governments respond.

Disruption Is a Certainty

If disruption is a constant in our VUCA world, then it behoves us to spend time thinking about how individuals, organisations, societies and countries can respond. The pre-emption and prevention of disruption, despite our best efforts, cannot be guaranteed. The name of the game is not imperviousness to disruption, but recovering, and even growing, after being disrupted. This is resilience.

Resilience

Judith Rodin, the President of the Rockefeller Foundation and who launched the "100 Resilient Cities" initiative of which Singapore is a part, provides a good definition of *resilience*. She writes, "Resilience is the capacity of any entity – an individual, a community, an organization, or a natural system – to prepare for disruptions, to recover from shocks and stresses, and then to adapt and grow from a disruptive experience."

The SARS Case Study

On 25 February 2003, the SARS virus entered Singapore through three women who had returned from Hong Kong with symptoms of atypical pneumonia. The virus then spread with frightening speed through the hospital system in Singapore. It confounded our medical authorities in the beginning. They did not know how the virus spread, and why it spread so aggressively. The fatality rate was shocking. By the time the SARS crisis was declared over in Singapore, 33 people had died out of the 238 infected.

SARS was not just a disruption – it was a big *black swan* for Singapore. It was also a very frightening time for Singaporeans. Then Prime Minister Goh Chok Tong described it as a "crisis of fear". Overnight, visitor arrivals plunged and the entire tourism industry came to a grinding halt. SARS severely disrupted the Singapore economy, leading to a contraction during the second quarter of that year.

A Resilient Response to SARS

When the normal flow of life is disrupted, as SARS did to Singapore, societies will need resilience to cope. Singapore's response to SARS is well-documented. One of the most critical early decisions was to designate SARS a national crisis, and not just a public health problem. This meant that all the resources of government – and in fact of the nation – could be harnessed in a *Whole-of-Nation* approach to tackle the *wicked problem* of SARS. The SAF put an entire Army division at the disposal of the health authorities. The Police did likewise. Within weeks, MINDEF's Defence Science & Technology Agency (DSTA) and DSO National Laboratories developed a contact tracing system, as well as the infrared fever screening system now adopted around the world. Such innovations epitomise resilience during a crisis.

Efficiency vs Resilience

But this could not have been achieved if the government had been organised with an obsessive focus on efficiency and optimisation. These are well and good – if everything goes according to plan. But things rarely go as planned. Most times, we cannot predict when disruptions will occur. The ability to quickly and decisively respond to crises and disruptions helps to manage uncertainty arising from our VUCA world.

Nicholas Nassim Taleb – who first coined the term black swan as a metaphor for strategic shock – notes that when disruptions occur in overly-optimised systems, "errors compound, multiply, swell, with an effect that only goes in one direction – the wrong direction."

But, as Taleb notes, "Redundancy is ambiguous because it seems like a waste if nothing unusual happens. Except that something unusual happens – usually."

So, to deal with disruptions, governments must go beyond a rigid and unthinking emphasis on efficiency. Lean systems that focus exclusively on efficiency are unlikely to have sufficient resources to deal with unexpected shocks and volatility. There should be some *fat* or contingency capacity in the system.

Futures Thinking

This is not an argument for establishing bloated and sluggish bureaucracies. Indeed, it is worth recalling that in 1967, Lee Kuan Yew said that, "Societies like ours have no fat to spare. They are either lean and healthy or they die." That maxim rightly articulated and reinforced the scarcity-vulnerability narrative, which was appropriate for a time when Singapore was hardly in a position to be profligate in its spending. It reinforced the need to be prudent in the use of our resources, and to save what we could for a rainy day.

But one thing that governments ought to have – as indeed should any large organisation that is concerned with its survival over the long term – is a small but dedicated group of people to think about the future. Their job is to look for challenges and opportunities emerging over the horizon. This is why I spent a good portion of my first lecture on the importance of this capacity. In Singapore, the government set up its own think tank for foresight, the Centre for Strategic Futures.

The skill-sets for thinking about the future – which is inherently uncertain and unpredictable – are quite different from those required to deal with short-term volatility and crisis. Also, those charged with thinking about the future should be allocated the bandwidth to focus on the long-term, without getting bogged down in the *minutiae* of day-to-day routine.

Of course, one could argue that it is the business of all government agencies – and the government as a whole – to prepare for the future. But even if they try to do that, it is not always easy for the planner or policy-maker to challenge the *official future*, especially when that future is consistent with an organisation's biases and preconceptions. Those who articulate a radically different future are at danger of being branded as subversive or lacking a sense of reality. So they will have a real incentive to make their scenarios more palatable for their audiences. But in so doing, they also inadvertently reduce the impetus for the organisation to confront uncomfortable alternative futures and to prepare itself for them. That is why Peter Schwartz, one of the most important of Shell's scenario planners, once said those whose job is to think about the future should also be court jesters – who can say the most ridiculous things and get away with it. They are supposed to help us suspend our beliefs.

Of course, this will not eliminate shocks. But by improving the ability to anticipate such shocks, we can reduce their frequency and impact. In turn, this will help make governments and nations more resilient.

Maintaining Reserves

Another part of the answer is the availability of reserves – if not reserves in natural resource, then other kinds of national reserves built from prudent policies and forward planning – saving for the proverbial rainy day.

The SAF and its supporting organisations like DSTA and DSO are part of the reserves of the nation in the sense that they are an insurance policy – and a large one at that – for a contingency that will hopefully never occur. But without that *fat* in the system, it is doubtful that Singapore would have been able to respond to the SARS crisis as it did in 2003.

Singapore's government is also committed to building ample financial reserves from the savings and surpluses of the government budget, giving the country a buffer to draw on in times of crisis. This is a reason why Singapore has one of the largest reserves in the world, at least on a *per capita* basis.

The utility of the national reserves was evident during the 2007-2008 global financial crisis. The Singapore government for the first time drew on the national reserves in the form of a S$20.5 billion *Resilience Package* – the name was not chosen randomly, I can assure you. This was primarily aimed at preserving and enhancing business competitiveness as well as promoting job retention, during a period of great uncertainty. A key aspect involved encouraging firms not to retrench workers, but to support retraining programmes, and to provide temporary part-time arrangements. Once the world economy began to recover, Singapore firms were able to respond with alacrity and speed to *catch the winds* of global economic recovery.

SkillsFuture is another example of how Singapore tries to *future-proof* the workforce by establishing a norm of lifelong learning, and by creating the infrastructure to make continuing education possible. Because it is not always possible to predict manpower trends accurately, having a system in place to encourage upgrading, and a culture that encourages lifelong learning, will help Singapore and Singaporeans ease through changes and uncertainties in the

employment landscape. It is part of a larger effort to ensure that Singapore remains resilient in the face of uncertainty and future shock.

Trust

But another issue was at play during the SARS crisis: fear. It rears its head not only during deadly epidemics. Even in financial crises, as in 2008 after Lehman Brothers collapsed, fear can go viral. As Franklin Delano Roosevelt said during the Great Depression in 1933, "the only thing we have to fear is fear itself."

The dissemination of trusted information is an important way of managing fear. During the SARS outbreak, Singapore took a transparent approach. The government laid bare the uncertainties and risks during SARS, even as other countries sought to reassure their citizens that SARS was under control. Singaporean leaders told people not only what they knew, but also what they did not know. They shared their concerns. They avoided providing false assurances.

This diffusion of trusted information – transparency, laying bare uncertainties and acting with empathy – was possible because of, and built on, the underlying trust, not just of the people in the government, but also of the government in the people. Singaporeans trusted the government for its effectiveness and integrity. The government trusted Singaporeans to deal maturely with the uncertainty as the SARS outbreak unfolded. This two-way trust, between the government and the people, formed a deep source of national resilience in Singapore during SARS. Indeed, trust is an important theme in my lecture tonight, and I will return to it later on.

Antifragility

Nicholas Nassim Taleb introduced another term, *antifragile* in his book of the same name. His proposition is that if fragile things break when exposed to stress, then something that is the opposite of fragile would not just hold together when put under pressure. Instead, it would actually get stronger. He calls this the quality of *antifragility*.

Strengthening the Social Fabric – Antifragility in Action

As I noted earlier in the definition by Judith Rodin, a resilient society not only returns to the state it was at before the disruption; it also adapts and grows. Similarly, an antifragile society reaches a new state – almost like a muscle that, tested by stress, grows stronger.

The cornerstone of Singapore's counter-terrorism strategy is a community response plan. This enhances community vigilance, community cohesion and community resilience. Singapore has built networks of community leaders and influencers by forming the Inter-Racial and Religious Confidence Circles (IRCCs). Through these networks, the leaders have helped strengthen understanding and build ties between different races and religions. For the Muslim leaders, they not only speak out against those who distort Islam, but also use the media, mosque and madrasah to assert mainstream Islamic values.

Singapore is also one of only six countries with structured programmes to rehabilitate and re-integrate terror detainees into society. The Religious Rehabilitation Group (RRG) was set up in 2003 after the JI terror plots were thwarted. RRG counsellors, all of them trained religious scholars and teachers, have helped terror detainees understand how they had been misguided by radical ideologues. The counselling sessions also extend to the family members of detainees. Every released terror-related detainee in Singapore has undergone counselling as part of rehabilitation. Most have returned to their families, found jobs, and integrated back into Singapore society.

The RRG also builds social resilience through outreach. It organises conferences, dialogues and briefings to educate the community – including the schools and madrasahs – about key Islamic concepts that have been misinterpreted and misrepresented by terrorist and extremist groups such as JI, Al-Qaeda and ISIS.

The example of the RRG illustrates a broader point. Just as trust between the government and citizens in Singapore predated SARS, strengthening the social fabric has been a key strategy since independence.

Singapore takes an interventionist approach to promote social mixing. It uses quotas to avoid the build-up of racial enclaves in public housing estates. It has introduced a raft of policies to

ensure that growth is inclusive: investments in public education, grants for skills training, and tax credits for the working poor.

Strengthening the social fabric also means building antifragility through simulations, designed not just to hone citizens' and agencies' instincts of how to respond in crises, but also to build confidence that we *can* overcome crises. The most recent initiative in this vein is *SGSecure*. In addition to raising awareness, SGSecure also runs exercises. This psychological strengthening is a key dimension of what Singapore calls *Total Defence*.

Risk

Let me now turn to my second area of focus in this lecture: risk. Disruptions, such as a terrorist attack or the SARS epidemic, are examples of *risk events*, acute and discrete occurrences. A *risk issue* is a development or trend that evolves over time. For example, the rise of transnational terrorism is a risk issue.

Risks can be defined not just in terms of trends or events, but in terms of whom it affects. There are *enterprise risks* that have an effect on an agency's objectives. These include operational risks that arise from the agencies' day-to-day operations and services.

And there are the *strategic risks*. There will always be threats to national outcomes, policies and plans, because no amount of analysis and forward planning will eliminate the volatility and uncertainty that exists in a complex world. These threats constitute strategic risk.

By their very nature, strategic risks often arise out of wicked problems, and involve cross-cutting issues that require a focus on the inter-connections between risks. In other words, strategic risks need to be dealt with at a *Whole-of-Government* or even a *Whole-of-Nation* level.

The Problem of Cognitive Dissonance

After the Asian Financial Crisis, in the boom years leading up to 2008, most people dismissed the risk of another financial crisis happening. Before 2008, central bankers felt that they had mastered macroeconomic management to the extent that prolonged inflation and deep recessions were no longer possible. A massive *hubris* dominated the financial world. Those

who foresaw an impending crisis were roundly ignored. The consequence – the global financial and economic crisis of 2008/2009 – was catastrophic and tragic.

Much of our reluctance to grapple with game-changing issues such as the global financial and economic crisis stems from an unwillingness to face the consequences of an uncertain and unpredictable future. These consequences interfere with long-held mental models – and business or self-interest – creating *cognitive dissonance*. At the heart of it, cognitive dissonance is about denial: the inability to acknowledge uncertainty, and an unwillingness to accept the need to adapt to a future that might be radically different from the current reality.

Cognitive dissonance leads to many organisations – including governments – underestimating risks, ignoring warning signs of impending crisis, and taking decisive action only when the crisis unfolds. This is the mother lode of *black elephants*, which I described in my first lecture. You can be sure that unlike its endangered real-life cousins, the black elephant is a species that is thriving in the Anthropocene.

How can we limit or counter the influence of such bias? Obviously, the occurrence of a crisis that radically alters our mental models is one corrective. The SARS crisis forced the Singapore government – as well as governments in China and Hong Kong – to take more deliberate steps to prepare for future pandemics. SARS corrected our biases, making us realise that the risks and costs of a pandemic were not trivial, and increased our alertness to the onset of another pandemic. Without SARS, it is difficult to imagine that our subsequent responses to the bird flu and the swine flu would be as aggressive and proactive as they have been. Contrast our response, and that of other Asian governments such as China and Hong Kong, with the lack of urgency in other countries which were largely unaffected by SARS.

But while crises can break our outdated mental models, they are an expensive way to force recognition of our biases. No government or society should have to wait for an actual terrorist attack to take the threat of terrorism seriously.

Risk as a Social Construct

Many big risks that governments have to deal with – natural disasters, pandemics, even financial crises and political upheavals – can often be assigned probabilities. This ought to lead

governments to take precautionary measures to mitigate these risks. But often they do not, because of cognitive problems.

It seems to me that big risk is ultimately not the province of actuaries. Instead it is a broader social construct, meaning that an organisation and its people need to agree that a risk exists. This is important as resources need to be allocated to prevent the risk, or to mitigate its impact, for example through contingency planning.

For obvious reasons, Japan takes the earthquake risk very seriously, because it is the most seismically-active country in the world. Everyone in Japan understands that earthquakes pose a perennial and at least life-altering – if not existential – threat. Because there is a national consensus, no expense has been spared to make Japan resilient to earthquakes to the maximum extent possible.

But before Fukushima, there was no such consensus on nuclear safety. Most Japanese believed that nuclear power was safe because the authorities declared it to be safe. They were lulled into complacency by this rhetoric. It proved to be a dangerous assumption. So, the triple disaster of 2011 – the Tohoku earthquake, the tsunami that followed, and the Fukushima nuclear disaster – was accentuated, because nuclear accidents were not in the Japanese pantheon of serious risk. No doubt, the Japanese now take the risk of nuclear accidents much more seriously.

But it is not just natural catastrophes that are risks. One risk issue attracting a lot of attention these days is Artificial Intelligence (AI). A hypothesis gaining traction is that AI poses an existential risk – in the vivid imagination of some, perhaps of the Terminator Skynet kind – and that this risk is in need of much more attention than it currently commands. It is a view that has attracted the support of famous names like Elon Musk, Bill Gates and Stephen Hawking.

Of course, the cost of responding to some extreme risks can be too high, especially when governments are seen as spending inordinate resources to prepare for a host of eventualities that may never happen. For instance, there is a possibility of the earth being destroyed by a planet-killing asteroid, but this is probably not a risk that we can meaningfully prepare for at this point in time, given the prohibitive costs today, that is, unless you are a Hollywood scriptwriter.

We cannot eliminate every risk, but we need to manage them in such a way that strategies and their premiums do not have to be all front-loaded.

The reality is that agreement on what constitute the greatest risks to a nation must be reached through consensus. Without that consensus, the government and political leadership will find it difficult to allocate resource to mitigate these large risks. A national conversation to assess these risks is important. Otherwise, the alternative is to wait for disaster to strike before action is taken. By then of course it is too late.

Our Singapore Conversation is an example of how risks are discussed at the national level. The risks of ill-health emerged as a big concern during Our Singapore Conversation, and arguably gave impetus to changes in health policy such as the introduction of MediShield Life.

Risk as a Psychological Construct

Risk is also a psychological construct because people have blind spots, or cognitive biases.

For example, the *availability heuristic* is the tendency to overestimate the likelihood of events with greater "availability" in memory, which can be influenced by how recent the memories are or how unusual or emotionally charged they may be. So, after a terrorist attack, we will think that another terrorist attack is a more probable risk than something else, simply because it is fresh in our minds.

The availability heuristic is illustrated via an observation made by Gerd Gigerenzer, a German psychologist who studies risk. He found that in the months after 911, passenger miles on the main US airlines fell by between 12% and 20%, while road use jumped. The change is widely believed to have been caused by concerned passengers opting to drive rather than fly. But the reality is that travelling long distances by car is more dangerous than travelling the same distance by aeroplane. Professor Gigerenzer estimated that an extra 1,600 Americans died in car accidents in the year after the 911 attacks – indirect victims of the tragedy.

Identification, management and communication of risk must take into account this human tendency to underestimate or overestimate risk because of their own cognitive biases or because it is inconvenient to admit to the obvious.

Risk and Uncertainty in Governance

It is inevitable that emerging technologies carry enormous risks, just as they promise huge opportunities. In recent years, a new wave of emerging technologies such as Artificial Intelligence (AI), drones, robotics, 3-D printing, big data, data analytics, cloud computing, and the Internet of Things (IoT), have begun to take off. Combined with the earlier wave of infocomm technologies, they promise to be disruptors and sometimes major game-changers, giving the individual capabilities and powers which were previously the province of only governments and large organisations. Cities, societies and economies are becoming more and more disintermediated.

Arguably, such technologies and their applications have been an enormous force for good. And yet, governments do not fully embrace these technologies. At most they have reached a *wary* accommodation, exemplified in the decision to separate government computers from the Internet. And rightly so, because while these technologies bring undoubted benefits, they also create risks. There are pernicious uses of technology, such as cyber-crime, and in the use of social media to promote extremist ideologies and to recruit terrorists. Social media also allows the proliferation of *fake news*, that bedevils governments today.

Experimentation

In our VUCA world, there are no perfect answers, in which outcomes are perfectly predictable. In such an operating environment, it is not always possible to make decisions on the basis of deterministic and linear analyses. Indeed, because change is happening so fast, such conventional approaches could lead us to miss the window of opportunity.

Instead, governments will often be called on to make big decisions under conditions of incomplete information and uncertain outcomes.

Of course, governments can play it safe and watch from the sidelines. But then, they will be overtaken by those who are nimbler, and those who are more daring. Or they can get some skin in the game now through research, test-bedding and pilots, so that they learn the limitations and potential of such technologies in order to be ready when these technologies take off. Pilot programmes and prototypes should be deployed where there is insufficient data for a proper

analysis, or if there is no precedent to fall back on. Exploration and experimentation are often more valuable than predictions of analytical models. *Beta testing* can also encourage citizens to co-create by delivering potential value earlier, which in turn gets their buy-in.

Car-Free Sunday SG is an on-going initiative by the Urban Redevelopment Authority. Roads in the Central Business District (CBD) are closed on the last Sunday of every month. The rare opportunity and novelty of cycling or walking along the open roads of the city attract people in droves. Car-Free Sunday SG can be seen as beta-testing of a desired future state – a *car-lite* Singapore. The participation of so many people and the feedback that they provide are part of a co-creation process to determine Singapore's future land use and design.

But to experiment, governments must accept, and even embrace, certain levels of risk. It is a form of risk management. I call this approach *safe fail*, rather than *fail safe*. Fail safe means you risk nothing, but you also achieve nothing, and there is no progress. But if such experiments succeed, then they can be expanded. If they fail, then the damage is contained, and a lesson is learnt.

And of course, to learn from failure. Thomas Edison, the great inventor of the lightbulb, is also famous for saying, "I have not failed. I've just found 10,000 ways that won't work."

The Innovator's Dilemma

The central thesis in Professor Clayton Christensen's seminal book, "The Innovator's Dilemma", is that successful organisations are doomed to fail in the long run, because there is tremendous inertia to change a formula that has worked well. In other words, the incumbents of today are locked-in to their mental models and success formulas. They are prisoners of what they know they know. It is this inertia that allows the insurgents, the revolutionaries, the start-ups, to sneak in, change the rules of the game, capture market share and dislodge the incumbent.

While this conclusion is based on the study of companies, Prof Christensen told me some time ago that he thought the same principles apply to governments.

Clayton Christensen's solution to the innovator's dilemma is to create small self-contained units within the larger organisation that have the mandate to experiment with new ideas and new

concepts. "Mainstream firms," he writes, "establish a timely position in disruptive technologies only when the firm's managers set up an autonomous organization charged with building a new and independent business around that disruptive technology." If these new units succeed, then their formula can be proliferated through the organisation. If they fail, then the organisational impact will be contained.

A model of this approach is DARPA – the legendary Defense Advanced Research Projects Agency of the US Department of Defense that has been the force behind game-changing innovations like the Internet, GPS, and quantum computing.

In a similar – though more modest – vein, MINDEF set up the Future Systems Directorate (or FSD) – now known as the Future Systems & Technology Directorate – some 20 years ago with the mandate to think about the longer term challenges facing the SAF, and to come up with new operational concepts, experiment with these concepts, and then implement them. MINDEF knew then that the FSD would generate frictions and tensions in the system by the very nature of its mission. It would make many feel uncomfortable. But I believe that the FSD was the catalyst for the innovation and the spirit behind it that transformed the Singapore Armed Forces from a 2G into a 3G SAF.

Going forward, this has to be the way for the SAF to stay ahead. It is not possible to maintain its strategic edge just by buying more and more weapons and platforms. The budget will not support this approach. Instead, the SAF's strategic advantage will be secured by exploiting its capacity to innovate and to change, changing the rules of the game, through better operational concepts and superior application of technology to realise these concepts.

Learning How to Exploit Underground Space

Singapore has experimented with radical concepts to address our land constraints, especially in the use of underground space. Some of the major experiments include the Underground Ammunition Facility (UAF) of the Singapore Armed Forces, the Deep Tunnel Sewerage System (DTSS), and the Jurong Rock Caverns (JRC).

The success of these experiments convinced the government to exploit underground space systematically, and it has now embarked on developing a comprehensive masterplan for underground space.

At the launch of the Jurong Rock Caverns, PM Lee Hsien Loong made some remarks that I think encapsulate the importance of such an experimental approach:

> "We must constantly think out of the box, be bold in tackling our challenges, be tenacious in execution in order to create new space for ourselves whether it is physical space, whether it is space which is metaphorical, thinking space, international space, and development space. It is not just that the sky is the limit, but there are also fewer limits than we think to the depths to which we can go because we are limited only by our own imagination!"

Imagination

This brings me to the importance of imagination.

I recently read a fascinating interview with the famous physicist, Nikola Tesla, the inventor of the alternating current. The interview is dated 30th January 1926. In that interview, Tesla talks about aircraft that will "travel the skies, unmanned, driven and guided by radio." He said that while "motion pictures have been transmitted by wireless over a short distance … later the distance will be illimitable, and by later, I mean only a few years hence." And he thought that "temperate zones will turn frigid or torrid." The world he described nearly a century ago is already upon us – drones, television and climate change.

There are also futures that are not quite with us yet, but they are emerging. In his interview, Tesla spoke of power being "transmitted great distances without wires." And his most fascinating vision was of wireless achieving "closer contact through transmission of intelligence, transport of our bodies and materials and conveyance of energy." In his vision,

> "When wireless is perfectly applied, the whole earth will be converted into a huge brain, which in fact it is, all things being particles of a real and rhythmic whole. We shall be able to communicate with one another instantly, irrespective of distance … and the

> instruments through which we shall be able to do his will be amazingly simple compared with our present telephone. A man will be able to carry one in his vest pocket."

We may not be a single global brain – yet – but our mobile phones certainly do fit into our pockets. In its time, Tesla's description was an amazing feat of imagination. We can aim to make improvements, step-by-step, but for a small country like Singapore, it is better to aim big, in order to stay ahead of the competition. In this regard, imagination is vital.

Imagination and the Smart Nation

Singapore has a big ambition, to become a Smart Nation. But what is a Smart Nation? At one level, it is about the exploitation of technologies in order to make the lives of people better, by giving them convenient and fast access to information, and to customised services, including those that we cannot even imagine today. The current state of technology already offers all the ingredients of a Smart Nation.

But at another – I would argue more fundamental – level, being a Smart Nation calls for innovation at the systems level – aggregating technologies and combining them with new operating concepts, policies and plans – to solve national problems such as the effects of climate change, traffic congestion, an ageing population, or simply to improve service delivery. But its realisation is the sum of many innovations, big and small. Its ambition should be big, but its implementation is in hundreds and thousands of projects, both large and little.

But at both levels, it is a product of our imagination, and it is only limited by our imagination. Like Nikola Tesla, we can only begin to imagine the endless possible futures.

Imagine a Smart Nation where there is increased efficiency, convenience and connectivity in and between workplaces and homes. Wearable technology such as hologram devices are used on the go to check and respond to work e-mails. Wi-Fi is available island-wide, eliminating restrictions from fixed data and limited call minutes. In the workplace, robots take over routine administrative tasks, coordinating meetings, conducting research and running daily errands. At home, robotic helpers do the household chores and prepare meals. They order groceries when food items are low in stock, which are then delivered by drone to the doorstep. Throughout Singapore, there are healthcare pods deployed island-wide at every housing block. These

provide medical diagnosis, dispense medicine and provide simple medical services as well. These make it more convenient for elderly residents who have mobility problems and for those who do not have the time to visit a clinic.

However, government may not be structured to reach this level of imagination and boldness of vision. Some might argue that it is not even its business. Innovation at this level is perhaps better achieved by the private sector, and by individual start-ups with the daring and the ideas.

Empowerment is key. Too much top-down control will kill the spirit of innovation that is central to Smart Nation. Instead, the role of government should be to facilitate such innovation by funding incentives and arrangements, and through flexible – rather than restrictive – regulations.

A good example of this approach is the Monetary Authority of Singapore's establishment of a regulatory sandbox last year to allow FinTech companies to experiment with products and services in an environment where if an experiment fails, "it fails safely and cheaply within controlled boundaries, without widespread adverse consequences."

The government also has a key role in connecting these innovations to their societal environments by encouraging and organising test-bedding and pilots of Smart Nation technologies in real-life settings, and perhaps even by insuring the risk of some of these experiments.

In Singapore, a precinct – One North – is now the site of a major pilot for the use of autonomous vehicles – or driverless cars – testing not just the technologies for the cars, but also for the road furniture. Such experiments and trials are essential because the development of these technologies and their applications need to be test-bedded in real environments. If the pilot is successful, then the programme may be expanded beyond this precinct into the larger national transport system, relieving road congestion and getting people to their destinations faster – and more safely – and, like Car-Free Sunday SG, helping to realise the vision of a car-lite Singapore.

The Politics of the Smart Nation

But there is a political challenge to such ambition. There are many misconceptions about the technologies associated with a Smart Nation. One big misconception is that in a 24/7 online world, constantly surrounded by innumerable sensors and smart objects, all connected to the Internet – the Internet of Things – absolute privacy and absolute security can be achieved.

As smart objects seek to gather more contextual information on behaviour and actions, the ability of smart devices to analyse people's lives and discover their identities will challenge traditional notions of privacy. Such information can clearly be misused and abused, compromising privacy and security.

There is another related issue – a fear, perhaps irrational in some countries, and rational in others – that the government will exploit these technologies to intrude into the private lives of citizens or to create an Orwellian system of mass state surveillance.

To overcome these misconceptions, a mature discussion is needed, not a polemical one. The government has a central role to play in shaping this discussion. It will have to persuade citizens that the benefits outweigh the risks of exploiting these technologies, and then explain how the risks can be managed. This is clearly in the realm of politics, and the onus must be on the political leadership to convince the people that such fears are misplaced in Singapore. But this can only be achieved if there is trust between the people and the government. As I observed earlier, trust in a fast-changing and complex world – the world of the Anthropocene – is a vital asset to good governance.

Leadership

Before I close, I would like to touch on a critical success factor in the complex world of the Anthropocene, where change is accelerating. Change cannot be avoided. Innovation must be continuous because the world does not stand still. Change and its handmaiden – innovation – must be embraced as an imperative of governance. Furthermore, there is no end point. It is a journey without a fixed destination, because the future is an ever shifting horizon.

But people dislike change – it is human nature. Change requires *leadership*, because it means leading people out of their comfort zone. Getting them to change is an act of will. The *future-fit*

leader has to persuade his people to believe in the need for change, instil confidence in change, and empower his people to change.

Successful leaders of change also make their people brave enough to express their opinions, change their behaviour, take risks, and learn from failure. They tolerate mavericks – even if they do not embrace them – because all *future-fit* organisations need mavericks. They are the ones who are prepared to challenge conventional wisdom and come up with the ideas that can change the rules of the game.

Some will argue that leaders should be more tolerant of mavericks. My response to this is "Yes, but only up to a point." A maverick is a maverick only if he is fighting the establishment. If he believes enough in his ideas, he ought to have the courage and conviction of his beliefs to push them, even against resistance. If he gives up the moment he runs into some opposition or official rebuff, then in my book, he is not a maverick. I think this is a sound approach. It is essentially a Darwinian process in which only those who have thought through their ideas, and are prepared to stand up and defend them, deserve the chance of a second hearing. Some mavericks will survive.

Conclusion

In today's world of accelerating change – the Anthropocene – we will need to dare to dream and to experiment with things no one else has done before. We must steel ourselves to embark on journeys of discovery in which the destinations are unknown, and where we must be prepared to cope with unexpected outcomes, to experiment, to manage the risk, to fail, and then to pick ourselves up and keep going.

Thank you.

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