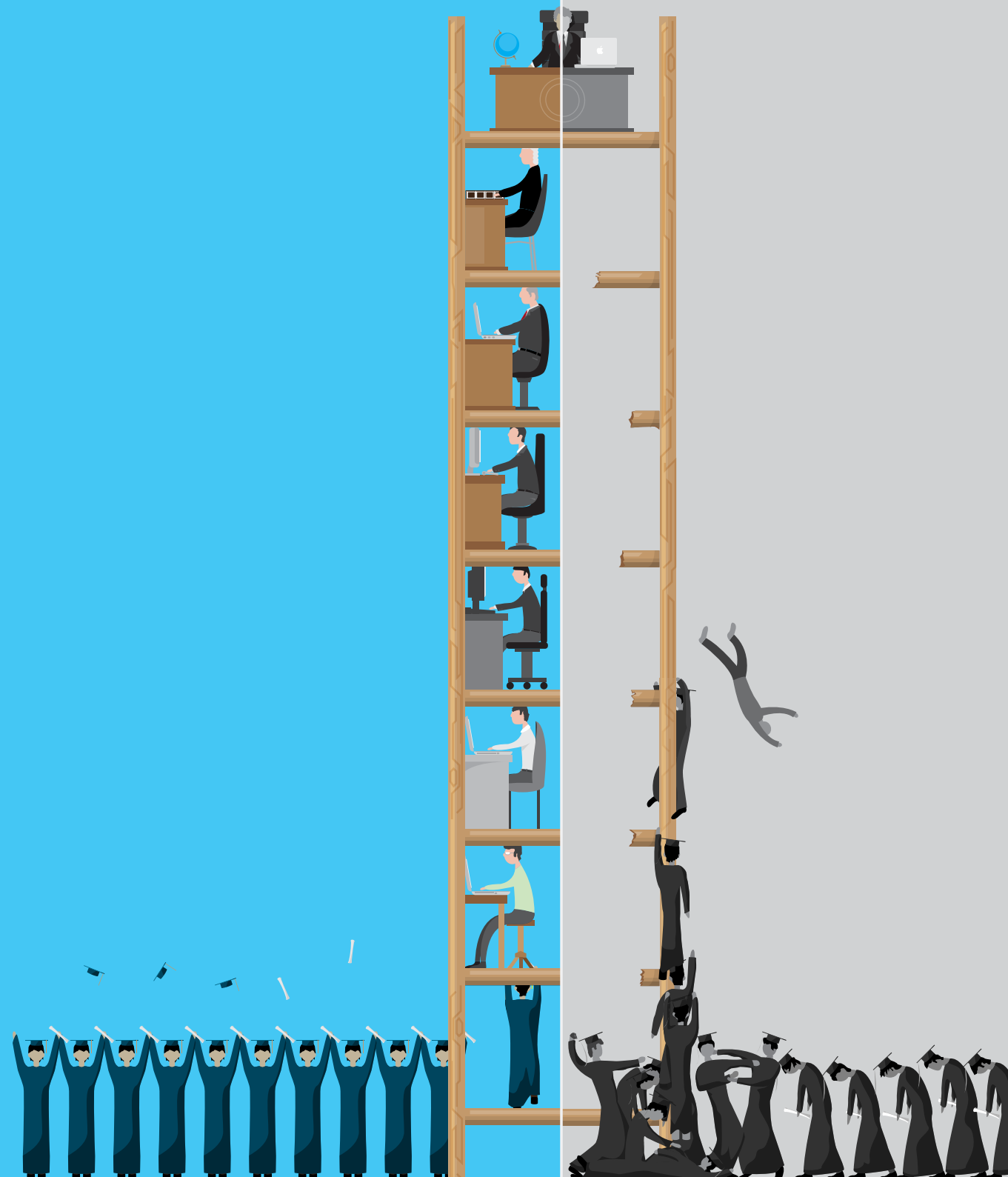
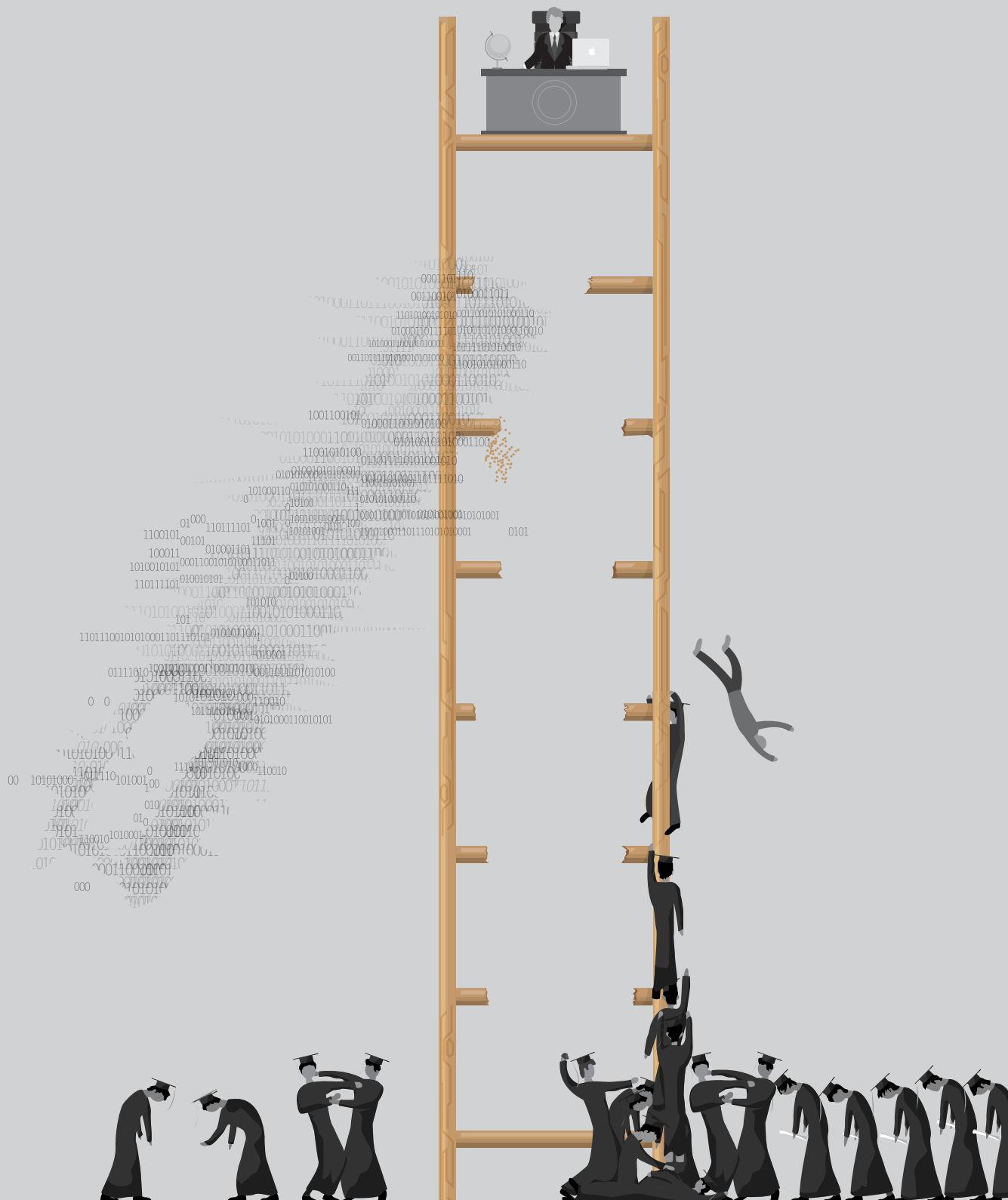


FUTUREtense



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Foreword

2012 has been a year of uncertainty. There have been major elections and leadership transitions in the USA, China, Mexico, France, Egypt, Russia. At the same time, tensions in the South China Sea and the Middle East, the economic and financial woes of the Eurozone crisis, and the prospect of a slowing Chinese economy, have raised volatility. Technology is accelerating changes in the way we live, and transforming businesses and industries. Additive manufacturing, or 3D printing, may change the way things are produced in the future. Artificial intelligence and robots increase work efficiency, but may also automate away many white collar jobs. There are many moving parts in the future ahead, and it is hard to see clearly how it might all unfold. But what is certain is that amidst uncertainty, there will be both opportunities and threats.

How can we shape our future? Singapore has always been able to overcome the odds and seize the opportunities despite our constraints. We balance our imagination with a healthy dose of pragmatism; we address immediate issues and also plan for the long term. Foresight plays a small but significant role in this. It serves as our lookout—to help make some sense of the uncertainty and to hopefully, enable us to see a little further than others beyond the horizon. This, plus a willingness to challenge assumptions, can help us navigate a path towards a future where Singapore continues to thrive.

MRS OW FOONG PHENG
PERMANENT SECRETARY
MINISTRY OF TRADE AND INDUSTRY, SINGAPORE
OCTOBER 2012

Foresight in MTI

We now live in what author Tom Hayes calls the '10-year century'. Events that used to take place in the course of a lifetime are compressed into the duration of a childhood. Since 2000, we have experienced three economic bubbles, more than one devastating terrorist attack, wars and unrest, and a global influenza pandemic which fortunately turned out not to be. Sensing what the future might bring has never been so important, nor so difficult.

A constant challenge a foresight group like the MTI Futures Group faces is how to balance the forward-looking nature of research topics with practical implications.

Too far out into the future, and we are talking about flying cars and jet-packs; ideas that are too removed from reality and will not be taken seriously. Too pragmatic and we could lose the ability to see blind spots and detect weak, but potentially disruptive trends.

The MTI Futures Group members find ourselves playing the role of a scout on the lookout for an anticipated event just over the horizon. The team catches trends that might fall through the gaps, looking at the same issues but from a different perspective and from a much longer timeframe. For example, at the end of 2007, the world experienced an unprecedented spike in the price of oil, which led to unexpected food price shocks. The MTI Futures Group had just prior to that, produced a research piece on the Future of Food, anticipating the food price shocks but also identifying threats and opportunities in the agricultural industry. In the study, it was highlighted how other countries were setting up overseas food zones to address the longer-term food needs of their populations. We shared the study at various government platforms, coinciding with the beginning of conversations about whether Singapore should set up overseas food zones. In May 2010, the Ministry overseeing National Development announced a collaboration with the Jilin food zone project in China.



The second challenge lies in leveraging networks. How do we pick up weak signals, achieve cross-silo effects and disseminate insights? MTI is not a particularly large ministry, but it can be easy for silos to form. A vast pool of knowledge and expertise already exists within the ministry and its agencies. To be effective, the Futures Group has had to leverage and connect with these sources, both to inform and validate our work and serve as platforms to receive ideas and research findings. We also tap into the wider Government network of foresight teams through sharing of methodologies and doing joint projects. This has been invaluable in helping the Futures Group increase its foresight capabilities.

The third challenge lies in 'translating'. How do we translate ideas into actionable insights that impact policy-making? Having a rich pool of ideas does not mean that it is clear how they would inform policy decisions. The ideas require a gestation period to breathe, percolate and develop into insight and strategy. For example, the Futures Group undertook a study on "batteries" in 2008, but it was not until we highlighted the implications for electric vehicles that an idea like "batteries" became actionable insights for the Singapore Energy Market Authority, which then set up a inter-agency task force to look at the feasibility of test-bedding electric vehicles in Singapore.

During the 2008 global financial crisis, MTI, like the rest of the public service, faced its own set of challenges. There were many conflicting signals on how the economy might have unfolded; a reality where little was could be made sense of and understood. In addition, there was immense pressure to deliver policy solutions. At that time, the Futures Group partnered with the economists at MTI and embarked on a study to look at the Future of Global Demand—how the post-crisis world might look like after the dust has settled.

With the global financial crisis, the short term outlook was akin to moving through a volatile and uncertain fog as economies and the financial system sought to adapt and respond. But the key question in all of this was: which future will emerge? This was where the Ministry found that having a dedicated Futures unit to do foresight analyses and suggest possible paths beyond the "fog" was very useful. The Future of Global Demand study postulated three possible future scenarios and gave clarity at a time of great chaos. We were able to use the insights from the research in many ways – to explain the crisis to our colleagues at MTI and the statutory boards through an informational video; to set the context for discussions at the Economic Strategies Committee through a report on the scenarios and their implications; and to inform the wider government through an article in the Civil Service College publication *Ethos*.

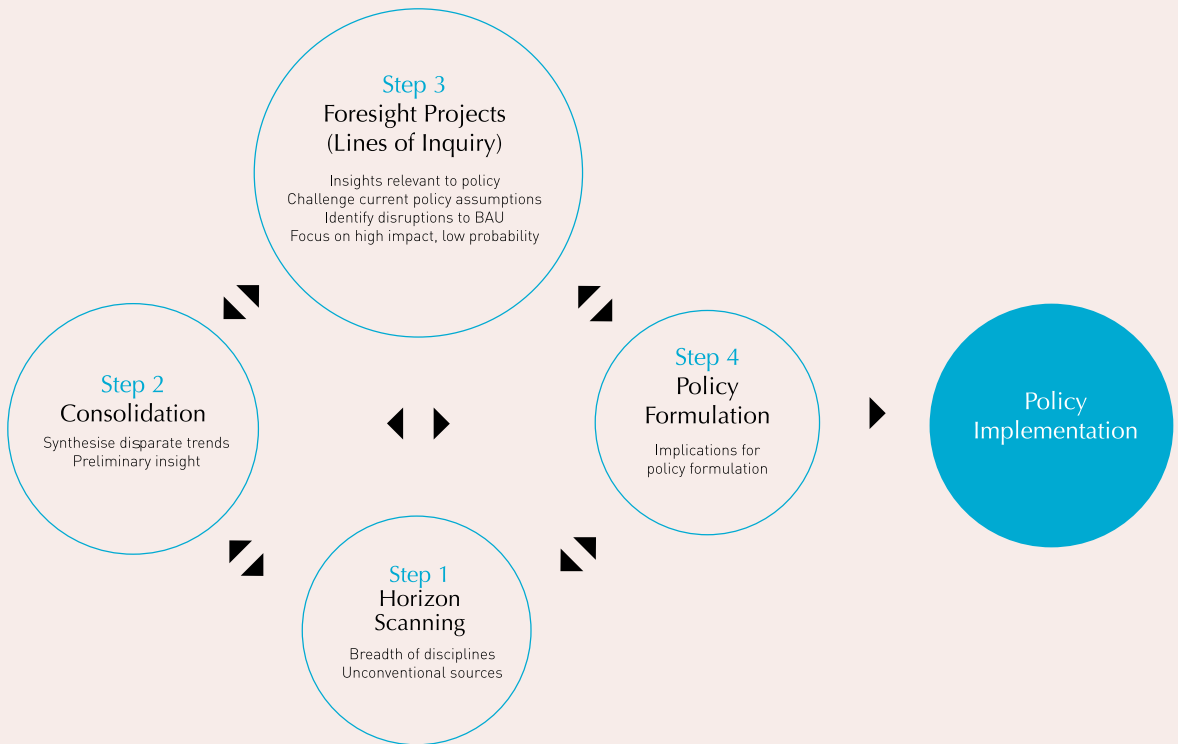
Where do we go from here? The MTI Futures Group continues to seed conversations about what the future might bring. Through these conversations, we hope to challenge mindsets and sensitise decision-makers to the unexpected, and contribute to better and more informed decision-making within the government.

FG's approach to foresight work—utility and surprise

FG's role in MTI is to scan trends on the horizon, identify weak signals, analyse their potential economic implications for the next 5 to 10 years, and coalesce them into insights to sensitise stakeholders to potential futures.

The framework for FG's work can be mapped against two axes. The first is utility, where high utility means we are able to articulate policy implications and generate a series of follow-ups. The second is surprise, where high surprise means we have, through projects, identified unexpected insights and novel ways of relooking at issues, and generated new ideas.

FG's role is thus slightly different from that of other policy divisions. We operate in the pre-policy space, or steps 1 to 4 in this "value chain"—generating high-impact, high-surprise insights and implications on topics relevant to policy-making.



1

In step 1, the foresight portion of the value chain starts with Horizon Scanning. The difference with the typical scanning process is the breadth of disciplines that we scan, especially from unconventional sources. For example, in the scanning for High Speed Rail, we unearthed interesting nuggets on China's high speed rail rollout, and economic studies done on the network effects of high speed rail from bulletin board discussions on Transport Politic, a portal for public transport enthusiasts.

2

In step 2, we synthesise disparate trends to generate unexpected preliminary insights and implications which have relevance for policy formulation. These steps are iterative, and sometimes we need to go back to earlier steps to further refine scans.

3

In step 3, we start identifying insights and implications in our foresight projects, which we term lines of inquiry. It is a given that not all insights are equal. We pursue insights that challenge current policy assumptions, and identify disruptions to business as usual. We also go after insights that have a high surprise element, and may have a high impact in spite of low probabilities.

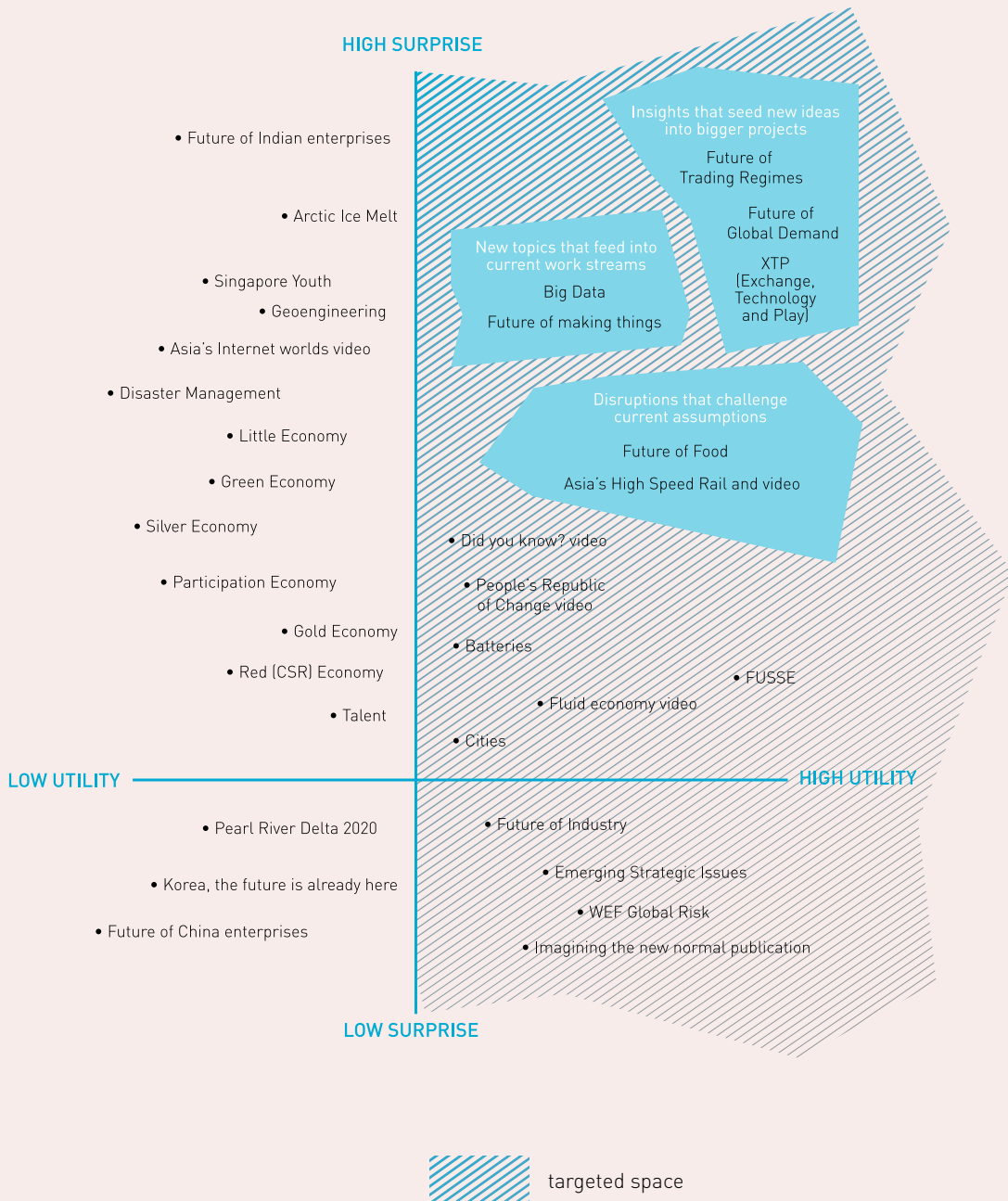
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In step 4, we try to translate these insights into policy implications for MTI. For our smaller projects like the videos, we will proceed directly from step 2 to 4.

Ideally, we aim to be in the right-hand quadrant of high utility and high surprise, but in the course of each project we may not always achieve that. We instead take a portfolio approach such that, at the end of the day, low-utility, high-surprise pieces can also serve future projects to aim for high-utility, high-surprise outcomes.

The following chart maps how the projects we have done over the past five years fare against this framework. In total, FG has completed 34 projects.

FG's role in the policy space puts us in a good position to identify unexpected insights and novel ways of approaching problems for MTI. This is represented by the shaded portion in the utility-surprise framework.



Of the 34 completed projects mapped onto the utility-surprise framework, we would like to highlight three clusters of projects. These clusters are in the high-utility, high-surprise quadrant. They exhibit characteristics of desired outcomes for FG projects. These characteristics are:

Insights that seed new ideas into bigger projects

New topics that feed into current work streams

Disruptions that challenge current assumptions

The first characteristic of a desired outcome is identifying disruptions that challenge current assumptions. We illustrate with two projects.

Future of Food started in 2007 with the question “Is Singapore ready for frequent food price and supply shocks?” It identified the insight that the food crisis is structural and not cyclical as in past food crises. This was a disruptive change. It challenged the assumption that Singapore can always afford to buy off the market. We benefitted from good timing as the food crisis broke out in December 2007 and there was good interest from senior forums. One of the ideas proposed in the project was overseas food zones, and FG met up with Singapore Food Industries (SFI) which was also exploring a similar idea. Together with SFI, FG presented the project findings to Ministry of National Development (MND) and then Agri-Food and Veterinary Authority (AVA) which then went on to collaborate with SFI on an overseas food zone in China. This long gestation of several years from idea to implementation is a feature of foresight projects.

The second project is more recent. The study on High Speed rail asked “What are the economic agglomeration effects of Asia’s high speed rail network on Singapore?” It identified the insight that rail network effects can disrupt regional growth patterns and lead to new winner and loser cities. This project also benefitted from good timing as it caught the wave of interest among senior forums of China’s high speed rail rollout. Sometimes external events derail, quite literally, the trends. In this case, China’s high speed rail crash has slowed down, but not stopped, the rollout of high speed rail networks.

The second characteristic of a desired outcome is identifying new topics that feed into current work streams.

Unlike the first characteristic on identifying disruptions, here the focus is on novelty, freshness and intellectual breadth. FG is able to bring a big picture view of the many moving parts of the future to complement the narrower focus of other government agencies’ work streams. This is illustrated with two projects.

The Big Data topic raised the question “How can we use data to give Singapore a competitive edge?” in 2009. During the research phase, FG found that several agencies were starting to explore big data. We contributed intellectual breadth and the big picture for other agencies to hang their work on, and brought them together with MIT Senseable City Laboratory to explore co-operation. This was followed, in June 2011, by the launch of LIVE Singapore! Project¹ by the NRF, EDB and the MIT Senseable City Lab². This long gestation cycle of several years from idea to implementation is once again a feature of foresight work.

The second project is more recent. Future of Making Things was completed in October 2011, asking the question “How can 3D printing undermine economies of scale and what is the impact on manufacturing?” FG again provided the macro view to complement the ongoing research of several agencies.

The third characteristic of a desired outcome is having insights that seed new ideas in bigger projects. This speaks to the strength of having a portfolio approach to foresight work as not all project outcomes appear in the high-utility, high surprise quadrant. Sometimes the insights need to take some time to ripen. Our example here is how they help bigger projects.

Bigger projects tend to be topical. For example, the Future of Global Demand piece was a joint project with the (then named) Economist and Strategy Division, researched during the 2008/9 financial crisis to explore possible outcomes of the global economy. The research was made richer by seeding it with farther out insights from the outcomes of other high-surprise but low utility projects.

Bigger projects are built on previous work. For example, Future of Trading Regimes was informed by the work done in Future of Global Demand, which was built on earlier work and so on.

Moving forward, we will continue with a portfolio approach of a mix of projects along the utility-surprise axes. For bigger projects, to be surer of the utility dimension, we will be refining our approach to adopt greater consultation with policy divisions on relevance to medium to long-term policy imperatives. Smaller-scale, more “surprise” projects will continue.

Paradoxically, we do not aim for 100% to be in the top right quadrant, as this may narrow the range of projects explored. Through trial and error, we find that a ratio of 70:30 produces a desirable outcome, where 70% of the work is in surprise pieces while 30% are in utility pieces.

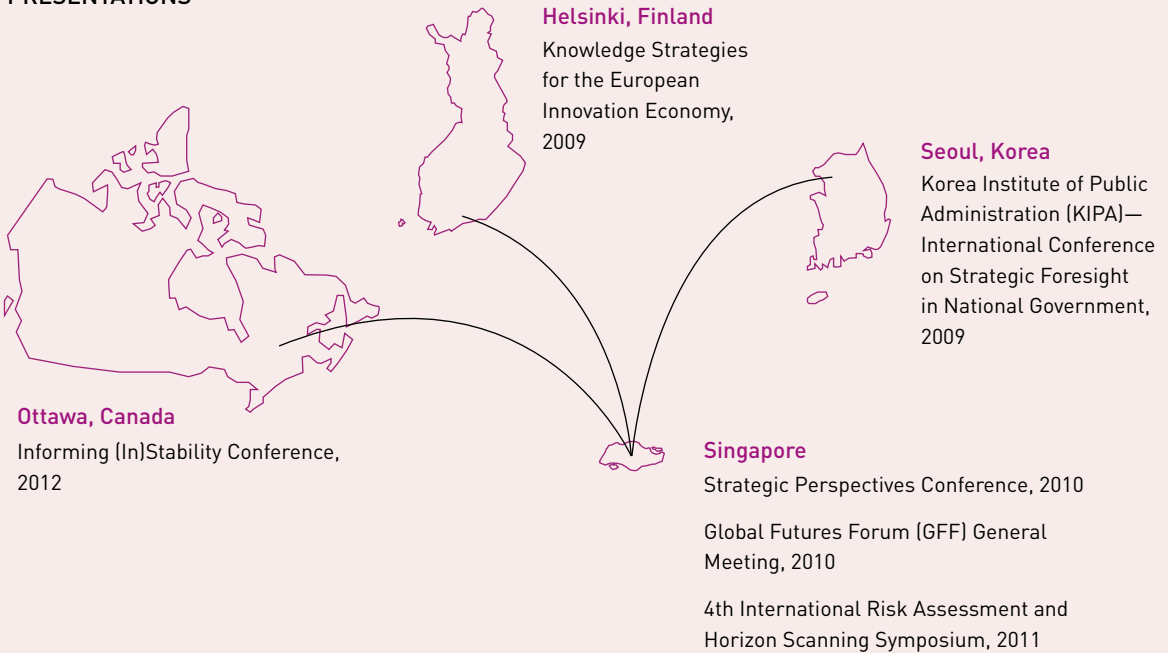
We hope that, by maintaining this utility-surprise tension, FG will continue to bring fresh views and identify unexpected insights and novel ways of approaching problems for MTI.

¹ LIVE Singapore! is a project developed as part of the Future Urban Mobility research initiative at the Singapore-MIT alliance for Research and Technology. It brings together multiple digital data streams from the city, giving citizens access to them through a series of dynamic visualisations. More at <http://senseable.mit.edu/livesingapore>
² MIT Senseable City Laboratory is a research initiative at the Massachusetts Institute of Technology to study and anticipate how digital technologies are changing the way people live and their implications at the urban scale. More at <http://senseable.mit.edu>

Destinations


Where FG and FG's work have landed.

PRESENTATIONS



PUBLICATIONS





Hardware is becoming much more like software. The internet democratized publishing, broadcasting and communications and the consequence was a massive increase in the range of both participation and participants in everything digital—the long tail of bits. Now the same is happening to manufacturing—the long tail of things.

Chris Anderson, editor-in-chief of *Wired* Magazine



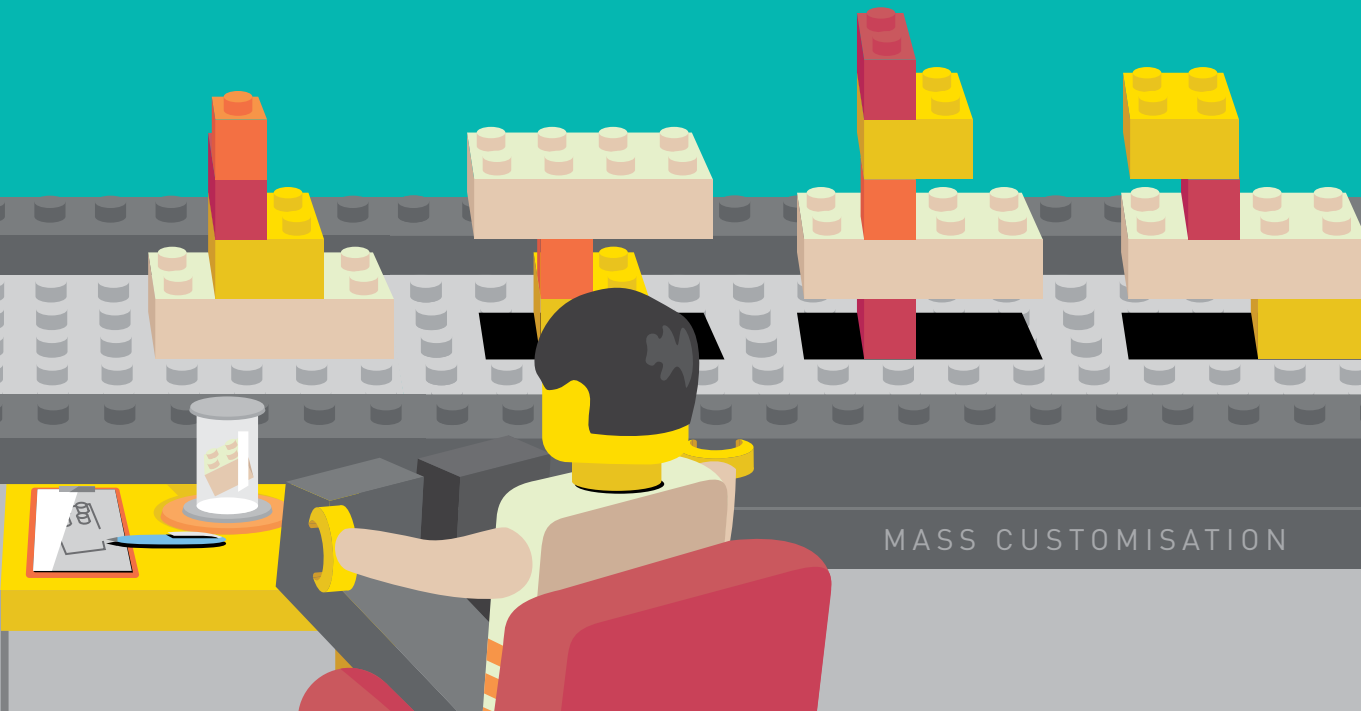
MASS PRODUCTION

CHERYL CHUNG

Future of making things

This paper explores the key trends driving this future, examines the implications relevant to Singapore, and imagines how it might impact Singapore over the next 15 years.

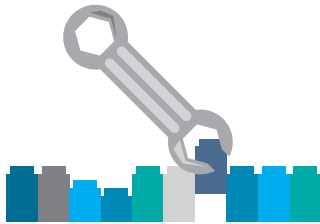
▶ Please see the companion video piece "Future of Making Things" at our youtube channel "futuresgroupsg".



MASS CUSTOMISATION

The future of making things is primarily driven by two trends—

New Tools and New Business Models

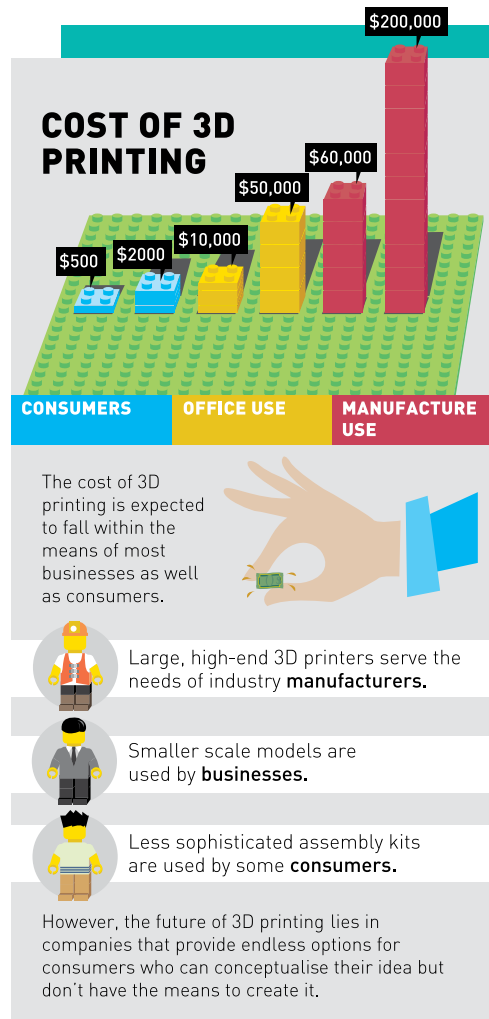


A NEW TOOLS

If the first industrial revolution was about becoming more efficient and manufacturing for many, then the next industrial revolution will be about becoming more personalised and manufacturing for one. New production tools, such as the 3D printer, allow engineers to make precise working prototypes from CAD files. (A list of new production tools can be found on the right page.) Two technologies, inkjet manufacturing and laser sintering, have been particularly important. They are both additive processes, which build up material layer by layer and do not require new machinery and tools to be fit out to make a different product. They have the promise to reduce the time and costs associated with conventional manufacturing processes (Soojung-Kim 2006). In addition, such additive manufacturing processes reduce material waste. In the current environment of resource constraints and economic uncertainty, this is crucial.

Early use of 3D printing was by hobbyists to create customised toys and gifts and by designers to make working prototypes of their designs. Production tools are following a path that is comparable to Moore's Law. As technology has improved and costs have fallen, the adoption of these new tools has been spreading fast. Dr Hod Lispon, Director at Cornell's Computational Synthesis Laboratory, has postulated that in ten years, 3D printing will be mainstream (China Business Forum, 2012). In 2010, Hewlett-Packard launched a mid-sized 3D printing machine, suggesting that mass-market positioning of such technology may already be on the cards. In Singapore, about 60 units of industrial 3D printers are in operation.

The additive manufacturing industry is growing quickly, with an estimated global value of US\$1.3b in 2010 and expected to hit \$5.2b in 2020 (Reuters 2011). There are



As technology has improved and costs have fallen, the adoption of these new tools is spreading fast.

The industrial revolution of the late 18th century made possible the mass production of goods, thereby creating economies of scale which changed the economy—and society—in ways that nobody could have imagined at the time. 3D printing makes it as cheap to create single items as it is to produce thousands and thus undermines economies of scale. It may have as profound an impact on the world as the coming of the factory did.

“Print me a Stradivarius”
The Economist, 10 Feb 2011

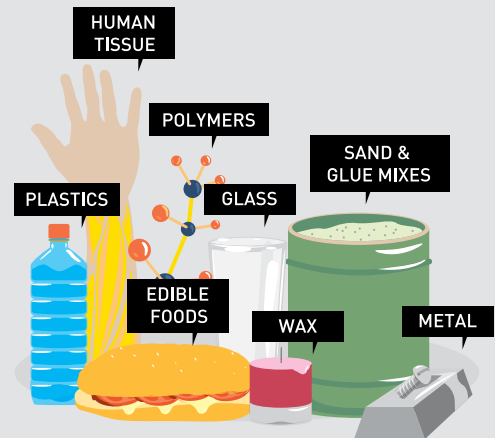
some predictions that desktop manufacturing will be a reality by 2030. However, it does not need to get there for the trend to have significant impact. We can already see weak signals in the form of the numerous Fabrication Laboratories, or Fab Labs, that have sprouted up all over the world. A Fab Lab is a small, high tech open workshop that offers digital fabrication services. The first idea of the Fab Lab was mooted by Neil Gershenfeld, who founded the Centre for Bits and Atoms at MIT. There are now more than 50 Fab Labs run by academic institutions and non-profits in 17 countries, each costing about US\$20,000 which enables users to make “almost anything”. Commercial Fab Labs have also sprung up. For example, TechShop, a chain of do-it-yourself workshops in the US, is a corporatised version of the Fab Labs which have risen in popularity over the past couple of years (Vance 2010).

The new maker toolbox

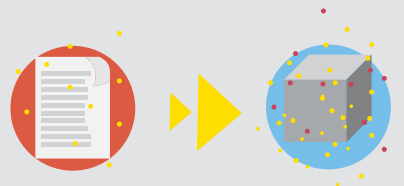
To understand what is in the new maker toolbox, we start with a simplified explanation of the difference between 3D printing and traditional printing.

3D PRINTING VERSUS TRADITIONAL PRINTING

The difference is twofold.



- 1 We are not printing with ink, we are printing with a variety of other materials.



- 2 We are no longer covering flat paper surfaces with a single layer of dots. Instead, we are printing a three-dimensional object by building upon layers and layers of covered surface.

3D Printing versus Traditional Printing

Mark Frauenfelder, editor-in-chief of Make magazine, explains what's inside the 21st century maker's arsenal.

COMPUTER-AIDED DESIGN SOFTWARE

CAD software can be used to make 3-D models of your project. Just a few years ago, most CAD packages were prohibitively expensive, hard to use, or both. But today you can get excellent 3-D design software for less than \$100. Solid modelling tools like Alibre Design Personal Edition (\$99) let you work on individual components and see how they fit together in a larger assembly. "Wire mesh" programs such as Google Sketchup and Blender can be downloaded for free.

COMPUTER NUMERICAL CONTROL MACHINES

After you've used your CAD software to design a gear for your robot or a new kind of brake calliper for your mountain bike, you can manufacture these parts using CNC equipments. These machines take your CAD data and carve the part out of solid piece of stock, such as aluminium, wood or plastic. The most common types of CNC machines are mills and lathes. A mill has a high-speed rotating bit that moves relative to the stock along three axes. A lathe, by contrast, spins the stock itself while a stationary blade carves away material. CNC equipment can also be used to drill and engrave material. Desktop models like the Taig Tools CNC Mill start at about \$2,000, but many makers opt to build their own machines for less than a grand. For more powerful equipment, you can join TechShop, which provides access to CNC machinery at three (soon to be seven) locations nationwide, plus the training to use it.

3-D PRINTERS

Unlike mills and lathes, which make parts by removing material from a solid block of stock, 3-D printers make physical objects by adding materials a little at a time. Several kinds of 3-D printing technologies are available. Selective laser sintering uses high-temperature lasers to melt powdered metal or plastics into durable 3-D parts. In stereolithography, laminate object manufacturing uses glue to bond layers of material that have been cut by a blade or a laser-cutter. Makerbot's entry-level 3-D printed, the Thing-O-Matic (\$1,300), uses fused deposition modelling to melt a filament—made of the same plastic used in Lego bricks—fed from a spool to its heated nozzle.

ARDUINO MICROCONTROLLER

This \$30 open source device allows designers and artists to make interactive objects. Want a box that dispenses a gumball when you give it a secret knock? How about a fully automated yoghurt maker or a wireless backyard weather station? An arduino board can help you realise these projects in a fraction of the time it would take with discrete components. You connect things to its input pins (sensors, say, or buttons) and output pins (LEDs, motors sirens, servos, and more). Then use the free Arduino software (Mac, Windows, and Linux compatible) to write a program that tells the outputs what to do with the input signals. Arduino isn't the only microcontroller platform out there, but its simplicity and versatility have made it the leader. A huge community of developers have published thousands of code examples you can download and incorporate into your own projects.

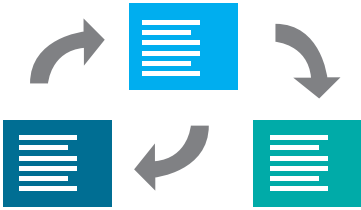
RAPID-PROTOTYPING SERVICES

When the desktop publishing revolution kicked off in the 1980s, laser printers cost more than \$3,000. At that time, most designers took floppy disks to a service bureau to have their work printed out. Desktop manufacturers face a similar situation today. High-end 3-D printers can easily cost \$50,000, but with rapid-prototyping services from companies like Ponoko and Shapeways, makers can upload their designs and have them made out of wood, plastic, rubber, or metals ranging from aluminium to titanium. What's more, these companies offer platforms for selling your products to others—letting you be not just a maker but a mini-mogul.

Excerpt from "How to Make Stuff" by Chris Anderson (Wired Magazine. April 2011).

If the past 10 years have been about discovering post-institutional social models on the Web, then the next 10 years will be about applying them to the real world.

Chris Anderson,
editor-in-chief of *Wired Magazine*



B NEW BUSINESS MODELS

The development of Web 2.0 enabled individuals from different parts of the world to connect, collaborate and exchange ideas online. Web 2.0 also unlocked the latent long tail of consumer demand, enabling even small businesses to successfully tap that market. As Amazon found out, the aggregation of products in low demand can result in a market share that rivals or even exceeds the few current bestsellers.

This trend is extending into the world of things. (see right) There are now many websites where people can document and share their projects such as Instructables, iFixit, Etsy, Make, Hack a Day and Adafruit (Anderson 2011). In addition, makers are now able to buy specialised parts and sell niche products at a much lower cost than they would have using traditional distribution channels. Both professional designers and amateurs have access to more avenues to commercialise their ideas. For example, on ponoko.com designers can find a manufacturer for their products. Jack Ma, Chairman of Alibaba, sees that consumer to business transactions will be a new avenue of trade: "If we can encourage companies to do more small, cross-border transactions, the profits can be higher, because they are unique, non-commodity goods." (Anderson 2010)

3D PRINTING SOLUTION

3D printing will create many **new opportunities** in almost every industry. Imagine a world where actual objects will be created with the touch of a button. Some may save lives, others extend lives, and yet others simply bring ease to our daily routines.

THE FOOD INDUSTRY



Edible objects will be created by syringes injected with edible food.



Decorating and designing foods with icing and other soft foods of liquid consistency will become possible.

MEDICAL SCIENCE AND RESEARCH

3D bioprinting will allow for the printing of cells placed in predetermined patterns to replicate human tissue, organ and blood vessels.



May potentially eliminate the need for organ donors.



May provide doctors and surgeons with on-demand human tissues.

A scanning device will examine limbs and provide a detailed computer image that can be sculpted.



Designing and printing artificial limbs and limbs with customised coverings.



The cost of making artificial limbs could be reduced to 1/10 of the traditional cost.

CONSUMER OPTION

Consumerism will transition from pre-fabrication to personal fabrication.

► Visit a 3D printing company's website and:



Choose from a variety of existing designs.



Modify existing designs.



Or create new designs using their software.

Provide print-on-demand and mass customization.

MANUFACTURING



Produce 3D parts and assemblies made from various materials in a **single build**.



Reduces the need for tooling, machining, and handcrafting prototypes.



More efficient designs, design changes, and more effective experimentations.



Reduces the need to maintain an **inventory** of physical moulds.

Implications:

A New Manufacturing Renaissance?

The two trends of new tools and new business models will lead to two shifts in the way we make things. Firstly, the ability to make things cost-competitive on a small scale and sell them online has made production more scale-free and shifted from manufacturing for many to manufacturing for one. Secondly, the ability to make physical objects from their digital representations has shifted production from a capital-intensive process to an information-intensive one. This section explores the implications of these two shifts on individuals, firms, industries and cities.



A INDIVIDUALS

The most obvious implication on the individual is that the consumer now has more choice. As production becomes scale-free, we will begin to see the adaptation of mass market products and the creation of new products for the individual consumer. These would be many more small operations trying to fulfil the needs of small and niche communities (Anderson 2011). In other words, mass customisation will become a reality. More interestingly, consumers will be more able to participate in the production process. Industrial design has traditionally been inaccessible to the non-professional. We will see a rise in the “maker” movement. While this might be a hobby for now, it is worth noting that the ham radio was similarly a hobby when people were just experimenting with packet radio. Nevertheless, this experimentation led subsequently to technological developments such as Wi-Fi and mobile phones (Anderson 2011). Similarly, the ability to perform 3D chemical printing at home today using a \$2000 3D printer may allow people to print and share recipes

for niche substances that chemical and pharmaceutical companies do not make (New Scientist, Apr 2012). Such enthusiasts will be among the first to acquire fabbing systems and figure out how to use them in ways that we never imagined. “The most interesting companies demonstrate emergent behaviour,” says Fred Wilson, a venture capitalist at Union Square Ventures, which invested in Kickstarter ¹. “People’s use of the service is never what the creators intended.” (Adler 2011). As the author William Gibson has observed, “the street finds its own uses for things.” (Hackers, William Gibson, 1982)

Limor Fried, founder of Adafruit Industries ², has said that she would be surprised if in five to ten years, every public school did not have a required class in robotic mechatronics. She predicts that there will be a return of the wood shop; however, in this new incarnation, students will be learning about sensors and technology. The future of making things will demand workers who are entrepreneurial, highly skilled, and able to collaborate with others. Fortunately, with the internet, video and online gaming, a generation of youngsters are acquiring design and manufacturing skills that can move straight from the living room to the factory floor (Soojung-Kim 2006).



B FIRMS

As the barriers of making things fall, production and innovation will begin to happen simultaneously (Soojung-Kim 2006). Scott Wilson, former global creative director at Nike, had the idea to create a wristband that would convert an iPod into a watch. He put up the idea on Kickstarter to source for funding and test consumer demand. This was a low-risk alternative to traditional product development which helped to shorten the production timeline from one year typically to 30 days (Adler 2011). The time to take a digital design from concept to physical production will drop by as much as 50-80% (The Economist 2011).

The compression of the production process will be a boon to inventors and start-ups, because product development will become less risky and expensive. A volatile business environment places a big premium on structured experimentation and the ability to innovate as part of production to address critical unknowns before making big investments will be very useful. Engineers are starting to collaborate on open-source designs for objects and hardware, just as open-source programmers collaborate by sharing software code. For example, many Fab Labs record how each product is made, which makes it easier to build on what has already been done.

The factory will also be transformed into a “digital production plant”. Compared to more conventional manufacturing methods, these new production tools require little set-up time and will enable factories to shift product lines in a few hours. That said, it is unlikely that additive manufacturing technologies will completely replace mass-production techniques that have been honed for over a century. Instead, the factories of the future are likely to have 3D printers working alongside milling machines, presses, foundries and plastic injection-moulding equipment, and taking on an increasing amount of the work done by those machines (The Economist, 2011).

This could turn the factory floor into a centre for a new kind of knowledge work, and make manufacturing more flexible, responsive, and information-intensive. These flexible factories would not be organised around production, but around demand. The ease and speed with which they respond to inputs, reconfigure to demand, even move to where they are needed will reshape our concept of the factory.



C INDUSTRIES

As the electronics industry was a front-runner in capitalising on web-enabled technology trends, many

expect that it will also be a first-mover to develop applications for 3D printing and related technologies. A*STAR has recently scaled up research into roll-to-roll printing systems for producing functional films and printable electronics.

Pricewaterhousecoopers has also suggested that industries which use a large number of component parts, such as the automotive and aerospace industries, may have the most potential applications for fabbing technologies. For example, aerospace companies are bringing rapid prototyping to the factory floor to make small runs of highly complex aircraft parts. In fact, Boeing spun out an On Demand Manufacturing subsidiary, which pioneered the use of a selective laser sintering rapid manufacturing process to make flight-certified aircraft components, as early as 2002. In Singapore, a marine company is using laser sintering technologies to repair marine components because it is cheaper and quicker than replacing them. Beyond just printing parts, some automotive firms, like Local Motors (case study next page) will let the professionals handle the elements that are critical to performance, safety and manufacturability while the community designs the parts that give the car its shape and style—showing how crowd sourcing can work even for a product which has stringent safety and performance requirements. Such products are niche; such a vehicle will not compete with the major automakers but rather fill in the gaps in the marketplace for unique designs.

There are also potential applications in the biomedical area. Medical device companies, such as those producing hearing aids or prosthetics where the products need be adapted to the users’ individual requirements, are early adopters of this technology. In Singapore, Bio-Scaffold International has licensed A*STAR technology in this area to develop customisable dental solutions for patients after tooth extraction. In addition, A*STAR has also started a new multi-disciplinary programme on bio-manufacturing for the manufacturing of bio-implants. 3D printing is one of the techniques being investigated.

New “fabbing supply chains” may also develop around raw materials and reverse logistics. Smaller quantities of raw materials would be transported to larger numbers of decentralised production sites (possibly even households). Transportation of parts and finished goods would decrease, while the reverse logistics for fabbed products would open up new areas of logistics activities.



D CITIES

It has been argued that countries with more expensive, but better educated workforces, with well developed and gaming cultures, will be better positioned to exploit these

¹ Kickstarter is a crowd-funding platform for creative projects. Project owners target a minimum amount of investment to raise by a specified deadline and Kickstarter aggregates pledges from the general public. Since its founding in 2009, Kickstarter has raised US\$40 million for 7,500 projects. The project success rate is about 45%. <http://www.kickstarter.com>

² Adafruit Industries sells kits and parts for original, open-source hardware electronics projects featured on <http://www.adafruit.com>

technologies. This seems to suggest that rise of 3D printing technologies will “undermine the advantage of low-cost-low-wage countries and thus repatriate manufacturing capacity to the rich world” (The Economist 2011).

However, manufacturers in low-cost-low-wage countries are likely to be just as well-placed to adopt these technologies (The Economist 2011). The “double helix of high economic growth and fast digital adoption” in emerging markets like China and India will drive the adoption of new tools and business models (Oxford Economics 2011).

In addition, innovation is shifting from adaptation to in-market development in emerging markets because the latter are large markets and low cost locations (Sheth 2011). This may lead to the emergence of new competitor regions. For example, we can expect that the Pearl-river delta in China might do very well with their *shanzhai*³-style innovation. Success in making things will depend less on scale and more on the quality of ideas.

There are new vulnerabilities arising from this future. Ideas can be copied even more rapidly when objects can be described in a digital

file. The relevance of patents in IP protection will be questioned even further. In fact, a survey undertaken by the University of California Berkeley in 2008 showed that start-ups from all industries feel that patents provide relatively weak to moderate (rather than strong) incentives to create, develop and commercialise technology. The battles over intellectual property are likely to become even more intense; there could be calls for restrictions on the use of 3D printers. As with open-source software, new non-commercial models will emerge.

A case study on local motors

Adapted from “In the Next Industrial Revolution, Atoms are the New Bits” by Chris Anderson (Wired Magazine, Feb 2010). Local Motors is the proof of concept of how small-volume

manufacturing can work in the car industry. This case study uses the example of Local Motors to illustrate how the developments in the future of making things might play out.

FRAMEWORK	EMERGING TRENDS	EXAMPLE OF LOCAL MOTORS	IMPLICATIONS
Invent	Non-professional hobbyists or “tinkerers” come up with ideas/inventions	Customers provide the concept for their dream cars.	Greater pace of innovation. Items are made by the public, for the public. This ensures the products can keep up with changing demands of customers.
Design	Crowd-sourced through design competitions	The exterior is selected through design competitions (crowd-sourced), while Local Motors experts select or design the interior components.	Built-to-order, customised products. Less managerial positions; more crowdsourcing.
Prototype	3D printing	Prototyping is done in-house, in the company workshop.	Rapid prototyping technology allows for greater control over the outcome of the final product, especially more complex objects. Reduces the need to outsource prototyping processes to other firms.
Manufacture	Outsource/ use 3D printing	The cars are manufactured at Factory Five Racing, a kit-car company and Local Motors investor located just down the road from Local Motors.	Prototyping within firm, hence reducing costs and streamlining the production process. Allows small start-ups with less than a hundred full-time staff to operate.
Sell	Online	Local Motors purchases components and prepares kits only after buyers have made a down payment and reserved a build date.	No need for physical store, saves retail costs.

FUTURE OF MAKING THINGS: SINGAPORE IN 2025

Today, 3D printing is a US\$1.3b industry dominated by hobbyists and designers (Reuters 2011). However, as the technology improves and becomes more mainstream, we can expect it to impact Singapore significantly.

Over the next five years, we could face increasing competition from cities like Shenzhen which have a strong *shanzhai* culture. The same entrepreneurial dynamism that led to the rise of *shanzhai* industries and the skills required to thrive in the low-margin, ultra-high speed operating environment means successful operators are well-placed to drive the manufacturing side of the maker revolution by being fast and flexible enough to work with small businesses and even lone designers (Anderson 2010).

When 3D printing becomes mainstream by 2025 (Reuters 2011), the industrial landscape could look very different. For example, the logistics sector will need to transform as demand for airfreight of specialised component parts plummets. At the same time, there will be new opportunities at the upstream end, such as for the development of new materials and equipment for 3D printing, as well as technologies associated with packaging and distribution of low-volume, highly heterogeneous mix of materials. Arising from these, requirements for industrial and factory space may change significantly.

There could also be murky regulatory waters to navigate. For example, in July 2012 a gunsmith in the USA made a rifle with a 3D printer. This has obvious implications for weapons control. Less extreme, but just as important, are implications for product liability. If a 3D print product fails, is it a design defect for which the designer is responsible or a manufacturing defect for which the manufacturer (the 3D print shop) is responsible? Should both be responsible? While this problem is dealt with in the traditional realm of product liability i.e. large companies with the resources to extensively test products before releasing them to the market, how about lone designers or small print shops? If a designer posts a design with a creative commons license that is subsequently redesigned by a string of

other designers, it may be very difficult to identify which designer is responsible for the defect. While a “maker beware” doctrine may be sufficient for trinkets that people can print themselves (regardless of where they get the design), the widespread use of more complex objects where defects could cause injury may be limited.

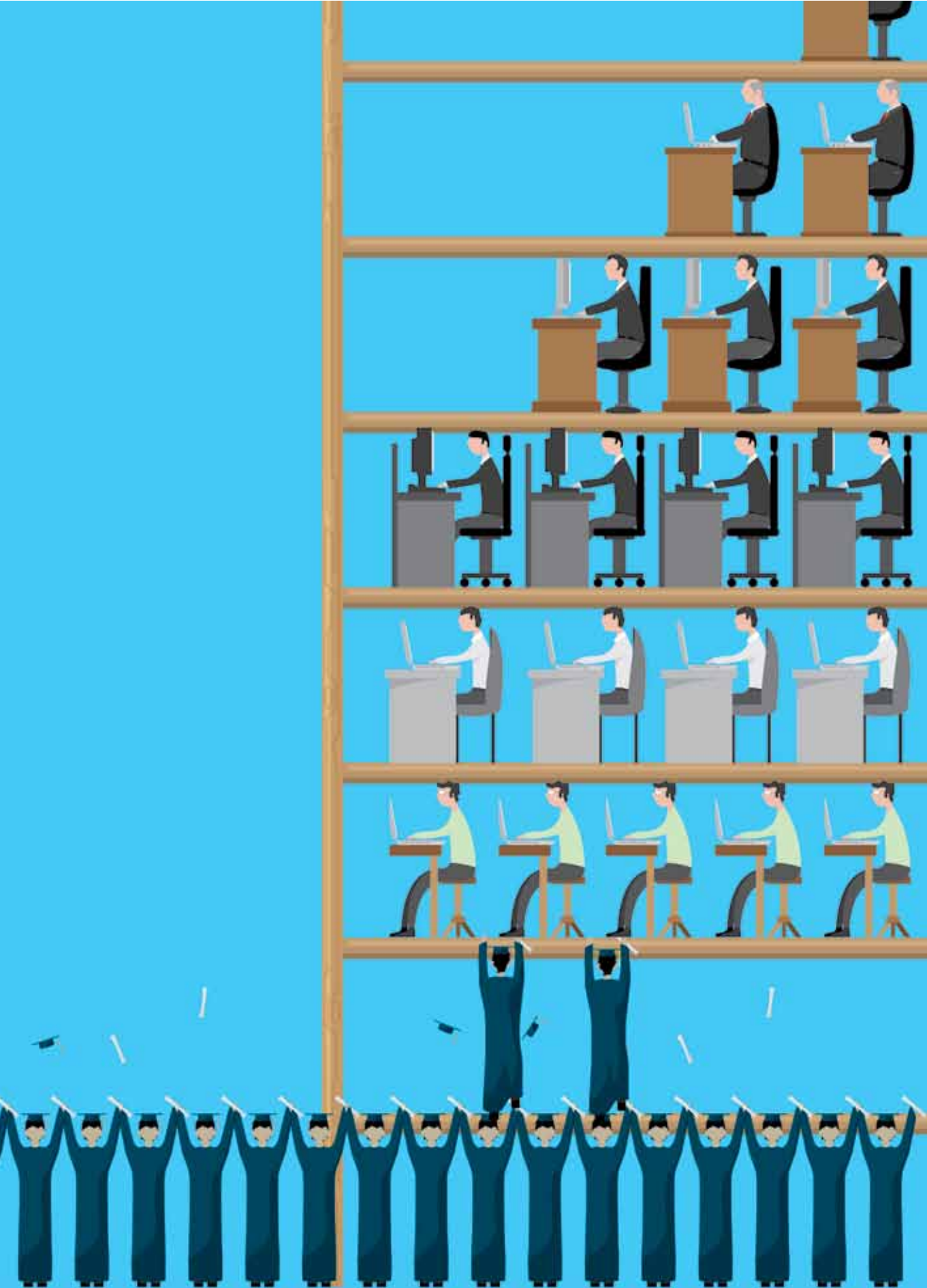
For 3D drug printing, the issues are even more complex. In addition to the confusion around liabilities discussed above, there are potential social and public health issues arising from wider access to drugs on demand, and it will be increasingly difficult to enforce possession and production laws. There is also the risk of non-clinically-tested drugs being used in non-scientific contexts with unknown risks for human and animal health.

Singapore will also need to think about the new intellectual property models that might emerge (like creative commons for software and digital media). The problems with music piracy and file sharing are likely to be transferred to the realm of tangible products.

What can Singapore do to prepare for the future of making things?

For starters, given the long leadtime needed to develop people with the skill sets to master this future, Singapore should start cultivating a “maker movement” by enabling students, hobbyists and professional alike to gain access to new production tools and Fab Labs to tinker and make things. The education system may need to incorporate robotics and mechatronics into the mainstream curriculum. In the context of mapping out scenarios for the future structure of the economy, we should take into account the potential of the new technologies to disrupt business models and the industrial landscape, and identify ways in which we can prepare businesses and people to develop the capacity and capabilities to make the transformation.

3 The term *shanzhai*, which derives from the Chinese word for bandit, usually refers to the thriving business of making knock-offs of electronic products.



NATHAN PENG, WANG NING AND SIM PHEI SUNN

FUTURE OF JOBS

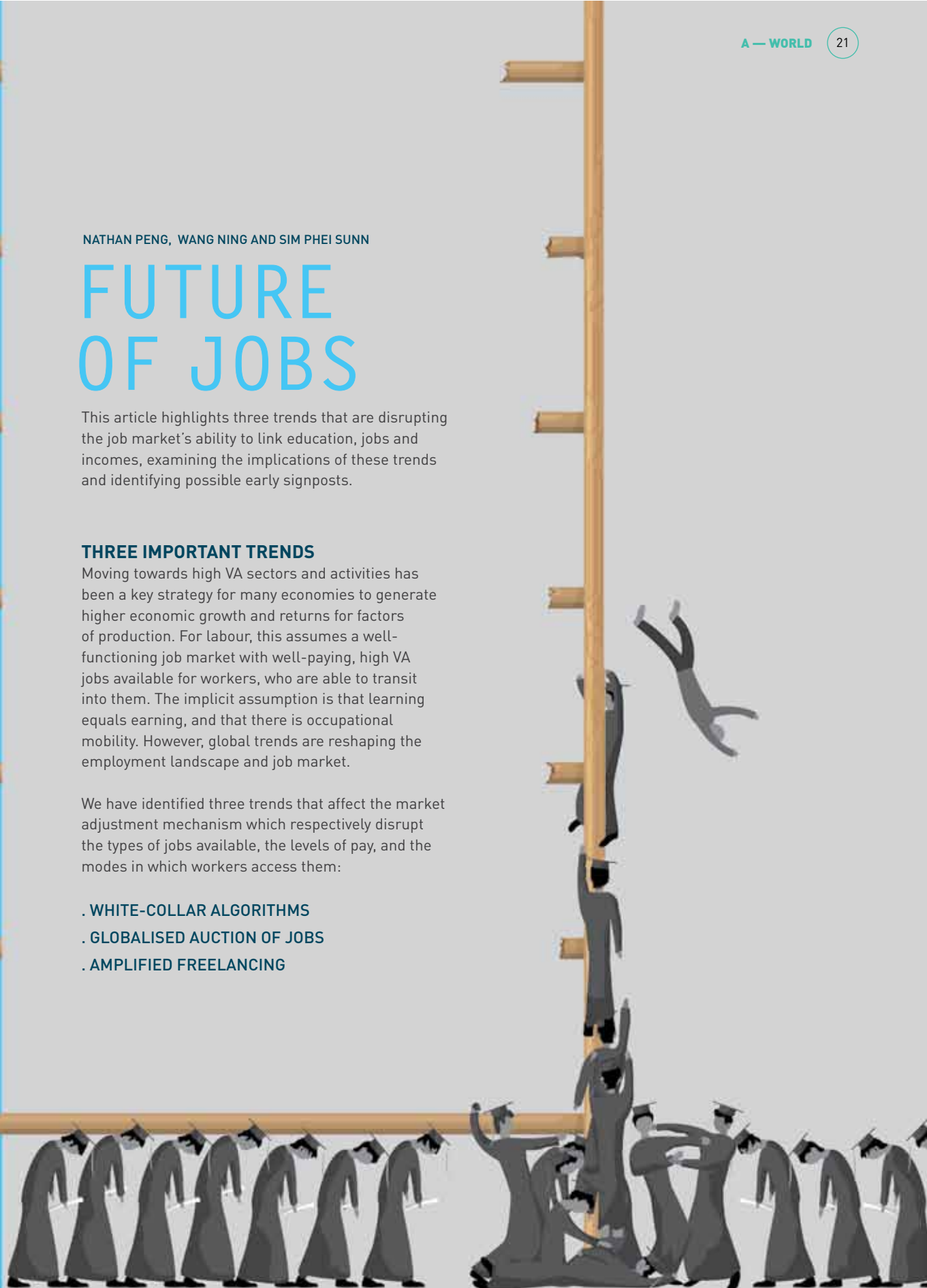
This article highlights three trends that are disrupting the job market's ability to link education, jobs and incomes, examining the implications of these trends and identifying possible early signposts.

THREE IMPORTANT TRENDS

Moving towards high VA sectors and activities has been a key strategy for many economies to generate higher economic growth and returns for factors of production. For labour, this assumes a well-functioning job market with well-paying, high VA jobs available for workers, who are able to transit into them. The implicit assumption is that learning equals earning, and that there is occupational mobility. However, global trends are reshaping the employment landscape and job market.

We have identified three trends that affect the market adjustment mechanism which respectively disrupt the types of jobs available, the levels of pay, and the modes in which workers access them:

- . WHITE-COLLAR ALGORITHMS
- . GLOBALISED AUCTION OF JOBS
- . AMPLIFIED FREELANCING

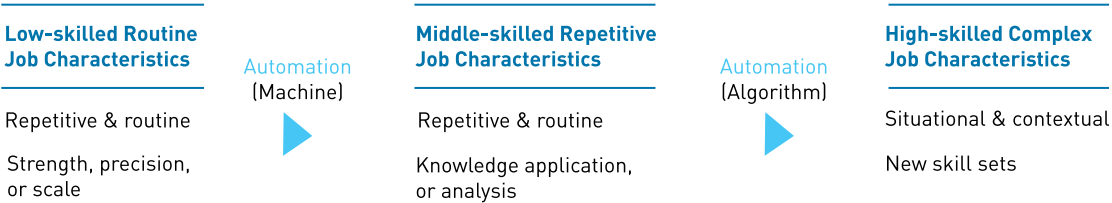


TREND 1. WHITE-COLLAR ALGORITHMS

The first trend suggests that smart algorithms will increasingly replace jobs that are higher up the value chain. In the industrial era, automation saw machines replacing repetitive and routine manual jobs that required strength or precision. Displaced blue-collar workers were retrained and redeployed to new higher-VA tasks where machines did not have an edge, for instance in knowledge application and analysis. Education was the key to acquiring higher skill levels for higher-VA jobs, in return for higher pay.

In a data-driven and computational world, massive increase in sensors and processing power will make almost everything programmable. Automation will take the form of smart algorithms running processes to replace repetitive and routine jobs that require basic analysis. Algorithmic automation is becoming sophisticated and increasingly able to perform white-collar functions, the traditional haven for knowledge workers.

There are three broad categories of jobs in the market, namely low-skilled routine, middle-skilled repetitive and high-skilled complex. The first category of low-skilled routine jobs requires little brain work and is typically location-based. These tasks are less likely to be displaced by smart algorithms, but also face depressed wages. The second category of middle-skilled repetitive jobs requires workers to apply knowledge to and implement repeated tasks with the aid of smart software. These are classic white-collar tasks at risk of being digitalised. The last category of high-skilled complex workers is given the “permission to think” and conceptualise new solutions. Tasks in this occupational group require contextual cognition and empathy, and are less susceptible to being programmed by algorithms. The table below shows the pattern of evolving job characteristics that are susceptible to automation over time.

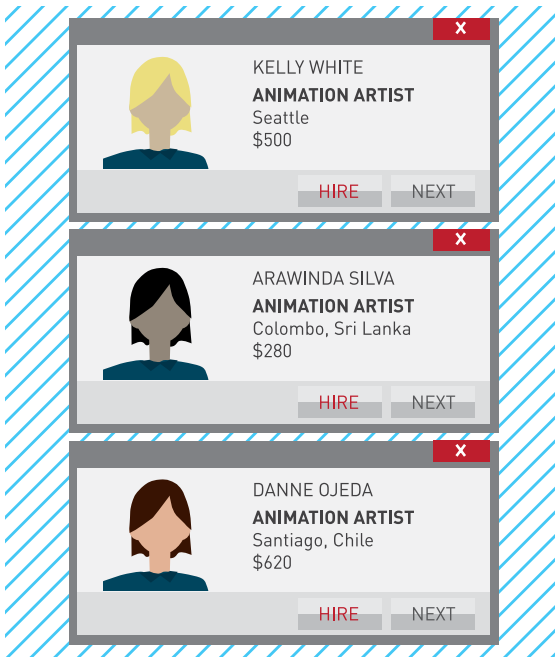


For example, in 1978, CBS paid US\$2.2mil for an army of legal analysts to examine six million documents manually. In 2011, Blackstone Discovery analysed 1.5 million documents at a cost of US\$100,000, in a fraction of the time taken. Mike Lynch, founder of Autonomy Corporation¹, estimated that e-discovery algorithms would reduce the need for skilled manpower and that “one lawyer would suffice for work that once required 500”. Displaced white-collar workers will have to be retrained and redeployed into areas where algorithms do not yet have an advantage.

The marketplace for work has gone digital and global, where workers are compared and judged against one another in a global auction of jobs.

1 Autonomy Corporation is a leader in the field of computer understanding of unstructured information, commonly known as meaning-based computing.
2 An increase of 53% from 98.4 to 150.6 million (UNESCO, World Conference on Higher Education 2009)

TREND 2. GLOBALISED AUCTION OF JOBS



The second trend relates to the development of a globalised auction of jobs. The pace of job outsourcing has intensified in terms of geographical coverage and scope of work. Online outsourcing platforms facilitate firms' listing of tasks that workers can bid for and undertake. In particular, services are weightless and easily moved around at extraordinary speeds to where there is available manpower. Concurrently, globalisation of high skills and college education introduced 52.2 million well-educated workers into the global workforce from 2000 to 2007². This has resulted in an excess supply of high-skilled workers who are hungry for jobs.

The marketplace for work has gone digital and global, where workers are compared and judged against one another in a global auction of jobs. This auction manifests differently along the spectrum of occupations. On the lower-end of the job spectrum, workers are subject to a Dutch (or reverse) auction-like bidding process³, where high-skill, lower-wage counterparts around the world are exerting downward pressures on wages. On the high-end, a normal forward auction⁴ is in place, where superstars in entrenched positions are able to command high premiums.

TREND 3. AMPLIFIED FREELANCING

The last trend is an amplification of freelancing as a result of online job matching portals. Freelancing occurs in two modes, either as a voluntary lifestyle choice or a transitory coping option. The former is driven by demographic factors such as longer life expectancies, desire to remain economically engaged or pursue better work-life balance. The latter is a response to greater volatilities in economic cycles and employment opportunities. Both modes are on the rise.

Whereas freelancing was largely confined within national or regional boundaries in the past, online job matching portals are amplifying these freelancing trends by providing structured access to a global talent pool of freelancers. Such portals improve information symmetry to match demand and supply of freelancers, as well as facilitate differentiation and ranking across a spectrum of skills through online feedback and credibility ratings. Some also negotiate group contracts or pool administrative resources for freelancers.

One example is ODesk, which promises firms and entrepreneurs the ability to build a qualified team of professionals via its database of candidates, backed by verified work histories, feedback from past engagements, cover letters, and skill test scores. To further support employers, ODesk allows them to assign work on flexible hourly-bases and track freelancers' work through an ODesk's Work Diary system. The system records screenshots and memos as the freelancers work, allowing employers to verify that time billed is spent productively.

Another major platform is Freelancer.com, with a current user base of four million employers and freelancers across 234 countries worldwide⁵. This global outsourcing and crowdsourcing marketplace recently launched its regional website in Singapore (Freelancer.sg) in February 2012, which allows Singapore SMEs to tap the large user base, and transact in SGD (Singapore dollars) across a range of jobs which typically costs under SGD250 per assignment.

³ A Dutch auction is where an auctioneer begins with a high asking price that is lowered until a participant accepts the price or when the predetermined reserve price is reached.

⁴ A forward auction is where potential buyers bid for an item and the highest bidder wins and receives the item.

⁵ Stats from Freelancer.com / Freelancer.sg

TREND IMPLICATIONS AT THREE LEVELS

The three trends do not act in isolation, but interact with one another. Broadly, we expect the following implications at the individual, firm and national levels:

1. **Broken Job Market (Individual-level)**
2. **Globalised Job Market (Firm-level)**
3. **Polarised Job Market (National-level)**

Trends	Broken Job Market (Individual)	Globalised Job Market (Firm)	Polarised Job Market (National)
White-collar algorithms	Broken ladder (occupational mobility)	Know more for less (digital taylorism)	Polarised jobs (credential inflation)
Globalised auction of jobs	Broken promise (learning equals earning)	Access more for less (cheap high-skill)	Polarised wages (stratified rewards)
Amplified freelancing	Broken income (unprotected uncertainties)	Do more for less (lean overheads)	Dual workforce (under-employment)

Implication 1. Broken Job Market (Individual-level)

Broken ladder Smart algorithms pose a major threat to white-collar jobs. While authors differ in their views on the extent of algorithmic automation, they agree that machines will become smarter, posing a threat to many services and white-collar jobs. Jobs requiring skills which were thought to be distinctly human, for instance recognising and reacting to the environment in real time, are increasingly at risk. Truck and cab drivers could be replaced by driverless algorithm-controlled vehicles, such as the ones currently tested by Google. IBM's Watson and Apple's Siri are further examples of smart, self-learning algorithms moving mainstream, and potentially taking over tasks that require pattern recognition and basic decision-making. The promise of occupational mobility towards better wages is at risk because the middle rungs of the job ladder are being broken.

Broken promise A global auction of jobs suggests that average wages will be depressed, while jobs at the high-cost end will continue to enjoy entrenched premiums. The long-held assumption of learning leading to earnings is increasingly eroded due to global competition from high-skill, lower-wage workers.

Broken income Amplified freelancing offers increased flexibility and control over one's job assignments, while expanding access to a global pool of job opportunities. However, the conventional risks of being a freelancer remain, namely, cyclical and uncertain income streams, and lack of rights and protection as a worker.



Implication 2. Globalised Job Market (Firm-level)

Know more for less With smart application of algorithms in well-designed business processes, firms can know more and achieve higher productivity without corresponding workforce growth and employment costs. For example, the US productivity growth of more than 2.5% from 2000 – 2010 was higher than previous decades, but total job count, by comparison, did not increase for the corresponding period. The process of “digital taylorism⁶” has allowed firms to scope and carve out portions of the value chain that can be programmed and automated, while moving deployable manpower to other critical components.

Access and do more for less Firms are also able to access a global high-skill, lower-cost manpower pool and bid down the costs of tasks that can be outsourced to the global job market. The conventional story of outsourcing has intensified in the decade up to 2010, with the global market size for active contracts across the services industry doubling from US\$45.6bil to US\$93.1bil⁷. Amplified freelancing further allows firms to access a global pool of talent and niche skills at competitive rates, and maintain a lean overhead. The result is that firms are able to know more for less, and do more for less.

However, asymmetric information may lead to a Market for Lemons problem where firms are unsure of and have no recourse over poor quality outsourced workers or freelancers. Firms are inclined to pay more for the tried-and-tested, than risk recruiting lemons. They increasingly hire against behavioural attributes and less of skills, which could be trained and customised to the firm’s needs. These attributes are signalled through reputational credentials and experience records. As such, global stars continue to shine, while the main body of workers may receive commoditised wages.

To fully reap the productive benefits of such a globalised job market, firms need to have the management capacity to organise and connect such modular global resources in real-time. A firm’s competitive edge does not lie in the amount of knowledge controlled by it or an individual worker, but its management agility.

Implication 3. Polarised Job Market (National-level)

Polarised jobs Algorithmic automation threatens to hollow out middle-skilled white-collar jobs. We observe an increase in employment at the low-skilled and high-skilled ends of the job spectrum, while the middle-skilled levels start to hollow out. In the US and major EU economies, the share of the middle-third group of jobs (by occupational skill) had consistently fallen between 1993 – 2006 (Figure 1).

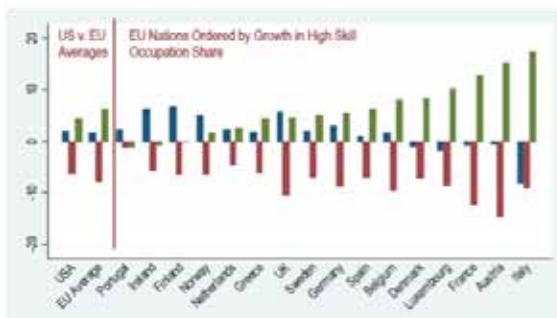


Figure 1:
Change in Employment Share by Job-skill Tercile (1993 – 2006)

One consequence of the hollowing out is that workers tend to interpret their inability to land well-paying middle-level jobs as being due to a lack of qualifications, and invest in more education. That eventually leads to credential inflation⁸ and over-education, and the returns to education qualifications decline.

Polarised wages In order for a global auction of jobs to be effective, business processes and tasks need to be simplified and well-defined. As functions get componentised, jobs become modularised, and the rewards structure highly stratified.

Dual workforce Intensified freelancing suggests that workers opt-out of the primary workforce into the secondary workforce, either by choice (Mode-1) or circumstances (Mode-2). A substantial secondary workforce implies an under-capture of economic activities, under-protection of employees’ rights, and under-employment. These economic and social downsides affect Mode-2 secondary workers in particular, as we are witnessing from the current job market crisis in Europe. Many retrenched European workers are turning to informal

⁶ Digital Taylorism refers to the process where the principles of scientific management developed by Frederik Taylor (Taylorism) are being applied to knowledge work in a knowledge-based economy; resulting in the standardisation, routinisation, and de-skilling of jobs due to technological advancement.

⁷ For contracts with total contract value greater than USD25mil. Source: Global Services (2011). 2011 Annual Global Outsourcing Industry Analysis.

⁸ Credential Inflation is similar to monetary inflation. If more people gain the qualifications previously required for professional or managerial jobs, and if the number of such jobs does not expand to meet the supply of qualified people, it leads to inflation and reduces the value of credentials in the job market.

and secondary employment to cope with the lack of available jobs. However, the debt crisis and rigid labour markets in Europe will continue to depress wages in the secondary workforce.

In Japan, such “freeters”⁹ are frequently highly-educated individuals who opt for casual employment as the means to pursue their creative or entrepreneurial ideals, despite earning considerably less than those in full-time employment. However, individuals who engage in a prolonged period of casual employment become trapped in a vicious lower-paid “freetering” cycle as organisations are then unwilling to employ them.

POSSIBLE SIGNPOSTS

Signposts provide early warning signals that the trends are approaching. They do so either through directional pathways (eg. A is happening upstream, and will soon impact B downstream), or extrapolation across similar situations (eg. A is happening in a context similar to B, and therefore may soon happen in B). The former provides a stronger signposting signal if the causal or directional linkages between A and B are strong. The latter provides similar contexts for us to monitor and learn from.

Possible signposts that could point the way towards job market failures and hopefully allow us some lead-time to anticipate and prepare for the eventual impact include:

WHITE-COLLAR JOBLESS RECOVERY IN OECD ECONOMIES

For instance, an increase in media reports of companies in OECD economies applying new algorithms and technologies to increase output and productivity, without corresponding job creation, could be a signal to look out for. They suggest that economies with large numbers of MNCs may face similar disruptions as companies flow through improvements and productive measures to their operations worldwide.

MISMATCH OF JOBS AND QUALIFICATIONS IN OECD ECONOMIES

Likewise, trends of over-qualified youths in OECD economies unable to gain entry-level white collar jobs, or of qualified middle-level ex-white collar workers turning to blue-collar jobs due to tight labour markets highlight the potential consequences for countries if there is a surplus of over-educated workers without matching job opportunities.

NEW REPLACEMENT TECHNOLOGIES COMING CLOSER TO MAINSTREAM

New tele-presence technologies, which combine tele-conferencing and robotics to provide a digital presence, replace the need for a physical human on-site. These applications are currently being experimented on the fringes and potentially allow workers to remotely control an “avatar” bot from anywhere in the world to perform duties somewhere else. Such tele-presence technologies could be applied to situations that require a comforting human face and conversation, with the robot executing the physical task. When such technologies come closer to mainstream, traditional physical jobs that are deemed resilient to automation will become at risk.

These applications are currently being experimented on the fringes and potentially allow workers to remotely control an “avatar” bot from anywhere in the world...

CONCLUSION

The long-held assumption regarding the link between education, jobs and rewards is increasingly being challenged. The convergence of the three trends of white-collar algorithms, globalised auction of jobs and amplified freelancing is likely to result in a broken, globalised and polarised job market. Investments in human capital alone would not resolve the broken link because the traditional job market mechanisms have been disrupted.

In a globalised job market, “credentials, jobs, and income are positional goods”, desired based on one’s relative position to another. The more stratified societies and rewards are, the more positions matter, and the more important it will become to establish clear signalling mechanisms in the job market.

At the worker-level, this could be done through regulatory requirements on skills and refining foundational work skills. At the firm-level, there are productivity and efficiency benefits that firms can reap if they manage modular resources right. At the sector-level, in-depth understanding of jobs and potential disruptive forces offer insights to pre-empt painful transitions. Ultimately, at the national-level, the key challenge for governments is not only how many people we can train to think, but how many can be matched to resilient and well-paying occupational positions in what will be a highly stratified job market.

⁹ “Freeter” is derived from German and means “free-worker”. “Is working freelance a vicious cycle?”, <http://sbr.com.sg/hr-education/commentary/working-freelance-vicious-circle>

Imagine machines and algorithms operating 24/7 in the background, making decisions, and organising production on behalf of humans. We live in a Big Data era, where we have exponentially more people accessing more information of a higher quality, and generating more insights. These developments allow us to mobilise people, unlock previously untapped productive value, and create a parallel digital second economy that supports our physical one. But the perspectives go further than that. By 2015, Songdo City in South Korea will be wired up by sensors and smart applications that will run the city—monitored by an intelligent control hub. Songdo will be the “world’s smartest city”.



WHAT

We intuitively understand that we are living in a Big Data era, where we have exponentially more people accessing more information of a higher quality, and generating more insights. Data thereby becomes an important factor input into consumption and production decisions, and is increasingly seen as a fourth production factor. It differs fundamentally from the other three traditional ones being land, labour and capital. Data per se is not subject to resource constraints. The more we consume data, the more data we generate, and the cheaper it gets.

SO WHAT

With Big Data, we can now better influence and mobilise people quickly. In recent years, we have witnessed the contagion spread of social and political causes over social media platforms. Some efforts are positive – mobilising support for search and rescue and rebuilding efforts during disasters. Others have a more disruptive spin, such as political unrest in the Arab Spring and the Occupy movements across cities.

Secondly, there is a huge release of new productive value. By connecting dots across different data streams, we can potentially unlock vast value that leads to better analysis and decision-making. Previously under-utilised machines and processes are optimised when we invent new uses for them. Lamp posts, when fitted with cameras to capture real-time traffic flows, become important data points in a location-based sensor network that includes our phones and GPS devices.

A recent McKinsey report on Big Data estimated US\$600bil worth of consumer surplus that is captured by the end-users in terms of better navigation, fuel consumption and so forth.¹

Businesses are also sieving through their 'dead data' or 'data exhaust' to uncover new correlations to generate ideas and business models.² Such high resolution of data allows them to precisely tailor services to very specific customer segments. In the same McKinsey report, US retailers can potentially increase their net margins by 60%, if they can realise the value from Big Data.³

Thirdly, the amount of digital processing and insights churning through the world is creating a "Second Economy". Professor Brian Arthur of the Santa Fe Institute recently coined this term.⁴ He describes it as a silent, vastly-connected, autonomous economy running in parallel to our real economy, with machines and algorithms operating 24-by-7 in the background, making decisions, and organising production on behalf of humans. These smart networks allow us to plan with precision, manage risks better, and augment our decision-making.

NOW WHAT

These implications can be either enablers for growth or disruptors, depending on how they are applied. In any society, there is a multitude of Big Data dynamics at play. The balance between enabling and disruptive tensions offers us insights as to where a city's competitive and its potential setbacks.

This can be illustrated with three cities that are along a spectrum of Big Data development in Asia and their potential Double-edged Bytes:

- A. Chongqing in southwest China
- B. Seoul in South Korea
- C. Singapore

1(McKinsey Global Institute May 2011), Pg 7 - 8

2 Dead data is data that is stored but unused, or in outdated formats. Data exhaust is information that is a by-product of user interactions eg. the clicks you make to get to your final online destination.

3(McKinsey Global Institute May 2011), Pg 7 - 8

4(Arthur 2011)

Chongqing illustrates how the future competitive edge of cities is a function of who has the data and the access, balanced against the control dynamics that come with it.

A. CHONGQING

Chongqing is one of the 50 largest cities in the world and is located in south-west China. It is the country's western economic centre, and houses a population of 32 million over a huge rural hinterland. Chongqing's economy is driven by domestic consumption and rapid urbanisation, unlike many export-led coastal cities.⁵ Hence it was shielded from the 2008 global financial crisis. It managed to grow at 14.3%, outperforming China's 9%.

Chongqing's relative inland position prompted it to court companies that provide services via the Internet and telecommunication channels. In March 2011, the Chongqing government announced plans⁶ to create the largest cloud computing centre in Asia. This Cloud Computing Special Zone will allow businesses to circumvent the Great Firewall of China.⁷

Around the same time (in August 2011), the government also announced plans to install 500,000 surveillance cameras by the end of 2012. The network is said to cover half a million intersections, neighbourhoods and public spaces over nearly 400 sq miles. This is about 25% larger than New York City. The project is expected to cost US\$3.1bil (RMB20bil) to promote "Peaceful Chongqing"⁸ and improve public security and safety. However, human rights and political activists are worried that the system will be abused. Companies, like Cisco and HP, had expressed interest to bid for the project, but they faced criticisms back home for selling gear to aid political suppression.

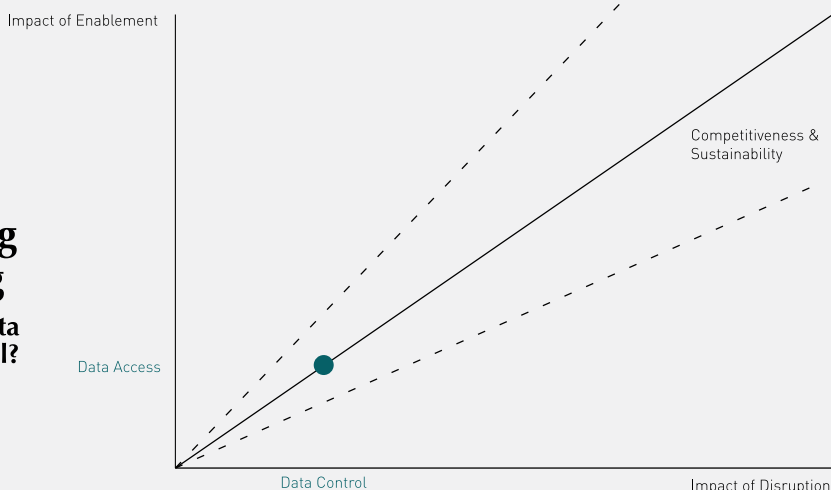
Chongqing's contradiction is perhaps a microcosm of larger developments in China. While the Chinese government appears to be relatively lax in consumer-related data and marketing activities, it continues to monitor and control data on politically sensitive issues.

As a disruptor, Big Data facilitates mobilising citizens against corruption, abuses and other social injustices. The Economist ran a feature on "Unrest in China" in its January issue, which highlighted citizenry protests and online criticisms on a range of issues, such as the fatal high speed rail crash in Wenzhou, unfair land sales in Wukan, and bad air quality in Beijing. It is unlikely that we will have a full-scale "Chinese Spring" like in the Middle East, but we will certainly witness many more mini-Springs to come.

Contrasting Chongqing

Who has the data access & control?

● Chongqing



Few countries have the administrative capacity to selectively encourage Big Data, while tightening control on its citizens like China. Chongqing illustrates how the future competitive edge of cities is a function of who has the data and the access, balanced against the control dynamics that come with it.

5 For example, 90% of its industrial products are consumed domestically.

6 10km² area of land has been designated as a Cloud Computing Special Zone, of which 3km² is reserved for state-of-the-art data centres. Hong Kong-based PacNet signed a MOU to build the data centres and jointly develop the zone. 10km² area of land has been designated as a Cloud Computing Special Zone, of which 3km² is reserved for state-of-the-art data centres.

7 In Dec 2011, the Chinese State Intellectual Property Office (SIPO) allowed Chongqing to build a "national cloud computing intellectual property experimental zone" to provide the IP support and security to fulfil its cloud computing ambitions. The trial period started on 1 Jan 2012 and will last three years.

8 Earlier in 2008, Chongqing identified five key development thrusts to improve its residents' quality of life. One of them was Peaceful Chongqing, which aimed to promote public security and safety. Chongqing carried out a massive crackdown on crime syndicates in 2009 and was awarded the 'safest city' in China in 2010. It is a title they intend to defend with this new surveillance network.



B. SEOUL

Next, we turn to Seoul in South Korea. Seoul's experience with Big Data paints a different picture. Big Data innovation in Seoul is driven mainly by corporate giants, sometimes with the support of the local government.

The most famous example is Songdo City. It is an ambitious plan to build the City of the Future on an artificial island west of Seoul. The target is to have some 65,000 people living in what developers imagine to be the “world’s smartest city” by 2015. Songdo is a private real estate venture between Gale International, an American real estate firm, and Morgan Stanley bank.

The city planners have roped in telecommunications giant, Cisco, to wire up every inch of Songdo, embed sensors everywhere and install many more smart applications that will run the city. Everything will be monitored by an intelligent control hub. The lure of Big Data has essentially propelled Cisco from being a 'plumber' offering wires, to being a city builder.

The South Korean economy is also dominated by many family-owned chaebols such as Samsung, Hyundai, LG and SK groups. Each of them has fingers in many businesses. One of the chaebols, SK Telecom, has a ubiquitous museum showcasing its latest technologies and services and how they will enable smart living in the future.

The target is to have some 65,000 people living in what developers imagine to be the “world’s smartest city” by 2015.

These are not brand new applications today. However, the fascinating aspect is that SK Telecom is not only a telecommunications operator.⁹ It is part of the SK Group, which has businesses in electronics, energy, electric vehicles, property, and so on.

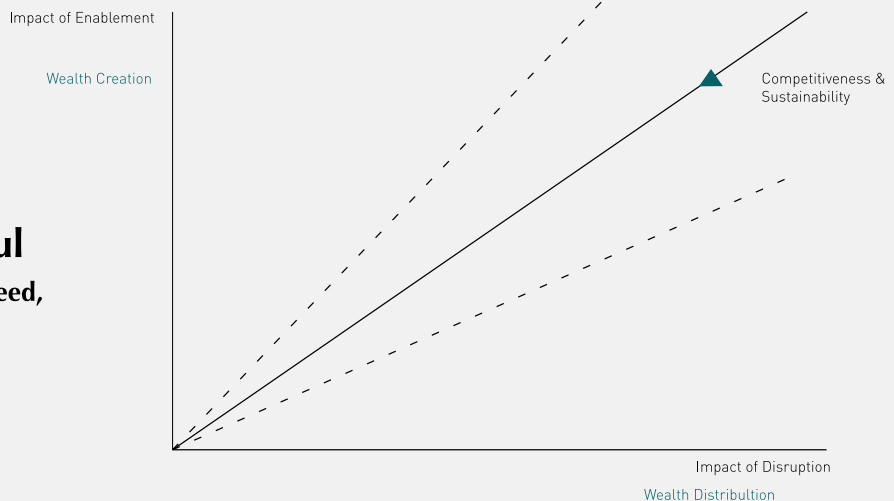
This is where Big Data meets vertically integrated conglomerates. The speed of innovation, prototyping and rolling out new services is a lot higher when you are able to control many parts of the data value chain.

As an enabler, Big Data has the potential to improve productivity and innovation gains for the economy. However, it can also disrupt employment and distribution of wealth. The new Second Economy will no doubt create wealth, but it may not create enough jobs for all. This digital neural layer will displace increasingly higher levels of skilled jobs, and we may end up with a highly polarised job market. Hence, the pressure for wealth distribution within a city or country will intensify.

Smart Seoul

Who has the speed, skills & transfer mechanisms?

▲ Seoul



Cities that can realise the potential of Big Data will be those which have the speed and skillsets, and ability to manage the wealth gap. Speed in creating a data-driven mindset and culture, supported by data availability. Skillsets in terms of having sufficient people (a) with deep expertise in statistics and analytics, and (b) business and public managers who can ask the right questions and apply insights from Big Data to run their organisations. And lastly, strong transfer mechanisms to share productivity gains and growth with consumers and citizens.

⁹ Through its subsidiary SK Communications, it has access to Cyworld – a popular social networking site, and NateOn (pronounced: Nae-i-tu) – a popular instant messaging platform.

As Big Data becomes the new factor of production, cyber-security becomes the new public good in need of proper governance.

C. SINGAPORE

Singapore is in between the two extremes of Chongqing and Seoul. Our approach to Big Data focuses on unlocking data that is currently disaggregated across networks and infrastructural systems in the city. The government aims to facilitate mesh-ups and build an ecosystem of platforms, for greater efficiency and productivity.

The government has taken the lead in many of our data initiatives. On the supply side, the public sector holds a lot of data sets. These have been progressively released for individual and commercial use in recent years.

One of the initiatives is Data.gov.sg. It brought together some 5,000 non-sensitive datasets from more than 50 government agencies, and made it available to the public. Another initiative is OneMap, a common platform for a geo-spatial data mesh-up. For instance, someone who wants to open a child-care centre can obtain and visualise data about population, age, average income, competitors and so forth in the geographical vicinity, and decide where to locate this new centre.

Beyond releasing data, Singapore has also focused on creating an ecosystem conducive for Big Data through research and industry promotion. The "Singapore Real-Time" vision aims to grow data-related services and develop the data industry. In 2011, the MIT Senseable City Laboratory tapped on a government research grant to launch the "LIVE Singapore!" project. They persuaded several government agencies and companies to supply real-time data on people and goods movement. LIVE Singapore! then provided a platform to pool real-time information from multiple data streams, and present them in visually compelling ways.

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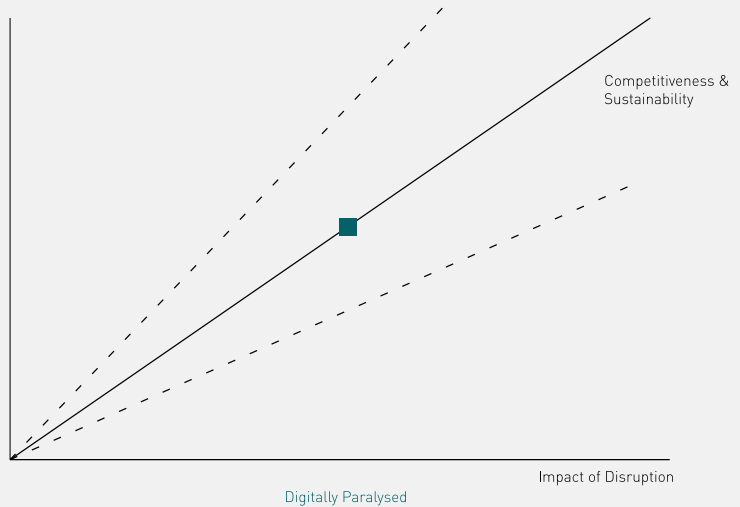
Secure Singapore

Who has the secure
data & platforms

■ Singapore

Impact of Enablement

Digitally Enabled



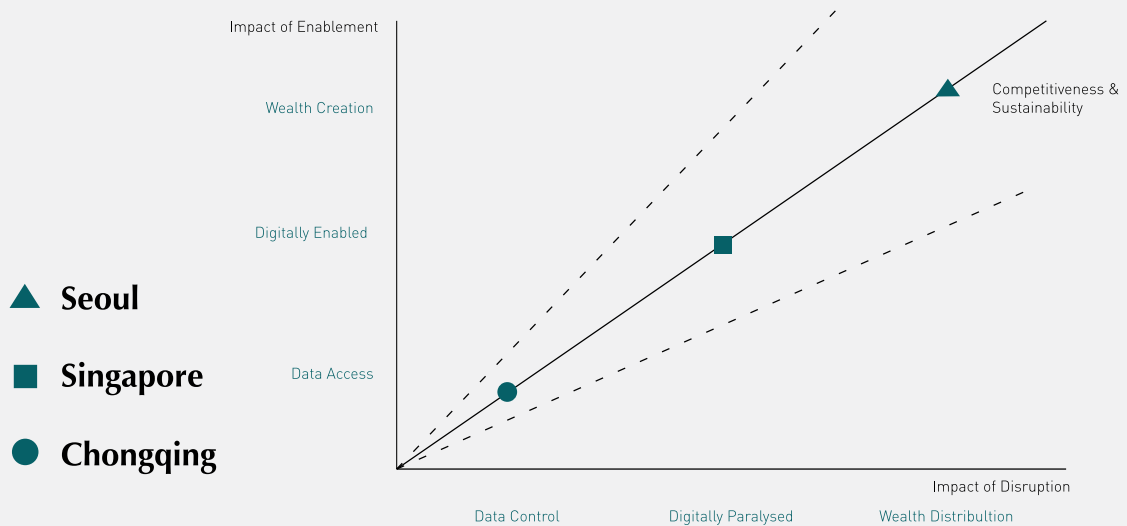
Singapore prides itself as being a secure and trusted hub for businesses. As Big Data becomes the new factor of production, cyber-security becomes the new public good in need of proper governance.

The competitive edge for cities in this case lies in the access to safe and secure data and platforms.

¹⁰ (World Economic Forum 2012)

¹¹ (Security & Defence Agenda 2012), Pg 43

CONCLUSION



...we skilfully
mitigate the
downsides, while
anticipating new
Double-edged
Bytes...

Cities at different phases of the Big Data development face the challenge of managing various Double-edged Bytes—from data access to data control, being digitally enabled to digitally paralysed, and from wealth creation to wealth distribution. Capturing the full value from Big Data requires that we skilfully mitigate the downsides, while anticipating new Double-edged Bytes and ways to harness or prepare for them.

Edited from a presentation the writer delivered at the
Informing (In)stability Conference held in Ottawa in Feb 2012.



The Changing Landscape Of Cities

IVY NG

Cities have become the major nodes of economic, political, cultural and community life. In 1800, a mere three per cent of the world's population lived in cities. By the beginning of the twentieth century, it was 14 per cent. In 2008, half of the world's population lived in cities. It is estimated that by 2050, 70 per cent of the world's population will become urbanites. In particular, most of the rapid urbanisation will be taking place in emerging economies.

This article offers readers a quick glance at the changing landscape of cities. There are four interconnected trends:

RISE OF MEGACITIES

EVOLVING CITY TYPOLOGIES

PERVASIVENESS OF SMART TECHNOLOGIES

INTENSIFYING COMPETITION AMONGST CITIES

FROM MEGACITIES TO MEGA-CORRIDORS

Megacities are cities with a population of at least 10 million. Today, there are 23 megacities and it is predicted that this number will double within the next 10 to 20 years. Most of this growth will come from South and East Asia. A number of these megacities are amalgamating to become mega-regions or mega corridors, forming the “endless city” phenomenon. The largest megacorridor today is the Hong Kong-Shenzhen-Guangzhou region in China with a population of 120 million.

According to McKinsey Global Institute, 60 per cent of the world's GDP is contributed by the top 600 urban centres. By 2025, one-third of cities from developed countries in the top 600 will drop out and be replaced by new cities, the majority of which will be Chinese cities.

PERVASIVENESS OF SMART TECHNOLOGIES

Notwithstanding city typologies, smart technologies are the chief enablers for cities looking to enhance their physical infrastructure and social connectedness. Cities, existing and new, are using smart technologies one way or another, to out-perform their competitors. Frost & Sullivan estimates that there will be over 40 smart cities in the world by 2020. In particular, the use of smart technologies can be found across all city typologies. Smart technologies are becoming ubiquitous in our daily lives. For example, there is the potential of resolving traffic congestion and pollution problems through the use of electric cars and networked infrastructure. As our societies become more networked, the development and application of these technologies will be shaped by the values, beliefs, interests and lifestyles of the tech-savvy younger generation.

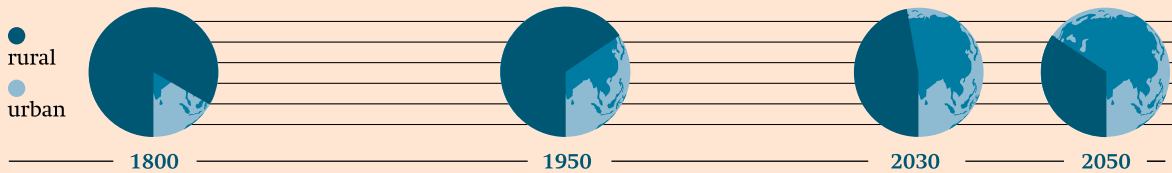
INTENSIFYING COMPETITION AMONG CITIES

Intensifying global competition among cities has led to keener interest in comparative benchmarking, indexes and rankings to enhance understanding of a city's competitive advantages and weaknesses, and support strategies for enhancing competitiveness. Such benchmarking tools, indexes and rankings are also being used by the mobile elite and firms in informing their re-location decisions.

EVOLVING CITY TYPOLOGIES

City typologies can help us better understand the characteristics of a city and enable us to leverage more effectively on them as sources of competitive advantage. The World Cities Summit has identified six city typologies, as reflected in this article.

The world is becoming more urbanised at an increasing rate



The Changing Landscape of Cities

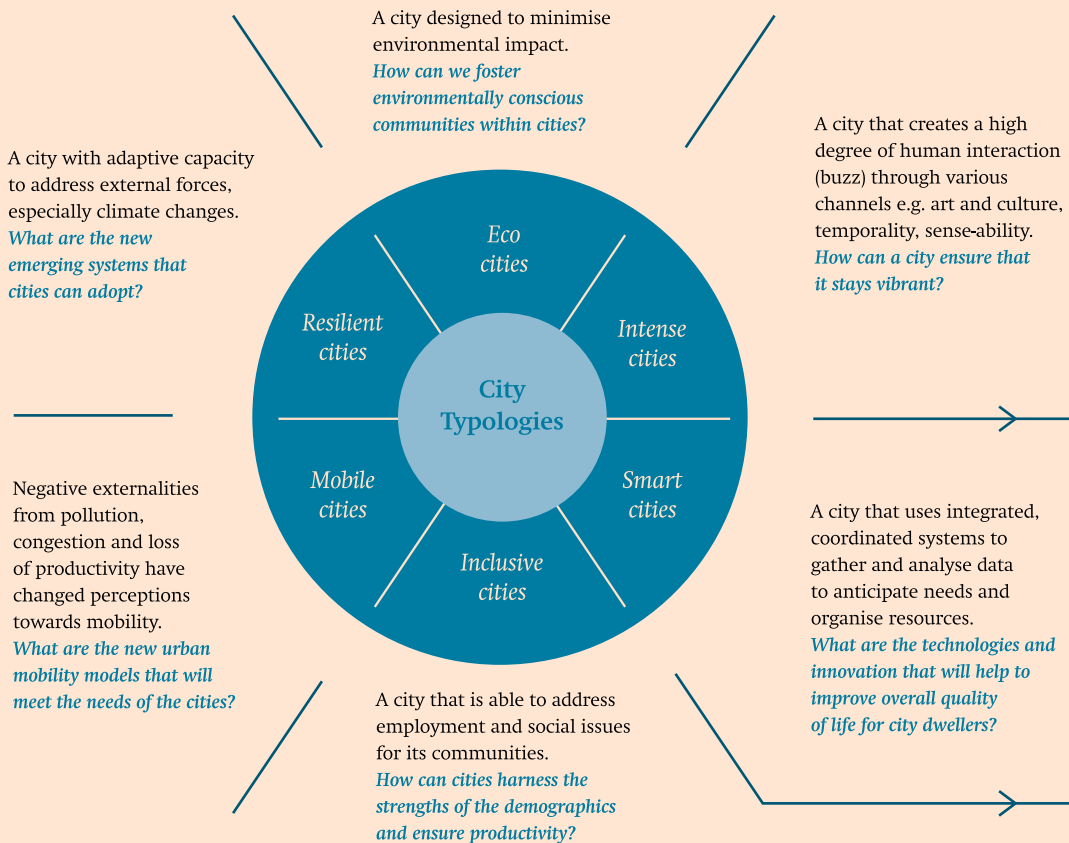
City typologies will shape the competitive landscape

60%

of global GDP is contributed by the world's **top 600** cities.

2025

one-third of the cities from developed countries will drop out from the top 600; and **100** of these will be replaced by Chinese cities.



Factors that attract businesses and talent

BUSINESSES AND INVESTORS	TALENT
<p>Intellectual, finance and economic activity</p> <p>High calibre infrastructure, real estate, digital facilities, efficient public services</p> <p>Political and ideational influence</p>	<p>Security, entrepreneurial freedom, liveability</p> <p>Employment opportunities for the socially mobile</p>

The endless city is gaining strength in numbers and size...



Mega City

City with a population of at least 10 million
e.g. London



Mega Regions

Cities integrated with surrounding suburbs
e.g. Johannesburg and Pretoria (forming Jo-Toria)



Mega Corridors

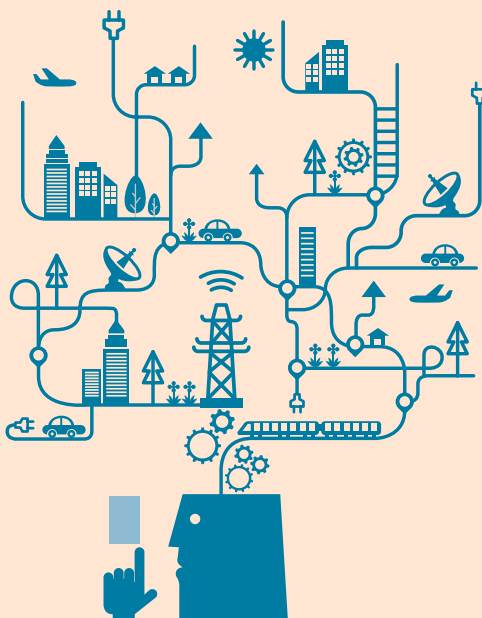
Two or more cities or mega regions connected together
e.g. Hong Kong-Shenzhen-Guangzhou

Smart technologies

Application of computing technologies to collect and process data into information by using technology enablers like sensors, storage devices and integrated communication systems.

Smart Infrastructure

Complex systems that make use of information processed by smart technologies to monitor, measure, analyse, communicate and act, thus optimising the performance of these systems in a more efficient and environmentally manner, e.g. smart buildings, smart grids and smart mobility.



A. Smart Buildings

An example of smart technologies that can be incorporated into buildings is the building integrated photovoltaics (BIPV) which can help to cool down and provide heating to a building more effectively. The global market for BIPV is forecasted to attain the capacity of 11,392 megawatts by 2015 at a CAGR of 56 per cent.

B. Smart Grids

Electric grids that make use of data analytics to enable real time monitoring of power flow. Global spending on smart grid data analytics is estimated to total over USD34 billion between 2012 and 2020.

C. Smart Mobility

Extends beyond the electric vehicle (EV) and EV charging infrastructure to include applying smart technologies to increase transport network capacity and reduce accidents and pollution. Examples are self-driving technologies and vehicle-to-vehicle communications technologies that allow vehicles to communicate with each other.

Rise of the smart cities

Over 40 global cities will become smart cities by 2020.



San Francisco
Vancouver
Seattle
Toronto
Bogota
Arcosanti
Boulder

Clonburris
Freiburg
Reykjavik
Barcelona
Stockholm
Dongtan
Mexi Lake

London
Montreal
Songdo
Moreland
Curitiba
Paris
St Davis

Destiny
Babcock Ranch
Coyote Springs
Treasure Island
Portland
GIFT

Copenhagen
Amsterdam
Oslo
Cape Town
Masdar
Pune

Kochi
Singapore
Chang Sha
Tianjin

Studies of city competitiveness

Comprehensive Studies	e.g. AT Kearney Global Cities Index
Infrastructure and Real Estate Indices	e.g. ULI-PwC Emerging Trends in Real Estate
Macro-economic Performance Indices	e.g. Milken Institute Best Performing Cities (US)
Finance, Investment and Business Environment Indices	e.g. fDI Global Outlook
Environment and Sustainability Indices	e.g. Mercer Eco-city ranking
Image, Brand and Destination Power Indices	e.g. Euromonitor International Top City Destinations
Quality of Life Indices	e.g. Asia Competitiveness Institute's Global Liveable Cities Index
Cost of Living and Affordability Indices	e.g. Mercer Cost-of-Living Survey
Comprehensive Knowledge Economy, Human Capital and Technology Indices	e.g. 2thinknow Innovation Cities Top 100 Index
Culture and Diversity Indices	e.g. Global Language Monitor Fashion Capitals





Major realignments in the global economy

LEE CHORPHARN

▶ Please see the companion video piece
"Unusually Fluid Global Economy" at our
youtube channel "futuresgroupsg"

There are storm clouds ahead. Globalisation is no longer just the channel to deliver higher growth and transform standards of living. Globalisation is also the transmission channel for synchronised shocks. At times, we will find that the negatives outweigh the positives.

There are storm clouds ahead. Globalisation is no longer just the channel to deliver higher growth and transform standards of living. Globalisation is also the transmission channel for synchronised shocks. At times, we will find that the negatives outweigh the positives.

Who would have thought that Greece, a member of the Eurozone—the largest economic bloc in the world, would end up with a worse credit rating than Pakistan? Who would have thought the USA would lose its sacred triple-A credit rating? Twenty-four months into the financial crisis, who would have thought that the USA would face a persistently high unemployment rate of 9% while China powers ahead with a persistently high growth rate of 9%?

All these events point to major realignments that are fundamentally changing the character of the global economy and how it functions. As Mohammed El-Erian, CEO of PIMCO said, “It is not just a crash, it is a new normal.”

Harvard Professor Joseph Nye, in his book “Future of Power”, describes these realignments as two diffusions of power: The first being the diffusion of power from developed markets to emerging markets; the second the diffusion of power from state to non state actors.

Let me explain the first.

In his Foreign Policy article “The Shape of the Global Economy will fundamentally change”, Mr El-Erian points out that many developed economies have deep seated problems both in the structure of their economies as well as in their national balance sheets [1]. However, policymakers have delayed implementing fundamental solutions. These problems are now deep-seated, and there is a real risk of adverse effects on the global economy. Both Europe and the USA are facing this issue.

In the meantime, emerging economies like Brazil, China and Indonesia are growing from strength to strength, seemingly decoupled from the troubles of the developed world.

The transition to a two-tiered global economy, where less mature economies are forging ahead and able to grow more sustainably than advanced ones, will not be easy for all. Tony Blair, after the Beijing 2008 Olympics, wrote in the Wall Street Journal:

“For centuries, the power has resided in the West, with various European powers including the British Empire, and then in the 20th Century, the US. Now we will have to come to terms with a world in which the power is shared with the Far East...It will be a rather strange, possibly unnerving experience.” [2]

Emerging economies are also driving a new wave of technological and policy innovation, at times leapfrogging developed nations, and achieving high levels of growth. Barring major disruptions, these realignments will continue.

Advanced economies will take several years, some say four years to a decade, to fully rehabilitate their balance sheets and restore the conditions for growth and employment creation. Some will choose debt restructuring, others budget austerity. Either way, this process will exacerbate inequalities, morphing what was an economic issue to a socio-political issue.

The USA, the anchor economy of the Anglo-Saxon global and economic financial systems, is engulfed in this. When its options to print money and inflate away its debt have run their full course and found ineffective, it will also be forced into greater austerity amid noisy political bickering. The messier this transition, the more international standing the United States loses, and the closer we will move to what political scientist Ian Bremmer calls the G-Zero world. This is a world of gridlock and stalemate, where no single power has the standing or capacity to make tough international decisions.

As emerging countries continue to grow, they will push for greater representation in global institutions and global governance over domination in global fora by developed countries. Multilateral negotiations, global governance, international institutions will need to be more respectful of the growing strength of the emerging world. The diffusion of geopolitical and economic power, coupled with prolonged stagnation and societal pain will discredit, and in the eyes of many, delegitimize globalisation in the developed world.

Who would have thought that a few US Congressmen and a Tea Party movement would hold the President of the United States, both Republican and Democrat parties, and the world, hostage during the recent US debt negotiations? Who would have expected the widespread riots and thefts in the UK? Who would have expected this year's troubled summer of riots that pit the wealthy old versus the indebted young in Europe?

These movements are driven from the ground up and self-coordinated. This brings us to the second diffusion of power, from state to non state actors. Let me explain.

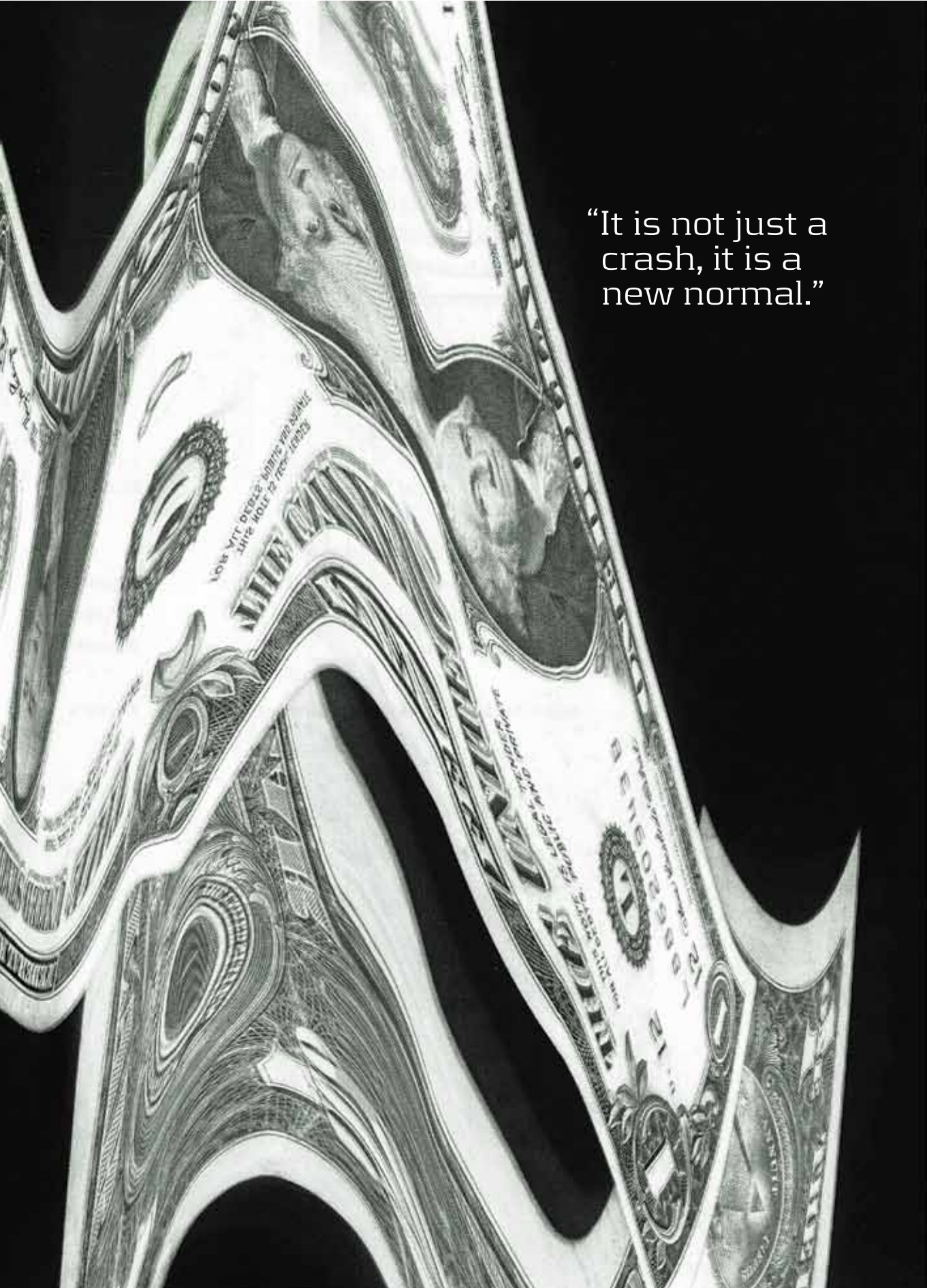
The increasing proliferation of mobile devices like blackberries and iPhones facilitates flash-mobs to quickly organise themselves around strong interests. This ability to 'hack' the system allows non-state actors like citizens to coordinate pressure on policy makers. These flash mobs are here to stay, and will change the way governments and businesses interact with their constituents and stakeholders.

It is not all bad. Social media has enabled many grounds-up, self-organised, everyday citizens and entrepreneurs to do good and rebuild communities, as we witnessed in the wake of global disasters in Haiti, China and Japan. We also see louder voices for economic equity, as seen in the tent protests of Tel Aviv, the anti PX-chemical factory protests in Dalian, China and the anti-corruption protests in India and the Middle East. We saw some aspects of this mobilisation in the General Election in Singapore in May 2011.

For businesses too, social media can be a source of disruption or growth if well-managed. Some companies have been savvy, but many others have been caught flat-footed.

Governments will need to learn to share power with entrepreneurs and citizens. This is another new normal we have to learn to live with.





"It is not just a
crash, it is a
new normal."

But there is more. There is another ongoing realignment that is harder to grasp. Foresight husband and wife team Ayesha and Parag Khanna asserts that technology will “take on a life of its own” [3]. They start with technology’s growing intelligence and cite how, on the game show Jeopardy in February 2011, IBM computer WATSON beat two human competitors in answering questions that required contextual understanding and language comprehension. This is a sign that technology is nearing human levels of intelligence.

Technologies are also growing more human, possibly enabling devices and to respond and interact with us on a “human” level. Futurist Bill Gibson has said how the future is already here but not evenly distributed [4]. We can look to societies like Japan to catch a glimpse of what could be. In 2009, a young Japanese man married the love of his life, a video-game character named Nene Anegasaki in a wedding ceremony with a real human priest. One of Japan’s rising J-pop stars, Hatsune Miku, has amassed a legion of fans who sing along gustily as she sings live on-stage at sold-out concerts. The difference is, Miku is a 3D-hologram avatar, and her voice created with Yamaha’s voice synthesizer.

The Khannas call this next stage of development “human-technology co-evolution”. When more than seventy-five percent of prostate-cancer surgeries in the United States today are robot-assisted, how dependent will our medical schools become on technology in the training of future medical personnel? Do gamers and hackers have the ideal skill set to thrive in an economy that demands co-evolution with technology? What about the worsening income inequality between those who can and cannot co-evolve?



SO, WHAT DOES THIS ALL MEAN?

As economic and social inequalities soar, societies will demand and put pressure on policy makers and corporations to deliver inclusive growth. This will be difficult to deliver.

In the developed world, increasing austerity and declining public budgets would mean sharing, and in some cases, simple offloading of the burden of delivering inclusive growth to corporations and citizens.

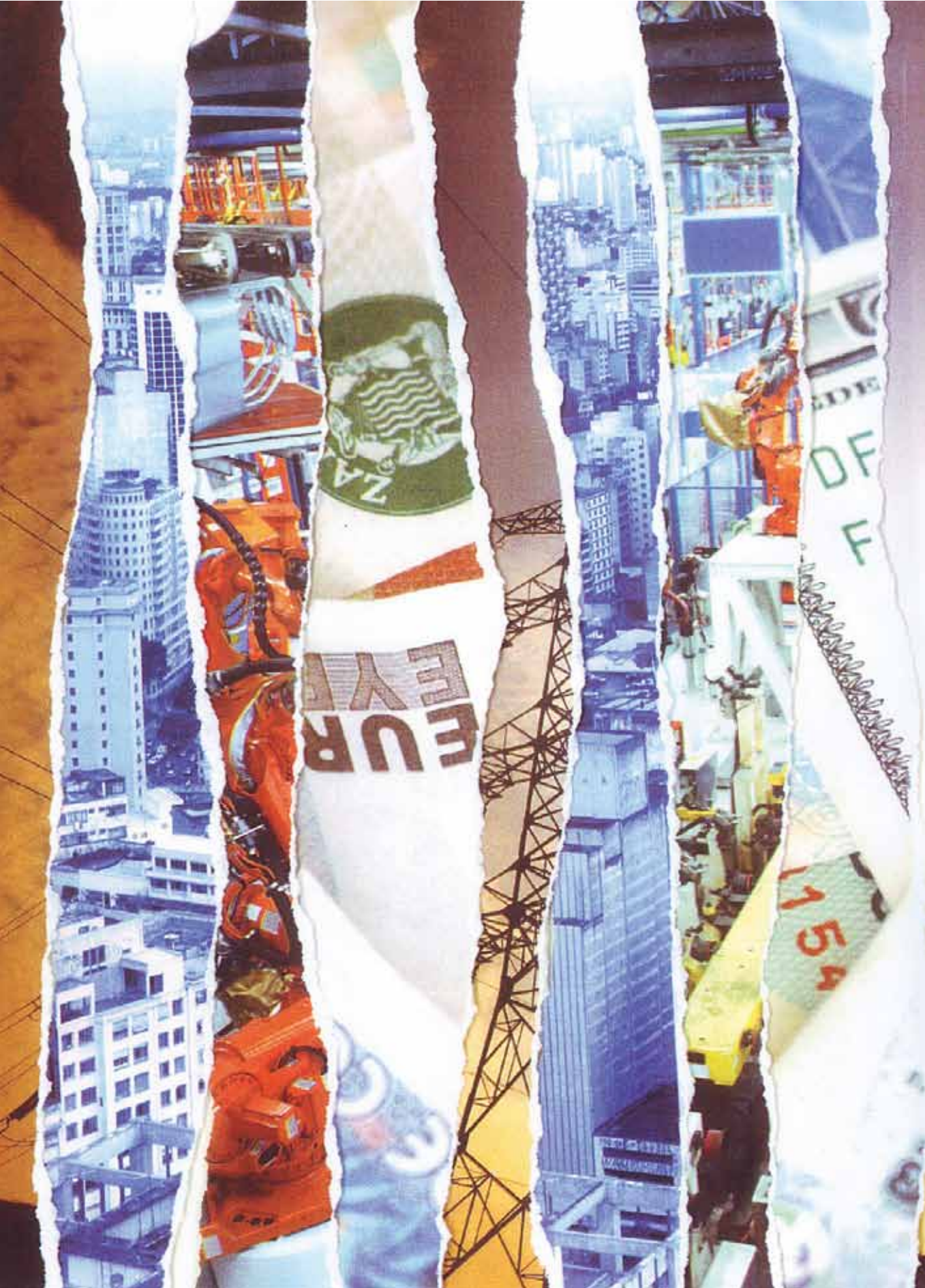
In the emerging world, there could be fewer governments that still have the resources to deliver the full spectrum of public goods. Some governments will be absent and will fail to provide adequate public services and deliver inclusive growth. In contrast, employees of major corporations like Facebook, Google and Infosys today spend their days on campuses that are essentially full-service cities. In the near future, would a corporate passport be a gateway to more ‘public services’ than national citizenship?

The sustained high growth of emerging economies will drive a prolonged period of upward pressure on energy and commodity prices, as suggested in Standard Chartered’s “The Super Cycle Report” [5]. Food-Energy-Water stresses will increase, hitting the poorer segments of societies particularly hard.

Climate change will drive countries closer to the extremes of desert and jungle, droughts and floods. But few societies have made preparations to be climate-change-ready. Income inequality will worsen between the climate-change-ready and climate-losers, pushing some to breaking point.

Whether it is governments, corporations, citizens or entrepreneurs that shape their societies’ response to the future, they all need to get better at innovation. This is not just R&D in the conventional sense, but also the ability to spot and quickly capture new opportunities which may present themselves precisely because of the higher levels of complexity we will experience.

The world is entering a period of volatility where many assumed certainties we have lived with in living memory will no longer be constants. We will have a greater chance of benefitting from these changes if we begin preparing for them now.



LEE CHORPHARN

AGE OF TURBULENCE

▶ Please see the companion video piece
“Age of Turbulence” at our youtube channel
“futuresgroupsg”

We have already entered this gap. Four major shifts hold the double-edged key towards unlocking opportunities and innovations, as well as key uncertainties in the decade ahead.

These are:

- A. The Big City
- B. Powering the Planet
- C. Automation of jobs; and
- D. New values





A. THE BIG CITY

The Big City refers to the challenge of building and rebuilding cities worldwide to support hyper-dense populations. Nearly half of what will be built by 2030 does not exist today.

Many municipal governments and budgets will not be able to meet the demands of this new growth. These governments need help, and the private sector has been quick to offer it. E.g. Kenya's Tatu city was built by Russian developers. Even existing cities can do with some upgrading. E.g. IBM's Smart City Operating Systems may take over the daily running of cities such as Rio De Janeiro in Brazil.

The shift in city management from the hands of the public sector to the private sector is taking place at more than one level. Internet moguls like Google and Facebook sit on mountains of data and have more real-time information about citizens at their fingertips than most governments do. "Data" companies may one day complement or rival governments in influencing citizens' behaviour.

But there is pushback. Citizenry participation in city development has traditionally been low, and real estate developers thrived in a low scrutiny environment. This is changing as open-data initiatives create a new level of transparency. We can expect newly empowered citizens to face-off municipal governments, real estate developers and other legacy interests to take control of their own cities.

This will spill over to increased scrutiny from 'natural' citizens of 'global' citizens. The Occupy Wall Street movement popularised the latter as the "1% global elite". Natural citizens see little convergence between the interests of this highly mobile global elite group and themselves. Cities like London and Hong Kong which position themselves as global hubs for global elites are likely to feel the most heat from their natural citizens.





B. POWERING THE PLANET

The second shift, **Powering the Planet**, will be driven by the increase in energy demand which is projected to up by as much as 45 per cent by 2030. This increase is largely to power the rapid economic growth in developing countries. The US Energy Information Agency expects oil prices to remain high and volatile, bulging to over US\$200 by 2035.

The key uncertainty here is shale gas. Thanks to advances in hydraulic fracturing, the US has regained its position as the world's largest natural gas producer. It has the potential to be a net gas exporter, a "Saudi Arabia" of gas. There are several possible consequences.

1.

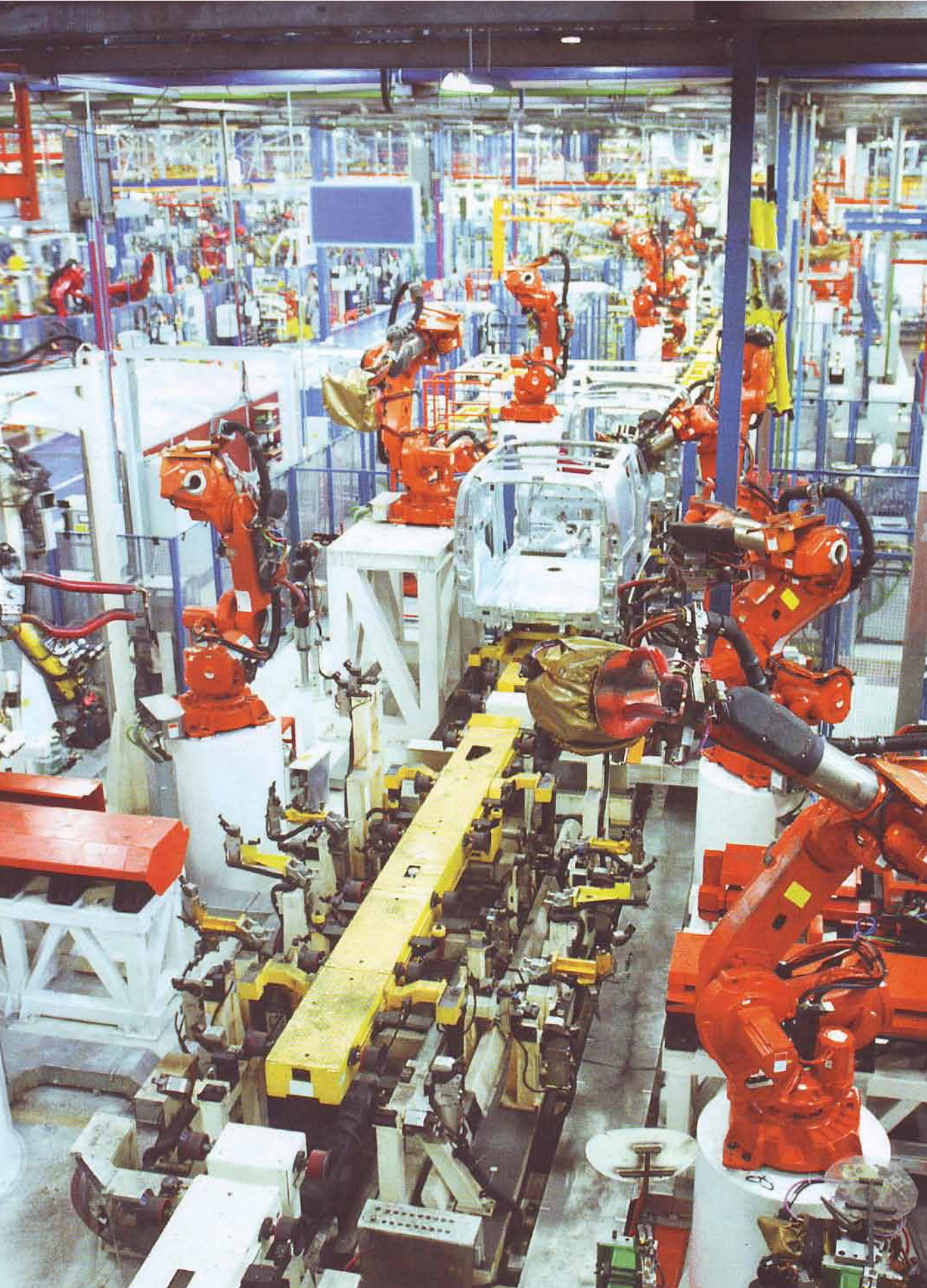
With greater energy sufficiency, the US can step down security engagement in the Middle East. China and the rest of East Asia will likely switch away from the Middle East and turn to the US for gas exports, re-balancing decades of trade imbalance. With lower energy prices, the US may see a resurgence of manufacturing back on its shores.

2.

With this geographical energy switch, the decades-old energy trade through the Indian Ocean and Straits of Malacca may dwindle, to be replaced by a new energy trade route across the Pacific.

3.

The emergence of cheaper natural gas may weaken the push for alternative energy—perhaps spelling the death knell for wind and solar energy.



C. AUTOMATION OF JOBS

The third shift, **Automation of Jobs**, highlights the challenges of providing jobs for the teeming masses. Job competition is increasingly exacerbated with automation of jobs, also known as “bot-sourcing.”

The leading wave of labour replacement is happening at the mass production level, with robots taking a rising percentage of manufacturing jobs. Somewhat surprisingly, robotics is taking off in labour-intensive East Asia with companies switching from low-cost labour to robotic labour. Foxconn, the largest private employer in China, has announced that it wants to replace up to 80% of its one-million workforce with robots in the next three years. In South Korea, prisons are testing the use of robot guards to monitor inmates. In a sign of the economic opportunities in robotics and autonomous systems, companies are starting to outsource what they call “steel-collar” workers. Michigan-based Steel Collar Associates today supplies Motoman industrial robots to the industry as contracted hourly employees.

A surprising amount of this “bot-sourcing” is also happening at higher skilled levels. Google’s self-driving cars have been shown to be safer than human drivers. This may one day lead to widespread replacement of taxi and truck drivers. Algorithms are now assisting, and may one day replace, lower to middle level skilled lawyers, accountants and surgeons. For example, in 1978, CBS paid US\$2.2mil to examine 6 million documents manually with flesh-and-blood human lawyers. By contrast in 2011, Blackstone Discovery paid US\$100,000 to analyze 1.5 million documents electronically, using algorithms.

Algorithms will become smarter and more sophisticated. They will move up the employment value chain and be deployed in more industries. However, quantifying the employment impact of algorithms is difficult. Some have estimated that with the help of algorithms, one lawyer would suffice where once five hundred were required. With automated work systems offering “24-hour labour with no time off for illness or vacation”, companies will naturally gravitate towards “bot-sourcing”.

Among the jobs not readily “bot-sourced” are service professions in healthcare, beauty, childcare—jobs that are traditionally performed by women. Technology futurist Jamais Cascio notes that these jobs require empathy and emotional intelligence, personal service and high touch interaction. We may be moving towards a future where these “pink collar” jobs—empathy-driven, largely performed by women—are the most significant set of careers without any real machine substitute, and without the downward pressure on wages that mechanisation produces.

When large numbers of jobless young and educated put pressure on existing government safety nets, some societies will question the expectation that a growing economy will grow jobs, and face the emerging reality of a jobless growth. This brings us to the next shift—new values.



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भारतीय रिज़र्व बैंक
भारतीय रिज़र्व बैंक

D. MARKET VALUES

Harvard philosopher Michael Sandel, in his book, "What Money Can't Buy: The Moral Limits of Markets," observes that in the last three decades, "we have drifted from having a market economy to becoming a market society. A market economy is a tool—a valuable and effective tool—for organizing productive activity. But a 'market society' is a place where everything is up for sale. It is a way of life where **market values** govern every sphere of life."

Sandel further argues that market values are crowding out civic practices. When public schools are plastered with commercial advertising, they teach students to be consumers rather than citizens. When we have separate, shorter lines for airport security for those who can afford them, the result is that the affluent and those of modest means live increasingly separate lives, and the class-mixing institutions and public spaces that forge a sense of common experience and shared citizenship get eroded. This questioning of the limit of markets will intensify as it moves from the academic arena into the mainstream.

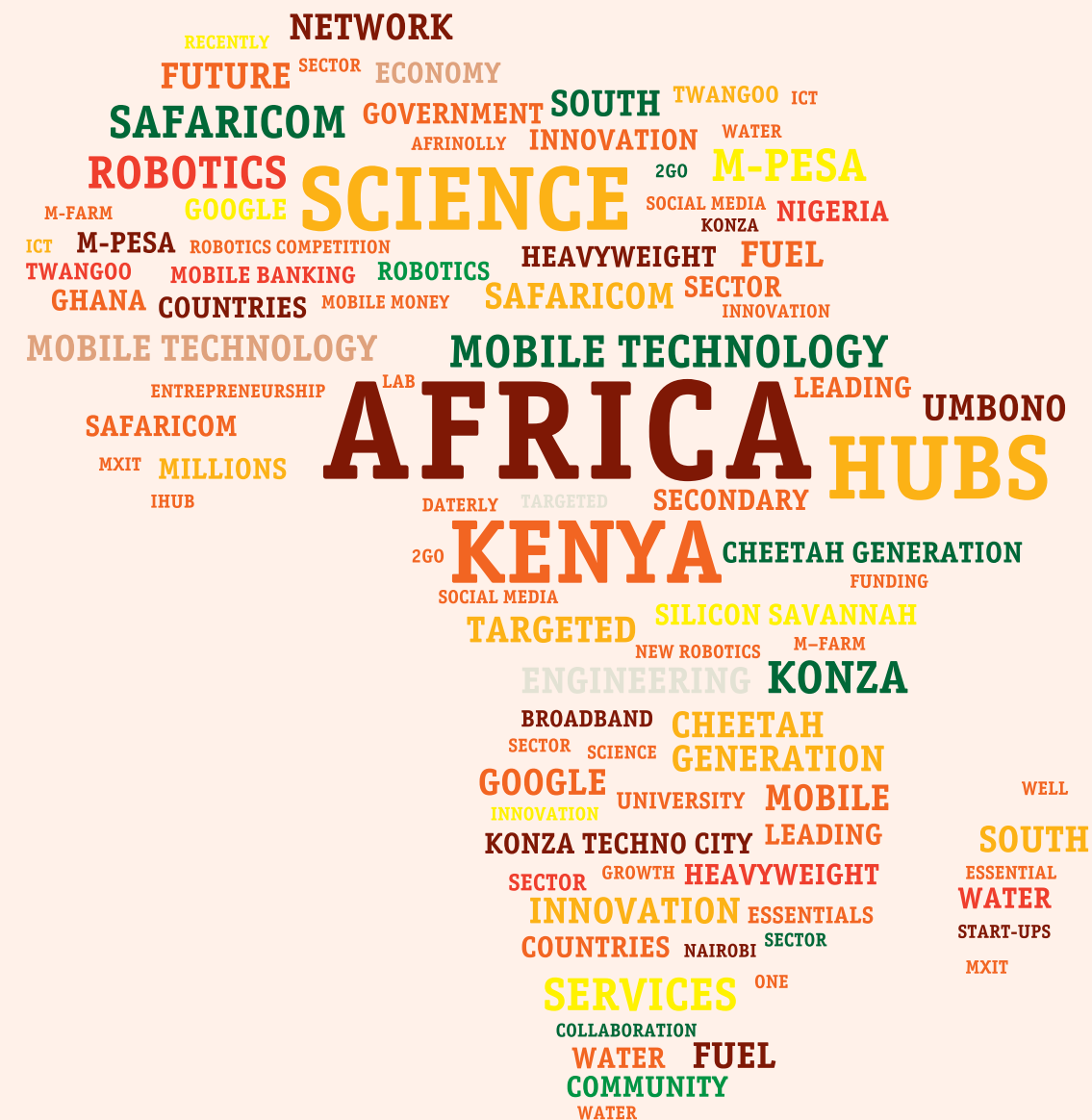
Already, some analysts are asking how societies like Japan and Switzerland sustain reasonable high living standards with zero to low growth. New platforms being explored are alternative currencies such as the Brixton pound in the UK that favour local consumption without relying on a national currency. New currencies such as the BitCoin, a digital-currency created through peer-to-peer computing with no central bank, have sprung up to facilitate trade. Others have started exploring new ways to measure value other than extrinsic motivation captured by money. Platforms like NeighborGoods and the P2P Foundation try to measure intrinsic motivations—friendship, community and wellbeing—other than the economic value of transactions.

None of these systems has become a standard method of buying and selling to replace the existing monetary system. Yet as the Atlantic crisis that began in 2008 deepens and evolves, such new models are finding larger and larger audiences, allowing more people to do more business outside the "normal" economy. These shifts of value, not shifts in value, may intensify and begin to disrupt the monetary-based economy.

As societies face the opportunities, innovations and key uncertainties in the decade ahead, they need to prepare for a leap from today's incumbent paths to tomorrow's emergent paths. There are high expectations for governments to guide their societies to make this leap.

But the gap between what governments can do and what their natural citizens expect has widened. Powers that once resided in nation states have been lost to global economic integration. It is harder to do the right thing, as one European prime minister has remarked, and then go on to win an election.

Notwithstanding these new realities, politics, and by extension policy-making, must in essence be about overcoming and shaping circumstances. Solutions may not be apparent immediately. But in the turbulence between the clash of incumbent paths and emergent paths, what may seem impossible may become possible. Societies that are nimble enough to experiment, make sense of, and ride the opportunities in the turbulence will do better.



Africa's emerging technology space

LAWRENCE WONG

Africa does not naturally spring to mind when we talk about technology or innovation. However, there are increasing signs that Africa could surprise the world in this area. This article will touch on the following trends:

1. Growing presence of technology heavyweights
2. Rise of innovation hubs
3. Frugal innovation
4. Robotics in education

1. GROWING PRESENCE OF TECHNOLOGY HEAVYWEIGHTS

Leading technology companies such as Google, IBM and Microsoft have been increasing their presence as well as their engagement with government and industry in Africa. IBM is present in 20 African countries and recently opened a research lab in Kenya's capital Nairobi—its first in Africa and 12th in the world—in collaboration with the Kenyan government's Ministry of Information and Communication. IBM and the Kenyan government will each contribute US\$10mil funding to the lab. IBM will provide the expertise, intellectual property and run the lab, while the Kenyan government will cover overheads and local research staff. The lab conducts basic and applied research in the areas of next generation public sector services (enhanced e-government capabilities through leveraging big data, analytics and cloud technologies), smart cities (the initial focus is water and transportation) and human capacity development.

IBM has signed a collaboration agreement with the University of Ghana to foster creative approaches to education and R&D and to support the adoption of new technologies such as cloud computing and business analytics. One immediate area of collaboration is to help establish and develop educational programmes and curricula to strengthen skills of students in information technology.

Google is also increasing its presence in Africa, even though it does not expect Africa to be a significant contributor to its revenues in the near term. It sees tremendous growth potential in Africa and is investing in the ground work to capitalise on this in future. Google is partnering with universities across Africa (e.g. Ghana, Nigeria and Uganda) to help expand bandwidth capacity to enable greater internet access to students through its University Program. It has also initiated and invested in an incubator Umbono (Zulu for “vision” or “idea”) in South Africa to support tech start-ups. Umbono provides seed capital of US\$25K to US\$50K to promising start-ups as well as free office space at Hub Cape Town, an innovation hub.

The investments and transfer of knowledge by tech heavyweights could help Africa shorten its learning curve in the adoption and advancement of technology and allow technology to be a key enabler of growth. This could help diversify the economies of African nations and forge a path towards more sustainable economic development.

2. RISE OF INNOVATION HUBS

Some African governments are putting in place broader plans to leverage technology as a driver for economic growth. Kenya, already known as the Silicon Savannah, is leading the way. Today, it has a thriving tech sector, growing at about 20% per year, faster than other industries. Kenya has lofty ambitions. Kenya's ICT Board¹ released an ambitious ICT master plan—Connected Kenya 2017—to make Kenya one of the world's top 10 tech hubs by 2017. The aim is to create 50,000 jobs, 500 new companies and 20 multi-nationals in the ICT sector within the next five years. The government has also initiated the US\$7bil 2000-hectare Konza Technology City—a technology business hub not far from Nairobi, to be developed over the next 20 years. The aim of this city is to help further catalyse the transformation of Kenya's economy into a knowledge hub.



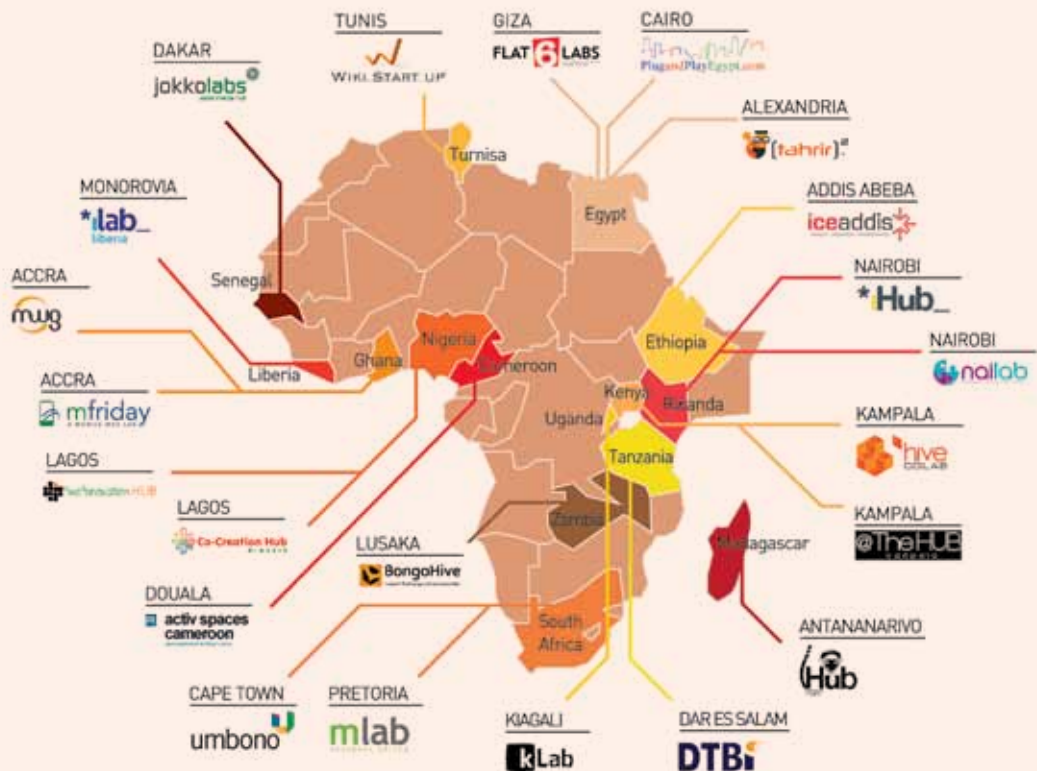
Artist's impression of Konza Technology City
Source: www.konzacity.co.ke

Innovation hubs, a relatively recent development in Africa, may be instrumental in enabling entrepreneurs and start-ups to gain access to resources essential to their growth, like infrastructure – space, electricity, broadband connectivity—and software—networks, venture funding. One example is iHub², targeted at the Nairobi technology community. It is partly funded by Omidyar Network, a philanthropic organisation started by eBay founder Pierre Omidyar.

Beyond Kenya, there are other hubs at a nascent stage of development like Hive CoLab in Kampala, Uganda and Co-creation Hub in Lagos, Nigeria. mHealth Africa, an online platform dedicated to promoting mobile technologies applied to healthcare, has mapped various innovation hubs across Africa.

¹ www.ict.go.ke; Kenya's ICT Board is a state corporation set up by the President in 2007. Its mission is to "rapidly and innovatively transform Kenya through promotion of ICT for socio-economic enrichment of (its) society".

² www.ihub.co.ke



NORTHERN AFRICA

WikiStartup.tn
Flat6Labs.com
PlugAndPlayEgypt.com
Tahrir2.com

WESTERN AFRICA

JokkoLabs.net
iLabLiberia.org
MobileWebGhana.org
mFriday.org
CCHubNigeria.com
WennoationHub.com
ActivSpaces.com

EASTERN AFRICA

IceAddis.com
iHub.co.ke
NaiLab.co.ke
HiveColab.org
TheHubKampala
kLab.rw
Teknohama.or.tz

SOUTHERN AFRICA

mLab.co.za
Google.co.za/Umbono
BongoHive.com
i-Hub.mg

Source: mhealthafrica.com

While still in their early days, Africa's innovation hubs could be the hotspots for the genesis and growth of start-ups in future. International companies may tap innovation hubs to acquire or partner with promising start-ups as a way to penetrate Africa's diverse markets. An example of an international acquisition is the case of Groupon, the leading international collective buying site, recently purchasing Twangoo in South Africa as part of its plan to expand into emerging markets.

Africa is the fastest growing mobile market in the world.

3. FRUGAL INNOVATION

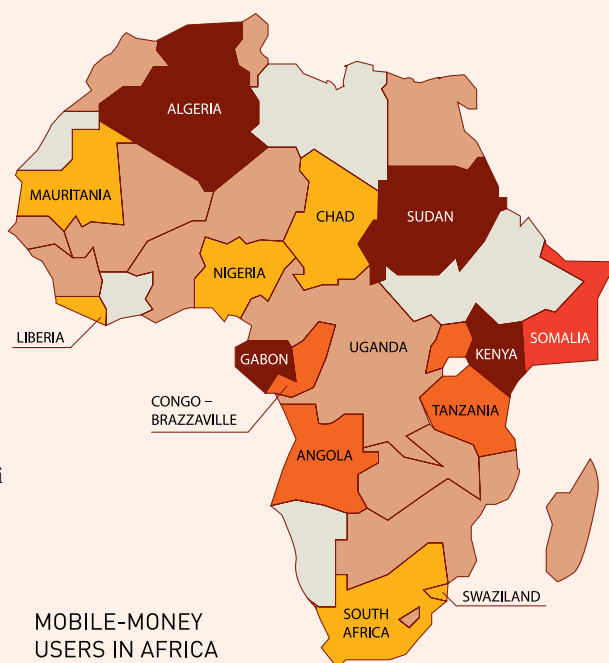
Innovation from Africa has some parallels with India's *jugaad* (frugal) innovation³. A good creative solution to overcome existing infrastructure constraints is mobile technology.

Africa leads the world in mobile money and mobile banking. According to The Economist, 68% of the adults in Kenya use mobile money—the highest rate in the world. The following chart shows the prevalence of mobile money users in Africa.

Mobile banking⁴ and money have circumvented the lack of banking infrastructure in Africa and provided millions across the continent with the ability to pay bills, shop and transfer money even if they do not have bank accounts. M-Pesa (M means mobile, while *Pesa* is Swahili for money) by Safaricom is a leading provider of mobile banking. Other players include Ecocash from Zimbabwe and Ecobank Mobile Banking from Ghana.

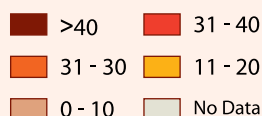
Africa is the fastest growing mobile market in the world. According to the GSM Association report on Africa, the number of subscribers has increased 20% each year for the past five years, reaching over 735 million by end 2012. Mobile technology has enabled the growth of other mobile-related services, such as education, entertainment, healthcare and even agriculture. For example, M-Prep offers quizzes to subscribers via mobile phones, providing students with an alternative way to learn. Esoko and M-Farm provide farmers with up-to-date price information, aggregate their needs and help connect them to buyers, enabling them to sell their produce collectively for better prices. Impilo allows people to locate healthcare providers 24 hours a day. AfriNolly, marketed as “African movies in your pocket” is a mobile application that allows subscribers to view African produced content, especially Nollywood movies (movies made in Nigeria⁵). Kazi560 links job seekers with job vacancies through a text messaging service.

In addition to helping fuel the future growth of Africa's economy by enabling easier access to funds, information, goods and services, such mobile technologies developed in Africa are being exported to other developing



MOBILE-MONEY
USERS IN AFRICA

Adults saying they used a mobile phone in the past year to pay bills or send or receive money, 2012, %.



Source: World Bank

countries. For instance, M-Farm and M-Pesa are already being used in India. Ushahidi, a crowdsourcing software for information collection, visualisation and interactive mapping, is also being used in many countries outside of Africa. During the recent Christchurch earthquake, Ushahidi was used to create a website to map locations of essential services such as food, water and fuel. Some start-ups have even given established international players a run for their money. South African social media start-up 2go has 10 million users in Nigeria, exceeding Facebook's 5 million.

³ *Jugaad* innovation in India was covered in Futures Group's 2011 publication "Imagining the new normal".

⁴ Mobile banking is a form of branchless banking service that allows users to do banking transactions using a mobile phone.

⁵ Nigeria has the second largest film industry in the world by annual number of film productions, behind India and ahead of the United States.

4. ROBOTICS IN EDUCATION

Robotics is in fact not new in Africa. The study of robotics or mechatronics engineering is typically offered at the degree or post-graduate level, for example in University of Stellenbosch and Tshwane University of Technology, both in South Africa. South Africa seems to be leading in the study of robotics in Africa. Research institutes, such as South Africa's Council for Scientific and Industrial Research (CSIR)⁶, have been conducting research in robotics. CSIR's Mobile Intelligent Autonomous Systems (MIAS) research programme has been running since 2007. Its focus is on developing engineering and technology capabilities in areas of field robotics that promote intelligent behaviour⁷.

What is interesting, however, is the emergence of robotics in pre-tertiary schools across various African countries. Robotics is increasingly used as educational tools in primary and secondary schools as the study of robotics is cross-disciplinary. It involves diverse fields such as mathematics, programming and engineering, and can help develop systems thinking and integration. Fundi Bots (*fundi* is Swahili for maker), a non-profit organisation that holds robotics outreach programmes, is bringing the field to the classrooms in Uganda. It was awarded the Google RISE⁸ award in 2012 in recognition of its work—one of the first organisations in Sub-Saharan Africa to receive this award. There are also initiatives to inspire students to study technology-related courses like engineering and computer science through exposure to robotics. For instance, the Mastercard Foundation-funded Ashesi Robotics Experience (ARX) is an annual week-long programme in Ghana that provides participants with hands-on robotic programming projects⁹.

There are numerous robotics competitions across Africa such as AFRON's "10 Dollar Robot" Design Challenge, Afrobotics and Africa Cup Robotics Competition. At the international level, South Africa has been participating in the First Lego League¹⁰(FLL) since 2004. Such competitions are typically targeted at the younger generation. For example, Afrobotics is targeted at students at secondary and tertiary students to generate greater interest in technology and engineering through using robotics to create simple technological solutions to everyday problems in Africa.

Organisations championing robotics have also sprung up recently, such as African Robotics Network (AFRON) and Robotics Association of South Africa. AFRON, launched in May 2012, aim to create a community of institutions, organisations and individuals interested in robotics. It already has 300 members in 25 countries.

THE NEXT SURPRISE FROM AFRICA?

Looking ahead, the pace of technological developments from Africa is likely to increase with higher broadband penetration and cheaper smartphones. Africa is already the fastest growing mobile phone market in the world. However, internet penetration is still low at about 13.5% (compared to the world's average of 32.7%)¹¹ in 2011. The tipping point could be when broadband bandwidth is freed up, which Kenya has done by privatising the information and communications sector and allowing the private sector to operate. This will enable millions across Africa to have faster access to online resources such as education and knowledge, greatly increase the opportunities for those who may not have access to schools or formal training to learn, and allow more Africans to connect and collaborate across borders.

Innovation receives stronger government support in some African countries, but much less in others. Nonetheless, the grassroots level will be instrumental in driving innovation in Africa. George Ayittey, a Ghanaian economist, argues that the future of Africa belongs to the “Cheetah Generation”—a new generation of fast-moving entrepreneurial leaders and citizens who will rebuild Africa, by taking the future into their hands rather than wait for the politicians to create change. These will likely be the people that will spearhead innovation and entrepreneurship, and start the next Facebook, eBay or LinkedIn. But long-term impactful change will be created when the grassroots, government and international organisations work together closely and forge Africa's future collectively.

Africa could well surprise the world.

What is interesting, however, is the emergence of robotics in pre-tertiary schools across various African countries.

Robotics is increasingly used as educational tools in primary and secondary schools as the study of robotics is cross-disciplinary.

6 CSIR is the South African equivalent of Singapore's Agency for Science, Technology and Research (A*Star).

7 <http://www.csir.co.za/mias/>

8 The Google RISE (Roots in Science and Engineering) Awards promote and support science, technology, engineering and maths (STEM) computer science education initiatives. It offers awards to organisations that work with primary and secondary school students to provide enrichment programme in these fields.

9 www.ashesi.edu.gh

10 www.flsa.org. FLL is an international Robotics Team Competition for children aged 9 to 16. It is a partnership between LEGO and USA-based organisation First.

11 <http://www.internetworldstats.com/>

Implications of trends in higher education for a Knowledge-based Economy

C.F. ZUKOSKI

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THE PROBLEM

The cost of tertiary education borne by the student in the US is growing. There is now more debt associated with educational loans than there is overall credit card loans. States cannot afford to support public universities at historical levels. Tuition levels are rising at unsustainable rates. A growing number of families are frozen out of participating in higher education. The Occupy Wall Street movement contains strong elements of frustrated college graduates who find limited job prospects. There are growing questions if the cost of a college degree can be recouped by the student during their lifetime. In response to these concerns, the cost of higher education will become a political football in the 2012 US election cycle.

The economic outlook of the US—both nation and states—suggests that public financial support for higher education will continue to drop in the near term and will not grow back to historical levels in the long term. High tuitions are thus here to stay. Individuals and families are forced to question if they have the financial wherewithal or the desire to take out sufficiently large loans to pay for a four-year education.

WHY IS THE COST OF EDUCATION INCREASING?

There are many proposed reasons for the increasing costs of higher education, including irrational subsidies of university athletic programmes, outsized and bloated administrative salaries, pandering to undergraduates with excessive amenities, faculty unions and tenure, and/or “lazy” faculty who would rather do research than educate. Of particular significance and at the root of much of the tuition increase

is the shifting burden of the cost of public education from the public to the individual, making education more of a private good than its traditional function as a public good.

“...the shifting burden of the cost of public education from the public to the individual, making education more of a private good than its traditional function as a public good.”

The increasing financial burden borne by the student in tertiary education in the US is coupled with historic changes to the global economy. Manufacturing jobs in the US continue to decrease in the face of off-shore competition and increasing on-shore productivity increases. The internet boom created new industries generating fabulous wealth but requiring fewer employees. Restructuring of the pharmaceutical industry is resulting in lay-offs of tens of thousands of chemists and life scientists. There is thus pressure on both blue-collar jobs and those that have been traditionally been considered white-collar and stable.

At the same time, new jobs increasingly require advanced skill sets, a flexibility associated with a broad but strong foundational education, and a willingness to

adapt as new opportunities develop. The displacements are associated with global economic restructuring and are part of the ongoing process which is confronting the US as a knowledge-based economy. Winning the competition for a job is increasingly associated with being well-educated. This process is driving ever-increasing demands for post-secondary education. The same forces exist in Singapore where the rising costs of manufacturing are necessitating a push for higher value-added manufacturing and a drive to increase the innovation output of the Singapore economy.

UNDERSUPPLY OF WORKERS FOR THE KNOWLEDGE-BASED ECONOMY

We generally equate the knowledge-based economy worker with an individual who has a four-year undergraduate degree. As a result, growth of a knowledge-based economy places increasing demand on institutions of higher learning to open their doors to larger cohorts of students.

Despite the size of public US universities, they are poorly adapted to expand through productivity increases to provide mass education. The university system was developed in the last century when the ideal was that public universities compete with private universities where scholarship and elitism are encouraged. The resulting process of education is costly and difficult to scale to meet the demands of the knowledge-based economy.

The US finds itself with a costly model for public higher education at a time when there is growing demand for tertiary education and when the federal congress and state legislatures are investing less.

In Singapore the costs of higher education do not yet feel the stresses seen in the US. Access and slots for areas in which to specialise are actively managed. The Polytechnic system offers educational channels for a large fraction of the population, a subset of whom subsequently go on to the Universities. With generous governmental support, one does not hear as much as in the US about the cost burden of a college education limiting the ability to attend.

Instead, the challenge is to be accepted into one of the universities (i.e. there are fewer slots than students who desire the degrees). The competition for places at elite secondary schools and junior colleges in Singapore that provide preparation for entry into the universities has families spending over US\$100mil dollars a year (for ~520,000 students) on private tuition classes that keep their children in the classroom well outside school hours.

One consequence is extremely well-prepared students who enter the universities. A second consequence may be downward pressure on the fertility rate in Singapore.

Neither a declining level of average academic achievement nor a fertility rate below replacement levels are optimum social outcomes.

My thesis is that cost of education will continue to rise unless the productivity of the educational system is greatly increased.

PRODUCTIVITY ENHANCEMENTS MAY BE LIMITED

Productivity gains in education will be difficult to bring about. Human metabolisms operate in a narrow range of rates and that metabolic rate limits the chemical processes

required to form neurons, establish synapses, and create the chemical basis of learning. In addition to chemical rate limiting steps, humans mature at a rate set by our DNA and our evolutionary development. For several centuries, humans have taken 3-4 years over the ages of 17-21 to acquire the depth of knowledge and develop the maturity to be professionals. While the education we impart today in primary and secondary school contains different material than was taught 100 years ago, the preparation level relative to the needs of the job market has hardly changed. The education acquired as an undergraduate is as much about facts as it is about learning to be a critical thinker who can be skeptical of arguments and be contemplative of implications and actions. Humans acquire this ability, if ever, in a tertiary educational process as they mature in their late teens and early 20s.

While we may not have yet reached the chemical rate limiting steps in speed at which we can educate individuals, given the length of time humans have valued education and learning fast, I suspect productivity gains based on new understanding of brain physiology will be limited. Thus I conclude that preparation of critical thinkers, who can creatively address issues in the workplace, is unlikely to happen with less than a dedicated period of 2 to 4 years of focused effort at the ages of 17 to 21.

If the rates of learning and maturation are fixed for humans and if the productivity of other activities in society increases, the cost of education will increase at a pace that exceeds inflation. As a larger and larger fraction of the population seeks tertiary education, the resources to enable those with the necessary

preparation to be educated are squeezed. Thus the real cost of education goes up at a rate faster than the broader consumer price index.

RETHINKING TERTIARY EDUCATION

The knowledge-based economy requires individuals with broad-based education; individuals who are skeptical and critical thinkers; individuals who are creative in their ability to compete in wealth creation. The education leading to productive lives and careers involves mastery of facts and an understanding of politics, the arts, history and literature.

Expansion of a knowledge-based economy then requires increasing participation in higher education which in turn requires limiting the cost of education or enhancing its perceived and/or real economic value so that individuals, families and the government are willing to pay the cost of that education.

Many degrees both STEM (science, technology and maths) disciplines and beyond are currently designed to educate the next generation of professionals in fields where employment lies essentially only in academia. Limited thought goes into shaping these degrees towards educating critical thinkers who will deliver value to society outside these disciplines.

Indeed, academia is resistant to the entire concept that a university degree should be evaluated from the perspective of workforce development. Universities pride themselves on educating the next generation of thinkers, not the next generation of knowledge workers. The ideal of many degrees is that

those who hold them should be scholars—individuals who are literate, understand politics, the sciences, economics, and history—not degree holders who have been educated to sustain the economy.

There is a tension between the needs of individuals who will participate in a knowledge-based economy and the academic ideal which is focused on creation of scholars. One might venture to suggest that the educational model currently being used continues due to momentum: we cleave to our current set of degrees and disciplines not because this education is somehow intrinsically better but because there are few alternatives.

The disinvestment in education currently taking place in the US can be understood as a statement that the return on an investment in higher education as it currently stands is smaller than the return yielded by other uses of that capital.

However, this situation will not likely persist. In the face of these pressures, as we look out a decade, what changes are likely to occur?

PEERING INTO THE FUTURE

The value of a tertiary education will continue to grow. Limiting access by increasing cost so only the wealthy can attend will be politically untenable. Limiting the number of overall slots would stifle a knowledge-based economy. Ultimately, there must then be a debate on how to ensure that the return on the outcome of gaining an education is worth the necessary investment.

I argue that increases in productivity and increased value will be derived

from restructuring the undergraduate degree.

TREND 1

In the short run, we are seeing efforts to restore budgets to sustain the current educational infrastructure.

One instance where this is occurring in the US lies in differential tuition rates for in-state and out-of-state students. Public state universities routinely charge higher tuition to students whose residence is out-of-state. For well-known, flagship universities, by opening up access to out-of-state students, substantial new income streams can be developed that off-set the reduction in state support.

Parents of in-state students and legislators have become deeply concerned that coveted slots are lost to out-of-state students. (This issue has a direct parallel in Singapore when university slots are opened up to non-citizens.) However, in the US, with the reduction in state support, governing bodies find this option more palatable than others. The result has been an increase in out-of-state enrollments of state universities across the country.

A second approach is to discount tuition to entice more students to gain degrees in their current forms. As an example, while offering substantial support to students from families with incomes with less than \$80, 000 per year, the University of California at Berkeley recently announced a programme to attract middle class students by subsidising the education of students from families with incomes of \$80, 000–\$140, 000 per year (paid for with income streams developed from the tuition

paid by out-of-state students). This discounting has a direct parallel in a sale at a store which finds itself burdened with carrying merchandise that costs more than the customer is willing to pay. Lowering the price in a sale is used to increase demand.

A third approach lies in building endowments where the income can be used to offset decreases in public investment.

A fourth approach is to operate the university in a more efficient manner through better use of infrastructure and reducing overhead costs associated with heating, cooling and lighting.

These efforts lower the cost to the individual and the public sector, reinforcing current educational models.

TREND 2

In the long run, despite the efforts to build endowments, run the university more efficiently, and increase revenue through enrolling out-of-state students, the increasing cost of education will force public institutions of higher education to recalibrate what is essential to educate critical thinkers who can be knowledgeably skeptical and seek creative solutions.

Rethinking the education of 17–22 year olds requires questioning the value of the content in current degrees. Such a process opens up the questions of what is valued and why. For academia, these are deeply disturbing discussions.

Asking the question of what should be taught opens discussions of the value of different disciplines in the

formation of educated individuals. There are no winners in debates over the intrinsic value of particular branches of scholarship.

Discussion of this question immediately plunges one into debates of academic freedom and tenure. The interest groups supporting the current model are deeply entrenched and battle-hardened to protect both their self-interests and what they genuinely believe are the interests of the student and society at large. These conversations of degree content are particularly hard at the flagship public universities because, with their success, they feel the least pressure to change.

Unfortunately, the pain associated with such conversations stifles serious consideration of how changes in society and in the global economy necessitate rethinking undergraduate education.

But developing solutions need not bring down the academic enterprise. Changes to the content of an education need not alter the scholarship in different disciplines or the standards applied to that scholarship.

Examples of experiments in restructuring universities include Arizona State University (ASU) where departments and colleges have been reorganised to create opportunities for educating more students faster. Representing an altered approach to public higher education at a research university, the jury is still out on the effectiveness of the ASU model.

A second example is the Singapore University of Technology and Design (SUTD) where traditional departments have been eliminated and the concept of design has been infused into the

“There is a tension between the needs of individuals who will participate in a knowledge-based economy and the academic ideal which is focused on creation of scholars.”

entirety of a technical education. SUTD is a bold experiment in rethinking the current educational paradigm and designed to educate a new type of engineer.

Enhancing the value of undergraduate education involves ensuring that graduates are able to think critically and have an understanding of how their specialised knowledge enables them to operate outside the disciplinary boundaries associated with an in-depth disciplinary focused

education. One concept that does not substantially alter the current structure of degrees is to require students in all disciplines to undertake a capstone course that forces conversations outside their discipline and addresses social, community, and industrial issues of breadth. Bringing together students from very different disciplines would ensure the student understands how their education enables critical thinking, skeptical discussions of different arguments and places their education within a broader context.

A second concept is to require all students to undertake internships. This would be a daunting task for public universities which might need to look for as many as 5,000-10,000 internships per year, and development of such a programme would necessitate diversion of resources currently going to research and scholarship. Nevertheless, if there is value to what the student learns, there should be internships available for the students in the private sector (corporations, banks, stores, real estate firms, insurance firms and etc), the public sector (schools, community and state governments) and non-governmental organisations. Building this type of educational experience would force a conversation between the university and the communities and states in which they are embedded.

A third concept is to increase value by simply reducing cost. An example of how this might be accomplished would be by moving away from a 9-month academic year to a 12-month academic year where, in 36 months, the contents of a current four-year undergraduate degree can be offered.

Perhaps the most disruptive concept is the use of the web as

“The disinvestment in education currently taking place in the US can be understood as a statement that the return on an investment in higher education as it currently stands is smaller than the return yielded by other uses of that capital.”

a unique educational tool. While currently being explored mostly for training - in mathematics or in programming skills, online education may offer unique opportunities to greatly enhance the productivity of educators. Ideas on how to unbundle the university so that courses

leading to a certified degree can be gathered from many sources are gaining momentum. Methods of how to accredit the quality of an online course are gaining serious attention.

The increases in productivity brought about by such educational methods, like increases in productivity in other industries, ultimately must result in fewer educators. There is some evidence that universities are responding with creating online curricula because they see this trend as an existential threat.

While focused currently on the training aspect of higher education (i.e. the transfer of specific knowledge and skills) in STEM areas, there is no reason such online courses could not replace the enormous lecture classes that form the introductory classes of most majors. For example, first-year psychology, economics, and history might be taught to thousands online with limited reduction in quality.

Thus there will be an expansion of such courses with growing competition among universities to provide the best experience and with the resulting questions of accreditation and acceptance of such courses as part of a conventional degree given by a specific university. In time, however, this will result in employers seeking not specific degrees but “badges” indicating successful completion of a certain set of courses that meet specific accreditation standards.

The challenge in this trend lies in how to educate the undergraduate to be a critical, skeptical and creative thinker. Our current methods of educating in new ways of thinking rely on discussion sections where students are asked to defend their views and discuss arguments put forward from

different perspectives. These skills are an essential to the successful knowledge-based worker and are less easily taught with online material as they require human interactions.

Indeed the real existential threat to the current university system will appear when new methods of face-to-face social and intellectual interaction developed outside the residential university lead to accredited evidence of accomplishment acceptable to employers. Nevertheless, the current trend will see an accelerated use of online courses to increase productivity and reduce the cost burden for learning advanced material.

TREND 3

Because of strongly held views about the purpose and value of an education, only under enormous duress can an institution undertake a wholesale rethinking of its educational programme.

External pressure to make changes will grow in response to demand from the public to have access to higher education.

The US definition of academic freedom and the resulting joint governance structures of universities place all things academic in the hands of the faculty, with the consequence that restructuring undergraduate programmes will occur slowly and with ponderous deliberation. Implementation of change, even if recommended, will be even slower. Acceleration of a transition that captures a deeper understanding of the type of education needed to prepare a larger cohort of undergraduates to be productive members of society will require a mandate from the outside.

Increasingly impatient oversight groups are beginning to impose these changes as reflected by the increasingly metrics-driven financing models being imposed by state boards of higher education in the US.

Having a history strongly associated with national development and with a different form of university governance, Singapore is not burdened with the traditions built in the US university management structures. The formation of Republic Polytechnic, which has a problem-based educational curriculum and SUTD, are examples of how the growth of investment in education can create new opportunities instead of merely expanding current ways of doing business.

Singapore is already mindful of the need for productivity gains in education as evidenced in the careful deliberations on faculty-to-student ratios and administrator-to-student ratios. The challenge for Singapore may lie more at the primary and secondary education levels where the competition to do well on MOE exams is enormous and is a potential source of social unhappiness.

TREND 4

There will be an increasing tendency to link education to economic growth and this will lead to ever-tighter collaborations between the public and private sectors in education.

Historically, education has been seen as largely a public good, and the resulting social contract did not require the private sector to directly support education. With an accelerating shift to education being a private good, the business sector will find its interests served by developing

pipelines to attract and retain the best employees in fields of importance.

The upsides to stronger academic-corporate ties are increased funding and stronger employment prospects for individuals upon graduation. The downsides include threats to universities as places that can express opinions without fear of repercussions as enshrined in the US concept of academic freedom. These issues are not just in holding back scientific or technology-related research results as they might be embarrassing to the corporate sponsor but also in the very important role of a university as being a source of social commentary.

TREND 5

An altered agenda for scholarship and research will emerge.

Even with growing costs, higher education will remain a recognised public good and tax payer subsidies will continue to support education of the workforce of tomorrow. The increasing cost of education will take larger demands of tax revenue streams requiring shifts from other areas: infrastructure, crime prevention, healthcare, defence, social welfare, and regulation. To accomplish these shifts governments must ensure that current activities will continue but at a lower cost. Thus a research agenda will develop with a focus on increasing productivity in the delivery of essential government services.

For example, to shift funds out of investments in infrastructure, the cost of building, repairing and upgrading infrastructure must be reduced, even though the fractional research dollar currently going into these activities is small.

In the US, much of the current costs of healthcare lie in crisis and end-of-life care. To transfer funds from support of healthcare to education, investments could be made in prevention, in chronic care and in launching a broad public discussion about end-of-life decisions. Such a shift may require a rebalancing of public research expenditures.

If there is to be a shift of funds from the regulatory arm of government to education, the regulatory apparatus must be more efficient and effective. A question of growing importance is then to understand the science behind regulation. Regulation becomes not only something that a government does but a subject worthy of understanding from a fundamental perspective. While there is increasing understanding of the fundamental basis of regulation in the financial industry, the scientific basis for regulation in the environment and healthcare are in an underdeveloped state.

Finally, the best way to develop funds to pay for education is to have a thriving economy. An expanding knowledge-based economy is based on innovation and the commercialisation of new ideas and products. Governments recognise the role they play in reducing the risk in the innovation cycle and fund upstream research that the private sector finds difficult to support. As we look into the future we will see increased demand for a return on investments made in publicly funded research. If that research is carried out at universities as is the model in the US, universities will be asked to play ever larger roles in economic development.

In Singapore, there is a separation of foundational research as carried out

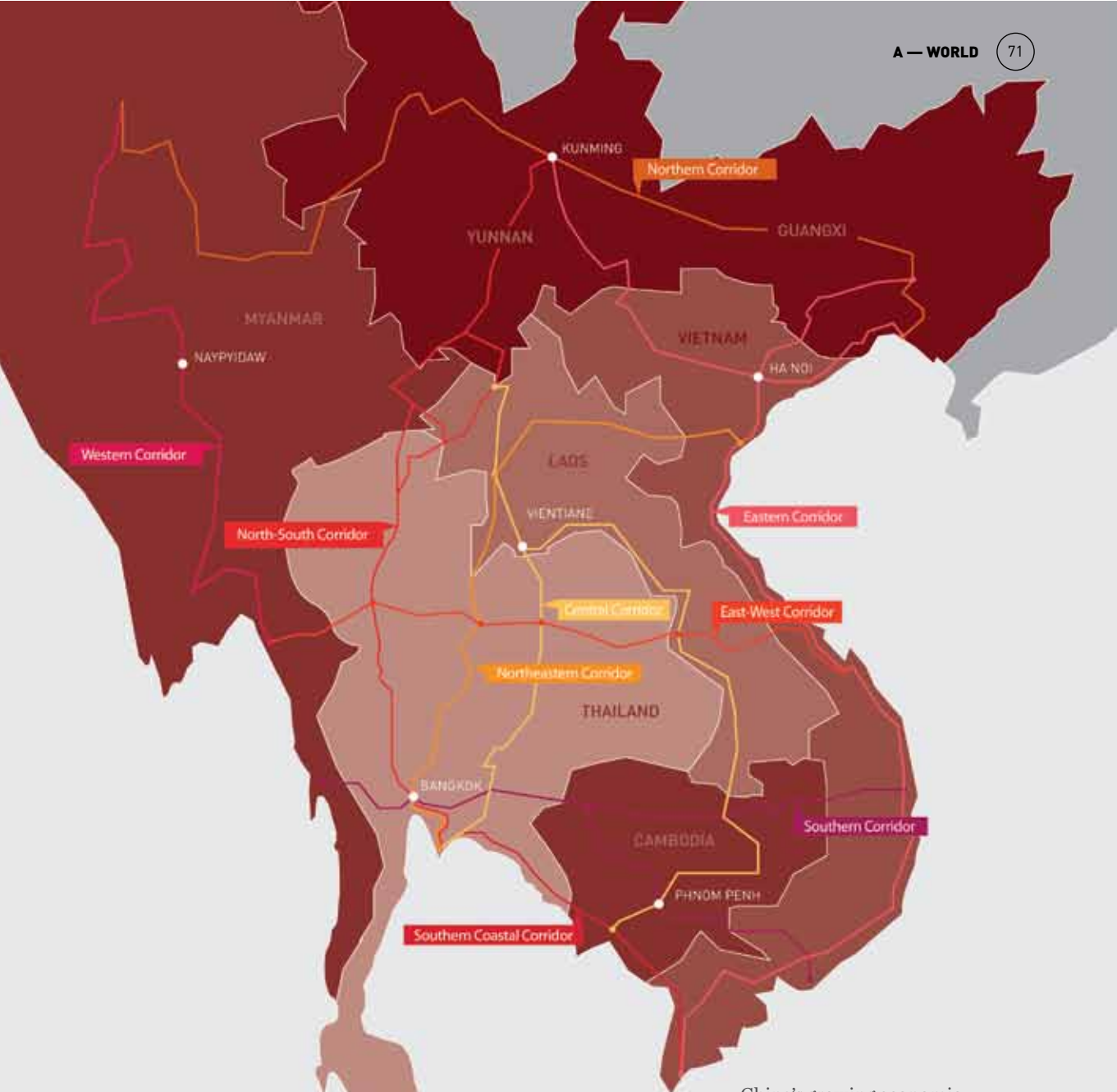
primarily at universities and research aimed at economic development as carried out at A*STAR. In the future there will be growing emphasis that the research undertaken by A*STAR have tangible economic returns while the universities will struggle to resist the temptation to swing too deeply into research of an economic development nature.

CONCLUSION

The cost of tertiary education in the US is increasing and is not likely to stabilise unless institutions of higher learning dramatically improve their productivity. The demand for tertiary education and the access this gives to jobs in a knowledge-based economy will only grow. Higher costs and increased demand will force a debate on the links between tertiary education and skills to be economically successful, especially outside the professional disciplines. The reluctance of academia to change will result in increasing metrics-driven evaluation of outcomes where one of the key outcomes of the undergraduate degree—the ability to think critically—may be lost. A growing drive for increased revenue from partnerships with the private sector will necessitate constant vigilance to ensure universities remain those places that can make social commentary, state popular and unpopular opinions, and report results that may not be seen as in the interests of their corporate sponsors. A research agenda aimed at lowering the cost of delivering government services may result from the need to shift funds to tertiary education while the emphasis for economic returns on public funded research will grow. At the same time the university as it is currently known may wither under the stress of online educational opportunities.

“The challenge in this trend lies in how to educate the undergraduate to be a critical, skeptical and creative thinker.”

Despite all this predicted turmoil, societies will continue to value tertiary education and universities will continue to be seen as attractive places to gain the skills necessary to live a high-quality life. A non-trivial aspect of life lies in the social connections made between humans and these will continue to be seen as being enhanced by attending a university (in particular, a residential university). Thus the angst over costs and access will force universities to change how they educate and how they prepare the next generation for positive and productive lives.



China's growing economic linkages with the **Greater Mekong Subregion** (GMS), namely Cambodia, Laos, Myanmar, Vietnam and Thailand, will introduce new dynamics within the ASEAN region. This paper examines the trends and broad implications for Singapore.

China and a Rising GMS

WANG NING

Knitting the GMS into southern China

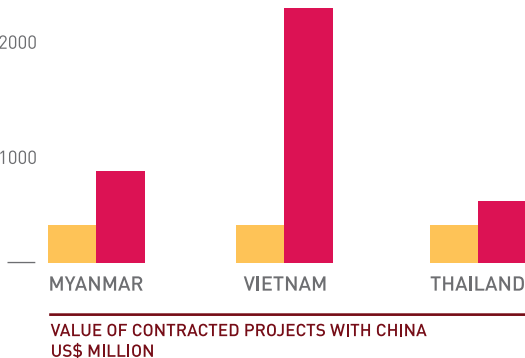
The GMS's potential for rapid economic growth is being unlocked with major infrastructural investments from southern China's Yunnan and Guangxi provinces. Yunnan spearheads China's 'Bridgehead Strategy' into mainland Southeast Asia. Guangxi, at the same time, is promoting its "One Axis, Two Wings" strategy.

Transport Routes

Over the last decade, with funding mostly from China and the Asian Development Bank (ADB), the GMS has built a web of economic corridors along railroads and high speed rails. The 16th GMS Ministerial Meeting in August 2010 endorsed an integrated railway system, with the vision of establishing rail links among all GMS countries by 2020¹. On 6 May 2011, the Chinese State Council issued a report stating that 9 major transport channels will be built linking Kunming, Hanoi, Kyaukpyu, Bangkok and Myitkyina. Key infrastructure include a new airport in Kunming, a trans-Asia railway from Kunming to the Northern Gulf and three highways linking Kunming to Hanoi, Bangkok and Yangon². The web of transport routes, when completed, will not only link China and the Mekong region, but also offers China direct access to the Indian Ocean.

People

As new transport routes knit together the various parts of the GMS, there are anecdotal accounts of Chinese migration to GMS cities. The growth of rubber plantations in northern Laos, for example, has led to rapid people inflow from China, including 400,000 illegal Chinese immigrants, according to unofficial estimates³. Actual numbers are hard to pin down. People flow in the reverse direction is also happening. China is offering scholarships to students in the GMS and more residents in the Mekong region are beginning to learn the Chinese language to better engage the Chinese. Cambodia, for example, has set up new consulates in China to promote tourism.

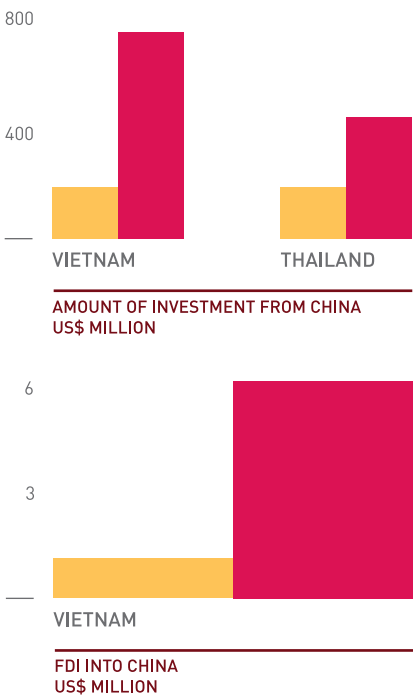


Financial support

There is an increasing volume of cross-border flow of goods, services and investments between China and the GMS. From 2005 to 2009,

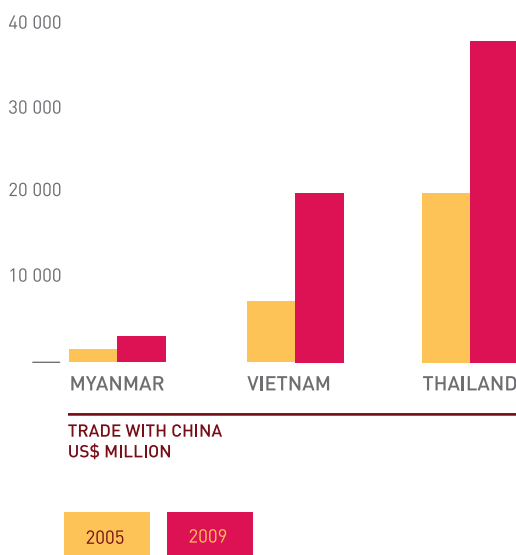
- the value of contracted projects from China in Myanmar, Vietnam and Thailand increased by 190%, 760% and 80% respectively;
- China's investment in Vietnam and Thailand increased by 220% and 100% respectively;
- trade between China and Myanmar, Vietnam and Thailand increased by 140%, 160% and 80% respectively; and
- FDI from Vietnam to China increased by 370%⁴.

At the same time, China is internationalising the RMB in the GMS by popularising the RMB as the preferred currency used in business transactions. Kunming, the capital of Yunnan Province, is positioning itself as a financial hub, specialising in cross-border RMB settlement with the Mekong region, offshore financial services, mergers and acquisitions, and project financing.



Resources

Even as the Mekong region benefits from the net inflow of financing from China and builds up its transport infrastructure and industrial base, China is extracting large quantities of resources from the Mekong region to support its domestic development. Chalco, for example, has been partnering Vinacomin in Vietnam's aluminium industry since July 2008⁵. China Nonferrous has also invested US\$810mil in Myanmar's metal industry. Through mining activities, China is tapping into the Mekong region's rich mineral deposits and has turned Kunming into an international mining industry trade centre. China is also becoming one of the Mekong region's largest importer and exporter of forest products.



Is the rise of the GMS a given?

Economically, the GMS holds interest for and has attracted investments from countries beyond China. Japan has committed US\$5.9 bil from 2011 to 2013 in the GMS through Official Development Assistance and the Japanese government is urging more private investment in the GMS, particularly in infrastructure. Vietnam and Thailand are also two of the top four worldwide destinations for investment, based on a survey of Japanese executives⁶. During the ASEAN Summit in Hanoi in October 2010, Korea proposed the creation of a regular meeting of economic ministers from Korea, Cambodia, Laos, Myanmar, Vietnam and Thailand to discuss ways to jointly develop the GMS. The US has also shown keen interest in the GMS by selecting the Mekong Basin as the focus of America's re-engagement with Southeast Asia⁷. This economic interest from Japan, USA and the EU has intensified in 2012 with the opening up of Myanmar.

However, even though the GMS holds economic potential, geopolitical conflict could hinder greater collaboration and integration. These conflicts could limit the choice of economic partnerships, impede growth and slow the pace of development.

Key areas of tension include:

1. Border clashes between Thailand and Cambodia along Northeastern Thailand and Northern Cambodia;
2. Vietnam's disputes with China in the South China Sea over the Spratly and Paracel Islands.

1 Wade, Geoff, "ASEAN Divides", Dec 2010 New Mandala. <http://asiapacific.anu.edu.au/newmandala/>

2 Li, Chengyang, "China's Developing Connectivity with ASEAN: Strategies, Projects and Prospects", East Asian Institute of National University of Singapore and Institute of Southeast Asian Studies of Yunnan University

3 Wade, Geoff, "ASEAN Divides", Dec 2010 New Mandala. <http://asiapacific.anu.edu.au/newmandala/>

4 Data from CSCOLLEGE

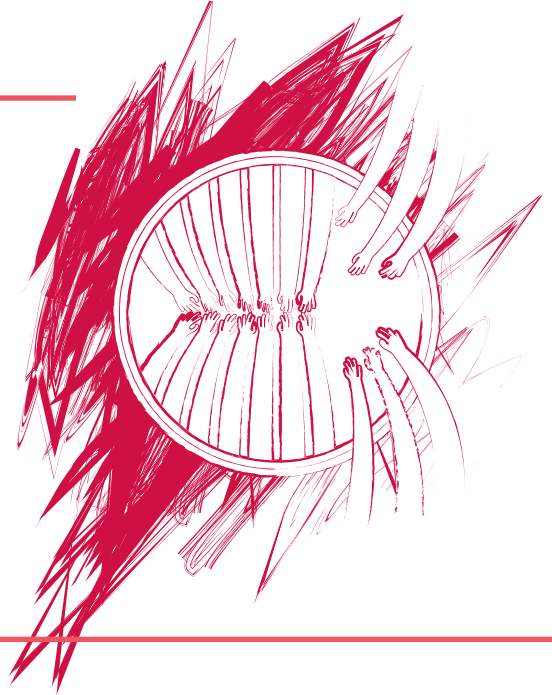
5 Aluminum Corporation of China Limited, or Chalco, is the world's second largest alumina producer and third largest primary aluminium producer. Chalco's partnership with Vinacomin is an example of the involvement of large Chinese corporations carrying out large scale operations.

6 Khanthong, Thanong, "Japan Stresses Infrastructure, Software Investment in GMS", September 2010, The Nation. <http://www.nationmultimedia.com/hom/2010/09/09/business/Japan-stresses-infrastructure-software-investment--30137570.html>

7 Wade, Geoff, "ASEAN Divides", Dec 2010 New Mandala. <http://asiapacific.anu.edu.au/newmandala/>

The impact of increased GMS-China links on cooperation within ASEAN

By making major investments and through its growth as an export market, China's economic linkages with the GMS are set to grow. However, the consensus among political watchers is that this is unlikely to result in a displacement of GMS ties with other ASEAN partners, as the GMS countries will likely be wary of becoming overly dependent on China. The likelihood of the GMS countries withdrawing from the ASEAN bloc is low.



The impact of increased GMS-China links on Singapore

OPPORTUNITIES

Economic expansion of the GMS could offer new opportunities for Singapore companies. Singapore's trade and investments in the region has increased considerably over recent years. A summary of Singapore's investments and trade relations with each of the GMS countries is provided below.

Laos. Trade volume between Singapore and Laos is relatively low at S\$44.2 mil in 2011, accounting for only 0.001% of Singapore's global trade in 2011. Most of Singapore's investments in Laos are in property, manufacturing and hospitality.

Cambodia. Bilateral trade between Singapore and Cambodia is relatively low, at approximately S\$1.4 bil in 2011. Singapore companies in Cambodia focus mostly on property development, energy, logistics, commercial services, and textile and garment manufacturing.

Myanmar. Total trade between Singapore and Myanmar increased by 70% from S\$960 mil to S\$1.6 bil over the period 2001 to 2011. At the end of 2010, Singapore's FDI into Myanmar reached S\$5.7 bil and hotel and tourism accounted for approximately a third of Singapore's investments in Myanmar. Other major sectors include industrial and real estate sectors.

Vietnam. Bilateral trade between Singapore and Vietnam increased from S\$5.0 bil in 2001 to S\$14.9 bil in 2011. Singapore is the fourth largest foreign investor in Vietnam as of April 2012. Singapore investments in Vietnam are quite diversified, covering both manufacturing and services. Major investments cover industrial parks, real estate, energy, logistics, financial services, healthcare and automotive.

Thailand. Bilateral trade between Singapore and Thailand is the highest among the GMS, at S\$31.9 bil in 2011. Singapore was Thailand's second largest foreign investor in 2011. Singapore's investments in Thailand are mostly in financial and insurance services, wholesale and trade and manufacturing.

Even as Singapore companies increase their connections and activities in the GMS, it should be noted that these are not without risk. Inflation, currency instability, over-reliance on foreign investment and uncertainty over the pace of political reform are key business risks which business investors have to watch out for, particularly for countries which are just opening up.

All things considered, a parallel China-GMS grouping could emerge with the growth of investment, trade and people flows between China and the GMS countries, which will introduce new dynamics in the ASEAN process. If some GMS members align their interests more closely with China, instances where ASEAN countries are unable to agree on a common stand on issues where China's interests are involved could increase.

Such an impasse took place at the ASEAN Regional Forum (ARF) meetings in Phnom Penh in July 2012, where ASEAN states could not agree on a communiqué for the first time in ASEAN's history. The disagreement

was over the inclusion of mention of the South China Sea dispute between Philippines and China in the communiqué. Dr Ian Storey, senior fellow at Institute of Southeast Asian Studies (ISEAS), interprets this as the deepening of the divisions within ASEAN. In addition, US interest in the South China Sea dispute adds further complexity to the issue.⁸ An increase in such situations could have profound implications for the future of cooperation among member states within ASEAN.

GREATER COMPETITION

While it is conceivable that the closer relationship between China and the GMS could eventually lead to stronger competition for the Chinese market, this is unlikely to happen in the near term.

Firstly, Singapore and the GMS companies are currently not involved in economic activities in the same part of China. The rise of the Mekong region is closely associated with Yunnan and Guangxi provinces in Southwest China. The activities of Singapore companies, on the other hand, are focused on densely populated and developed metropolitan areas mostly along the east coast, as well as emerging provincial capitals and county-level cities in the interior.

Secondly, Singapore's trade links with China are based primarily on shipping routes to China's eastern ports. The GMS, on the other hand, with its interconnected web of railroads, high speed rail and highways, is linking up with the south-western provinces of China. As trucks and trains have much lower transport capacity than ships, the volume of goods transported through the GMS is unlikely to catch up with the volume of goods transported through Singapore. As a result, it is unlikely for the volume of goods shipped from Singapore to China to be affected significantly.

Related to the above, Singapore's positioning as the choice port-of-call is likely to be maintained for some time. While the GMS is also developing its port

capabilities, notably in Myanmar and Thailand, in addition to investing in land transport, the viability of some of the projects has been questioned. For example, Myanmar plans to build a deep sea port at Dawei and subsequently to develop Dawei into an Indian Ocean industrial hub. However, questions have been raised regarding the ability of Italian-Thai Development Public Company Ltd (ITD), the contractor and Thailand's biggest construction company, to develop an \$8.6 bil industrial zone.⁹ Thailand has announced a re-assessment of the strategy to develop trade transport infrastructure overseas, after Myanmar blocked proposals by ITD to build a 4,000MW coal power plant to fuel the Dawei project. Instead, Thailand now plans to develop Laem Chabang near Bangkok as a regional hub.¹⁰

Conclusion

Although this paper has largely discussed the implications of stronger linkages between China and GMS countries as a group, it should be noted that the GMS countries in fact differ quite significantly. Given the complex geopolitical backdrop against which the developments will play out, a more detailed study at the individual country level would be needed to project how these will intersect and shape the future economic profile of the ASEAN region, and inform Singapore's response to the opportunities they will bring.

⁸ Choong, William, *Healing the Rifts in ASEAN*, *The Straits Times*, 21 July 2012.

⁹ Krause-Jackson, Flavia, Kate, Daniel Ten, *Myanmar Raises Doubts on Italian-Thai's Deep-Sea Port Plans*, May 3, 2012. www.bloomberg.com/news/2012-05-03/myanmar-raises-doubts-on-italian-thai-s-8-6-billion-port-plans.html

¹⁰ Boot, William, *Dawei Port in Doubt with Bangkok Hub Plan*, March 9, 2012. www2.irrawaddy.org/article/php?art_id=23176

Global-Asia Confluence

The inaugural “Global-Asia: The Singapore Summit” was held in Singapore from 21 – 22 September 2012. The summit brought together the international advisors and senior guests of the Monetary Authority of Singapore (MAS), Singapore Economic Development Board (SEDB), Government of Singapore Investment Corporation (GIC) and Temasek Holdings, providing a unique opportunity and setting for industry and thought leaders to interact.

Based on the theme “Global-Asia Confluence”, the Summit discussions focused on how the global environment would affect Asia and, in turn, how a rising Asia would be able to shape and influence the rest of the world. Panel sessions at the Summit featured distinguished business and thought leaders, who discussed how macroeconomic and geopolitical developments (including demographic and technological trends, shifting consumption and investment patterns), regulatory reforms, as well as evolving economic flows, production networks and industry clusters will shape the Global-Asia landscape.

WHAT IS GLOBAL-ASIA?

Asia is being globalised and, at the same time, the world is being “Asianised” at an unprecedented scale. Asia and the rest of the world are more interdependent than before. However, collaboration and convergence have become increasingly difficult, amidst a fragile global economy and domestic pressures. With the emergence of new players and institutions in a state of flux, there is a need to proactively define, understand and manage the confluence of Asia and the world.

This necessitates a fundamental shift away from paradigms based on geographically defined dichotomies to a “Global-Asia” paradigm that focuses on the interconnections between Asia and the rest of the world. How well countries, cities and companies fare in the evolving global order will depend on their ability to build and deepen linkages by traversing and transcending differences.

HOW TO USE THIS MAP

This map, and three associated perspectives, were developed as tools to help visualise coming changes discussed at the Singapore Summit. The map depicts five major drivers of influence, delivering three levels of impact where Global-Asia would change the economy, society, and lives over the next decade. The three perspectives — **1** Employing the 9 billion, **2** Energy Abundance and the North American Renaissance and **3** A New Global Nervous System—are described in detail after the map.

LEADERSHIP & IDEAS

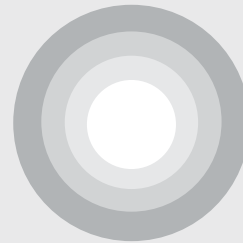
FIVE MAJOR DRIVERS OF INFLUENCE:

This map is organised around five major drivers of influence. These are core stories that define the interactions of political, economic, and social forces.

Powered by People

THEMES WITHIN EACH DRIVER OF INFLUENCE:

Under the umbrella of each major driver of influence are three themes that relate to, and expand on, the bigger stories.



AREAS OF IMPACT:

Radiating out from the five major drivers of influence are three rings, or areas of impact, that signify how the power of the hyphen will affect our economy, society, and lives.



SIGNALS FOR EACH LEVEL OF IMPACT:

These are signposts to the future, categorised by area of impact.

Transaction

interesting data that we see today

Transition

trends and possible tipping points

Transformation

speculative questions that point out different pathways the world might take

Global - Asia

The Power of the Hyphen

Average actual retirement age in the EU and North America (1970-2010) fell from around 68 to 63, even as life expectancy increased.

(OECD, The Economist)

TRANSFORMATION

TRANSITION

TRANSACTION



Governments seeking to improve the value of the public dollar may increasingly turn to corporates to provide public services

More content is generated on YouTube in one week than all the global news networks in one year.

Cisco runs new Songdo city.

Shared Leadership: Presidents, Mayors and CEOs

Powered by People

LEADERSHIP & IDEAS

Convergence and Competition

MONEY & INSTITUTIONS

Green Light for Redback

New Global Governance Structure

Internationalism and Regionalism

How will deeper government-business partnerships evolve under greater public scrutiny?

Gaming unlocks the value of networked and unpaid crowds.



Languages and firewalls separate the English language Internet from 500m Chinese users - twice the number of Internet users in the US.

RMB-denominated trade settlements to account for 30% of China's total trade value by 2015.

(Deutsche Bank)

The Occupy Movement has spread to more than 130 cities around the world.

What will society look like when Facebook and Google rival governments' ability to influence citizens' behaviour?

Will a highly polarised electorate result in global political gridlock?



RMB may account for 15% of global currency reserve holdings within the next decade.

The number of FTAs signed in the last 10 years has increased, while participation in international organisations has fallen.

The ASEAN+3 Macroeconomic Research Office has been set up for surveillance across the regional countries.

International and regional groups fail to achieve common outcomes on transboundary problems.

Will the world move towards a multi-reserve currency arrangement?

The ASEAN Capital Markets Forum seeks to grow the ASEAN regional capital market to 15% of the world's market capitalisation.

More plural monocultures lead to new social fissures.

Melting Pots, Boiling Over

Young vs Old or Young and Old

SOCIETY & DEMOGRAPHICS

Economics of Envy: Skill Disparity

New Frontiers

NATURAL RESOURCES

New Energy Powerhouses

New Abundance, New Scarcities

REAL ECONOMY

Augmented Economy

Global Corporations, Global Impact

The Great Trade Rebalancing



The UN projects that in 2030, Africa will be the youngest continent in the world.

Will societies begin to include more redistributive approaches into their social contracts?



Will young societies build up their institutions fast enough to capitalise on their demographic dividend?

While 3 million graduates and post graduates enter India's workforce annually, industries consider less than 25% of them employable.

(NASSCOM)

Deep sea mining to exploit undersea mineral wealth leads to new frictions.

What new international treaties and regulations should apply?

US leads global shale gas exploitation and becomes a major natural gas user.

Denmark, Norway, Russia, Canada, US have all staked mineral claims to the Arctic.

Will developments in fossil fuel extraction impede investment in alternative energy sources?

Canada has the second largest proven petroleum reserves, mostly from non-conventional sources.



Energy independent North America becomes major global LNG exporter.

30% of global fish stocks are depleted, as seafood consumption rises.

Technological progress becomes reliant on increasingly exotic materials, like rare earths, specific plant products.



What if the oil/LNG trade route switches from the Middle East to the Pacific?

Sales per employee
Google: \$1.2m
Walmart: \$100k

(McKinsey)

Foxconn is replacing 80% of 1 million workers with robots in 3 years.

How do we employ 9 billion people when most work is done by algorithms or robotics?

Samasource's cyber platform delivers computer-based work to women, youth and refugees living below the poverty line, connecting them to the global economy.

(Samasource)



Corporates plug North Africa into Europe's energy market via a utility supergrid.

How will corporate bottom lines evolve?

By 2014, China's trade surplus will turn into a deficit.

(Nomura)



PERSPECTIVE ONE EMPLOYING THE 9 BILLION

Chris Ng

Chris Ng is a lead foresight strategist at the Ministry of Finance where he continually annoys his colleagues with his thoughts on technology, energy and perpetual doom.

In this Singapore Summit micro-story, we explore how the interactions of unequal demographic growth with the emergence of a machine-to-machine economy may lead to wide disparities in skills, employment and income. This will create distinct challenges for societies and corporations across the globe. In this scenario, the ability of citizens to provide for their families and themselves, and contribute effectively to their societies and economies, becomes a point of uncertainty. Absent of a sustainable strategy towards job creation and employment, societies and economies risk becoming unstable and may regress in their pursuit of progress.

The United Nations Population Division estimates that in a medium case scenario, the world's population will peak at 9 billion people in 2050 before falling as fertility rates in the developing world start to erode. However this population decline is not uniformly distributed. As different regions of the world experience different rates of economic development, they will experience unequal demographic growth.

Europe and East Asia are experiencing rapid population ageing. Decades of low birth rates coupled with affluence and access to medical care and nutrition mean that the elderly live much longer even as fewer babies are born. With the sole exception of the US, falling fertility rates in the advanced economies are resulting in shrinking, ageing native populations. They face a fiscal challenge. The increased public expenditure on healthcare and pension systems are large fiscal burdens which the state will find difficulty financing given the conditions of a shrinking population of working adults, falling tax revenues and high dependency ratios.

Without prejudice to Singapore's efforts to raise fertility rates, these problems appear to be intractable. An OECD study of its members found that once countries fall below the TFR of 2.1, they almost never return to the level of population replacement (with the exception of Sweden for a brief period in the 1980s, and the US through the injection of Hispanic immigration from Mexico). Developed countries will likely turn to a mix of the following strategies in order to maintain their economic competitiveness, standards of living and unique social contracts¹:

Population augmentation – Import of young labour and/or global talent to sustain labour intensive industries and create new economic opportunities for the host economy. This is the dominant strategy but has cultural limits. If and when countries where traditional labour sources develop and move up the economic value-chain, the labor supply available for import will dry up. Developed countries will need to import from non-traditional sources, but there are questions of cultural integration. Well-known examples are the North African and Turkish ghettos in their northern European host countries.

Capital augmentation – Some societies prefer technology deployment to immigration to compensate for a stagnant or shrinking work force. Japan and Korea are the best examples, relying on an increasing level of automation and robotics.

“Silver capital” augmentation – As developed nations’ economies become increasingly dependent on the augmented economy (below) as a source of growth, elderly experienced knowledge workers may become an asset and a competitive edge for developed countries instead of a fiscal drain. This may however require significant advances in technologies to support active ageing.

Demographic growth patterns pose a different set of challenges to developing and emerging economies. Less developed regions like Africa and the Indian subcontinent continue to see birth rates significantly above the 2.1 replacement ratio. Although their birth rates will fall as their societies develop and more women enter the workforce, greater access to health care and nutrition mean higher survival rates of infants reaching adulthood. This explosive growth of a young workforce is called a ‘population dividend’. Rapid population growth could, however, result in overwhelmed public infrastructure (e.g. roads, housing) and institutions (e.g. education, access to government services). Many of these economies will face the challenge of gainfully employing their expanding young populations and pacing their infrastructure and institutions to cope.

If they succeed, they may be able to reap their “demographic dividend” and grow rapidly into middle-income economies. If they fail, high unemployment and unserved communities may become increasingly restless and agitate for political change and revolution. The International Labor Organization has attributed partial cause for the Arab Spring to youth unemployment in its “Global Trends for Youth Employment 2012” report.

There is more. The story of technological progress displacing human labour is an old one. At the start of the 20th century, approximately 40% of the US labour force was employed in the agricultural sector. By the 1980s, agricultural technology improvements drove that share down to 2%. Many of these displaced workers had to be re-skilled for the burgeoning manufacturing sector, but this was a slow process that took decades.

In a 2012 McKinsey Quarterly publication, the economist Brian Arthur coined the phrase “The Second Economy” (we call this the Augmented Economy) to describe a second, machine-to-machine economy that is emerging. Human beings may design it, but few are involved directly in running it. While it may create

economic growth with higher revenues and profits, it creates few new jobs while displacing many existing ones.

The productive power of the Augmented Economy is best expressed in the examples of Walmart and Amazon. Walmart, one of the largest and most successful companies of the old generation physical economy, generates revenue of approximately \$200,000 per employee. Amazon by contrast generates \$1 million dollars per employee. But Amazon hires 60,000 people, while Walmart employs over 2.1 million. That said, while Amazon might be more employing a more profitable and productive business model, Walmart’s net income of \$16 billion still dwarfs Amazon’s \$380 million. These disparities outline in sharp relief the different models at work in the global economy.

The stark contrasts in productivity could have a severe effect on the social compact between state and citizen, with many workers becoming displaced by robotics and new manufacturing techniques, and new sources of wealth generation created by a few enterprising and talented individuals. The wage share of each economy may become increasingly shared by fewer and fewer workers, creating large swathes of unemployment and exacerbating existing income inequalities.

In the face of rapid technological changes, how can developed-ageing and developing-young societies rapidly re-train their workers for the Augmented Economy? With increasing income inequality, how will societies re-write their social compacts to mitigate the effects of wage concentration at the upper rungs of the wage ladder?

These disjunctures might present dilemmas for which there is no satisfactory resolution. As former Institute for the Future president Bob Johansen quotes from Kissinger about world problems, “They are dilemmas, and dilemmas cannot be solved. They can only be survived”. Countries will have to navigate through these dilemmas, and manage the impact and ensuing consequences of demographic decline or growth and technological change on productivity, jobs, wealth creation and distribution.

¹ Particularly for countries with implied social contracts where the elderly expect and receive a large amount of social support for pension and healthcare.



PERSPECTIVE TWO ENERGY ABUNDANCE AND THE NORTH AMERICAN RENAISSANCE

Cheryl Chung

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Pundits have warned for many years of an energy-scarce future. However by 2030, with increasing production of unconventional oil and gas, the US may become energy independent. With this seismic shift from energy scarcity to energy abundance, the US can solve many of its intractable problems. Energy abundance can fuel a manufacturing renaissance, correcting decades of trade imbalance with emerging Asia. National revenues could increase – something that could be welcomed in an era of austerity. The US could politically extract itself from the Middle East. A resurgent US will likely lead a wider North American renaissance.

There is a revolution in North American energy supply underway with the tapping of unconventional oil and gas sources. Innovative extraction techniques have enabled the recovery of natural gas trapped in shale formations that were previously too difficult and costly to recover. In 2000, US shale gas production was virtually zero. Yet, over the last 10 years, the US has emerged as a leading producer of shale gas. Today, shale gas contributes to a quarter of US natural gas. According to the James A. Baker III Institute for Public Policy at Rice University, this proportion is expected to rise by half by 2030.

The price for gas, unlike oil, is set regionally. European and Asian markets pay roughly 4–6 times more for their gas¹ than the US. This is a major source of competitive advantage for the US that will last over the medium term. While China and Europe also have substantial shale gas reserves, they face challenges in recovery. According to its Ministry of Land and Resources, China has the world's largest reserves of non-conventional gas – double the US estimated reserves. However, China's relative lack of equipment, experience and water may inhibit development. In Europe, uncertainty about geology, and the political and public acceptance of the environmental impact hamper shale gas extraction. Concerns of its financial viability, together with disparate national authorisation processes across EU member states exacerbate those concerns.

For oil, according to the US Energy Information Administration, nearly half of the crude oil America consumes will be produced domestically by 2020. By 2035, according to OPEC, oil shipments from the Middle East to North America "could almost be nonexistent" partly because of more efficient car engines and a growing supply of renewable fuel. Strategic policy decisions such as paying a premium over world oil prices from North American sources to ensure security of supply could gradually move the US to energy independence².

US energy independence has wide ranging implications on energy security and geopolitics in the Middle East. The burden of ensuring security in the region is likely to shift to other rising powers, like China and Korea. The net savings in defence expenditure, if channelled to investments in research and development and social and physical infrastructure could lay the foundations for future US economic growth.

But even if the net savings in defence expenditure are not re-channelled, unconventional oil and gas recovery are likely to contribute substantially to the US economy. In a 2012 study by consultancy firm IHS, shale gas production alone will create some 1.5 million jobs by 2015.

According to PricewaterhouseCoopers, there has been a shift in offshore chemicals manufacturing back to the US to take advantage of low-priced natural gas feedstocks. The same report estimates that the shale gas revolution could add one million US manufacturing jobs by 2025. Shale gas-rich states in the US are likely to benefit the most as manufacturing investments tend to gravitate to locations where transportation costs are relatively low.

Beyond the energy, chemicals and transport sector, certain industries could find it attractive to relocate back to the US due to lower energy costs. These industries are likely to be those that have a lower share of labour costs and a higher share of logistics costs. They include fabricated metals, appliances and electrical equipment, machinery and furniture. The Boston Consulting Group estimates in the 2012 "US Manufacturing Nears the Tipping Point: Which Industries, Why, and How Much?" report that the US is poised for a manufacturing renaissance between 2015 and 2020, and is projected to gain 2 to 3 million jobs from higher exports and production work shifting from China.

Government revenues are expected to be impacted positively. By 2020, total government revenues from unconventional oil and gas activity will be about US\$111 bil³. In an era of high social spending and public debt, this would be a welcome addition to public revenue.

As gas production continues to grow, the case for exports will become stronger. According to US-based gas producer Cheniere Energy, gas production in the US has grown at twice the rate of demand since 2005. Currently, the Federal Energy Regulatory Commission has approved the construction of only one LNG export terminal (Sabine Pass) but more approvals could come pending the outcome of the report by the Department of Energy to evaluate the effects of exporting LNG on domestic gas prices. A new Pacific energy trade route from the US to

feed emerging Asia's energy needs may emerge. Coupled with a US manufacturing renaissance, this would help reduce the US trade deficit and help reverse decades of trade imbalance.

Although the North American renewable energy sector has also been growing strongly in recent years, experts are concerned about the impact of shale gas on the emerging alternative energy sector. The shale gas boom comes at a time when green energy is still struggling to lower its costs to be competitive with fossil fuels. By bringing gas prices down, shale gas can crowd out and hobble alternative energy, especially as the US is phasing out many subsidies for this sector.

An energy abundant future for the USA is by no means certain. Wildcard events such as natural disasters, political change, industrial accidents etc may trigger policy decisions that result in a trajectory very different from the future just described. Nevertheless, energy is arguably the most important lynchpin of economic competitiveness and with it, the USA has the potential to solve many of their intractable problems, paving the way for a wider North American renaissance.

1 Whereas the West has used free market mechanisms to secure oil and gas, some countries such as China are adopting a different strategy of "controlling the supply of resources". As a result of China's growing proportional size on the energy market, the nature of this energy market may be affected by becoming less liberal than it currently is.

2 Experts argue if energy independence should be a goal for the US, suggesting instead that energy diversity is better for the economy.

3 Cumulative tax revenue from unconventional oil and gas activity is estimated at US\$2.5tril between 2012 and 2035.



PERSPECTIVE THREE A NEW GLOBAL NERVOUS SYSTEM

Chor Pharn and Eddie Choo

In the past few decades of hyper-globalisation, developed market corporations have led the way in driving global integration, building a global nervous system to connect nations through trade, supply chains and in/out-sourcing. Corporations today own most of the global infrastructure connecting nations. For example, 30 corporations control 90% of world Internet traffic. Regional supergrids have plugged once 'off-grid' economies into world trade faster than state planning or dictat. One example would be 'Desert Tech', a privately run European utilities multi-country grid that links sun-drenched North Africa's solar energy output to Europe's electricity markets.

By contrast, countries and governments' roles on the globalisation stage had been diminishing, until the global financial crisis of 2008. The actions which governments were forced to take during the crisis, such as bailouts of mighty global banks and MNCs, appeared to have reversed the tide of growing dominance of corporations within and across nation states.

This power reversal may be brief. According to a PricewaterhouseCoopers report on 2030 trade flows, the shift towards emerging markets will re-chart global supply chains in the next decade and a half, leading to new major trade corridors being created between Asia and Africa, Asia and South America and within Asia. Transport operators from emerging markets will very likely be the corporations that build the new infrastructure for these radically changing trading networks.

What is perhaps more interesting is how corporations are likely to augment the role of the state within national borders. We have described, in the "Age of Turbulence" article within this publication, how corporations are starting to run core national assets like cities on behalf of governments in the emerging world.

This phenomenon will increasingly become more pervasive in the indebted West as it undergoes a decade or more of deleveraging. The compact between citizen and state is being redefined as governments struggle to deliver on their roles within newly reduced means. What is different from the era of Margaret Thatcher's privatisation of the UK is the extent to which corporations, charities, social enterprises and NGOs are being involved. However, the transformation may not be smooth. Take physical security—the provision of which is deemed the defining characteristic of the modern state. During the run-up to the 2012 London Olympics, the organising committee signed a contract with G4S, the largest private security firm in the world, for £236 million. Two weeks before the start of the Games, G4S alerted that they would not able to deliver. Two days after the admission, the military was asked to step in. As this cautionary example illustrates, governments in the West may have to choose between the proverbial rock and a hard place in an era of diminishing budgets.

For corporations, charities, social enterprises and NGOs to deliver public goods is admittedly not a novel idea. They have often stepped in where governments are either inefficient or deficient in delivering those services. In the Global Nervous System however, we are witnessing a different set of commons being created by private companies, one which builds on increasing seamlessness

of connectivity linking people together, within and across states, creating new interfaces—synapses, to use the biological metaphor. The importance of connectivity has led Finland to declare broadband access a legal right for citizens, and private telcos will be obliged to meet the requirement.

The same can be said for social networking platforms. Mark Zuckerberg declared Facebook a “social utility” in 2007, perhaps an unintended signal of things to come. Facebook is certainly not a country, even if 1 billion people “live” in its blue-and-white virtual space representing the world’s largest structured web of people. The lines between private preferences and public good become blurred, however, when nearly a seventh of the world’s population is using the service. Facebook has established a system of rules to make decisions about content and resolve “resident” disputes, paralleling some roles of a government. Although not a direct comparison, the difference in notional productivity is stark. Facebook has a billion “residents” with a few hundred Facebook employees (supported by algorithms) to make these decisions. Palo Alto city, where Facebook is based in the real world, serves 65,000 residents with 617 full-time government employees.

Facebook has created a system of governance optimised for totally different values (such as more time spent on Facebook) than traditional governments. Facebook “residents” do not get to vote on the system or the rules. Even when Facebook offered its users the opportunity to vote on a new privacy policy in April 2012, voter turnout was only 0.038%. Digital citizenship is much weaker than national citizenship. This apathy allows a few hundred developers to be de facto legislators, bureaucrats, police and judges of the 1-billion “residents” of the quasi-state of Facebook.

Today, Facebook developers have more real time information about real-world citizens at their fingertips than most governments. Soon, they will be able to complement, or rival, governments in influencing citizens’ behaviour. If the role of public policy is to influence citizen behaviour, then the rules or regulations imposed by corporations such as Facebook are, in effect, more efficient policies than traditional governance. Users have no choice but to comply to access networks run by these new “digital technocracies”. Since governance is by a knowledgeable elite who makes the decisions, these new

digital technocracies are not democratic. When Facebook founder Mark Zuckerberg met UK PM David Cameron, was it a meeting between two heads of state? It was, and it wasn’t.

There is no universal digital technocracy at present, nor is there likely to be. Facebook, Google, Amazon, Apple and their Chinese counterparts (behind the Great Firewall) Renren, Baidu, Alibaba and Tencent represent the ways in which the facets of digital citizenry are demonstrated and expressed. A new global nervous system is taking shape; one where the developing neurons of Facebook, Google, Renren, Baidu and the like are reaching out and connecting the world and within countries. Their connections and service delivery make traditional states appear slow by comparison. But this is a misleading comparison. The new digital technocracies are far narrower in their span of “governance” and indeed require the structures of the traditional state to scaffold their service offerings upon. The question is thus not when or whether the new digital technocracies will render nation states redundant; the question is how the role of these new digital technocracies and traditional states will interface, connect with each other and co-evolve.

Taking the long view: managing across capital flow issues, fiscal policy imperatives and social security goals

DEVADAS KRISHNADAS

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CAPITAL FLOWS

Capital flows today are large and have proved volatile. The economist Hyman Minsky observed that in periods of economic uncertainty, capital is likely to be put to speculative move than investment purposes. This is because there is reduced confidence in the longer term global macro-economic picture and a motivation to take advantage or seek safety from high velocity cycles in economic performance. It would be fair to say that since 2008, we have been in a Minsky period of speculation-driven capital.

Minsky was writing in the 1970s. Today, technology has made moving capital about even easier and less costly. As significantly, we have seen the advent of large private movers of capital in the form of hedge, mutual and money market funds. These large blocks of capital under the control of financial market players could be overshadowing the size of the traditional source of capital flows—FDI or foreign direct investments by corporates into real economies.

A government's fiscal policy may be disrupted as a second order effect of volatile capital flows. In the first instance, the inflow and outflow of capital can create and deflate asset bubbles, drive up and down the sovereign currency leading to fluctuating export competitiveness and create an unstable investment climate. Depending on the volume of flows relative to economic size and frequency of volatility, the real economy can be severely destabilised or merely buffeted. In either case, there are knock-on effects on government revenues and there will be calls on government for expenditures to dampen out the effects of the volatility by intervening in the economy, or to stabilise the currency.

But capital flows can be good or bad. The distinction lies in whether the flows are first 'sticky'—in other words, do they stay committed?—and secondly, whether the flows manifest themselves in positive real economy forms such as construction, R&D investments and sectoral growth. Governments should seek out and encourage 'sticky' investments which help boost growth and add vibrancy and have positive spillover effects to their economies.

The challenge is how to avoid the less desirable speculative flows which can be destabilising while attracting productive capital flows. There is no good answer to this—in the first instance, diagnosing the character of any particular flow is difficult and second, there is no consensus on the optimal set of policy choices to selectively dampen capital flows.

FISCAL POLICY

Capital flows are presently volatile and uncertain in good part because of a lack of confidence in the economic future of the advanced economies. Capital is seeking opportunities for better returns and to take speculative advantage of volatility.

Over the past three years, governments have injected liquidity though fiscal injection from stimulus packages, central banks have done more through quantitative easing and have also set easy credit conditions. The global economy therefore is not short of money but it is short of places to allocate it. The advanced economies of Europe and the United States have experienced weak growth since 2008. The Eurozone is struggling with a sovereign debt and a related banking crisis. Regardless of the outcome of the ongoing efforts to stabilise the debt situation, the Euro countries that recover will make

“The global economy therefore is not short of money but it is short of places to allocate it.”

structural adjustments in their social benefit and labour relations models which will take time. The US is still working itself out of a very deep trench with medium term challenges of rebasing their housing market and getting unemployment numbers down toggled with the long term challenge of managing down their fiscal deficit. Doing the latter will also call for structural adjustments on both the revenue and expenditure sides. These adjustments are politically fraught and we have seen the ensuing deadlocks during the August debt ceiling discussions and the failure of Congress’ Debt Super Committee.

The combination of ready liquidity and low interest rates but poverty of investment opportunities could be creating asset bubbles in equity and selected property markets. In contrast to advanced economies, emerging economies represent a positive narrative to investors thus attracting capital flows. These economies have recovered quickly from the shock of the 2008 global financial crisis, they have youthful populations and they are well embarked on development pathways. Many of these economies have also

learnt lessons from previous crises such as the Asian Dollar Crisis in the late 1990s and practice prudent monetary and fiscal policies with a keen eye on ensuring that the risk exposure of their financial systems is kept modest. These attributes are sources of attraction for capital looking for investment returns, the market knowing this, speeds further capital hoping to make speculative returns on the direction of flows.

The positive example of emerging economies learning from past crises is testimony to the fact that the government is not just an observer to events but can set rules and terms. Governments need to make judgements about the risk tolerance of their financial systems and act as safeguard for private actors for whom the attraction of cheap capital, especially when leveraged, proves irresistible. The upshot of failing to do so may well be the necessity of bearing the contingent risks of those exposures—thus inducing moral hazard and the ignominy of privatising gains while socialising losses.

FISCAL MANAGEMENT

Against the backdrop of the effects of volatile capital flows I would like to offer three principles of fiscal management.

First, notwithstanding short term volatility, fiscal policy should remain focused on the longer term. This applies both to ensuring a stable flow of revenue as well as expenditures focused on laying the ground work for sustainable growth. Longer term investments are important to make to create conditions for social stability and growth. These two conditions are integral to national development and collective prosperity.

Since 2008, cost of capital in the open market has fallen dramatically and with the weak global economic forecasts, may well remain low for some time. Governments themselves may be tempted to undertake debt financing when credit conditions are cheap. Thus second, there is a need to stress test financing options under a range of future scenarios. Debt financing needs to be judged carefully and be undertaken with self-restraint lest the seductiveness of cheap capital lead to complacency in expenditure discipline. In which case, over time the demands of debt servicing may build up, significantly limiting fiscal flexibility in future years.

Third, while capital flows may be uncertain, fiscal policy should be clear and consistent. Through coherent and well-communicated fiscal policy, Governments can, to a degree, counter-balance the disruption from fluctuating capital flows. A predictable fiscal policy reassures firms, markets

“While capital flows may be uncertain, fiscal policy should be clear and consistent.”

and workers. A well-articulated fiscal policy means that the taxpayer, be it firm or worker, knows how much and why they must make up public revenues and also what they are getting in return over the long run. Fiscal policy is a multi-plex tool—it can be used to help individuals, households and to boost economic activity through incentives, co-sharing risks as well as disciplining behaviour away from injurious social or economic activity. In the final analysis, the goal of fiscal policy is to promote sustainable growth.

SOCIAL SECURITY

The concept of social security could be said to have three levels of meaning. First, the level of social investments. The second, a general level which covers social benefits—subsidies and other entitlements extending beyond the investments in social infrastructure. Third, a discrete level of meaning specific to the challenge of ensuring retirement adequacy.

SOCIAL INVESTMENTS

Sustainable growth is growth that we can have confidence in over the longer term. For each country, this will mean something different given their mix of location, economic stage, resources, population and unique developmental challenges. The case for using fiscal policy to make financial investments or to boost targeted economic activity is clear and established. However, one dimension which should be common to all emerging economies but which is less often stressed is the challenge of ensuring that their people do better for themselves over time, their young have opportunities to grow and develop, their workers can upgrade their skill and be resilient in the face of economic volatility and their aged can have a peace of mind on how to finance their retirement years. Each

of these is a major policy and fiscal challenge.

To undertake them successfully, it is necessary to adopt a particular mental perspective when one looks at fiscal outlays into education, health, worker training and retirement adequacy as social investments rather than social expenditures. While seemingly semantic, this subtle change actually connotes a profound difference in attitude towards fiscal policy.

Social investments do not have an immediate or direct causal link to economic performance. However, they are fundamental to ensuring the well-being of the population, the upward mobility of youth, and can even foster a sense of merit-based equity in wealth distribution. The investments which lead to a healthy, secure, educated and skilled population are also conditions to attract productive human and financial capital from abroad to further boost the economy.

Good quality education that is accessible and affordable lays the foundation and provides a ladder for a population to pull itself up to higher stages of affluence. Putting in place worker training and upgrading schemes helps to ensure that workers avoid structural unemployment through skill obsolescence and boost productivity. Good environmental and health service provision keeps the population healthy and energetic. After a lifetime of work, some mechanism should be in place to help ensure that older people have the financial resources to retire.

Of course, there is no standard formula for how to optimise across the range of these needs when they compete for limited fiscal resources.

Nonetheless, progressively putting these elements in place are integral to fostering a resilient economy, labour force and population.

SOCIAL BENEFITS

We have had the benefit of the example of comprehensive and generous welfare systems in the advanced economies. The difficulties they are facing presently have a complex causation. But one common factor in every case is fiscally unsustainable social benefit systems. The point here is not to debate about the philosophical or moral merits or otherwise of the state's provision of extensive social benefits. Rather, it is that the decision to put in place these entitlements must be in the context of fiscal sustainability. We cannot ever be certain that the prevailing good fiscal position at the time of introduction will remain the case over time while the entitlements, being structural will certainly continue to be a demand on public expenditure.

Emerging economies have the advantage of learning this valuable lesson at the expense of the advanced economies. Consequently, they have a choice of whether to devote finite fiscal resources on providing entitlements or to put in place the conditions which create good jobs and developmental opportunities so that people can provide for themselves and their families. More can then be employed, pay tax and thus contribute to revenues which can then strengthen the fiscal base instead of simply being consumers of fiscal resources through entitlements.

RETIREMENT ADEQUACY

It is an observable phenomenon that when developing economies reach advanced stages of development, their populations, increasingly affluent, typically begin to experience

falling total fertility rates. Japan, Korea and Singapore are good examples. Eventually, this leads to ageing populations. There are complex reasons for why this is so. For our purposes, the main insight is the effect this trend has on state-managed retirement planning. Governments have the choice of defined payments or defined benefit systems—a choice sometimes also referred to as between self-funded and pay-as-you-go models. If we assume that the demographic trajectory is as suggested, then a pay-as-you-go model is ultimately and unavoidably unsustainable as is evident from the examples in Europe and that of the United States social security systems. It is more prudent to adopt a self-funded model. The challenge for governments then becomes ensuring discipline in the model and to work tirelessly to

preserve the collective capital to ensure that liabilities to citizens can be met when called upon at their individual points of retirement.

LONG TAIL TO CHOICES

Every decision made on social security carries a long fiscal tail. There is, however, a profound difference in the economic and social outcomes that come at the cost of these tails. It is for the governments and the people to negotiate on the path which they choose to take.

Two considerations should be kept in mind when doing so. First, the fiscal burden of the choice made in one generation will continue to be carried by future generations, while depending on future fiscal health, the benefits and entitlements may be front loaded. Second, it is always difficult to unwind entitlements once they have been put in place.

“They have a choice of whether to devote finite fiscal resources on providing entitlements or to put in place the conditions which create good jobs and developmental opportunities so that people can provide for themselves and their families.”

PLANNING FOR THE FUTURE

While there are limits to what emerging economies can do to manage capital flows, these limits and the flows themselves, do not inhibit governments from making fundamental decisions for the longer term. It is better to form and act on a plan for the future rather than to depend on the unreliable fancy of capital inflows to provide an easy sensation of progress. To do so is the duty and purpose of governments.

RETHINKING FRAMEWORK PRODUCTI

Motivation For The Project

Singapore's economy has almost reached its production possibility frontier based on the physical resources it can access. This stage has been reached faster than any other country because of two factors: firstly, the country's small territorial size and secondly, its high rate of economic growth over the past four decades.

Moreover, Singapore's growth model has traditionally been resource intensive:

- A** Only about a third of economic growth over the past four decades has been due to productivity growth;
- B** Singapore has brought in significant amounts of foreign labour to support its economic growth. The number of non-citizen residents grew from 87,800 in 1980 to 541,000 in 2010 and the number of non-residents grew from 131,800 in 1980 to 1,305,000 in 2010;
- C** An increasing amount of land has been devoted to industrial activities. This is especially problematic given the many competing uses for land.

Although the need to tackle the problem of economic growth in a resource-constrained environment is not unique to Singapore, the imperative to do so is much sharper than for other countries.

A new way of looking at the model of production, which adds important intangible input factors of production and which further expands on the driving forces within the

production process, could provide a way for Singapore to grow economically even in a (physically) resource-constrained environment. This is because there is a degree of elasticity of substitution between the tangible and intangible input factors.

These intangible input factors of production also enhance the long-term sustainability of economic growth by contributing to the generative (ability to produce value) and regenerative (ability to renew itself) capabilities of the economy. To illustrate how intangible input factors are important, this paper will discuss in detail two such factors: social capital and intellectual capital. To show how broadening the set of driving forces of production can be important, this paper will discuss the example of creativity.

Classical Model of Economic Production

The model of economic production in mainstream economics traces how input factors are transformed through the production process into products and services of value. Input factors of production include classical, tangible factors such as land, labour, and capital. The main driving force of (motivation for) production is assumed to be the profit motive.

Recent Additions to the Classical Model of Production

It has only been in the past three decades that economists have identified human capital as a separate but important input factor of production. Human capital is considered

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RETHINKING THE FRAMEWORK FOR PRODUCTION—This paper is a thinkpiece which reflects on current thinking on the economic model of production, and considers how a better understanding of the intangible input factors of production as well as the driving forces of the production process may support sustainable economic growth.

to be less tangible than the classical input factors. Putting human capital on equal footing with other factors is arguably one of the most original developments in economic theory. As economies shift towards innovation and knowledge-based production, other recently identified intangible input factors such as intellectual capital and social capital are also gaining credence within the academic community.

Although not an input factor per se, creativity is important as a driving force in the production process because it relates to the ability to conceptualise new products and services and to combine the input factors of production to create these new products and services. Traditionally, the profit motive has been considered to be the primary driving force within the production process, and other driving forces such as creativity, motivation, passion, and altruism have not been factored into the model of production.

Driving Force of Production Example: Creative Capacity

Given Singapore's resource constraints, a critical factor in the next phase of development would be the creative capacity of our economy. Creative capacity is the ability to generate new value by combining or modifying the various input factors through the process of production into novel goods and services.

The creative capacity of our economy cascades down to the innovativeness of our companies at the firm level and the creativity of our people at the individual level. Amidst increasing global competition and exponential change,

we must have the capacity to continuously innovate, re-define existing paradigms and create new value to stay ahead of the competition. This capacity also allows us to create new products, services and experiences that the world demands and remain relevant in the global context. Even if we are not the creators, we should have the ability to identify promising ideas and commercialise them. For example, Apple did not invent the mp3 player or the smartphone, but was able to dominate these sectors and has grown into one of the most valuable companies in the world. Fundamentally, creative capacity strengthens the ability of both our economy and our society to adapt to change and turbulence and ultimately, allows Singapore to be more "future ready".

The importance of creativity and innovation to Singapore has long been recognised. In 2003, the Economic Review Committee (ERC) identified the creative industries, along with education and healthcare, as new economic growth sectors. In 2010, the Economic Strategies Committee (ESC) subcommittee on Making Singapore a Leading Global City proposed the strategy of developing Singapore into "New Asia's hub for innovation and creative enterprise". MICA completed a recent study in 2011 on Creativity and Innovation and demonstrated how creativity can impact productivity, which ultimately leads to stronger economic performance.

Some industries contribute more than other industries to creative capacity. They help bring ideas to market, facilitate the diffusion of ideas or enable cross-collaboration or co-creation across different sectors. Examples of such

“horizontal” industries are design and information and communications. These industries are able to work with diverse industries and contribute towards their value creation, for instance through enhancing the development and delivering of their products and services. Therefore, they are also likely to have higher spillover contributions to the economy.

Intangible Input Factor Examples: Intellectual and Social Capital

Intangible input factors such as intellectual and social capital are considered to be capital in the following senses:

- A** They are resources into which other resources can be invested with expectation of future return.
- B** They are appropriable (transferrable) and convertible.
- C** Like human and physical capital, they require maintenance to be productive.
- D** Like human capital, they do not have a predictable rate of depreciation but become more productive with use.

Intellectual Capital

The study of Intellectual Capital is a relatively new field, which started in the early 1980s and which focused primarily on the micro-economic context. It was only in the late 90s that the Edvinsson and Malone (E&M) Model to measure intellectual capital was popularised. It is now accepted that intellectual capital at a firm or micro level forms a sizeable amount of value in the capital of firms, which is not reflected in the enterprises’ balance sheet. Peter Drucker also commented that knowledge will eventually replace machinery, raw material and labour as the basis of business operation in his 1993 book *Post-Capitalist Society*.

However, it has only been in the last decade that researchers have attempted to measure intellectual capital at the macro and even regional level. As it is a common understanding that knowledge is an important source of economic competitiveness, it is only logical that a greater proportion of GDP—and ultimately wealth—will reside in intangible economic commodities. A World Bank report circa 1998 highlights that policies adopted to augment and increase a nation’s intellectual capital can, in the long term, improve the lives of the populace beyond purely economic gains. Increasingly, there are calls globally to better understand the role that intellectual capital plays with the focus on how to:

- A** Quantify the knowledge capital of nations.
- B** Identify and develop intellectual capital flows within and between knowledge capital clusters.
- C** Cultivate knowledge capital of regions efficiently, with an emphasis on renewal.
- D** Capitalise on knowledge capital through new stronger social systems such as better horizontal links across industry clusters.

In theory, national intellectual capital refers to difference in the market value and the value of physical assets that can be attributed to knowledge, structure and processes—similar to how intangibles such as goodwill can be assigned a market value. The intellectual capital of a country includes visible, separable and controllable assets such as patents and trademarks, and in this realm the government is limited in its ability to influence through fiscal measures. This is because there will inevitably be methods to circumvent any controls placed on the physical forms of fundamentally abstract intellectual assets—such as through copying, counterfeiting and design workarounds. There are also hidden, non-separable and uncontrollable assets such as tacit knowledge and work experience, which have an enormous potential for future wealth, that the government is entirely unable to control.

By the above definition, and in a ranking of 40 countries on national intellectual capital, Singapore came 6th overall. However, this relatively high ranking may not be fully representative, as we did not fare well in Human Capital (ranked 18th) and Renewal Capital (ranked 13th)—indices that are more quantitative in nature. The higher ranking in qualitative variables may reflect that Singapore has been able to maintain a beneficial international perception due to our pro-business environment, strong IP protection regimes, and liberal trade policies. However, as the measurement of intellectual capital becomes more standardised and more countries are included, we will not be able to maintain our relatively high ranking.

Social Capital

Social capital is the “wealth” that exists because of an individual’s social relationships. Fundamentally, social capital allows individuals to mobilise other factors of production to engage in activities that further the collective well-being.

Social capital is vital as an intangible input factor of production because it helps to lower transaction costs

There is a degree of elasticity of substitution between the tangible and intangible input factors.

(due to increased trust) and because it helps individuals gain access to new knowledge and resources. However, because social capital is still a relatively new concept, there is a lack of high-quality empirical research that demonstrates a connection between social capital and national economic competitiveness. Nevertheless, several smaller scale studies at the firm and regional level indicate that this direction of inquiry could prove promising:

A In the paper “Social Capital and Value Creation”, researchers Tsai and Ghoshal showed that there was strong support for the argument that social capital facilitates value creation (at least at the firm level). However, strong social capital at the team or group level needs to be complemented by (relatively weaker) social capital across teams in order to generate value for the firm.

B Many sociologists have tried to unpack the puzzle of the success of Silicon Valley, and have come to the conclusion the horizontal relationships that individuals develop through social interactions outside of their firms help them gain access to new knowledge and mobilise resources efficiently to capture business opportunities.

Moreover, social capital can have a huge impact on inter-generational or inter-workforce transfer of other intangible input factors such as human capital. If the quality of relationships is low, the wealth embodied in

human capital can degrade as it gets transferred. This would impact both the generative and re-generative capability of the economy.

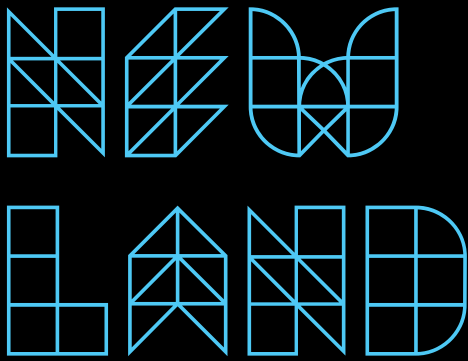
Singapore does not fare well on questions related to trust (as a proxy for social capital) from the World Values Survey. For example, for data gathered from the first four waves of the survey, Singapore came last for Question A165 “Most people can be trusted” when compared against a sample list of other developed countries and also some countries in our region (US, UK, Switzerland, France, South Korea, Japan, India, Taiwan, Vietnam, and Australia).

It is our hypothesis that social capital has had little effect so far on economic production in Singapore. This is because hierarchical organisations (e.g. firms and government agencies) account for the bulk of economic value creation. These organisations will have in place processes that cultivate the social capital necessary for production to take place. However, in the longer run, weak (inter-organisation) social links could be vital for the sustainability of economic growth by enabling the organic creation of value outside of existing organizations.

Conclusion

The classical model of production has served Singapore well in the past few decades of economic development. While the ideas set out in this paper require much deeper study, the preliminary sense is that going forward, a better understanding of how the production process may be influenced by the quality of intangible input factors and a broader set of driving forces could be useful, to inform economic planning and support the goal of achieving sustainable long-term economic growth.

Although Andrew Wilfred works for the Singapore Economic Development Board, he likes to think of himself as a free agent. One who hunts for interesting ideas to introduce, and novel questions to answer, especially in the intersections of political, social, economic and environment realms. He is powered by chocolate.



A LOOK AT **VERY LARGE FLOATING STRUCTURES**

Very large floating structures (VLFS) are large, tethered buoyant structures on a body of water. Due to land reclamation, heavy sea traffic and a narrow strait to the north which is shared with Malaysia, Singapore has little territorial waters to spare. These considerations will constrain large-scale VLFS deployments.

Globally, however, there has been increased national and private sector interest and investment in VLFS to create new land, to the extent of “seeding” new nations known as seatopias. This paper documents some of these possibilities.



VLFS are classified as semi-submersible structures in open waters e.g. oil rigs, or pontoon-type structures which are essentially floating boxes longer than 60 metres. Unlike typical traditional floating structures such as ships, VLFS are usually larger¹, more costly (US\$ 5 -15 bil) and have longer design lives (50-100 years). The benefits of VLFS relative to reclamation as a solution to land constraints are:

FLEXIBILITY. VLFS can be deployed over deep waters and soft sea beds while reclamation requires sea depths of less than 20 metres.

ENVIRONMENTALLY FRIENDLY. VLFS do not damage the marine ecosystem, silt-up deep harbours or disrupt tidal/ ocean currents.

FASTER TO CONSTRUCT. VLFS can be constructed in about a year while reclamation can take up to several years to complete.

SCALABILITY. Being composed of modular units, VLFS can be expanded or removed according to demand and provides greater flexibility than reclamation.

SUITABILITY FOR A RANGE OF USES. VLFS's relative position to the water is constant, facilitating their use as piers and berths and are unaffected by changes in sea levels.

One of the first VLFS proposed was the Armstrong Seadrome in 1924, a floating station that would serve airlines crossing the world's oceans. The concept was later taken up by the land-strapped Japanese in the development of Kansai International Airport. Kansai International Airport is so integrated with Japan's land infrastructure that most visitors would not realise the terminal floats. Other VLFS projects which have applied this theme of extending infrastructure include an offshore harbour by IronClad Mining of Australia (planning stage), floating bridges such as the Albert D Rosellini Bridge in Seattle, USA, which spans 2.3 kilometres (1.42 miles) and floating car parks like the Umihotaru (picture), situated along the Trans-Tokyo Bay Highway. In Singapore, floating oil storage VLFS help extend Jurong Island's infrastructure (which houses Singapore's petrochemicals industry) to augment land-based storage units.

VLFS are also being considered for more unconventional uses, driven by new concerns like climate change and opportunities like geothermal energy and ocean fisheries. In the 2009 Map of the Decade, the Institute for the Future highlighted the oceans as a source of next generation clean energy, green materials, medicine, habitats and more seafood as land-based societies start to spillover to more permanent settlements at sea.

We are seeing some weak signals of the possible shift of human, economic, and social activity to the oceans and the central role VLFS could play. Echoing the movie Waterworld, which depicted a world where humans subsist on floating cities in a sea-covered planet, rising sea levels from climate change have prompted the Maldives government to engage Dutch Docklands, a company from the Netherlands, to create floating islands in place of sinking ones.



Umihotaru Carpark, Japan

As VLFS move towards the centre of efforts to tap the potential of oceans for energy, resources, and creation of new land, we should continue to watch this space.

While the Maldives 2.0 will be internationally recognised as part of the Maldives, recognition and sovereignty over newly created land could be trickier. Although ownership of existing land-masses has been carved out by sovereign states, much of the oceans is still free game. In 1967, a man named Paddy Roy Bates set up home in a floating fort off the coast of England and declared himself the sole sovereign (officially 'Prince Regent') of the Principality of Sealand, complete with a constitution and national symbols. Though never officially recognised diplomatically, the legal implications have been recognised. The Pirate Bay, an internet file sharing platform, tried to buy over Sealand to host their servers in 2007 after facing legal issues in Sweden.

This potential to circumvent national laws has not been lost on the private sector. Recently, Silicon Valley entrepreneurs have expressed interest in the Blueseed project, a start-up to house floating offices off the shores of California to create 'offshore tech incubators' to circumvent restrictive US regulation and immigration laws.

Paypal founder Peter Thiel has set out a vision to form new nations as seatopias. He co-founded the Seasteading Institute in 2008 to facilitate the creation of seasteads (a more permanent and autonomous version of VLFS). Peter Thiel proposed in 2011 to create an independent nation by floating it in international waters. The idea was for this to be unbound by national legislature and make for an interesting social experiment in libertarianism. It is early days in the movement for seasteads or new land, and the Seasteading

Institute and other similarly aligned movements are conducting research to answer engineering, legal and basic business questions such as:

How can seasteads be engineered to be safe (survive heavy storms), economically viable (affordable to people with average incomes), comfortable (house an average family under most sea conditions) and modular (easily expandable as the population grows, allowing sections to join, separate and reconnect at will)?

How should laws and taxes for seasteads be determined? What legal or geographical considerations could give rise to unique business opportunities for seasteads?

How can seasteads avoid interference in internal affairs by existing sovereign states?

Can seasteads be self-sustaining in terms of food and energy? How can the security of supply be ensured?

These are some of the slew of questions that will need answers before VLFS can make the transition from extensions of land-based economic infrastructure to viable economic alternatives for new nations. But there is great potential, particularly as global population is projected to reach 9.3 billion by 2050, and space will increasingly be at a premium. As VLFS move towards the centre of efforts to tap the potential of oceans for energy, resources, and creation of new land, we should continue to watch this space.

¹ The length scales are around $10^3 - 10^4$ metres, with displacements of $10^6 - 10^7$ tonnes.

Governance in Singapore—Looking to the Future

AARON MANIAM

Aaron Maniam was the first Head of Singapore's Centre for Strategic Futures and concurrently Deputy Director of the Strategic Policy Office in the Prime Minister's Office. He is currently Director of the Institute for Policy Development at the Civil Service College; the Institute conducts training programmes for high - potential officers in the public sector.

This is an expanded version of an opinion piece published in ETHOS, the journal of the Singapore civil service, in October 2011.

The government in Singapore has experienced several transformative shifts since independence in 1965, broadly categorised by the following stages:

- I. Providing basic services to citizens, and dealing with fundamental security imperatives
- II. Becoming cost-efficient in a world of scarcity
- III. Establishing enduring, long-run institutions that maintain efficiency beyond the short-term, in response to internal and external volatility
- IV. Cultivating and sustaining institutions that are adaptive, innovative and change-ready
- V. Moving beyond impersonal institutions to governance that is relational, empathetic and engaging in dealing with diverse citizen and stakeholder expectations and interests.

These stages are not mutually exclusive. Each supplements rather than supplants the previous. With each transformation, the demands on and expectations of the government grow in magnitude, diversity and complexity.

Stage I included both traditional security, like defence and internal affairs, as well as human security issues like health and housing. Both were priorities for a newly-independent Singapore in the years immediately following our departure from Malaysia in 1965.

Singapore moved from Stages I to II relatively quickly, during an industrialisation drive in the 1970s to build our domestic economy and

attract Foreign Direct Investment (FDI) from multinational corporations.

Stage III began in the late 1980s, in response to the prospect of internal political change with Lee Kuan Yew's plan to step down as Prime Minister, as well as international volatility arising from the collapse of the Eastern bloc and the aftermath of successive global debt crises. In the mid-1990s, the building of long-run institutions dovetailed with the early stages of the PS21 ("Public Service for the 21st Century") movement, which encouraged public officers to Anticipate, Welcome and Execute change.

The government in Stages I to III required efficient and effective meeting of public needs, adopting what economists would call "optimisation" measures to carry out the functions of government. Particularly from Stage II onwards, the drive towards a "lean" government was pursued, with outsourcing of secondary services becoming more prevalent.

New Frontiers

The government currently operates at a combination of Stages IV and V. The adaptive capacity described in Stage IV is increasingly necessary, as demonstrated in successive and evermore frequent disruptive shocks that require alacrity and flexible responses from the government—including the 1997 Asian Financial Crisis, the terrorist attacks of September 11, the occurrence of Severe Acute Respiratory Syndrome (SARS) in 2003, and the risk of H5N1 and H1N1 pandemics in the mid-2000s.

There have also been growing calls for more empathetic and engaging

policy-making since the mid-2000s. The growing diversity of citizen views and preferences predated, but has been uniquely enabled by, the growth of social media.

“Perhaps most fundamental to governance of the future will be the growing need to constantly remake policy, reinvent ideas and re-perceive the world. It is likely to involve acts of creation, not just maintenance of existing systems.”

At Stages IV and V, governance involves:

- wisdom to operate at the frontiers of trade-offs and make difficult prioritisations. The double-digit growth of Singapore’s post-independence years, and more recent post-recession times, cannot be sustained indefinitely. Singapore now operates on, rather than within, our production possibilities frontier. The opportunity costs of our policy choices will be felt more acutely, until and unless we shift the frontier outward through technological improvement. Increasingly, we make policy under assumptions of some level of austerity, rather than resource abundance.
- being creative and finding new sources of ideas, innovation and

productivity, rather than relying on tried-and-tested policy options. This requires shielding small, entrepreneurial teams—akin to “skunk work” groups or the growing number of futures or strategy units in the government—who have the freedom to consider out-of-the-box issues, without being bogged down in daily routines.

- working multi-sectorally to harness the potential of the private and people sectors in delivering “governance”, a concept beyond the exclusive remit of the public sector. Less of an “elite” endeavour than traditional “government”, governance involves a spectrum of cooperative modalities, including: communicating alternative policy choices; consulting business and civil society on options generated by policy-makers; coordinating amongst different groups with interests in particular aspects of a policy area; co-creating policy with non-government entities when appropriate; or even community-ownership of policy areas where there are no particular public good functions to be met by government provision.

- navigating a state of constant adaptation, experimentation and innovation rather than having the comfort of any stable “equilibrium”. Instead of seeking elusive “right” answers from the inception of a policy, policy-makers will find themselves leaning toward more iterative and experimental approaches, which emphasise the process of governance as much as the final product. Incremental improvements on initial prototypes, rather than pre-packaged policy that is “ready upon delivery”, will become more common. Current examples include how to operationalise “public engagement” in a way that responds to citizen

preferences, but does not descend into populism.

- working beyond “hard” policy options and embracing the need for “softer” aspects like effective engagement of citizens, resonant communication and policy-making that connects emotively, not just analytically—with the “heart”, not just the “head”. This will involve policy-makers seeing the public not just as taxpayers, customers or service-receivers in transactional relationships, but also as citizens with a stake in Singapore’s collective future.

...and New Capabilities

Stages IV and V of governance require qualitatively different capabilities from earlier stages. The exact capability set will not be static, but dynamic and kaleidoscopic – shifting and evolving as governance acquires new facets and dimensions. Nonetheless, several key ideas can already be discerned:

- As uncertainty grows in what Anthony Giddens has called our “runaway world”, policy work will increasingly be less amenable to solutions that are obvious ex-ante. Instead, policy-making will be characterised more by indirect approaches or “obliquity”, a term popularised by John Kay. Rather than tackle policy challenges “head on”, practitioners of governance may find it more useful to address the systems surrounding a particular policy experience—an often undervalued policy technique. Singapore’s effort to increase Total Fertility Rates, for instance, have moved beyond merely providing financial incentives and access to affordable childcare, to tackling ostensibly ancillary issues like the length of the workweek.

Implementing obliquity will be challenging, calling for significant lateral thinking from policy-makers more familiar with direct approaches, as well as patience to explain indirect measures to an impatient citizenry and potentially critical Opposition parties. Time-constrained decision-makers will have to exercise some suspension of disbelief for oblique approaches to play out fully.

- “Optimisation” will become less useful. The Washington Consensus has spawned what could arguably be termed an “efficiency fetish”, as governments attempt to operate systems with engineers’ precision and arrive at economists’ optimum points. In Stage IV and Stage V, the emphasis will have to shift to balancing tensions, trade-offs, dilemmas, contradictions and paradoxes. The government will increasingly find itself making delicate, discerning judgement calls, without the clarity of obviously “correct” responses. In complex and untidy situations, policy-makers will need what F. Scott Fitzgerald described in *The Crack-Up* as “a first-rate intelligence...the ability to hold two opposing ideas in mind at the same time and still retain the ability to function.”

- Policy-makers are also likely to find themselves applying “bio-empathy”, a term included by Bob Johansen, former president of the Institute of the Future, on his list of ten leadership qualities for a volatile, uncertain, complex and ambiguous (VUCA) world. Bio-empathy involves understanding the soft, emergent, non-linear qualities of complex systems, which are far more like biological ecosystems than mechanical systems’ immutable input-output relationships. Greater bio-empathy will help policy-makers understand that they might not

be able to predict all the phase transitions in a complex system, many of which arise from self-reinforcing feedback loops. The Arab Spring and other governance challenges, like climate change and falling fertility rates, possess quasi-biological characteristics, with major consequences sometimes resulting from minor perturbations.

- Perhaps most fundamental to governance of the future will be the growing need to constantly remake policy, reinvent ideas and re-perceive the world. It is likely to involve acts of creation, not just maintenance of existing systems. In many ways, this will give expression to latent “maker instincts”—inclinations among some policy-makers to be what Douglas Thomas and John Seely Brown have called “homo farens”, the doer, not just “homo sapiens”, the thinker. Brown extends this argument to include the need for some of us to be “homo ludens”, engaging in creative play geared towards innovation. This ability to participate in strategic play will be key if our innate maker instincts are to operate obliquely and bio-empathetically.

Capability Building and Training

Plus ça change...
(The more it changes...)

In response, the training offered to policy-makers, particularly policy leaders, will also have to be more oblique, bio-empathetic and play-related. Some training techniques will be experiments in themselves. At the Singapore Civil Service College, such experiments include:

- Sessions combining training and “sense-making” functions: instead of seeing training as one-way trainer-to-

trainee communication, sessions are structured much more as “facilitated” discussions, where facilitators learn as much as course participants. Such platforms for dialogue are critical sources of new ideas, especially since most of our programmes involve participants from multiple agencies, whose experiences of what Stuart Kauffman has called different “adjacent possibles” provide rich new insights to their colleagues. These sessions require facilitators with both depth of experience in guiding such open discussions, as well as breadth of policy exposure, who can draw connections among the work of different agencies to illuminate both their commonalities and contrasts.

- Sessions involving policy gaming and simulations: while the military has had a long tradition of “wargaming”, such techniques have been less widely used in the civilian sector. Current small-scale experiments involve exploring how to craft such exercises, where participants can be immersed in realistic, if not totally life-like, circumstances that hone their instincts to make decisions under dilemma-ridden conditions of complexity, incomplete information and unpredictability. These are not always comfortable exercises, but the expansion of participants’ comfort zones is in fact a key aim.

...plus c’est la même chose
(...the more it is the same thing)

Complementing these experiments is a set of fundamentals in the Singapore Civil Service training philosophy that we believe will continue to be useful, even as the nature of governance evolves.

First, training must continue to be systematic and regular. As demands

on policy-makers intensify, our development programmes must grow more intentional and purposeful. We currently conduct leadership programmes for:

- new entrants;
- those taking on supervisory roles for the first time;
- new Directors or Heads of Department; and
- new entrants into senior public sector leadership / agency head positions.

This calibrated sequencing is not likely to change. Each training intervention takes place at a key career inflexion point—usually involving a qualitative leap in both the complexity of issues dealt with, and the depth and breadth of leadership required.

Second, the Whole-of-Government nature of training programmes will continue. Even as governance extends beyond government in a multi-sectoral world, our leaders' core competencies in government tradecraft must be well-developed. There is twofold value in such cross-agency interaction. It is analytical, inculcating understanding of how the government operates as a system, not discrete silos; and facilitates the formation of social capital, through networks and bonds of trust developed over the programmes, which last between two to nine weeks.

Third, we continue to adopt a "practitioner-based" teaching/facilitation model. Senior officers share experiences and insights with junior colleagues, building a culture of mentorship. Some invited practitioners from the private, non-profit and academic sectors also provide useful non-government perspectives. Each sharing

encompasses both best or good practices as well as learning points from policies that did not pan out as anticipated. Either case nurtures a deep awareness of the Public Service's shared history, which in turn informs the thought processes of future generations of public officers.

Next Steps

The five-stage model of governance at the core of this analysis can be refined. Three outstanding issues stand out particularly:

First, how far do Stages IV and V apply outside Singapore, to the complex and relational issues being managed by other governments? Without being triumphalist or overly universalist about Singapore's experiences, I believe there are transferable lessons to be derived about what constitutes good governance, and how conceptions of governance can evolve.

Second, while this article focuses on national governance, it would be useful to explore the modalities that would characterise global "governance", as opposed to global "government", in Stages IV and V. One area of interest is how global governance, in responding to complexity and the need for relationality and engagement (e.g. in harnessing epistemic communities, global civil society and other non-government networks), will deal with deeply entrenched international norms like Westphalian sovereignty.

Third, this article deals with governments, and in particular Singapore's, that are largely benign—seeking more information, capabilities and tools to function effectively, objectively and rationally. To such governments, the innovations

and broadening of mindsets described above present opportunities. However, if the challenges of governance are viewed from more traditional power political lenses—for instance, if governments' flaws stem from a fundamental principal-agent problem between rulers and ruled, as seen in the growing lack of trust that has sparked off anti-elite sentiment and mass protests in several countries, or examples of capture by powerful lobby and interest groups—then new policy-making tools and mindsets will not take root so easily. How comfortably traditional notions of power will sit in Stage IV and V governance will be interesting to ponder, as new modes of governance continue to evolve.

Communicating foresight

IVY NG

This is adapted from a speech on communicating foresight given by Ms Bernadette Foong, Director of Futures and Strategy Division, Ministry of Trade and Industry at the 4th International Risk Assessment and Horizon Scanning Symposium dated 18 October 2011.

French critic and poet, Paul Valery (1871 – 1945), once said, the trouble with our times is that the future is not what it used to be. Within the space of four years, we witnessed a global financial crisis considered to be the most severe since the Great Depression of the 1930s; a nuclear emergency in Japan brought about by a devastating tsunami that resulted from one of the most powerful earthquakes ever to hit the country; the overthrow of what appeared to be entrenched dictatorships in the Arab world. Today, the world is bracing itself for yet another crisis of global magnitude—the result of weak growth and sovereign debt crises in the developed world. The clustering of disruptive events, which has exacerbated volatility and uncertainty, is due in part to technology-enabled changes, disrupting both the natural pace of change as well as the interrelationships within and among constituencies and society asymmetrically. Sensing where the discontinuities might occur and communicating plausible futures to decision-makers has never been more important.

Cassandra of Troy in Greek mythology was cursed by Apollo to prophesise the truth but never be believed. One of her most famous predictions was that of the Greek siege behind the gift of the Trojan horse. A set-up like the MTI Futures Group faces the continuous challenge of balancing the need to provide practical implications while probing plausible futures, and communicating these in meaningful and compelling ways to policy- and decision-makers. The Futures Group's raison d'être is to help decision-makers be more forward-looking through insight



Cassandra Warns the Trojans
Engraving by Bernard Picart
(1673 – 1733)

from foresight. However, in practice, ideas that are not immediately perceived as linked to current reality are not easily accepted, or fail to be taken seriously. When the analyses from foresight point to the equivalent of a Trojan horse (although most of the time they are more tenuous than that), identifying the target audience, framing the message and tailoring the communication approach are key to changing mindsets and priming decision-makers for the future. To this end, the Futures Group experiments with a variety of communication tools to convey the outcomes of foresight analyses in the most compelling way to decision- and policy-makers. The three examples are given below, to give an idea of the issues which Futures Group has worked on, the motivations behind the communication tools used and the outcomes achieved.

A part of the Futures Group's work is to identify and filter weak signals and identify the ones which have the potential to impact Singapore significantly, draw out the implications and communicate these to decision-makers. Two signals that have been observed in 2010 were the rise of new production technologies, such as 3D printers, and the emergence of new business models enabled by the internet. The confluence of these two trends and the entering of 3D printing into mainstream production could disrupt manufacturing and logistics which are key sectors of the Singapore economy. The weak signals of new production tools and new business models have not yet had a transformative impact on manufacturing and as such there was no certainty that they would disrupt manufacturing in a significant way. On the other hand, the potential for these trends to cause disruption could not be discounted. To best coalesce the trends and communicate the possibilities presented by 3D printing to decision-makers, and to prompt thinking towards possible pre-emptive measures, the Futures Group put together a video to establish a baseline understanding of the topic, imagine a disrupted future and prompt deeper thinking on the issue.



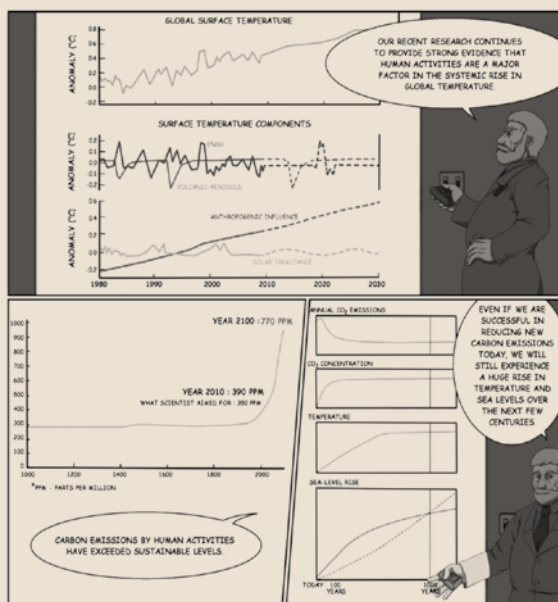
FG Website • Videos • Publication • Manga • FGAnimates

Another project was Geoengineering, which refers to the deliberate large-scale intervention in the Earth's natural systems to address climate change. The objective in undertaking the project was not so much to prompt policy- and decision-makers to action. The aim was to draw attention to non-mainstream approaches, which if embarked on by other players either unilaterally or as a response to collective sentiment, could have a major impact on the global climate change agenda and consequently on our island. The intention was to disseminate this as widely as possible, in an easily digestible form such as a comic or manga, which would be highly visual and easy to access. The approach to the manga was to highlight the various Geoengineering methods being researched, while weaving in the social, political and environmental complexities and challenges which any decision to adopt geoengineering methods would need to address and overcome. The research was shared at various government platforms, coinciding with the dialogues which are just beginning on global geoengineering governance.

The Futures Group has at times needed to communicate broad-level strategies, their underlying motivations and the potential implications to a broad audience. In order to reach out to everyone present, it is helpful if the mode of communication is able to engage the audience in all senses—visually, textually and audio-wise. A recent experiment has been with the use of the RSA Animate technique which has received positive feedback, the approach, borrowed from graphic facilitation, supports the communication of complex ideas to the audience.

The latitude of not being wedded to any particular approach makes for an exciting ride for Futures Group, in that we are able to experiment with unconventional tools and approaches to communicate our insights and findings. That is not to say we are not uncertain at times about going out on a limb, and worry about how receptive our audience will be towards our products. But that is not going to hold us back. As Dale Carnegie aptly put it, we have to 'do the thing that we fear and keep on doing it... as that is the quickest and surest way ever yet discovered to conquer fear'.

▶ See the videos at our youtube channel "futuresgroupsg".



Geoengineering (Manga)

Complexities and uncertainties relating to Geoengineering methods

Smart Efficiency

AUYONG HAWYEE

Futurists need to advocate for change to cope with how the world is expected to change. We do this in the context of a constant need for growth. However, we need to understand that growth through increasing efficiency comes at the cost of an increase in the risk of failure. Smarter systems and policy design can help us manage such risks. This article examines how.

It is a bright summer's afternoon on August 14, 2003. Two minutes after 2 pm eastern time, a 345 kV overhead high voltage power transmission line in northeast Ohio overheats while straining to shunt the massive amount of energy which an advanced economy like the United States needs on a daily basis. This line in Walton Hills, Ohio is carrying extra capacity today because a particularly troublesome FirstEnergy power plant in Eastlake, Ohio is shut down again for maintenance. The power line overheats, sags and makes contact with some trees that had been left untrimmed along its path. As the trees short-circuit thousands of volts, automatic systems cut power to the line, but an alarm fails to sound off within FirstEnergy's control room. Engineers struggle to diagnose the problem as automatic systems reroute power through other lines. More overheated lines sag into trees and are cut off. By 4 pm, so many power lines have been overloaded and shut down in Ohio that the power grid is forced to inhale 2GW of power from the neighbouring state of Michigan. One by one, power lines are overloaded and trip out in a continent-wide cascade that spans Ohio, Michigan, Pennsylvania, New York, New Jersey, and even Ontario in Canada. By the time the cascading failure ends at 4.13 pm, 256 power plants are offline in the biggest blackout in American history. The Mayor of New York City Mr Bloomberg says in a statement to the New York Times, "It wouldn't be the worst thing to do to take a day off."

After almost a decade of deregulation that started in the 1990s that sought to squeeze extra efficiency out of an ageing system, former utility executive John Casazza predicted in 1998 that "blackout risks will be increased". Casazza, and other experts sounding similar warnings, were paid little attention until the 2003 blackout.

After the financial crisis in 2008, Singapore's labour chief Mr Lim Swee Say developed the phrase "cheaper, better, faster" to communicate his vision for Singapore's next phase of economic growth. That phrase is another way of saying that our economy needs to become more efficient or productive. Singapore is well known for its legendary efficiency, from the way we channel large numbers of visitors through our airports and containers through our seaports, to the way our public services are run. However, a singular focus on efficiency does not come without risks, as the example of the US northeastern blackout of 2003 shows us.

In many systems, a narrow focus on efficiency can build up hidden risks that can increase the chance of catastrophic failure.



THE PROPAGATION OF UNEXPECTED SHOCKS

In his book *The Collapse of Complex Societies*, archaeologist Joseph Tainter examines various theories on why complex societies are so prone to collapse. Some of the theories posited that a narrow focus on efficiency (defined as “high output or return per unit of investment”) increases the chance of catastrophic collapse. As resource allocation becomes more efficient, fewer resources are used in non-critical or low-return activities. A society that efficiently allocates all of its resources foregoes the benefit of a “hidden resource reserve” that is available to be repurposed in the event of emergencies such as an external shock to the society like natural disasters.

Beyond just reducing the “hidden resource reserve”, an efficient allocation of resources in a complex society in effect tightens the coupling between various functional modules to such an extent that any shock to the system will propagate too quickly to be corrected.

One can readily see how this contributed to the recent financial crisis. In *A Demon of Our Own Design*, a book written before the most severe parts of the crisis occurred, Richard Bookstaber explained:

Tight coupling is a term I have borrowed from systems engineering. A tightly coupled process progresses from one stage to the next with no opportunity to intervene. If things are moving out of control, you can't pull an emergency lever and stop the process while a committee convenes to analyze the situation. Examples of tightly coupled processes include a space shuttle launch, a nuclear power plant moving toward criticality and even something as prosaic as bread baking.

In financial markets, tight coupling comes from the feedback between mechanistic trading, price changes and subsequent trading based on the price changes. The mechanistic trading can result from a computer-based program or contractual requirements to reduce leverage when things turn bad.

In fact, risk reduction measures that look at risks in isolation while failing to address the issue of tight coupling can have the perverse effect of increasing the risk of failure because relationships between possible failures are not taken into account and not addressed at the systemic level.

Even as nations are still digging themselves out of the previous crisis, the high stakes game of high finance continues its pursuit of blind efficiency through the use of high frequency trading (HFT), where trades are executed on time scales of milli- and microseconds. At this speed, catastrophes can occur literally in the blink of an eye, and often much too fast for any sort of intervention. For example, in the Flash Crash of May 6 2010, the Dow Jones Industrial Average lost nine per cent of its value (about 1,000 points) within minutes. Complex HFT algorithms had interacted in an unexpected manner to cause the plunge, and everything happened much too fast for anybody to find the plug, let alone pull it.

These sorts of risks due to automation will increasingly occur beyond just the financial sector. The blog Macroeconomic Resilience examines this in some detail, and concludes that even an automated “defense in depth (ie putting on more layers of automatic control systems)” offers little comfort:

In complex automated systems, the redundancies and safeguards built into the system also contribute to its opacity. By protecting system performance against single faults, redundancies allow the latent buildup of multiple faults.

Moreover, failures are taken as evidence that more, not less, automation is needed; increasing the risk of rare but catastrophic failure as human operators become less and less equipped to deal with the overwhelming complexity of multiple automated systems.

HUMAN COGNITIVE BIASES WORSEN THE COST OF CATASTROPHIC FAILURES

Worse still, a tightly coupled system that appears stable for long periods of time before blowing up plays off human cognitive biases, leading us to under-insure against such failures.

Nassim Nicholas Taleb, author of *The Black Swan* who made his fortune betting against traders who underprice the risk of rare events, likens the way our financial system generates profits to the act of “picking up pennies before a steamroller”.

Restricting ourselves to non-financial examples in the Singapore context, we can recall two recent examples in which a narrow focus on efficiency and an underestimation of the risk of failure have contributed to a higher cost of failures.

SINGAPORE CASE STUDY 1:

UNDERINSURING AGAINST FAILURE IN THE MRT DISRUPTIONS

Related to the recently concluded committee of inquiry into the spate of MRT failures in end-2011, the Today newspaper reported that between 2009 and 2011 there was a reduction in the number of wheel-profiling works even though there was an increase in incidents of wheel defects over the same period. SMRT's maintenance budget had also not kept pace with the increasing ridership.

It is likely that an absence of regular, smaller failures led the SMRT management to underestimate the likelihood of a catastrophic failure, leading them to skimp on maintenance in the pursuit of cost efficiency. Moreover, the same lack of regular failures led the company to cut back on bus services that run parallel to MRT lines, which worsened the effects of the MRT stoppages. As fallible human beings, we rarely appreciate how significantly we can underestimate the likelihood of failures, especially when the model we use to estimate risks is flawed.

SINGAPORE CASE STUDY 2:

THE RISK OF RUNNING SYSTEMS AT PEAK CAPACITY

When parts of Bukit Timah were flooded in November 2009 following heavy rainfall, it was assessed to be a once-in-50-years event. Unfortunately, events almost similar in scale continued to occur over the next two years. The risk of failure from operating infrastructure at close to capacity again came to light when the basement of Liat Towers along Orchard Road was flooded once more in December 2011, despite flood barriers put in after the 2009 incident. This time, the cause was traced to the underground Stamford Canal into which the basement water was supposed to be pumped. The canal was filled to 100% of its capacity because of the heavy rainfall and could not accept any additional discharge.

ROBUST EFFICIENCY NEEDS HUMILITY

Pursuing efficiency comes with increased risk of failure, but risk mitigation is helped greatly if we understand how we are prone to errors in our thinking.

One could formulate the First Basic Law of Managing Rare Events as follows:

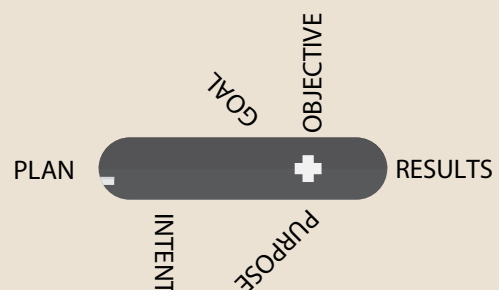
Always and inevitably everyone underestimates the risks from rare and infrequent events, but only when the everyday encounter suggests safety and stability.

The qualification is necessary because human cognitive biases also have the opposite effect of causing us to over-estimate the risk of rare events (sometimes by several orders of magnitude) if they are sensationalised or have great emotional impact.

The first law means that our trust in our risk models should always be accompanied by a healthy dose of skepticism, that they might not account for factors that turn out to be important. Designing critical systems to run constantly at peak capacity can be a recipe for disaster.

The Second Basic Law of Managing Rare Events states:

The mitigation of the consequences arising from catastrophic rare events is better done through the design of generalized, flexible response systems rather than multiple specialized systems designed for specific failures defined a priori.



Skepticism and humility should apply not just to our risk models, but also to our ability to identify possible types of failures—it is always the unimagined failures that will cause us the greatest trouble. It is better to spend resources on building flexible systems that can respond to a wide variety of challenges rather than to exhaustively list possible failures and plan for them, because we will always and inevitably miss some critical ones. Moreover, flexible systems can be designed to contribute to normal operational needs, while specialised systems are pure insurance.

Compare two different types of computing machines. Our semiconductor-based computers are very efficient—running calculations at millions of times faster than our brains, but extremely fragile—small variations in the operating environment can crash the whole system. In contrast, our biological brains are quite inefficient computers, but extremely robust. After a stroke that damages parts of the brain, patients are normally able to recover some functions through a process called neuroplasticity whereby the brain repurposes other functional areas to replace damaged ones.

In complex systems like organisations and societies, a small amount of flexibility and decentralisation can go a long way to increase both the system's efficiency and survivability. James Surowiecki, author of *The Wisdom of Crowds*, in writing for *The New Yorker*, described how retailers like Uniqlo and Costco manage to be successful despite having higher labour costs by designing flexibility into their employee's jobs, and how too much focus on efficiency can in fact hurt businesses by reducing their capacity to respond to novel situations.

The most successful retailers maintain efficiency despite having more staff by providing intensive cross training, such that employees don't over-specialize, and can always find something to do that contributes to the companies' bottom lines.

Software company Valve Corporation takes this philosophy to a ridiculous (but also ridiculously successful) extent by not assigning any pre-defined work to its employees and having zero hierarchy. Instead, as the company states in its employee handbook:

That's why Valve is flat. It's our shorthand way of saying that we don't have any management, and nobody "reports to" anybody else...

Deciding what to work on can be the hardest part of your job at Valve. This is because, as you've found out by now, you were not hired to fill a specific job description. You were hired to constantly be looking around for the most valuable work you could be doing.

You would think this sort of anarchy only works at a small startup, but Valve has managed to expand to almost 300 employees on this philosophy. And the profitability per employee at Valve is higher than Google, Amazon, or Microsoft! This system certainly does not come without problems, but its very flexibility enhances the long-term survivability of the company.

Efficiency and productivity are certainly laudable goals, but in pursuing them, we should be aware that they do not come without risks, and it is imperative that we design our systems and policies to take into account such risks in order to avoid catastrophic failures. This lesson is especially pertinent for policy-makers in Singapore as we try to efficiently utilise our limited resources to cope with an increasingly complex world.

Personal Adventures in Futuring

INSIDE FORESIGHT

AUYONG HAWYEE

As a relatively new entrant to futures work, I took the opportunity to sit down with two of Futures Group (FG)'s senior strategists to talk about personal experiences and challenges in futuring. I spoke with Cheryl Chung, who is now with the Centre for Strategic Futures on her experience in working on FG's The Future of Making Things project (also included in this publication) and with Lee Chor Pharn, now FG's Deputy Director in MTI's Futures and Strategy Division, on the process of distilling insights.

Another FG colleague, Sim Phei Sunn, had previously written a "Demystifying the FG Process". The article, that appeared in our 2011 publication, had tried to elucidate the "art" of futuring. I try here instead to provide a more personal exploration of what futuring means to me and the people I interviewed.

WHAT'S NEEDED TO BE A FUTURIST AND WHAT DOES A FUTURIST DO?

When I joined FG, the first thing that struck me about the people in this line of work was their optimism—that things will get better, or if there are problems, that we as a nation will figure out how to overcome them. I guess you do need to have a certain optimism to explore the future—it is easier if

you imagine the future to be a better place than the present. I can imagine how it could be draining if you have to keep visiting a place that you imagine to be dreary. On top of being professional optimists, the people I have encountered in foresight tend to be personal optimists as well who have a strong belief in continual self-improvement and in better things to come.

But is optimism fundamentally useful? I think so. Optimism helps us to look for solutions, which lead to new opportunities. "An optimistic framing is useful especially for economic agencies like ours," remarked Cheryl when I put the question to her. "This is because we are, by nature and training, eager to sense new opportunities, and an optimistic frame works for us."

"But it's not for everyone," she clarified. "The security and home affairs agencies respond better to a pessimistic, frame because their job is to deal with threats. For us though, optimism works."

Futurists are also usually people who have an insatiable sense of curiosity, people who are not content to know the what and the how, but also, sometimes annoyingly to those they question, the why. They have an obsession to understand what makes stuff tick, and they always try to dig deeper. In a sense, they are failed scientists—they have a curiosity that they are compelled to feed, but are not seized by just a specific area of inquiry. This obsession with the why makes talking to them sometimes frustrating and sometimes exasperating, but always enlightening.

Because of this wide-ranging sense of curiosity, good futurists would usually have developed skills in picking things up quickly, at least enough to ask intelligent questions to dig deeper into the why. Digging deeper is a very valuable skill in futuring; very often an understanding of the underlying reasons for a trend can lead you to deeper insights than just taking things at face value. And sometimes it might turn out that several trends are driven by the same underlying causes (e.g. how an endowment of natural resources can be both a boon in one context and a curse in another).

Because they need to absorb information from a wide variety of sources, futurists need to be, above all, good generalists. This is because "futuring isn't strategic planning," explained Chor Pharn. "In strategic planning, you need deep expertise to extrapolate from domains that are conventionally important. That process has its value. Strategic planning looks further, but futuring looks to the

“outside” for inspiration and for unexpected disruptions to business-as-usual.”

Generalists are important because “you need to be prepared to read outside of the immediately relevant material to come up with insights—material that would seem to be tangential,” said Cheryl. “For *The Future of Making Things*, it was only when we delved into business writing on the logistics industry that we cracked the puzzle of how new business models [centred around the 3D printer] would work.”

Futurists also tend to have a high degree of self-awareness, which means a strong meta-cognitive ability. I have personally not met a bunch of people more prone to introspection and self-criticism. Part of our work involves understanding cognitive blind spots that can cause policy-makers to be surprised by events, but with that comes the occupational hazard of worrying about your own blind spots.

“What am I missing?”

“Am I looking at this the right way?”

“Is this already being done by someone else?”

“Are we justifying our salaries?”

“What’s the meaning of life?”

Except for the last one which only pops up occasionally, the rest are constant refrains that I hear within the group almost on a daily basis.

“You need to know when you’ve become too attached to a project that just isn’t working out,” said Chor Pharn. “About 40% of our projects eventually “fail” [Chor Pharn does the air quotes], in the sense that they don’t produce valuable insight. Perseverance is a virtue, but you need to be able to take a step back to see that you’re flogging a dead horse. That allows you to take a step back, either reframe or move on to a new project.”

HOW DO WE ARRIVE AT INSIGHTS, AND WHAT ARE THEY?

Once you have identified a topic, collated and then digested a lot of data on a topic that seems interesting, the next hurdle is to cross the insight gap. This involves pushing for a discovery or an epiphany that, as Chor Pharn put it, “shocks you so much that it moves you and your audience to action, thereby creating a long tail [extended impact over time] for the project”.

I happen to disagree. While I think this is something that every project should aim for, sometimes it is not realistic for every project to have the same level of insight as, say, Ray Kurzweil’s *Singularity*. When I pushed Chor Pharn on this point, he admitted that not all projects can generate Insights with a big I, “sometimes we do have to settle for just communicating trends instead of insights. But a good way to know that you are at least headed in the right direction of potential insights is by looking at the kind of questions you’re asking. You should be asking questions that bring you further back along the causal chain to unearth deeper causes.”

HOW CAN WE MAKE SURE OUR WORK HAS IMPACT?

Translating insights into impact is often the toughest part of a futurist’s job. “You need to understand that the way you think can be very different from the way your audience thinks,” Cheryl pointed out. “Our audience [within policy circles] tends to be a skeptical one partly because pragmatism is highly valued in the Singapore civil service. Given that foresight tends to attract people not usually renowned for their operational excellence, a lot of hard work needs to be done to help our audience see how a future scenario is plausible by bringing them through a series of easily visualised steps.

“This is where a certain understanding of history comes in useful. Historical analogies which convey how similar disruptive trends have happened in the past can do a lot of the convincing for you. One of the issues with foresighting is that we tend to let ourselves off too easily by not investing enough time in translating the project for the policy-makers. We shouldn’t outsource the blame.”

Translating our work so that it moves other people besides just the foresight community in government is important because the FG team is small and because we have neither the mandate nor the expertise for implementation. It is inevitable that “other people have to carry on the work,” said Cheryl. Her project on the Future of Making Things has fed into current EDB projects on 3D printing.

Convincing other people of our vision for the future has the added benefit that we can move on to other projects with a peace of mind that somebody is dealing with a potential disruption that we have identified. “The marginal return in investing more time in a project is low after you close the insight gap,” said Cheryl.

Happy futuring!

The Foresight Landscape

AN INTERNATIONAL SCAN

SIM PHEI SUNN AND EDDIE CHOO

Strong networks with local and international foresight communities provide a rich reservoir of ideas and resources useful to the Futures Group's foresight work. Through our interactions with individuals and organisations from the public, private and academic sectors, we have gained insights into the foresight landscapes in different countries. This series of short articles shares our insights. Although not intended to be conclusive or authoritative, the articles illustrate how national foresight systems do not follow a common model. Instead, they are shaped by the operating context and manner in which foresight is used to inform policy formulation in different countries.

KOREA

Korean *chaebols* dominate the country's industrial landscape. These large conglomerates are instrumental in shaping the future of Korea. Given the symbiotic relationship between *chaebols* and Korean society, the former also seeks to influence local Korean attitudes and policies to support their business interests.

Chaebols such as Samsung, LG and Hyundai have their own research institutes that perform foresight functions.

One notable example is the Samsung Economic Research Institute (SERI), which has more than 100 researchers, providing analysis on macroeconomic developments, global issues, technology and industry trends, public policy, human resources and management issues. SERI also acts as an expert consultant on issues affecting organisations in government and industry, and conducts conferences and presentations for leaders in the public and private sector. Another *chaebol*, SK Telecom, has set up an immersive "Museum of the Future" to promote its consumer technologies and services.

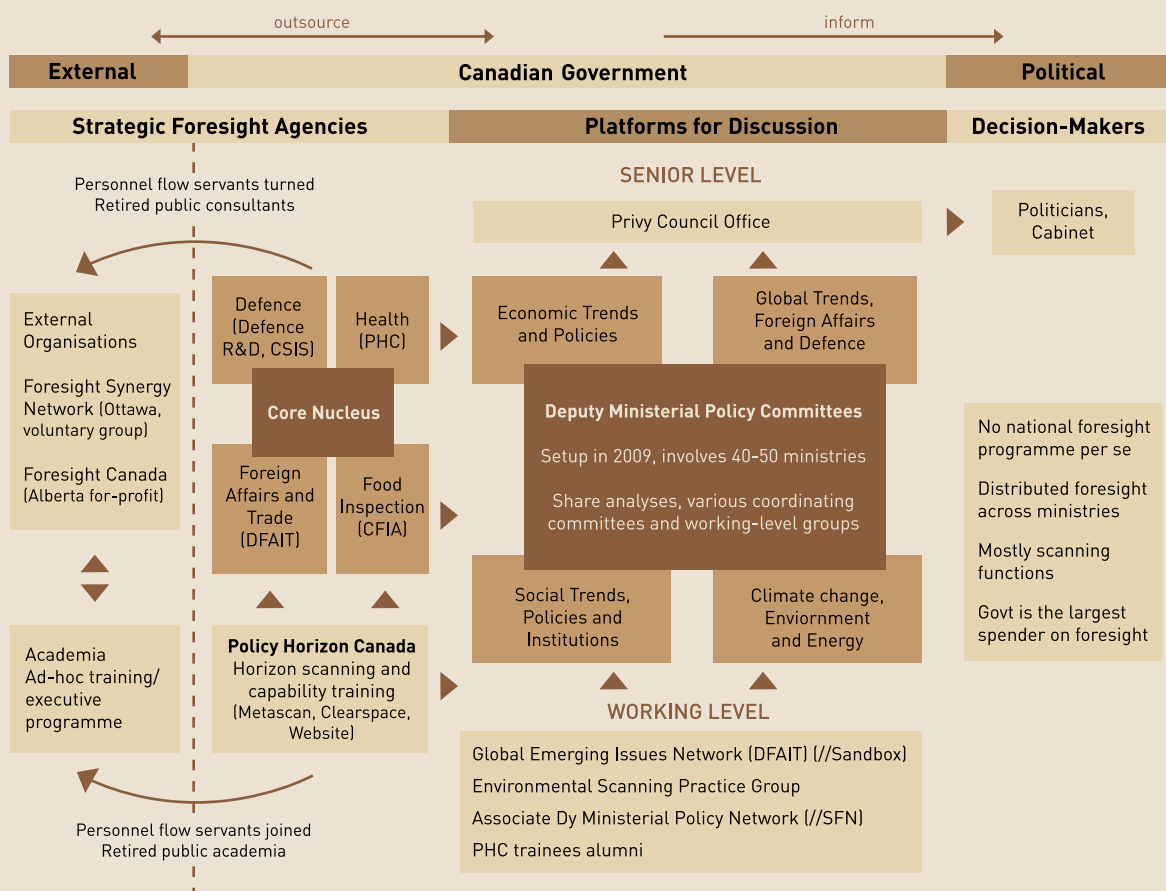
Foresight work is performed by the government to enhance Korea's competitiveness internationally. The Korean Institute of Public Administration conducts research in public administration and organises conferences to generate ideas with Korean companies.

At the highest political level, foresight is undertaken by the Presidential Council of Futures, which reports directly to the President and the political party. This is an advisory body that provides guidance for setting national strategies and policy priorities.

CANADA

Foresight in Canada is distributed across government agencies, which collectively constitute the largest demand for foresight output. There is no national foresight programme although there have been attempts to build a more coordinated approach in recent years. Most of the governmental foresight activities are concentrated at the Federal governmental level, with teams primarily engaged in horizon scanning functions, and surfacing key trends and drivers to their decision-makers. The more advanced teams, such as defence and intelligence services, and public health and safety, may also undertake scenario exercises and more sophisticated planning approaches.

There are four Deputy Ministerial¹ policy committees overseeing the foresight and strategic planning for their respective themes: economic trends and policies; global trends, foreign affairs and defence; social trends, policies and institutions; and climate change, environment and energy. These policy committees coordinate thematic work across ministerial departments, and submit reports and recommendations to the Privy Council, which in turn uses the information to support the Cabinet in policy and decision-making.



Complementing these activities, Policy Horizons Canada provides horizontal cross-cutting support through government-wide horizon scanning, capability training and coordination of general foresight work across agencies. An example is the Canada@150 project, which brought together 150 civil servants to brainstorm on and identify the challenges that Canada could face in five years' time in 2017.

There is some circulation of foresight capabilities as practitioners move from public sector to the private and academic sectors. These foresight researchers and consultants are mainly based in Ottawa in the National Capital Region, working with government agencies on foresight consultancy and research projects.

AUSTRALIA

Foresight in Australia takes place at multiple levels of public, private and academia, notably at the municipal level.

For instance, the "City of Sydney" is a city council, responsible for planning for the business and physical environment in Sydney as well as systems to support the well-being of its residents. To do so, they are constantly engaged in foresight work. The city council has adopted an inclusive approach in city-planning. Sydneyoursay.com.au is an online portal where Sydney-siders can express their views on future plans for the city.

Sydney also embarked on "Sustainable Sydney 2030" in 2008, involving planning for the upcoming challenges of global warming, rising oil prices, lower housing affordability and growth. The initiative was put together through crowd-sourcing amongst Sydney-siders while roping in the expertise of urban planners, architects and design teams. "Sustainable Sydney 2030" was coordinated by the City of Sydney's internal strategy team and an expert consortium. The inputs from the community were incorporated into a blueprint—2030 Vision Document, which was subsequently implemented.

1 The equivalent of Permanent Secretary levels in the Singapore civil service context.

FINLAND

The Finnish foresight system is characterised by an emphasis on futures research as a social good, an established ecosystem, and supported by open sharing of knowledge as a public good.

Foresight as a Societal Competence

Foresight work has a long tradition in Finland, driven by competitiveness considerations. A TEKES (the national funding agency for technology and innovation) 2007 strategy review specifically identified foresight as an important societal competence required for the country's continued development. This was in addition to other traditional areas such as ICT, S&T, service and business competencies.

Well-entrenched Ecosystem

There is a well-entrenched ecosystem of foresight work within Finnish society. Foresight work begins at the political apex with the Parliamentary Committee for the Future, and cascades through the respective public agencies, taking direction from the framework endorsed by the Parliamentary Committee. It is supported by strong academic futures research and private sector participation. The research output is then disseminated and widely used by companies and industry associations. Futures tools are also employed by companies for strategy- planning.

Finland is unique in having the Parliamentary Committee for the Future entrenched in the Finnish legislature, within the parliament and comprising elected political leaders. This structure distinguishes it from the foresight setups in other countries, which are usually positioned in the executive branch of government. The Finnish Parliamentary Committee for the Future gained permanent status in 2000, after several individual champions lobbied hard for the government to conduct a serious study of Finland's future landscape, and for systematic foresight work. Recognising that new problems cannot be studied through traditional parliamentary procedures, the Committee commissions research institutes to produce futures research to support its work. The Committee also prepares the Government's Report on the Future during each electoral period, and assesses the social impact of technological development in Finland.

The public administration takes its directions from the government on future areas of societal concerns and policy focus. Many ministries and public agencies have a team trained or involved in futures work. They often work in close collaboration with the academia and private practitioners on joint futures studies and reports.

In academia, the Finland Futures Research Centre is the largest academic futures research organisation among Nordic countries, and consults extensively with the Parliamentary Committee for the Future and public agencies. A strong network of futures researchers and a rich pool of joint research projects in Finland facilitate interaction and cross-fertilisation of expertise. These experienced practitioners move across the academia, private companies and consultancies, thereby deepening interpersonal links amongst the organisations and community.

Transparent Sharing of Knowledge

There is a strong culture of public consultation in the Finnish policy-making process. Key policy studies undertaken by public agencies usually comprise working committees of private and academia experts, and involve rounds of public consultation and reiteration. Most of the primary futures research output is in print publications. These reports then form the baseline research for consultancies and businesses in their strategic decisions.

Research findings from joint futures projects and commissioned studies are widely disseminated to private sector companies, to create awareness of issues and implications. The sharing and dissemination extends to the international audience as well. Members of the private sector and public are willing to volunteer their services on various committees because they can gain from the information exchange with the agencies.

Networks and Futures Research as a Public Good

Private sector foresight research in Finland tends to be niche, focused, and for internal consumption. This results in overlapping efforts and inefficient research, especially in areas of general societal interest.

Public agencies hence recognise futures research and networks as a public good to further dialogue and planning. They play an important role in highlighting new signals, feeding trend information to industries, and facilitating networks of futures communities to fuel idea exchanges.

FORESIGHT IN THE FINNISH NATIONAL INNOVATION SYSTEM

— FORESIGHT IN THE PUBLIC SECTOR

Parliament

Committee for the future: technology assessment, important major developments in/for society

Science and
Technology
policy Council:
Policy review

Government, Future report, Foresight network

Ministry of Education;
Anticipation of training
needs

Ministry of Employment
and the Economy;
innovation strategy,
economic, labor market
forecasts;
technology-society-
innovation; Weak Signals

Other ministries and
administrative sectors
and institutes
(esp. defence, transport,
environment);
R&D strategy

Ministry of Finland; science
watch for programme
strategy FinnSight2015

Tekes: technology
strategy, programme
strategy FinnSight2015,
Signals2006, Trends

Sitra: structural and
societal Challenges and
opportunities; National
Foresight Network

Universities and
polytechnics; research
strategy, also research in
foresight (process,
methods, evaluation)

VTT: research strategy,
TF consultancy of
industry, TF processes
and methods

TE-centres and other regional actors:
Business and regional development; training needs

— FORESIGHT IN THE PRIVATE SECTOR

Companies' "strategy, R&D,
new products and services"

Business associations:
sectoral technology
strategies

Consulting firms with
experience in foresight
processes and methods

— INTERNATIONAL FORESIGHT: PRESENT AT ALL LEVELS

SINGAPORE

Singapore's development of forward planning techniques arose from the need, following independence in 1965, to strengthen the ability to respond to uncertainties.

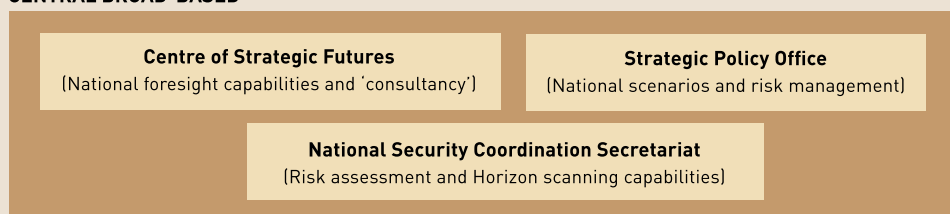
Strategic foresight was formalised in the 1980s with the widespread use of scenario planning as a planning tool, following the 1970s oil shocks and recession. As the operating environment became more globalised and complex, the Risk Assessment and Horizon Scanning (RAHS) programme was launched in 2004 to complement scenario planning. The RAHS programme comprised tools and processes to detect weak signals and examine complex issues where cause-and-effect relationships are not easily discerned.

Most of Singapore's foresight capabilities is concentrated within the public sector, which adopts a whole-of-government approach to strategic planning. In addition to the RAHS programme, the Strategic Policy Office (SPO) and the Centre for Strategic Futures (CSF), act as key focal points for futures-related work in the public sector. The two agencies develop futures thinking and strategic planning capabilities across Singapore's public service. They also develop national scenarios and for selected key cross-cutting issues, such as climate change and social media.

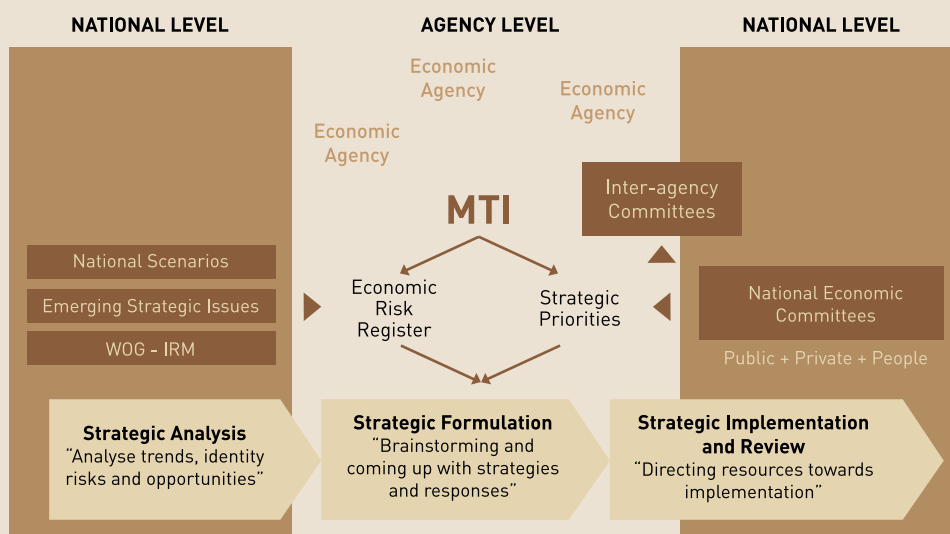
In terms of economic planning, national economic committees such as the Economic Review Committee (2003) and Economic Strategies Committee (2010) bring together key stakeholders from the public and private sectors to articulate policy directions for the Singapore economy. These are translated into work priorities for economic agencies and inter-agency committees.

Complementing the central whole-of-government efforts, distributed foresight units across various agencies undertake foresight to inform forward planning for their respective areas of responsibility. For example, the Futures Group at the Ministry of Trade and Industry scans for trends to analyse their economic implications for Singapore and to inform economic policy formulation. There is close coordination across the agency-specific foresight units, in terms of information sharing and capability development, with many of the networking opportunities initiated by the Centre for Strategic Futures.

CENTRAL BROAD-BASED



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