MiGHT
Malaysian Industry-Government Group for High Technology

02/2012

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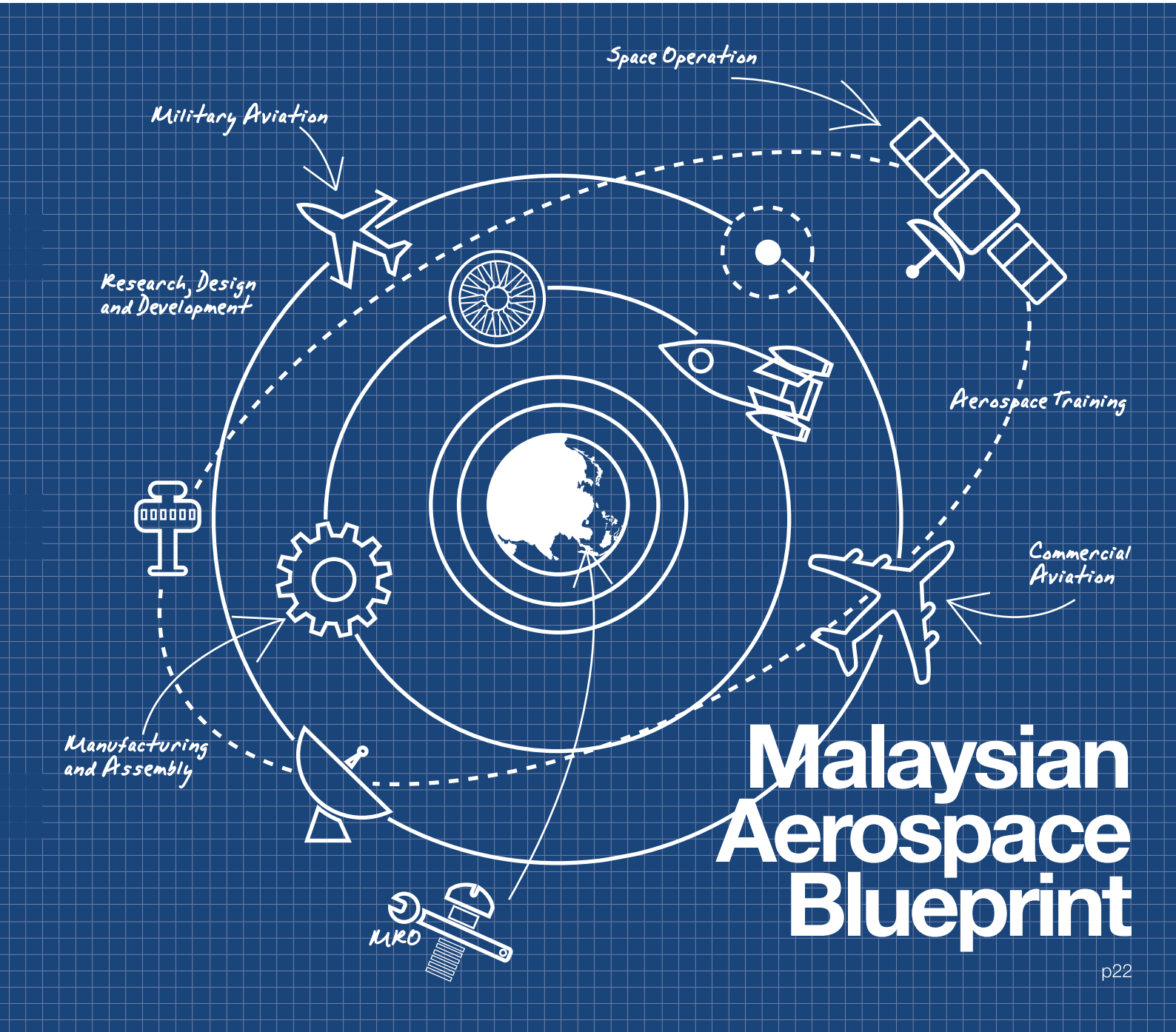
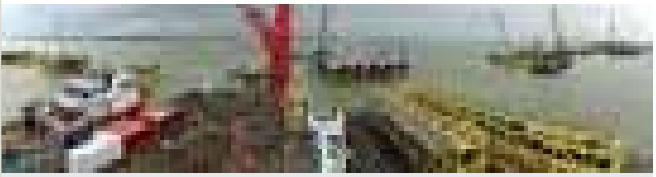
MALAYSIA'S NATIONAL FORESIGHT MAGAZINE



Malaysian Aerospace Blueprint

p22

PLAYING A ROLE IN THE GROWTH OF NATIONS

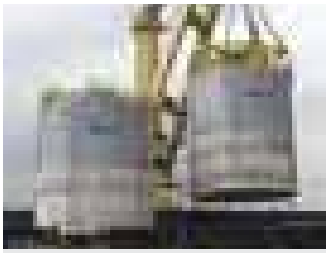


LNG Regasification Project, Malacca

Offshore Craen FAVCO PC 1000 for Jack Up Barge B.V Lifting Capacity: Max. Lift 1000 tonne @22m radius Boom Length: 60.76m to 97.23m

Newly fabricated 70m Anchor Handling Tug supply/DP2 – MV IDS Darussalam by Muhibbah Marine Engineering (MME)

EPCC of Central Oil Distribution Terminal (CODT), Sarawak



Pre-assembly Gorgon LNG jetty & marine structures project for Barrow Islang LNG plant, Australia

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features

editor's note

The foresight institute will be a centre that integrates idea and promotes networking across a broad spectrum of individual futurists, private think tanks and academic establishments

Initial Thoughts

BY
RUSHDI ABDUL RAHIM
Director
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"It never ceases to amaze me that even though foresight has been acknowledged internationally as effective tool for future planning, its usage and adoption in Malaysia is scarce and very much at an infancy stage"

Greetings and salutations from all of us at myForesight™. It certainly has been an eventful quarter for us. The time was spent engaging diverse stakeholders including various ministries, agencies and committees.

The work we have done in supporting the National Science & Research Council has resulted in the recommendation of National Research Priority Areas. This was then presented by the Science Advisor to the Prime Minister; Emeritus Professor Dato' Dr. Zakri Abdul Hamid during the National Innovation Council on the 28th of February 2012. Subsequently the priority areas were also shared with various research institutions, agencies & ministries. A copy of the presentation could be downloaded at www.myforesight.my

This National Research Priority Areas were also presented during the "UK-Malaysia Partnership in Science" Symposium.

After more than 8 months, we are also concluding the work we are doing on Future Rail 2030, mapping out the strategies and action plan for the development of the rail industry in Malaysia. This initiative is co-conducted with SPAD (Land Public Transport Commission) and should pave the way for the sustainable development of Malaysian Rail Industry. Keep monitoring this space for further updates; we are pretty sure this will be big news during the upcoming months.

Speaking of the news, our trends scanning initiatives has also received much attention lately. Our monitoring of trends especially in Malaysia has enabled us to support various MIGHT activities as well share it with others for their benefit. As mentioned before, what foresight attempts to do is to create a better understanding of the drivers of change and the megatrends as well as its impact that will enable us to have a new understanding about the future. For this we have been presenting findings on future impacting trends among others on youth, work & career, green, mobility as well as food security.

editor's note

From what was mentioned, you can probably see that we have been going around sharing our body of work which have stirred an enormous interest. During all of these sessions, references were made on other foresight works undertaken by others. Works done by global organization like UNIDO, UNESCO, WEF & OECD involving foresight were regularly quoted. However, it never ceases to amaze me that even though foresight has been acknowledged internationally as effective tool for future planning, its usage and adoption in Malaysia is scarce and very much at an infancy stage. Therefore this is one of the reasons for the creation of National Foresight Institute

If you have been reading the news, the formation of a National Foresight Institute is also in the pipeline. I am hoping by the time you read this, the institute is already up and running.

Since news broke out of the formation of the National Foresight Institute, questions were asked on the main objectives and activities of the Institute. This includes questions asked during a parliamentary sessions.

In an effort to mainstream and expand foresight beyond MIGHT; upon consultation with the Science Advisor, it was decided there is a need to create a National Foresight Institute, under the purview of MIGHT. The move will enable the institute to be a referral center for foresight & future oriented activities in Malaysia.

It will also assist the National planning by;

- Mainstreaming of foresight through formulation & implementation of a national programmes
- Developing human capital in the field of foresight
- To act as a reference point on foresight practises and activities in Malaysia

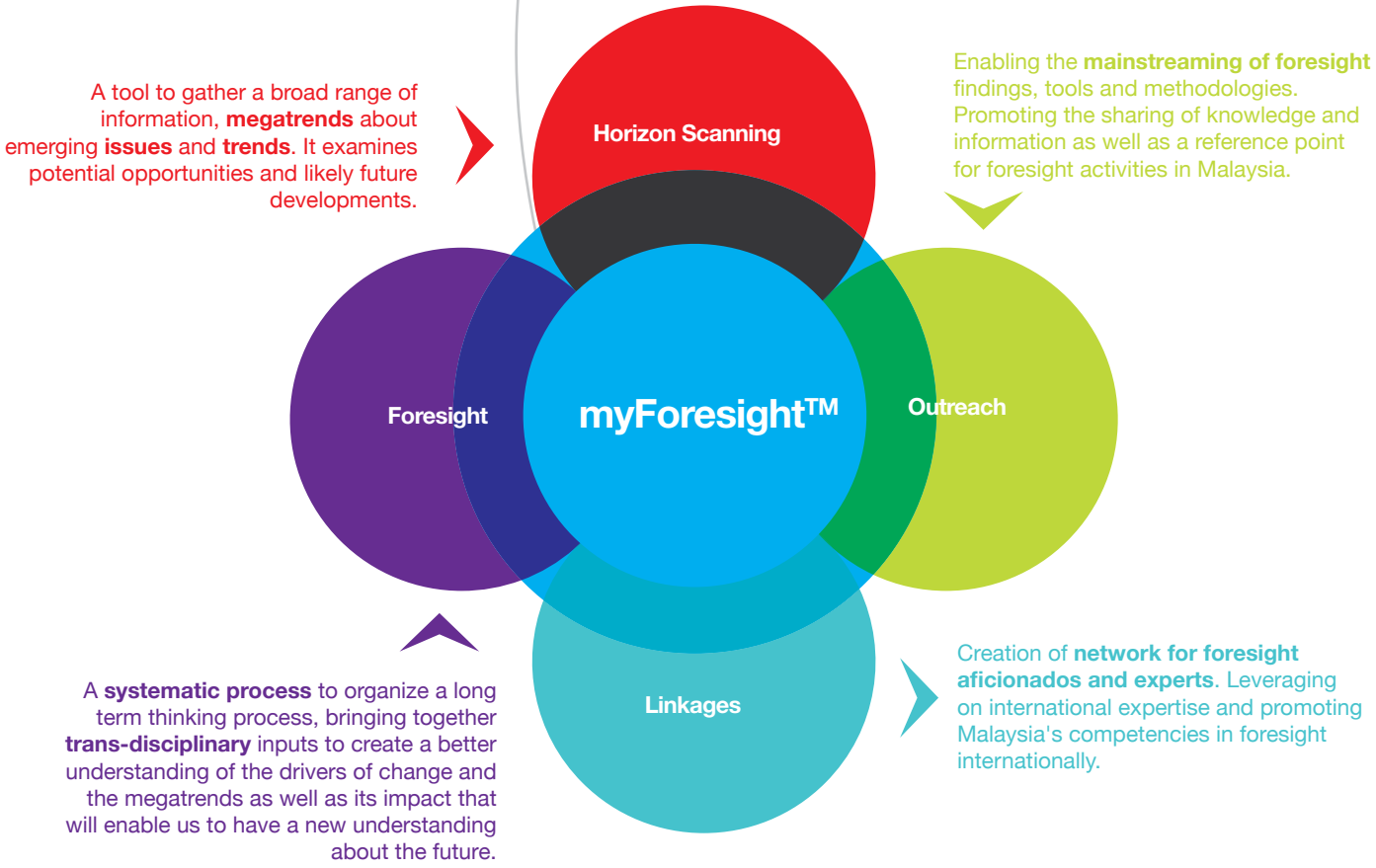
The foresight institute will be a centre that integrates idea and promotes networking across a broad spectrum of individual futurists, private think tanks and academic establishments, developing framework for competencies in foresight via evidence based prediction (Horizon scanning activities)

The following will be the activities of the National Foresight Institute.

We certainly hope the creation of the Institute will promote collaboration and joint effort of foresight in various fields' and subject matter with multiple organizations for the benefit of the nation.

As usual the magazine has to date provide a means for us to reach our stakeholders and hope to continually do so in making the magazine beneficial and thought provoking.

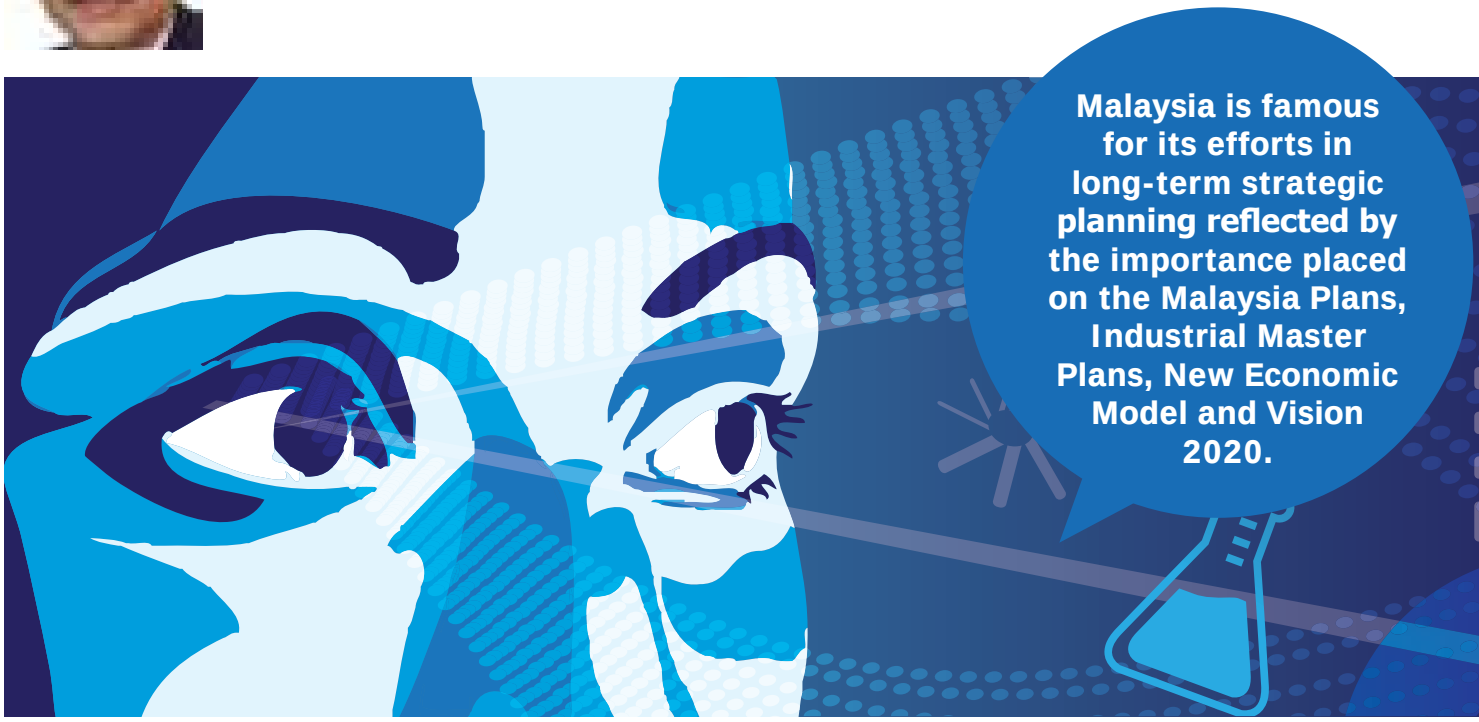
After reading the magazine, we expect you to have your opinion on certain matters. You might agree or disagree. Whichever it goes, we want to hear them. We welcome your feedback and contributions.



leader's insights

The Foresight To Do Mighty Things

BY
MOHD YUSOFF SULAIMAN
President & Chief Executive Officer, MIGHT



FORESIGHT has been loosely defined as the ability to predict or plan for the future. As the pace of change in our interconnected world continues to accelerate, those who can best predict, plan and respond to changes are those most likely to succeed. Strategic planning is nothing new to Malaysians. Malaysia is indeed famous for its efforts in long-term strategic planning reflected by the importance placed on the Malaysia Plans, Industrial Master Plans, New Economic Model and Vision 2020.

Nor is strategic planning new to companies, many of which employ strategic planners who regularly review and craft new plans for companies that look five or 10 years down the road. This process is of even greater importance for technology companies that operate in a rapidly evolving, highly complex and often volatile environment.

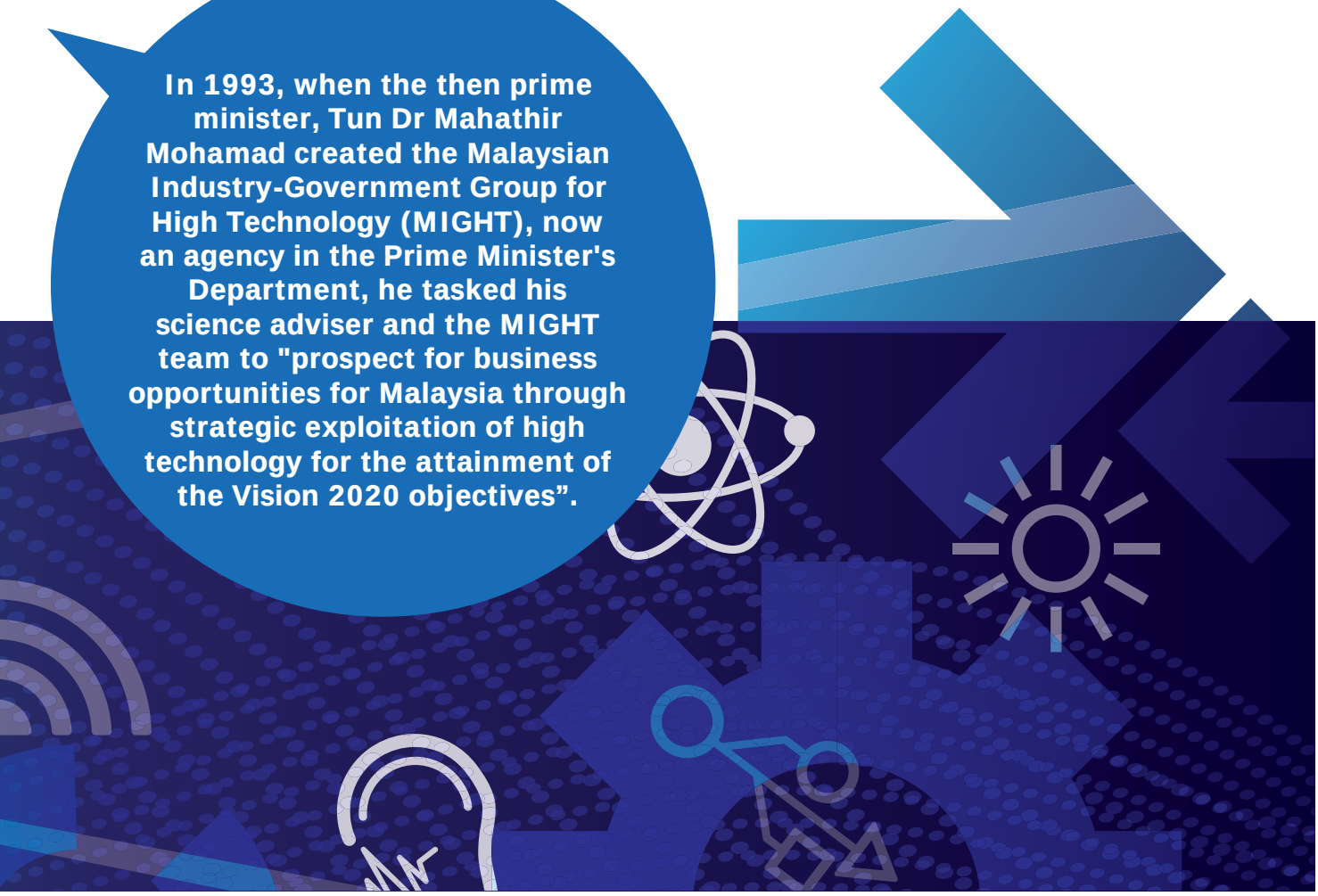
In 1993, when Prime Minister Tun Dr Mahathir Mohamad created the Malaysian Industry-Government Group for High Technology (MIGHT), now an agency in the Prime Minister's Department, he tasked his science adviser and the MIGHT team to "prospect for business opportunities for Malaysia through strategic exploitation of high technology for the attainment of the Vision 2020 objectives".

Since then, MIGHT has used the Delphi Method, a systematic approach to forecasting based on input from experts from industry, government and academia. One of MIGHT's earliest contributions to national economic development came in the form of the National Aerospace Blueprint, which has helped drive 11 per cent growth in the industry annually and most recently, the Shipbuilding and Ship Repair Strategic Industry Plan, which is expected to drive the industry's contribution of RM6.6 billion to gross national income by 2020.

As with the vast majority of MIGHT's strategic industry plans, both reports go beyond conventional desktop research and interviewing and leverage off the unique nature of MIGHT's position between industry and government. Calling on about 100 members, MIGHT has gone beyond the norms of government or business planning to include the insights of policy makers, companies, academics, researchers, operators and regulators.

The result has been plans that are directly in touch with current needs and provide solutions to issues involving multiple stakeholders. Over the years,

In 1993, when the then prime minister, Tun Dr Mahathir Mohamad created the Malaysian Industry-Government Group for High Technology (MIGHT), now an agency in the Prime Minister's Department, he tasked his science adviser and the MIGHT team to "prospect for business opportunities for Malaysia through strategic exploitation of high technology for the attainment of the Vision 2020 objectives".



the process has evolved and adapted to the latest techniques and methods for foresighting change and opportunities.

Forecasting has moved beyond breakdowns by vocational boundaries to inculcate a multidisciplinary approach to identifying green-field opportunity through consolidated decision making based on scientific evidence.

This revised approach has the ability to go beyond Malaysia's traditional follower-strategy that has dominated planning and left the country susceptible to low-cost regional competition in areas such as automotive manufacturing and electronics.

Foresight gives Malaysia the tools needed to identify blue ocean opportunities and markets by developing products in new and emerging technology and areas of competitive advantage.

In April, MIGHT will launch the National Foresight Institute, whose Foresight team has applied these advanced and proven methodologies to give Malaysia such guidance as the National Technology Foresight Study and the preliminary Railway Industry Strategic Plan 2030.

However, Foresight can no longer afford to be the sole domain of MIGHT. Like South Korea, Finland, Singapore and Brazil, Malaysia must adopt Foresight at the national level and streamline this process into national planning initiatives.

The National Foresight Institute has made strides and the institute's Foresight now provides some of the most fundamental input on the nation's science and technology policy through direct input to the National Science and Research Council. The seismic importance of improving the nation's ability to track evolving trends, predict and adapt to probable future outcomes cannot be understated.

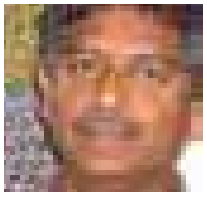
Foresight must go beyond technology forecasting and planning and be woven into the industrial and economic planning works of this country.

Only then will Malaysia be sufficiently outfitted to adapt to the coming changes of the world around us, seize new opportunities presented and create a global role as a high-income, high-performance competitor in the industries of the future.

This article was published in New Straits Times - 27 February 2012

experts' insights

Crystalline Silicon Photovoltaics: A Sustainable Solution to Energy Generation



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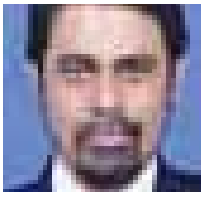

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The ability and infrastructure to generate, distribute, and effectively consume electricity determine a society's educational, social, and economical well being. For example, near universal access to electricity, through transmission grids connected to large scale power plants, has been largely responsible for economic prosperity of the industrialised world. This centralised electricity distribution model is expected to be replaced by small scale de-centralised micro-grids connected to an array of distributed energy generators. Continuing maturation of renewable energy generation and distribution technologies has been the driving force behind this paradigm shift. A critical feature of this paradigm shift lies in the concept of energy generation at the point of use. For third world countries, this paradigm shift offers unique opportunity to achieve economic progress in much the same way as telecommunication has evolved from telephone lines to wireless.

Crystalline silicon photovoltaic (PV) technology will play a leading role in this transition to small-scale distributed networks. Silicon (Si) forms almost 26 % of the Earth's crust, it is uniformly distributed across the globe, and is free from economics of resource-depletion. Silicon is also the most dominant component of integrated circuit (IC) electronics; hence the IC-based infrastructure advances will continue to be accessible to the PV industry. Malaysia has been blessed with sunlight, silicon, and an infrastructure of technologies spanning the photovoltaic supply chain. Unfortunately, a majority of these technologies are dominated by multi-national companies focused on exploitation of cheap labour and natural resources; almost all finished products are exported. There is an urgent need for the Malaysian economic planners to take ownership of this energy sector, not only for the benefit of their own country, but also to become regional and global leaders in the field of renewable energy.

This article examines crystalline Si photovoltaics in terms of its physics, technology, and economics with the aim of developing self-supported, globally-distributed indigenous PV industries. While this goal is realistic and achievable, its success is critically dependent on implementation of energy infrastructure based educational policy. Without appropriate educational infrastructure, transition of emerging economies from carbon-based fuels to Si-based resources will not be possible.

ACKNOWLEDGEMENTS:

Authors would like to express their gratitude to myForesight™ magazine for inviting us to contribute this paper. One of the authors (SHZ) would also like to thank many organizations including NSF, DoD, DOE, Sandia National Laboratories, and individuals including Sam McCormack, Richard Marquardt, Karen Dezetter, Dave Modisette, Rich Winder, Scott Wilson, Ross Bunker, Geri Velasquez, Siu Leong Cheow, and Suhaila Seapi; their contributions have been instrumental in the work presented here.

Complete realization of human potential is critically dependent on access to energy[1]. Energy is required for basic human necessities including food, transport, industrial manufacturing, and medicine. Worldwide disparities in energy usage are reflected in drastic economic inequalities; such inequalities lead to incalculable loss to our civilization. Therefore, the supreme moral obligation and responsibility of our generation lies in creation of a global civilization in which the playing field is level for all humans. This challenge is viewed through the prism of energy. To meet global energy requirements, an energy source must satisfy three conditions: (a) economically (and environmentally) sustainable, (b) inexpensive, and (c) technologically flexible to become indigenous. Based on these considerations, crystalline Silicon (c-Si) based generation of electrical energy mediated by photovoltaic process[2] has been identified as the most logical solution. Si forms approximately 26 % of the Earth crust[3], and combined with free energy from the sun, offers an unlimited energy resource uniformly distributed across the globe. Maturation of the Si PV technology combined with advances in distributed energy generation[4] and microgrids[5] have helped create a paradigm shift away from conventional approaches to energy generation, distribution, and consumption. As this paradigm shift develops and universally adapted, the long-cherished goal of economic equality across the globe will become a reality.

ELECTRICITY GENERATION AND GDP

A brief analysis of electricity generation and its relationship to gross domestic product (GDP) is highly instructive. Figure 1 (left) plots worldwide

Figure 1

Left: Global distribution of per capita electricity generation,
Right: GDP dependence on per capita electricity usage.

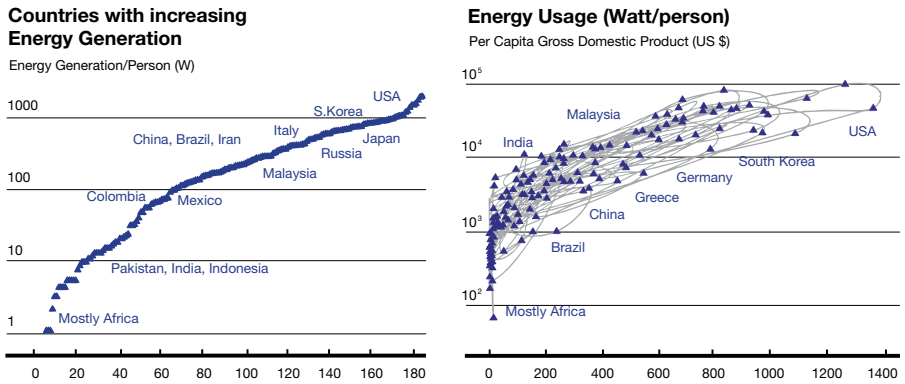


Figure 2

Cumulative per capita electricity generation for countries producing energy in 1-100 W/person range (left) and in 300-400 W/person range (right).

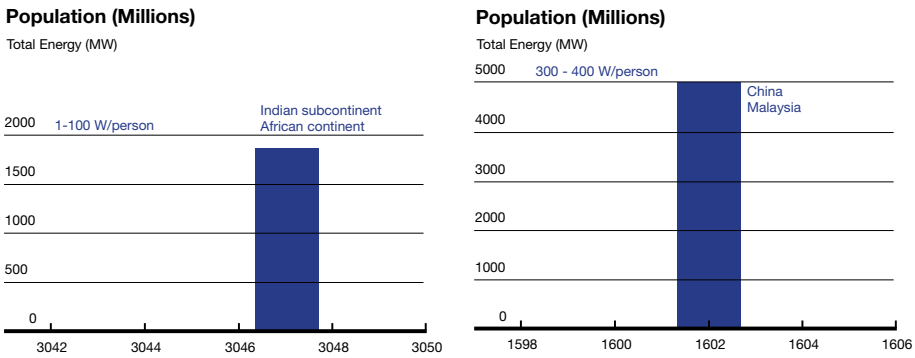
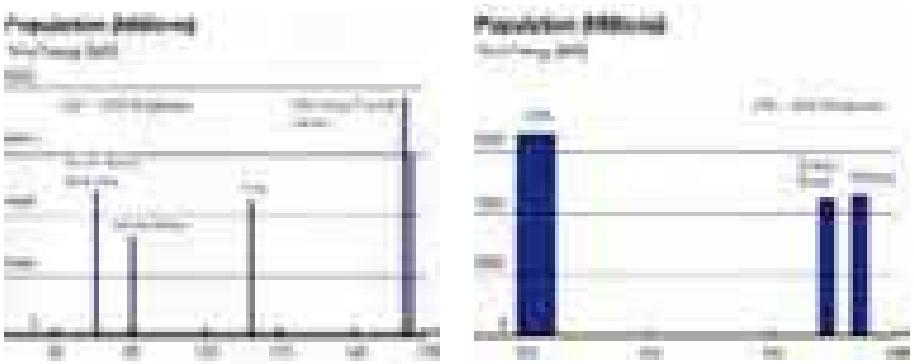


Figure 3

Cumulative per capita electricity generation for countries producing energy in 400-1000 W/person range (left) and in 200-400 W/person range (right).



per capita daily energy usage (total electricity generation per year/population)[6]. Perhaps the most significant feature of this data is the realization that a majority of world's population has practically no access to energy. By plotting GDP as a function of per capital energy usage (Fig. 1, right), relationship between energy usage and economical development can be better understood; countries with highest energy usage appear to have the highest incomes. The principal features of the plotted data in Fig. 1 have been summarised below.

i. Three orders of magnitude generation gap across the world; most countries in Africa barely produce any electricity (Fig. 1, left),
ii. Developed countries could be categorised with per capita energy usage in ~ 600-1000 W,
iii. Almost four orders of GDP variation as a function of energy usage, and
iv. Countries with the highest population generate lowest energy.

In order to better understand the relationship between per capita energy usage and GDP, data in Fig. 1 is plotted in Figs. 2 & 3 as a function of per capita energy usage over a broad energy range. The vertical bar represents total population of countries in the per capita range selected. The principal features of the data in Figs. 2 & 3 have been summarised below.

i. Per capita energy generation is less than 100 W for approximately 3000 million people (Fig. 2, left),
ii. China (Fig. 2, right) is poised to join advanced countries with per capita energy usage just below 400 W,
iii. Developed countries with lower populations produce far more energy than poorer countries with significantly larger (~ 10-20 times) populations (Fig. 3, left), and
iv. Indian subcontinent as well as the African continent supports the largest population generating the lowest per capita energy.

Table-1 selectively reproduces per capita energy and GDP statistics for representative countries across the entire range potted in Figs. 1-3. As noted above, economic disparity as a function of energy generation and GDP produced is huge. For example, the ratio of energy generation between USA and Congo is ~ 136; almost ½ of the GDP ratio of ~ 229. The higher energy generation does not always lead to higher per capita GDP as observed in the case of Russia. Similarly, some countries such as Mexico have higher per capita GDP despite much lower energy usage. Such discrepancies may be attributed to higher revenues generated from oil export. In most cases, higher energy generation capacity leads to higher

experts' insights

GDP. Per capita energy usage of ~ 500-600 W is generally associated with a developed country; see for example Italy with GDP of ~ US $ 37,000.00.

Therefore, creating worldwide level playing field in energy generation will require approximately per capita energy of 600 W/day for a population of about 3000 million, i.e., ~ 1.5 E12 W.

Assuming conventional carbon-based energy generation resources, greenhouse emissions have been estimated for 1E6Wh range in table-2[7]. Therefore, carbon-based energy generation of ~ 1.5E12 W will add green house emissions of ~ 1-2E9 lbs per hour. Such huge influx will lead to catastrophic weather changes with global impact. Therefore, even apart from moral considerations, our survival requires transition from carbon-based to Si-based energy generation resources; PV energy generation does not produce any green house emissions. Earth receives daily sunlight of ~ 174E15 W, therefore, less than 1 % conversion of this energy will be sufficient to meet all our energy requirements[8].

ELECTRICITY TRANSMISSION

Electricity generation and transmission model in developed countries is simply described by the schematic diagram in Fig. 4. Large (100's MW) electricity generation plants based either on fossil fuels, nuclear, or hydro sources, use transmission grids extending to hundreds of miles to deliver electricity to vast regions[9]. This model traces its evolution to the early days of electricity generation and distribution in which small scale (100's KW) of electricity generation plants served small neighbourhoods through transmission grids extending to a few miles (Fig. 5); in the early days, it was more expensive to produce large power plants[10]. With time, it became cheaper to produce large scale power plants, while the cost of large scale transmission grids was low. In today's world, this system of electrical transmission is becoming increasingly redundant due to several factors including high resistive losses[11], high cost of grids (both environmental and economical)[12], long lead time of large scale power plants[13], and increasing availability of distributed energy resources (both renewable and carbon based)[14]. This is, perhaps, the most important paradigm shift of the 21st century, and if channelled appropriately, will redefine the way electricity is generated, distributed, and utilised.

In developed countries, the transition from macro-grids to micro-grids is inhibited by the presence of fully-developed transmission grids aided by

Table 1 An Overview of Per Capita Energy Generation and GDP

NUMBER	COUNTRY	POPULATION (millions)	PER CAPITA ENERGY (WATT)	PER CAPITA GDP (US $)
1	Republic of Congo	72	10	209.7
2	Bangladesh	142	19	809.86
3	India	1210	57	1,523.14
4	Vietnam	90.6	108	1,342.16
5	Mexico	112.3	184	10,552.1
6	Brazil	192.4	249	13,087.32
7	China	1347	389	5,187.03
8	Italy	60.7	591	37,001.65
9	Russia	142.8	783	13,200.28
10	Japan	128	859	45,742.18
11	USA	313	1363	48,119.02

Table 2 Greenhouse Gas Emissions For 1 MWH Electricity Generation

Fossil Source	Co_2 Emission (Lbs)	N_2O (Lbs)	Sulfur Oxide (Lbs)
Coal	2249	6	13
Petroleum	1672	4	12
Natural Gas	1135	1.7	0.1
PV	0*	0*	0*

* Energy utilised in creation of Si solar cells and panels has been neglected in this calculation.

Figure 4 Electricity generation and distribution methods in practice across the world.

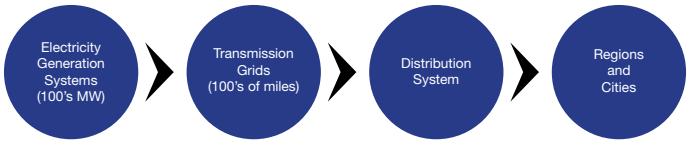


Figure 5 Electricity generation and distribution in its early phase.

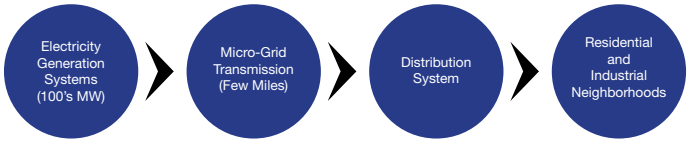


Figure 6 Integration of renewable resources into existing macro-grids.

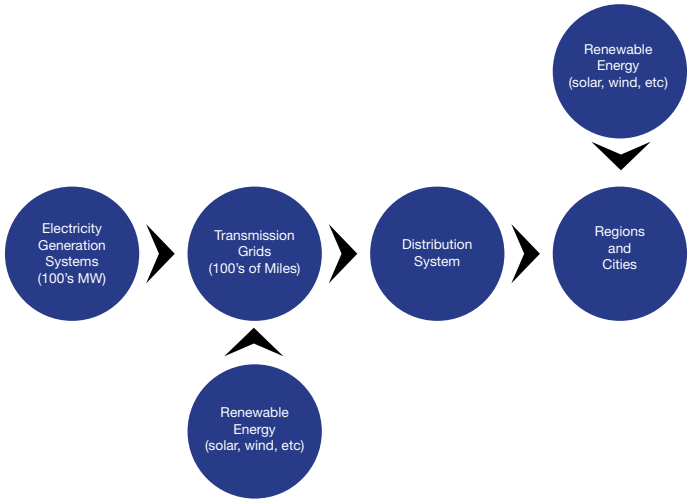
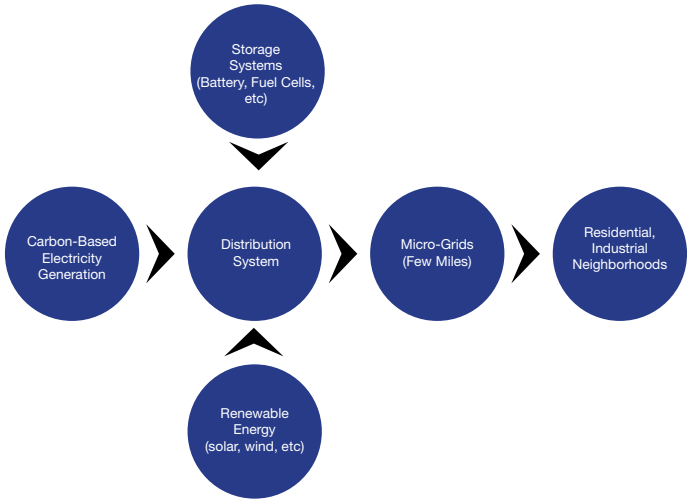


Figure 7 Distributed energy generation based on microgrids and energy generation at the point of use.



the monopoly of utility companies that control the grid as well as generation[15]. Transition will be slow, and is expected to take the form described in Fig. 6, where the grid will be slowly augmented with renewable energy sources. This situation will hold until some such time where the carbon foot print of large scale power plants will become too high to sustain for environmental and economic reasons. When this phase is reached, the macro grids will be divided into small scale distributed energy resources focused on energy generation at the point of use (Fig. 7). In this distributed energy system, several energy generation resources (renewable, carbon based) are combined with storage systems (batteries, fuel cells) to deliver electricity to small scale residential and industrial communities through micro-grids extending to a few miles.

Therefore, advances in energy technologies combined with fossil-fuel depletion and greenhouse emissions have created the conditions for a paradigm shift ideally suited for economically disadvantaged countries. By following distributed energy distribution model, the cost of building macro grids is eliminated, and by generating energy at point of use, urban sprawl is eliminated[16] with the added benefit of decentralised economic development[17].

CASE FOR CRYSTALLINE SILICON PV TECHNOLOGY

We are blessed with almost unlimited (~ 1000 W/m2) source of energy in the form of sunlight[18]. A number of solar or photovoltaic technologies have been competing to become the renewable energy source of choice by focusing either on efficiency, or low manufacturing costs. In order to differentiate between competing PV technologies, a comparative analysis in terms of economics, resource availability, environmental impact, and social benefits has been carried out. Each PV technology sector has been examined in terms of its physics, start-up capital cost, and recurring production costs. For each technology, an analysis of available of materials and supplies has also been considered in order to determine sustainability under high volume manufacturing required to meet energy demands described above. Environmental impacts are examined in terms of greenhouse emissions, toxicity and recycling ability.

Thin-film PV technologies including cadmium tellurium (CdTe)[19] and amorphous silicon (a-Si)[20] appear to be highly desirable on account of their perceived low-costs. However, a deeper look reveals serious raw materials availability issues and efficiency limitations; toxic effects have also become a serious environmental concern. For instance, the concentration of Te in earth's crust is the same as Pt[21]. Similarly, due to its toxicity, Cd is one the six elements banned by European community making it difficult to recycle CdTe panels[22]. The thin-film a-Si PV technology has long suffered from low efficiencies and light-induced degradation[23]. In contrast, crystalline Si technologies have established a track record of performance dating back to almost 50 years[24]. Crystalline Si-based PV technologies benefit from R&D advances in semiconductor integrated circuit (IC) manufacturing. Start-up costs depend on the manufacturing approach[25], and are often times substantially lower than thin-film technologies[26]. Principal advantages of c-Si-based PV technology include: (a) higher (~ 14-22% range) efficiencies, (b) abundance of resource availability of key ingredients such as Si and Al; Al is ~ 9% of the Earth's crust[27], (c) identification of pathways through integration with Ge[28] and compound semiconductors[29] to boost efficiencies, (d) natural division into technology sectors such as crystal growth, solar cell, and panel manufacturing, and (e) simple enough to transition into indigenous industries.

experts' insights

Global PV market, dominated by Si, has been growing at ~ 30 % over last twenty years (Fig. 8, left)[30]. This growth has largely been attributed to grid-connected installations in Europe and Japan, and has been sustained in large part by government subsidies. Respective market share of PV technology sectors for year 2009 has been plotted in Fig. 8 (right); crystalline Si, in its mono and poly Si formats, dominates the market[31].

Resource Comparison

Figure 9 plots concentrations of five key elements used in thin-film and crystalline PV technology. Concentrations of these elements in Earth's crust have been plotted on linear (Fig. 9 a) and logarithmic (Fig. 9 b) scales in order to identify the differences clearly. Principal features of the plotted data in Fig. 9 have been summarised below.

i. Compared to Si, all other elements are negligible,
ii. Te, the key component of CdTe thin-film solar cell has a concentration approximately 1E10 lower than Si, and
iii. Other elements fare better but are still far (~ 1E6 lower) less abundant than Si.

Businesses as a matter of practice do not disclose their plans on securing raw material and supplies. Even so, the case of Te deserves a closer look in view of claims of its low cost[32]. It is an integral component of the solar panel. According to First Solar's production estimates, it required approximately 13 tons of tellurium in 2007[33]. Assuming that First solar CdTe captures 10% of the American 2008 installed capacity; it would require 7,260 tons of tellurium[34]. At present, Te is produced as a byproduct of Cu mining[35]. Impacts of such large increase in Te production in terms of costs in the metal mining and refining industry have not been understood and reported. Even if all Te supply is secured, the fact remains that it is one of the scarcest elements on the Earth; reliance on it to meet our energy requirements needs is at best short-sighted, and at worse, no better than our current reliance on fossil fuels.

CIGS-based thin-film PV technology fares better in resource terms[36]. However, despite its potential, it is yet to establish any significant market presence. The third thin-film PV technology based on a-Si suffers from light-induced degradation that fundamentally limits its effectiveness; extensive research efforts over last thirty years have so far failed to solve this problem[23]. In contrast, the building blocks of c-Si PV technologies are Si (~ 26 % of the Earth's crust) and Al (~ 9 % of the Earth's crust). Both are in abundant quantities and uniformly distributed across the globe so that there is no unequal distribution as that for carbon-based fuels.

Figure 8

Left: Global distribution of PV manufacturing over last 20 years.
Right: Market distribution of PV technology sectors in 2009.

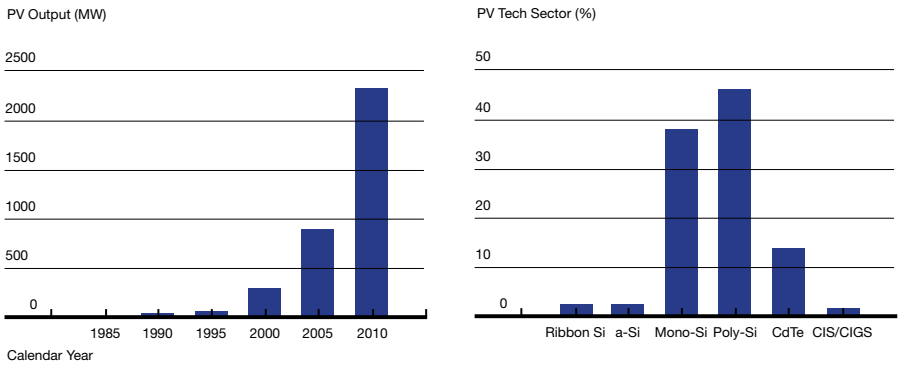
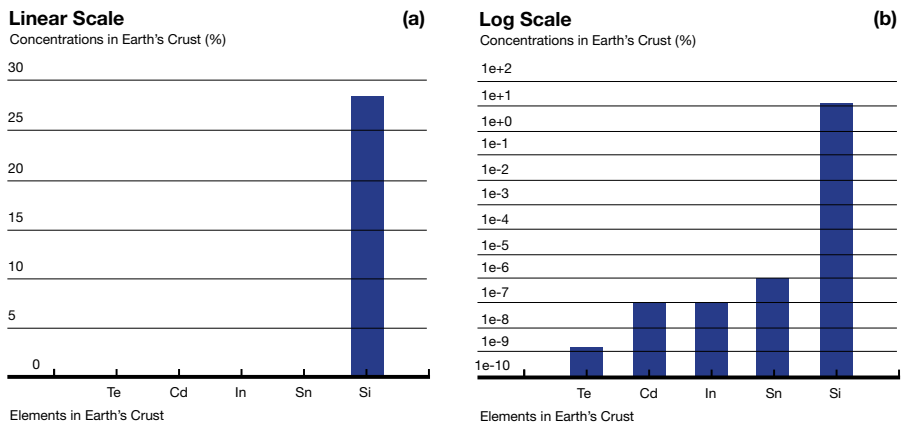


Figure 9

Concentrations of key elements in manufacturing of thin-film and crystalline PV technologies plotted on linear scale (a) and logarithmic (b) scale.



Crystalline Silicon Supply Chain

Figure 10 schematically draws supply chain of the c-Si PV technology. The first step is production of metallurgical grade Si through chemical reactions between high-purity coal and silica (either in the form or quartz or sand)[37]. At high (~ 2000 °C) temperatures, silica (SiO2) reacts with carbon (C) to form SiC, SiO react with C to form Si and CO; liquid, metallurgical Si is thus extracted from the bottom of the furnace. Approximately, eleven to fourteen MWh of electricity energy is consumed in producing 1 ton of metallurgical grade silicon[38].

Metallurgical Si (~ 98 % purity) must be further purified for semiconductor and photovoltaic applications. Most of these silicon purifications processes are based on chlorine. In this purification process, Si chemically reacts with chlorine to form trichlorosilane from which highly pure poly Si is synthesised[39]. Other applications of metallurgical Si are in Al alloys[40] and plastics[41].

Purified Si (99.99999999) also known as Si feedstock is the starting raw material for both IC and solar industries[42]. Fig. 10 identifies both mono and poly Si processes for wafer manufacturing. High purity Si feedstock is placed in a quartz crucible. The entire assembly is melted and slowly raised as it rotates to form single crystalline cylindrical ingots based on CZ process (Fig. 11)[43]. Typical ingot diameters are in 4-12 inches with lengths over six feet[44]. These ingots are subsequently sliced into wafers for IC and solar cell manufacturing. In the poly Si wafer manufacturing process[45], large ingots or bricks of multi- crystalline (mc) orientations are solidified

Figure 10 Si-based PV technology supply chain.

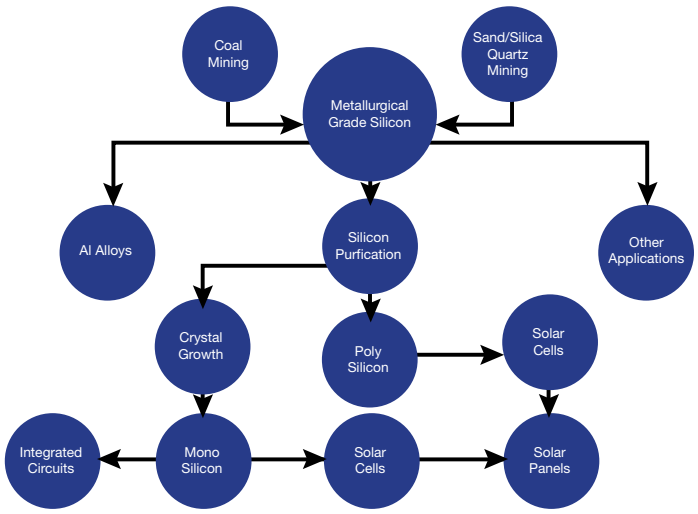


Figure 11

Monocrystalline Si growth using CZ process (left), typical crystal growth equipment (centre), and example of a fully-grown mono-Si ingot (right).

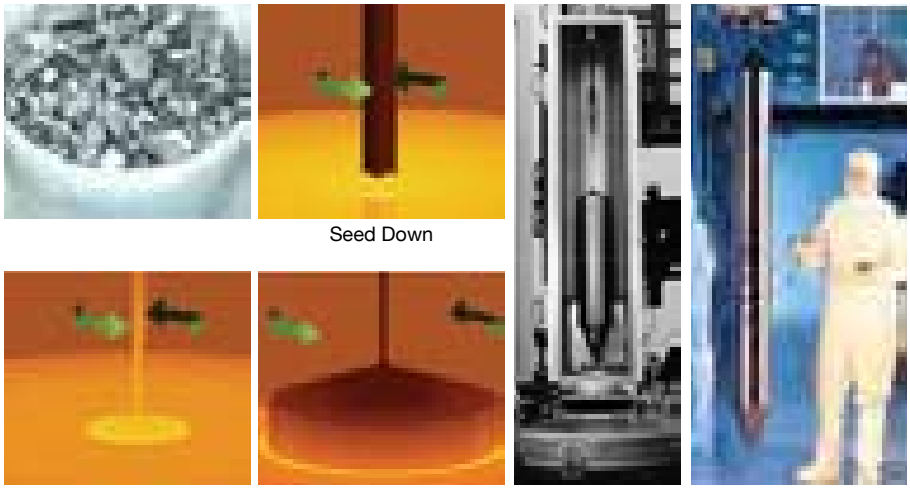


Figure 13

Silicon cost as a function of its purity

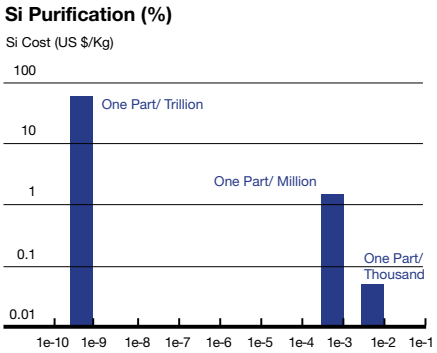


Table 3

Si requirement and revenue generation

Efficiency (%)	Watt/ gm	Si Required (Kg)	Si Cost (US $)
15	0.3218	4.66×10^9	233 billion
18	0.3863	3.88×10^9	194 billion
21	0.451	3.33×10^9	166 billion

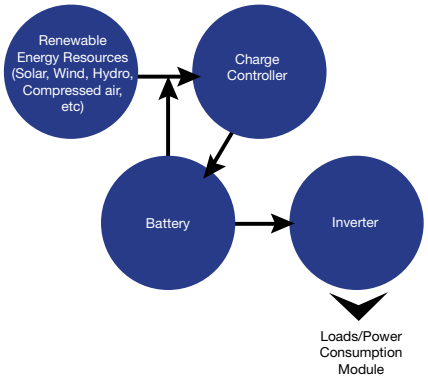
in a quartz crucible. These bricks are subsequently sliced to form mc-Si wafers for processing into Si solar cells; this is the only application of poly-Si wafers. Solar cells based on either mono or poly Si wafers are then packaged into solar panels. Solar panels are subsequently arranged into electricity generation systems; the simplest configuration has been drawn in Fig. 12[46]. In view of the intermittent nature of sunlight-based electricity generation, system design is based on the use of batteries as the constant source of electricity; solar panels are used to charge batteries. A dc to ac inverter is used to deliver power to customers.

Economic Benefits of Investment in Silicon

Silicon solar cell industry has been growing at average rate of ~ 20 % over last 20 years (Fig. 8, left). When fossil-depletion and green house effects are included in analysis, the solar cell-generated electricity requirements are expected to exceed all growth projections. Figure 13 plots

Figure 12

Basic configuration of a renewable energy based electricity generation system.



the average prices of semiconductor materials in the solar manufacturing process[47]. Materials cost vary over four degrees of magnitude varying from ~ $ 0.1/Kg for silica to ~ $ 1000/kg for electronic grade wafers. Therefore, through processing of an inexpensive, readily available material, extremely high and sustainable economic benefits can be realised.

Si mass and cost required for generating energy of 1.5 E12 W have been calculated in table-3. Energy generated per gram of Si is calculated for a 200-µm thick crystalline solar cell. Silicon in excess of 4.66 billion kg is needed. Assuming US $ 50/Kg, this comes out to be about US $ 233 billion for 15 % efficient solar cells. Approximately 10

million tons of quartz will be processed to produce this much Si[48]. Current purified Si production is ~ 5E9 kg/year; most of which is used for integrated circuit manufacturing. Therefore, a doubling of current purified Si would be enough to meet our energy requirements. Note that even one percent of the purified Si market will be worth about US $ 2 billion.

CREATION OF INDIGENOUS PV TECHNOLOGIES

Silicon solar cells, based on photovoltaic effect, were first fabricated in the early 1950s[49]. Since then, the growth of PV technologies aimed at sunlight to electricity generation has been truly phenomenal. However, world-wide generation of PV electricity has yet to realise its early potential to meet our growing energy demands. Principal factors responsible for slow replacement of carbon-based fuels by Si-based fuels have been summarised below.

i. Stiff competition from fossil-fuel technologies operating at lower costs,
ii. High energy conversion and capital cost per kWh of PV technologies, and
iii. Inherent intermittent nature of sunlight requires investment in storage systems to provide continuous energy.

It is expected that the competition from non-Si resources will continue to inhibit PV growth; however, it will eventually be eliminated through depletion of fossil fuels and environmental degradation from greenhouse emissions. At the same time, it is necessary to understand the fundamentals of the PV technology in order to fully realise its potential.

Crystalline Si PV technology requires processing of Si wafers into solar cells. In contrast with ICs fabricated on Si wafers, a solar cell is a pretty simple structure; essentially a large area diode[50]. In this basic configuration, sunlight enters the cell from the top front surface. An internal electrical field separates the light-generated current, which is collected by the metal contacts at the top and bottom of the cell and transferred to an external circuit. In order to simplify solar cell manufacturing, the authors have designed and implemented a simplified manufacturing process drawn in Fig. 14[51-56]. In this simplified design, solar wafers are cleaned and textured to reduce surface reflection. Surface properties are evaluated through simple spectral reflection and minority carrier measurements. Textured wafers are diffused to form n-p junctions followed by screen printing and annealing to extract photo-generated current from the solar cell. Completed solar cell response is evaluated through LIV, spectral response, sheet resistance, and electrical contact resistance measurements. All of the characterization and manufacturing equipments have been designed and built using simple, low-cost methods easily adaptable for indigenous manufacturing. Figure 15 shows pictures of the front and back surfaces of the solar cells, its microstructure, and the simple LIV measurement system to evaluate solar cell efficiency. This approach has been used to fabricate solar cells in ~ 15 % efficiency range; higher efficiency is limited by the quality of the starting material[57].

A similar approach has been developed by the authors to manufacture solar panels[58-60]. Figure 16 schematically draws principal steps in manufacturing of a solar panel. Solar cells are tabbed and connected into series using simple equipments shown in Fig. 17. The strings of solar cells are combined to form complete panel circuit. Simple current-voltage measurement under a suitable light source is used to evaluate suitability for lamination. Panel is laminated using commercially-available vacuum laminator. Post lamination testing for cracks or damages is carried out through a combination of light source and telescopic visual enhancement. Laminated

Figure 14 Simplified process for manufacturing and characterization of c-Si solar cells.

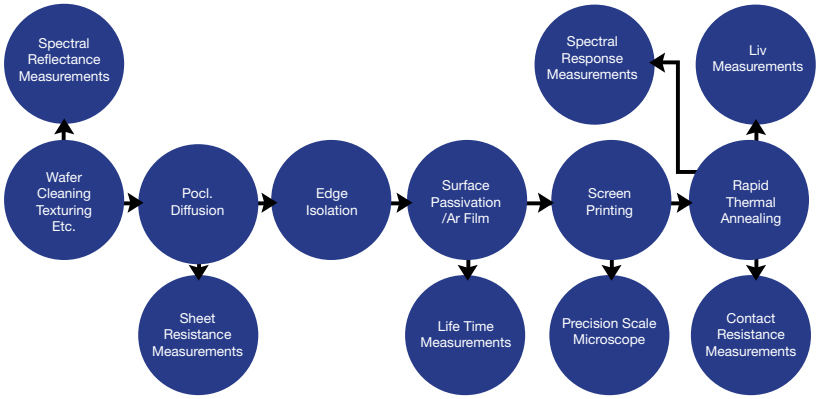


Figure 15
Six-inch round crystalline Si solar cell, front and backside metal contacts, its microstructure, and the LIV characterization system.

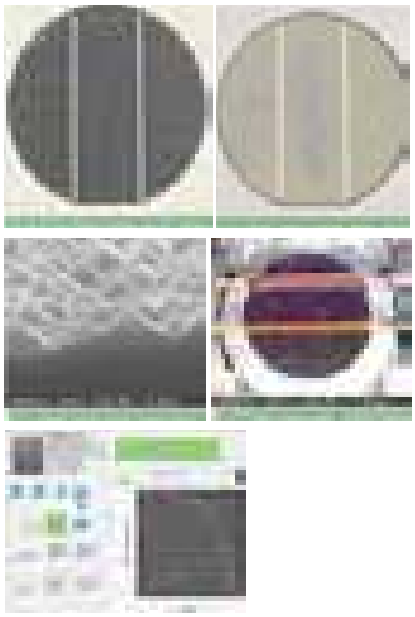
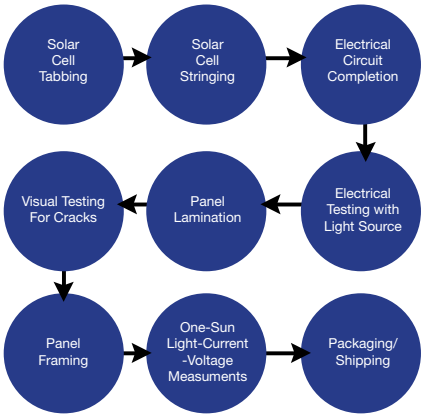


Figure 16
Simplified schematic diagram for manufacturing of solar panels.



panels are framed and LIV tested using simple semi-automated testing equipments. Figure 18 shows pictures of solar panels and their LIV measurements. Solar panels manufactured through this process have achieved ICE certification[61].

Integration of solar panels into an electricity generation system based on the principles described in Fig. 12 is straightforward. Figure 19 shows a schematic diagram of a simple 300 W panel-battery backup system designed to power a light source, an evaporative cooler, and a water fountain.

ENVIRONMENTAL IMPACT OF PV TECHNOLOGIES

Long-term sustainability of PV technologies will require evaluation of their impact on environment. A brief overview of impacts of large scale PV technologies on environment is briefly discussed below.

Cadmium Environmental Impact

Cadmium is the key element in CdTe thin film solar cells. It is considered hazardous for humans. The most dangerous form of occupational exposure to cadmium is through inhalation of fine dust and fumes, which can result in pneumonitis, pulmonary edema, and death[62]. Cadmium is also an environmental hazard. In the case of CdTe solar cells formed through the vacuum sputtering process, the residues left in the metal and vacuum pumps pose very serious health hazard for workers. Cadmium is one of six substances banned by the European Union's restrictions on hazardous substances (RoHS) directive which bans hazardous substances in electrical and electronic equipment but allows for certain exemptions and exclusions from the scope of the law[63]. The supply and use of cadmium is restricted in Europe. Although there is no danger of Cd exposure during the operation of a CdTe solar panel, the recycling of non-functional panels would require stringent safeguards, i.e., they can't simply be disposed into a landfill.

Tellurium compounds are considered to be mildly toxic, need to be handled with care, although acute poisoning is rare[64]; Te is not reported to be carcinogenic

Water Usage

Excessive water use in PV manufacturing is considered a negative impact on environment. In Si PV technologies, it has been estimated that a million gallons of water are used for each MW of production; this figures includes all PV technology sectors[65]. Extensive research efforts aimed at recycling, reduction of water usage, and in some cases, its complete elimination will help make Si PV technologies more environment friendly.

Economic Benefits of Indigenous Si PV Manufacturing

Comparative analysis of thin-film and c-Si PV technologies shows that while thin-film technologies have role to play, their long-term sustainability in terms of supply chain, environmental impacts, and efficiency improvements is not clear. Their long-term track record in comparison with c-Si has also not been demonstrated either through accelerated testing or by other suitable means. Si PV technology appears to be the only long-term sustainable option. Investment in Si PV creates a technology infrastructure that spans over many fields and has the potential of becoming indigenous. The investment in thin-film PV, in contrast, leads to a centralised facility with all imported equipment, most supplies also imported, and the workforce is not trained in technology basics.

Figure 17

Tabbing and stringing of solar cells using simple equipments.

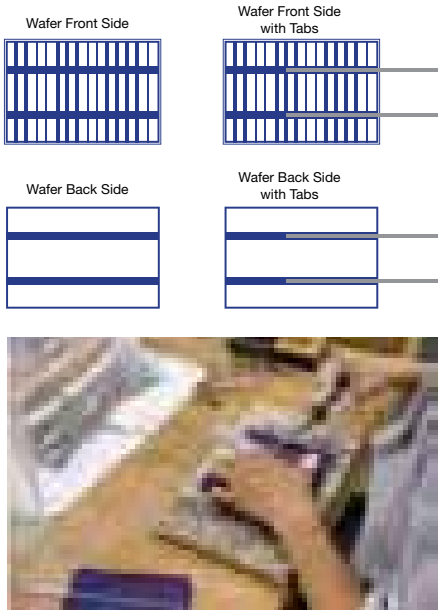
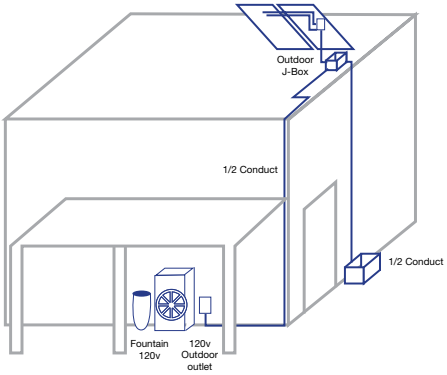


Figure 18

Conventional thirty-six and seventy-two solar panels and their LIV characterization based on equipments and processes described above.

Figure 19 Simple 300 W solar-panel, battery-based electricity generation system.



experts' insights

The solar cell production may be understood in terms of two extremes: the small scale cottgare industry or μ-solar franchies with output in 1-5 MW range and large scale macro-solar with output in ~ 20-100 MW range. Simplified methods for fabrication of solar cells can be adapted towards industrial manufacturing. This can be better understood through a simulation of PV output by making the following assumptions:

i. Mono-crystalline (100) wafers,
ii. 180-200-μm thickness,
iii. 16 % to 18% efficiency, and
iv. 24 hour, year round continuous operation.

Figure 20 plots the PV output as a fucntion of wafers processsed per hour for efficiencies in 16-18 % range. Several conclusions can be drawn including:

i. Output dependence on cell efficiency is critical only at extremely high outputs,
ii. High outputs > 20 MW require full automation due to very high wafer/hour processing, and
iii. Low outputs < 5 MW, simple, manual and semi-automated operations are possible due to considerably lower wafer/hour requirement.

The inset in Figure 20 also plots the enlarged version of the μ-soalr franchise. While the opeartion of a μ-solar franchise is a combination of manual, semi-automated, and fully-automated equipments, the macro solar must necessarily depend on full automation to achieve high throughputs. Table-4 provides a qualitative comparison of μ-solar and macro solar franchises. In almost every category except marketing, μ-solar franchise is more beneficial. Since, the starting capital costs for tyical μ-soalr franchises are 10-15 times lower than a macro ranchise for the same output, this approach reduces the entry barrier for new players, and perhaps, most importantly, it makes it possible to make PV tecnology indigenous. This approach is modular in nature, therefore, capacity extension is simply a matter of adding additional lines, or creating another franchise.

The ability to grow Si wafers significantly impacts the success of μ-soalr franchises since it is the most critical element in the process, and if not produced locally, it will be expensive. Therefore, any long-term investment in PV technology must inlcude Si wafer growth in the first phase, and Si purification in the second phase. Considering the integrated circuit related applications of this technology, such investments will pay for themselves in very short time frame.

SUMMARY AND RECOMMENDATIONS

Growth of PV technologies will critically impact our future social and economic growth. It is apparent from the analysis carried out in this paper that c-Si PV technologies offer the only long-term sustainable option for renewable generation to meet our energy requirements. Si PV technology is particularly desirable when considering the following factors:

i. A solar cell is just a large area diode,
ii. Manufacturing model based on cottage industry approach, and
iii. Substantial reduction in energy conversion cost ($/W) is achievable.

However, in order for this vision of indigenous PV technologies to be realised, several steps must be implemented, most critical are listed below.

i. Investment in PV technology infrastructure (education, manufacturing, and infrastructure),
ii. Development of energy-based curriculum from school level,
iii. Investment in PV technology creates economic growth, and
iv. Government commitment to provide electricity for all citizens.

Conventional wisdom suggests that manufacturing scale is the key requirement for cost reduction. This model has worked very well in IC manufacturing industry where costs of computers have kept low while their functionalities have continued to grow. The economies of scale have worked in IC industry because of extremely high value-added cost of the integrated circuit devices. In contrast, the value of a Si wafer appreciates by a factor of 2-3 by the time a solar cell is completed. Therefore, it makes more practical sense to reduce start-up capital costs and make technology more affordable in order to

Figure 20 PV output as a function of wafers processed for efficiencies in 16-18 % range.

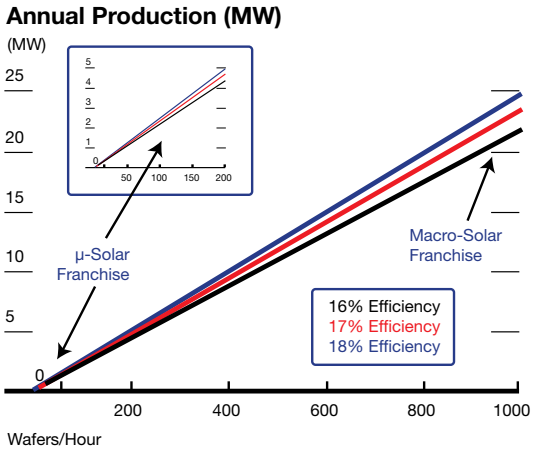


Table 4 Comparative Evaluation of Micro And Macro Solar Franchises

Description	Capital Investment	Jobs	Million /Job	Education Benefits	Insfrastructure Development	Quality of Life Impact
Macro-Solar	3-5 times higher than x	3-5 times lower than y	0.1	Insignificant workers are trained in a compartment -alized manner	Minor, most of the times suppliers and vedors are from overseas	Negative, localized job concentration, large factories with jobs contribute to urban sprawl
μSolar	x	y	0.035	Major, requires development of trained manpower	Major, requires local suppliers	Positive; decentralized job growth

reduce costs and incorporate human innovation. The large scale production model supported by multi-national companies will limit technology access through high entry barriers and limit innovation in order to meet production targets, In contrast, small scale franchises distributed across the land will lead to decentralised power generation, reduces migration from rural to urban areas, and help enhance social life and education at remote locations.

In the final analysis, when considering PV technology, following factors must be taken into account:

i. PV Technology is Special in its unlimited potential to solve our energy problems,
ii. It is needed most by poorest of the poor,
iii. As currently configured, it is expensive,
iv. To meet worldwide energy requirements, PV technology must become indigenous, and
v. PV technology must evolve into cottage/community industry.

As transition from carbon-based energy resources to Si-based energy generation is achieved in the 21st century, a Paradigm Shift as Fundamental as that from coal to oil in 20th Century will be realised. The paradigm shifts that most of us are already familiar include cell phones versus land-based line phones, and satellite TV systems.

Comparative analysis of thin-film and c-Si PV technologies shows that while thin-film technologies have role to play, their long-term sustainability in terms of supply chain, environmental impacts, and efficiency improvements is not clear.

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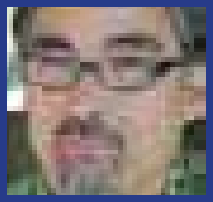

BY
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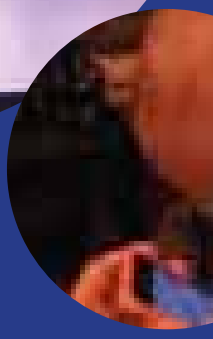
In the spirit of earlier talks that started with an activity, I want everyone to open up your laptop, iPad, or smartphone, and check your email. While you're doing that, take notice of something: Are you holding your breath? You probably are. Almost everybody holds their breath when they check mail, and almost nobody realizes it. It's a small thing, but every time you do it (and think about how often your check your mail) CO^2 builds up in your bloodstream, your body interprets that as a warning, and your anxiety level goes up a little. Your fight or flight reflex switches on.

This often feels like an inevitable state of affairs; and indeed, plenty of people will tell you that it is. Historians of media argue that every new information technology since the invention of writing has been followed by dramatic, sometimes disorienting, shifts in learning and cognition – and we just happen to be living through the latest.

More recently, neuroscientific explanations for our addiction to technology have become popular. We learn to crave the dopamine shots that come when a new text message arrives on our smartphone.



experts' insights

tive Computing

An ancient, subconscious physical system accidentally triggered by a modern technology illustrates how complicated – and problematic – our relationships with information devices have become. Most problematic is that we live in an age of information that often feels like an age of distraction. Technologies that were supposed to help us think better, work more efficiently, and connect more meaningfully with others now interrupt us, divide our attention, and stretch us thin.

I argue that this condition of perpetual distraction is not inevitable. Technologies often seem to be rational, efficient products of impersonal historical processes. They do a great job of hiding space for contingency, choice, and human agency, but they can never destroy it entirely. I want to bring that space back to the surface of our relationship with information technologies. I want you to see that by thinking about your mind and how it interacts with your devices and the Web; by understanding how information technologies change the way we think about ourselves; and by applying some very old ideas to this problem, you can retake control of your digital world, and expand your attention, your ability to focus, and your creativity.

experts' insights

4 Big Ideas

I call this approach contemplative computing. That sounds like a contradiction or oxymoron, and in today's world it is; but it doesn't have to be. Contemplative computing differs from things like "cloud computing" or "ubiquitous computing," that describe technical constellations or capabilities. Those are things you can buy. Contemplative computing, in contrast, is something you do. I'll highlight four big ideas that help you do it

EXTENDED SELVES AND CONTEMPLATIVE PRACTICES

1 *The first big idea is that our relationships with information technologies are incredibly deep, and express fundamental human capacities.*

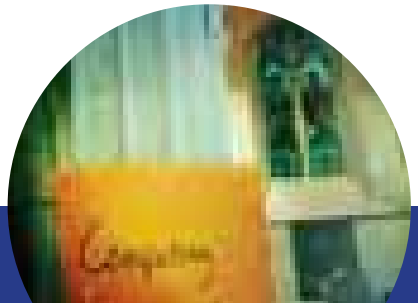
Andy Clark, a philosopher and cognitive scientist at Edinburgh University argues we're "natural born cyborgs," forever seeking to extend our minds through technology. This is so, continues Clark, because the "mind" is not confined to the brain, or even to the body.

It's more useful to think of ourselves as having "extended minds" made up of a network of brain, senses, body, and objects, a network around which different cognitive functions can migrate, be shared, or be outsourced. (Quick example: if you're like me, you haven't memorized a phone number since you got a smart phone.)

The extended mind model is valuable because it helps us see what's at stake when our relationships with technologies go bad. Today's information technologies, I contend, cause us pain not because they're supplanting our normal cognitive abilities. These have always been flexible, and it's not obvious that offloading your memory for things like phone numbers and email addresses is necessarily bad.

The problem is that today's information technologies are often poorly-designed and thoughtlessly used: they're like unreliable prosthetics that we have to depend on, but can't quite control or trust. (This also highlights the limitation of things like the Digital Sabbath movement, which encourages unplugging from the Internet on a regular basis. This can be a good thing, but it's a break from the problem, not a permanent solution.)

We need those breaks because our high-tech world, in which contemplative spaces are melting as quickly as tropical forests, where work and life are becoming more frantic, and where technologies grow more demanding and irresistible, present unique challenges.



2 *But here's our second big idea. Humans have always had to deal with distraction and lack of focus – and for thousands of years, we have been cultivating techniques that effectively address them.*

Buddhism, Zen, and many other contemplative practices have all evolved to tame what Indian teachers called "the monkey mind" – the distractible, chattering, undisciplined mind that can't focus, can't sit still, and can't achieve anything. (Sound familiar?)

Contemplative practices seem to have emerged about three millennia ago, in different parts of the world, as urbanization and the pace of civilized life quickened. In the last three decades, neuroscientists, psychologists and therapists have all observed that contemplative practices can help restore cognitive abilities – memory, attention, focus – lost to physical injury, post-traumatic stress, or chronic illness.

This suggests that contemplative practices don't just offer a way to settle the monkey mind. They can help us regain control of the extended mind as well.

REDESIGNING TOOLS AND SELVES

3 *This brings us to our third idea: that in order to change your extended mind, you must first understand how the digital world tries to change you. You have to look closely at how you interact with information technologies, and how you think about those interactions.*

Since the Victorian era, interactions with information and communications technologies – with the outer reaches of our extended minds – have influenced our mental models about technology, work, and ourselves. These models often carry unexamined, and damaging, assumptions.

An ancient, subconscious physical system accidentally triggered by a modern technology illustrates how complicated – and problematic – our relationships with information devices have become.

To take but one example, we normally equate intelligence with speed: in English, we say that someone is "a quick study" or a "fast learner." By this standard, computers are getting faster, cheaper, and more powerful, while we're stuck with the same brains as our ax-wielding, cave-dwelling ancestors.

But this comparison obscures the fact that even though we use similar terms for them, computer and human intelligence are actually very different things.

We don't get smarter through physical changes to basic brain structure; from the Neolithic period on, cognitive archaeologists tell us, cultural evolution and increasing intelligence have been driven by increasingly complicated interactions with material environments. Our experiences with computers have recalibrated our ideas about human work and intelligence, and led us to value such computer-like qualities as efficiency, speed and productivity over human qualities of creativity, deliberation and thoroughness. But knowing about such effects can let us resist them.

4 The fourth big idea in contemplative computing is that you can redesign your extended mind. How do you go about doing this?

One thing to do is to self-experiment. Self-experimentation is just what it sounds like: the systematic observation of your own physical or psychological reactions to specific interventions. Self-experimentation, in its general aims and emphasis on pragmatic tinkering, can be seen as a personal version of the do-it-yourself [DIY] movement, which encourages users to experiment with technologies, adapt them to better suit their own needs, and think about what makes devices really useful.

Meditation is an especially powerful kind of self-experimentation (one biographer of the Buddha wrote that he treated himself as a laboratory where he conducted experiments on the mind), but you can also self-experiment with different ways of using information technologies and workflows.

This kind of self-experimentation generates long-term data series that are unique, and cannot be gathered by traditional user studies or focus groups. Self-experimentation is also a reminder that only you have the knowledge and ability to redesign your extended mind.

Likewise, it's good to tinker with devices and practices, to see how they can be improved to work better with you. Tinkering is a pragmatic, improvisational approach to technologies that emphasizes flexibility, rapid learning, and practicality. It's not about just memorizing the manual; it's about getting under the hood and creating your own knowledge about a technology. This gives tinkering a playful, engaging aspect that some describe, in a nice coincidence, as "Zen-like."

Self-experimentation and tinkering are complimentary strategies for redesigning your extended mind. Self-experimentation starts with you – with the center of your extended mind – and works outward; tinkering starts with technology – with the edges of your extended mind – and works back.

Over time, you'll learn to notice details of technology use that you hadn't before (like holding your breath when you check your email); understand where they come from; and experiment with solutions that work for you.

You'll get better at figuring out how to adapt new devices to suit your life – not by following abstract ideas about productivity or efficiency, but by shaping devices to fit you.

Distractions actually become less appealing, as the inherent pleasure of attention – of being able to focus your mind where you want – replaces it.

And in the course of becoming more contemplative about technology, you become more contemplative while using technology.

CONCLUSION

It's important to conduct these kinds of experiments, and to learn how to create extended minds that support contemplation, right now – because the problem of technology-accelerated perpetual distraction is only going to get worse.

I don't think anybody here will have any trouble imagining a world in which every built object has a unique digital fingerprint, and anything of value can have its own Internet address. Add inexpensive flexible displays that make any room into Times Square on New Year's Eve. Just for fun, top it off with cheap cameras and sensors that make it trivially easy to document every second of our lives.

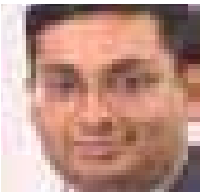
Then mix in online games, nano-niche advertising, location-based services, surveillance analytics, real-time social media, software agents and telemarketers. Now imagine all of these competing to capture, commoditize, and resell our attention, immersing us in a bath of related content, friend requests, status updates, reviews, recommendations, ridiculously huge offers, daily deals, and instant alerts. Whether we want it or not.

If we're not thoughtful – if we're not contemplative – this could be the world in a decade. But it doesn't have to be that way. Future technologies can be designed to cultivate attention, or to commoditize it; to preserve our powers of concentration, or to waste them.

It's said that in life, pain is inevitable but suffering is a choice. In other words, we cannot escape death and loss – they're a part of – life, but we can shape how they affect us. I would argue that our entanglement with information technologies is inevitable. But if we understand how our extended minds work, how our devices try to program us, and how contemplative practices can help us remake our extended minds, then distraction can be a choice.

It's more useful to think of ourselves as having "extended minds" made up of a network of brain, senses, body, and objects, a network around which different cognitive functions can migrate, be shared, or be outsourced.

Research to Riches: Transforming Research to Wealth in Malaysia



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Throughout the world, research and development (R&D) remains a key priority in the national agenda of developed and developing countries. R&D has been recognised not only as engine of growth for the economy, but also a catalyst for the further development of mankind as a whole. In this article, we will examine the role of research and development as a generator of wealth for Malaysia, and also the approaches that can be taken to realise this. The challenges and possible problems that can arise in making research and development a key component of the economy are also examined.

RESEARCH IN MALAYSIA: AN OVERVIEW

The government of Malaysia has long recognised the importance of research and development as engines of growth for the economy. In our previous article, we examined research and development activities in Malaysia, with a particular focus on conducting research with outputs that were relevant to the needs of the public and able to reach the market. The reason for this is simply that research and development is a very expensive endeavour, and to conduct R&D purely for the sake of knowledge is a luxury that can be ill-afforded, especially in a developing country such as Malaysia, where funds must be allocated to the needs of the public.

Malaysia is efficiency driven economy and not yet innovation driven. This is evident from the country's ranking of 26th in the World Economic Forum competitive ranking. Furthermore, Malaysia's 5.7 utility innovations per million population in 2009 with the percentage of GDP for R&D standing at 0.64% as of 2006, which is not surprising as Malaysia is still a developing country. This infers that the goals and the priorities of the nation are still focused on the development of the nation and not primarily research and development. The question that arises now is whether or not to increase the focus on research and development, and at what cost? This requires prioritization by the nation, where subsidization or expenditure for the research and development can be balanced with subsidization or expenditure for the public or in simpler terms: to increase research output (inclusive innovation and products) without skewing wealth distribution.

Another challenge of research in Malaysia is realising actual products from research outputs. Every year, a significant amount of funding is allocated to universities and research institutions around Malaysia for the purpose of R&D activities. However, the returns from these investments by the government cannot yet be quantified. Rarely, if not at all, do the research activities carried out yield tangible results. In this regard, the cause of the problem is multi-pronged; they range from a mismatch of expectations (research outputs from the universities and research institutions do not match the needs of the industry and the public) to breakdown in communications (a lack of communications hinders the transfer of knowledge) and even different areas of contention (knowledge vs. profit). In order to move towards an innovation drive economy, this key stumbling block must be overcome.

For Malaysia to progress towards its ultimate goal as a developed nation by 2020, immediate attention must be given towards resolving the current challenges of research commercialisation, lest it become a metaphorical 'white elephant' in the economy of the nation. But addressing this problem is not easy. There is no single solution, no magic formula. It requires a concentrated effort between the government, academia as well as the industry and the general public. It will require cooperation, understanding and a lot of 'give-and-take'. There are two main areas which must be given attention in order to realise research and development as a contributor to the economy of the nation for the future, namely funding and market support.

TRANSFORMING RESEARCH TO WEALTH: THE NEED FOR FUNDING

As the old saying goes, it takes money to make money. In the world of research and development, this adage holds especially true. Numerous studies have shown that adequate funding is a critical factor in seeing the successful commercialisation of research outputs. A 1973 survey by Norris & Vaizey shows that research and development phases account for between 15 to 30% of the commercialisation of a product. Traditionally, funding for research and development activities can be procured from a number of reliable sources, such as universities, research institutions and industry partners. Further funding to take research outputs to the product level can be obtained from angel investors and venture capitalists, but in a country like Malaysia where there are no angle investors, the government would fulfil this role. However, this sort of funding is not easy to come by, and as a result much of Malaysia's research outputs, which have a high potential for becoming products, cannot be commercialised. Specifically, the problems being faced in procuring funding are:

- Lack of pre-seed and seed funding, market funding and prototype funding;

IT HAS LONG BEEN RECOGNISED THAT RESEARCH OUTPUTS CAN ONLY BE SUCCESSFULLY COMMERCIALISED WHEN RESEARCHERS WORKS CLOSELY WITH MEMBERS OF THE INDUSTRY, END USERS, SUPPLIERS AND CUSTOMERS.

- A serious lack of funding to support private sector research and commercialization;
- No angel investors;
- Poor venture capital availability, with almost no private VCs
- Lack of support from traditional banking sector for new start-ups.

In order to overcome these limitations, a number of steps can be taken:

- Pre-seed and seed funding can be obtained by streamlining the current research funding available from the government. The government is the primary source of funding for research and development activities in Malaysia, but the availability of current funding is somewhat skewed purely towards research, with little funding available for commercialisation activities. The government can take measures to streamline the available funding so as to put a focus on research that can be commercialised, but it would fall on the government to undertake due diligence, providing support for research which can be commercialised, and not provide funding for just any research.

- Funding and support for the private sector must be given equal importance as funding for the public sector. Research and development undertaken by the private sector has a higher chance of being commercialised as a result of the private sector's closer proximity to the actual market. As with the case of the private sector, the funding can be made available by the government, but again due diligence must be taken to support only viable and responsible research activities, which will give a return to the government's investment.

- Angel investors and poor venture capital can be enticed to provide more funding in Malaysia by introducing incentives and support such as tax breaks, easier access to local markets, etc. The same approach can also be taken with the banking sector, providing them with better incentives and support so as to make it easier to obtain funding for various commercialisation activities.

BRINGING RESEARCH TO THE MARKET: THE NEED FOR COLLABORATION AND LINKAGES

It has long been recognised that research outputs can only be successfully commercialised when researchers works closely with members of the industry, end users, suppliers and customers. The success of the Taiwanese company HTC is proof of the need for this close collaborative effort. In Malaysia, the need for collaboration has been demonstrated by Chandran et. al. in 2009, and although somewhat successful, it is still limited by a number of factors. First and foremost of these issues is that SMEs in Malaysia are content to remain just as suppliers, and not taking efforts to leverage from global production networks and the relocation of MNCs manufacturing activities to the ASEAN region. This lack of absorptive capacity as well as weak systems of knowledge assimilation, due to lack of human capital development result in a majority of the country's R&D output not being able to be commercialised. Secondly, the perception of industries towards universities and research institutions needs to be changed. As pointed out by Raisah and Chandran in 2009, industries do not view universities or research institutions as an important source of innovation. The reason for this could stem from a number of issues, most prevalent of which is that the industry, being objective orientated, would expect returns on R&D investments quickly. Furthermore, large organizations tend to conduct R&D solely by themselves due to wide range of issues, e.g., confidentiality, IP issues and bureaucratic processes and procedures. In fact, most foreign MNCs in Malaysia do not conduct R&D with local universities, instead relying on their home country R&D. Another issue that places a strain on the relationship between researchers and the market is the gap between the nature of R&D activities between the industry and universities or research institutes. Industries mainly involve themselves in process or incremental innovation that includes process and product improvements while universities embark in blue sky research.

Resolving the challenges of building collaborations and linkages will not be easy, but it will be possible. Among the steps that can be taken to realise the building of better linkages between researchers and their target markets are:

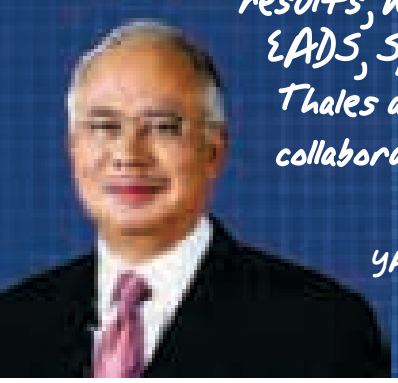
- Restructure the role of government agencies and NGOs to become better centres of collaborations. Most government agencies do play a role in seeing the transfer of knowledge and output from universities and research institutes to the market. However, in most cases the roles that these agencies play either does not suffice or overlaps with those from other agencies. The government can take up the task of streamlining the roles these agencies play to increase their efficiency and also reduce overlaps. In the same manner, universities and research institutions that have commercialisation units should take steps to streamline their roles and activities with that of the relevant government agencies. This will create a smooth linkage between all parties and facilitate a smoother flow of information and knowledge.

- There is a need to establish one-stop centres capable of disseminating the necessary information on commercialisation efforts to interested parties. A significant cause of most research not being commercialised is simply that no one hears about it. A one-stop centre would act as an information coordination centre, allowing researchers and their relevant markets to connect with each other. The same centres should also ensure and promote industry sponsored research.

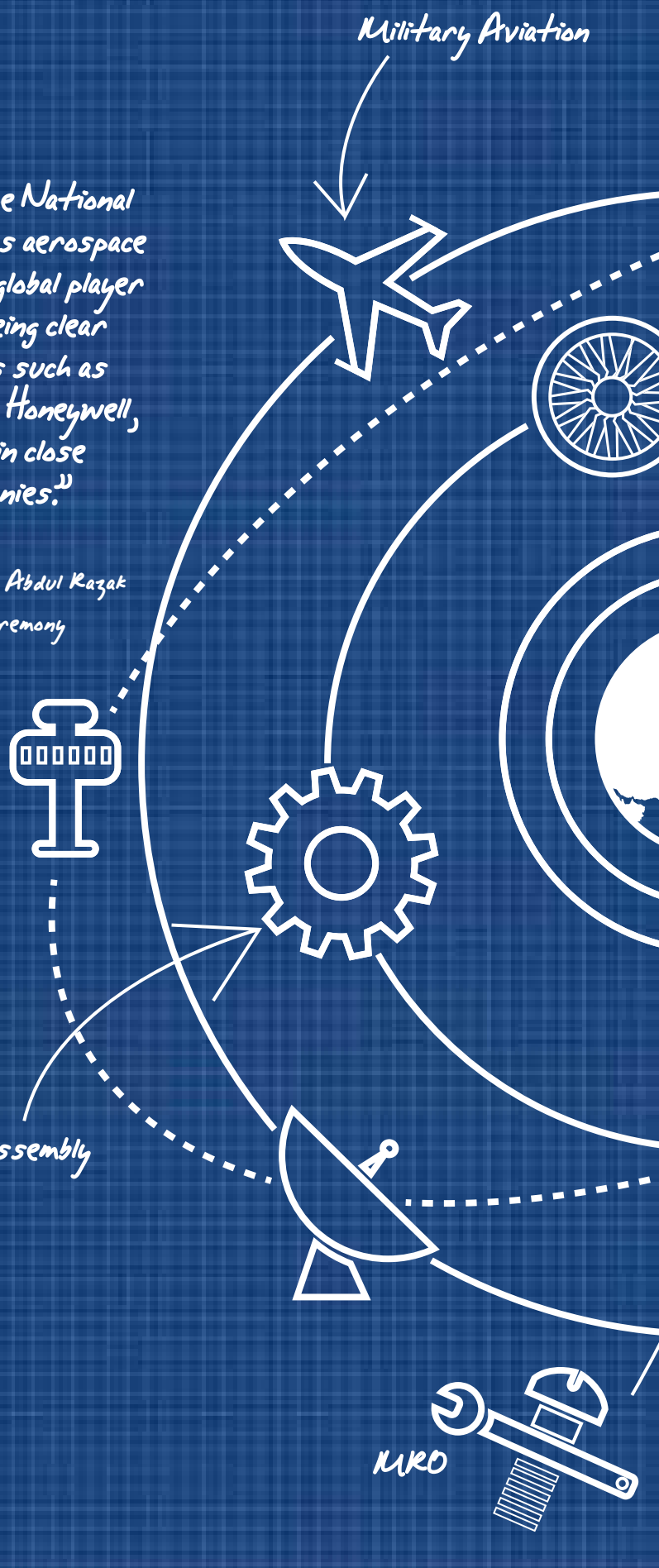
- It is necessary to have government agencies that act as monitoring stations to gauge the success of commercialisation efforts and assess the returns garnered from funding provided for research activities by the government. Every year, the government invests a significant sum into research and development, and it is necessary to obtain some form of economic return from this. Government agencies could serve as a coordination point, identifying potential outputs from research activities and selecting capable market partners for commercialisation. Doing so would create the necessary linkages that can push research outputs to the market.

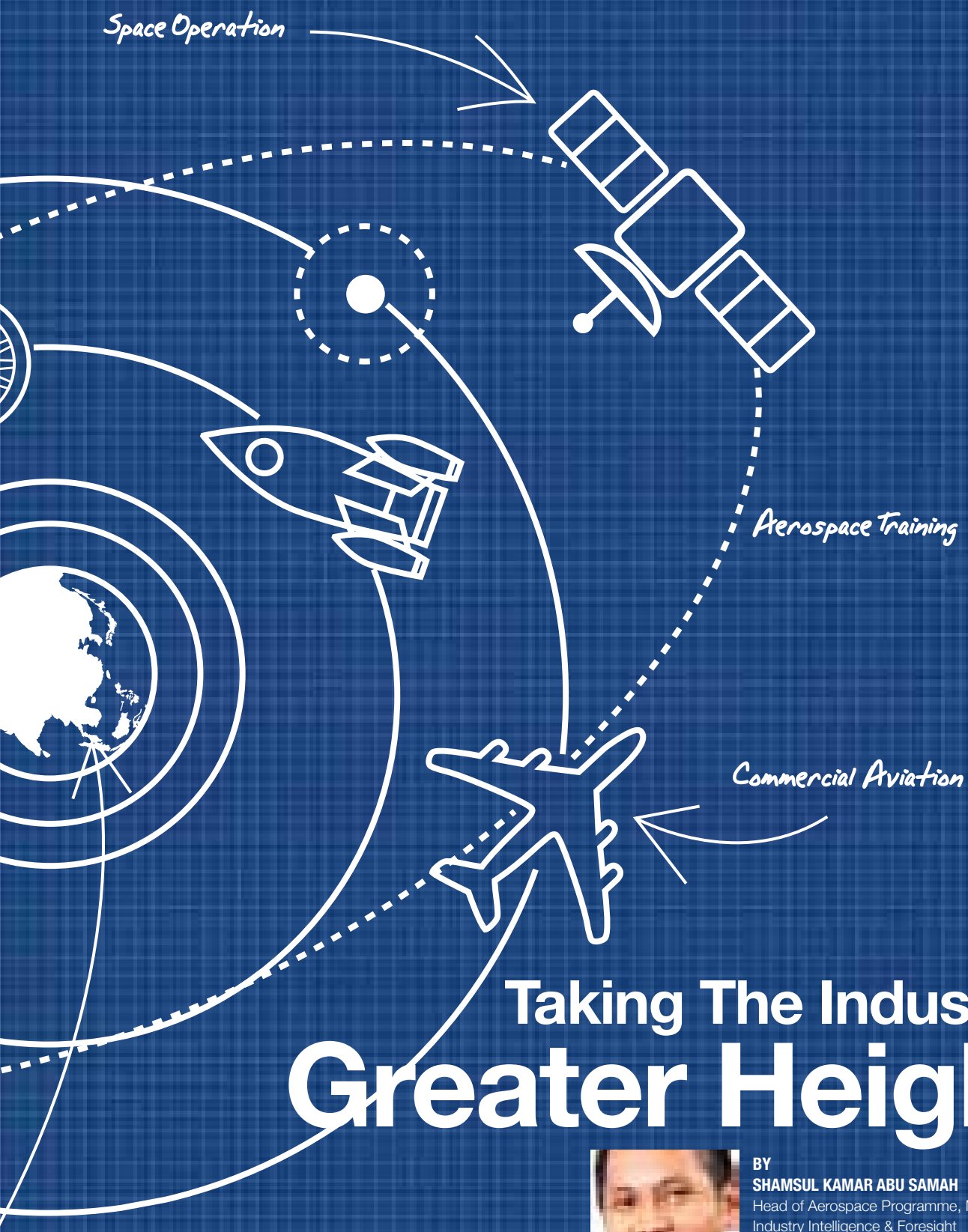
The challenge of bringing research to the market is not an easy one. Even the superpowers of the world have been known to stumble in the face of research commercialisation. But it is imperative that we do not give up, that we keep moving forward, for research, development and innovation are the means in which the future global economy will depend on. By taking those difficult but essential steps now, we are preparing Malaysia for its place in the world of the future and to truly realise the dream of Wawasan 2020.

"Here at LIMA in 1997 we launched the National Aerospace Blueprint, which set Malaysia's aerospace industry on the path to become a truly a global player by 2015. Today, 15 years on, we are seeing clear results, with international players such as EADS, Spirit Aero Systems, GE, Honeywell, Thales and many others working in close collaboration with our local companies."



YAB Dato' Sri Mohd Najib Tun Haji Abdul Razak
- LIMA 2011 Opening Ceremony





Taking The Industry to Greater Heights

BY
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The Malaysian Aerospace Industry has been developing rapidly since the early 90s. The industry is estimated to record RM26 billion turnover in 2011. This created an employment of approximately 54,000 thousand including more than 15,000 skilled and knowledge workers in various areas. Malaysian companies are now recognised as a part of the Global Supply Chain supplying aircraft parts and components to the OEMs such as Airbus and Boeing as well as leading Maintenance, Repair & Overhaul services provider to global fleets.

This positive development has been contributed mainly attributed to clear National mission and vision including the continuous support from the Government, Industry and Academia. The achievement is a testimony to the successful implementation of the National Aerospace Blueprint (NAB) launched in 1997 by the Prime Minister. The Blueprint provides a strategic gateway to position Malaysia as a technological competent and competitive nation, in preparation to become a global aerospace player by 2015. It laid out 45 recommendations covering aerospace manufacturing, commercial aviation, general aviation, systems and space.

THE MALAYSIAN AEROSPACE COUNCIL

The Malaysian Aerospace Council (MAC) established in 2001 and chaired by the Prime Minister, as one of the key recommendations of the Blueprint, has become the only national level steering body dedicated to the development of the aerospace industry in Malaysia. The objectives of the Council are focused or providing:

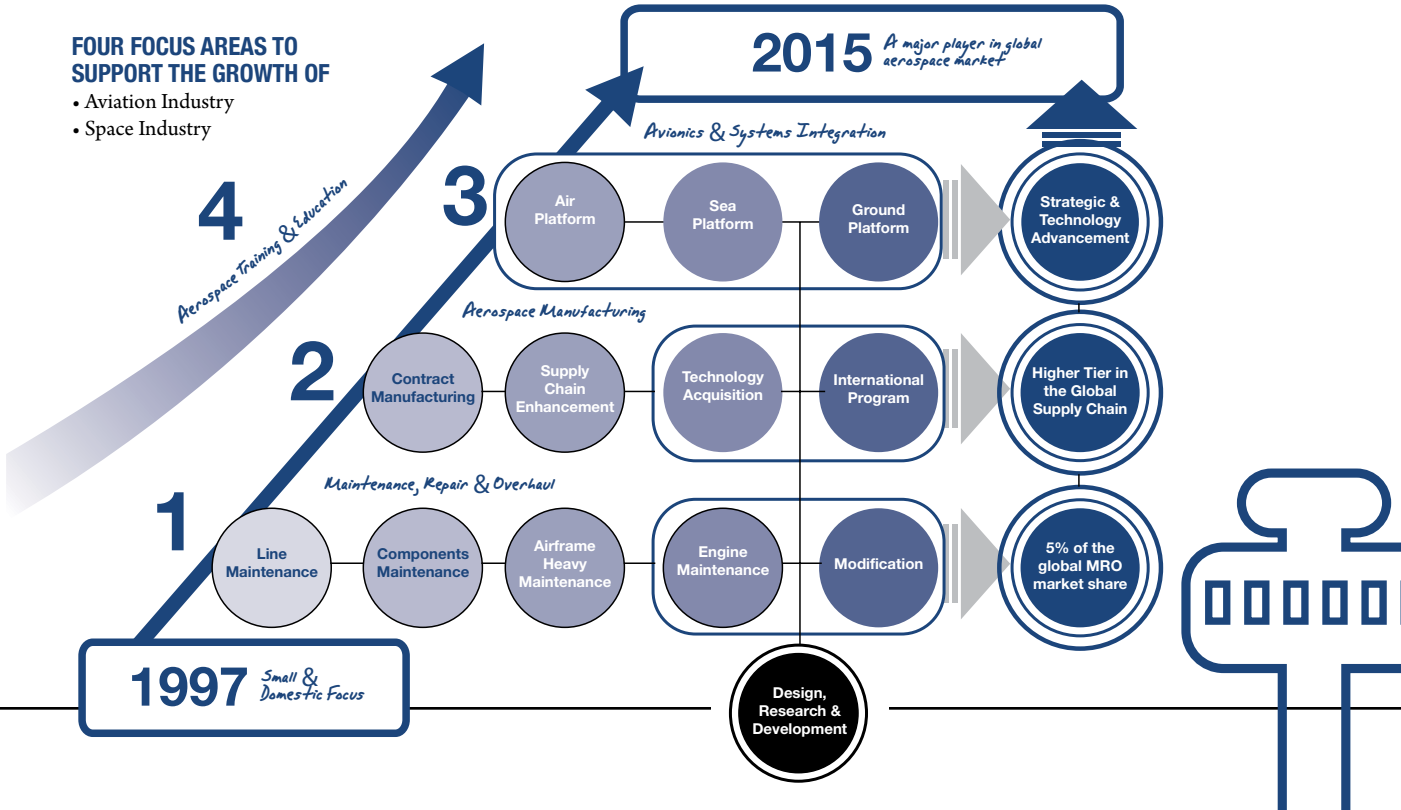
- vision, direction and the overall development plan of the national aerospace industry
- policy guidelines and identify priority areas of aerospace activities

The Council also monitors the implementation of the actions plans including the rationalisation on the development of the Malaysian aerospace industry. In 2001, the Council decided that Malaysia should focus on the niche capitalize that Malaysia's strengths, namely:

- Maintenance, Repair and Overhaul
- Parts and Components Manufacturing
- Systems Integration and Avionics
- Aerospace Training and Education

In line with the recommendations of the NAB, a numbers of National Programs has been introduced as the catalyst to development the 4 focus areas, i.e. :

- Converting the former Subang International Airport into the Malaysia International Aerospace Centre (MIAC) to be developed as a regional MRO hub
- MRO Action Plan
- Preparing Malaysia for the Next Generation Aircraft Program
- Establishment of Aerospace Malaysia Innovation Centre (AMIC)



- Bridging Program (Human Capital Development) on Aerospace Design & Engineering
- National Unmanned Aerial Vehicle (UAV) Program
- System Integration Capability Development Program
- National Satellite Development Program

The Government has further introduced few other initiatives for the aerospace industry through the Economic Transformation Program (ETP) whereby Two Entry Points Projects (EPP) are implemented under Business Services. The first project known as "EPP1-Growing the MRO Services" is led by MAS Aerospace Engineering while "EPP5-Growing Large Pure Play Engineering Services" is led by Strand Aerospace. Through these initiatives, it is expected to contribute RM16.9 billion of GNI in 2020 and create approximately 32,200 jobs.

MIGHT, THE NATIONAL AEROSPACE COORDINATOR

At the national level, MIGHT has been mandated to serve as the secretariat to the MAC is the key agency and coordinator in promoting the development of the aerospace industry. MIGHT plays a pivotal role in the development of the aerospace industry through its significant contribution its policy inputs embedded in the National Aerospace Blueprint. In delivering its mandate, MIGHT continue to provide a neutral platform for effective co-ordination of the industry, representing the different interests of aerospace stakeholders in the country. Among its activities include among others:

- Conducting industry intelligence & market research.
- Establish & maintain Malaysian aerospace industry databases.
- Conducting specific studies on aerospace industry covering MRO, aero-manufacturing, aircraft systems integration, human capital development, research & technology, incentives, aerospace parks among others.
- Through MIGHT Interest Group (MIG) platform, consensually prepare proposals, memorandums and industry updates to be presented to the MAC.
- Monitor implementation of MAC decisions by the respective parties.
- Coordinate with relevant Government agencies on industry development activities such as promotion of aerospace investment, human capital development program, research & technology development initiative and etc.

In addition to the above MIGHT also publishes biannual Malaysian Aerospace Industry Report that serves as the official source of reference for the Malaysian Aerospace Industry. The report was first undertaken as an industry inventory exercise in 2001. It was further developed to become a comprehensive Malaysian aerospace industry database in 2003. The database has been made available online since 2007 (www.might.org.my/aironline) to provide latest industry information to public at large and the industry particularly.

MIGHT undertakes the management of aerospace-related offset program through its Technology Depository Agency (TDA) since 2004. The TDA developed Technology Database, which consolidates information extracted from market intelligence and research activities carried out by MIGHT. The database stores information about the industry sub sector list, application of the technology, name of the technologies, the current status and the prospects. The database also stores information about priority area, available resources, and market, industry and government aspirations. In addition, the database stores information about preliminary landscape evaluation and assessment on selected focus areas. The database is dynamic in nature of which information are updated continuously. From the database, the stakeholder will be able to identify suitable offset requirements and register their technology needs with Offset Program Management Office on their technology requirement deemed relevant to the capital purchase.

TRANSFORMATION OF DCA

Another key recommendation in the Blueprint is to transform the Department of Civil Aviation (DCA) into an autonomous body that will serve to spearhead the development of the aerospace industry in Malaysia. A specific proposal to transform DCA to Malaysian Aviation Authority (MAA) was tabled & approved in 4th MAC meeting in 2005.

The need for immediate implementation is also addressed under EPP1, Business Services of ETP. It is recognised that in order to build up its aerospace industry, Malaysia must improve key civil aviation regulations. Through the Ministry of Transport, DCA will be corporatised and a governing board comprising industry and Government will also be established as per the recommendation of the Blueprint.

Responding to the growth of the industry, DCA on 2 November 2010 announced the migration of aircraft maintenance licensing system from BCAR Section L to EASA Part 66 commencing January 2011 and is expected to be completed for full implementation by January 2016. The move towards EASA systems is timely as it will facilitate MRO players to fast track human capital development to cater for the growth of the MRO industry.

AEROSPACE MANUFACTURING

Prior to the launching of the Blueprint, Malaysia has embarked into the manufacturing of light aircraft led by CTRM Aviation and SME Aviation. Though the Blueprint recommended a consolidation of National Light Aircraft manufacturers, the Council decided in 2001 that Malaysia is to focus on parts and components manufacturing for both composites (CTRM) and metallic (SMEA). The rationalisation of this sub-sector has successfully positioned Malaysian companies at Tier 2 of the Global Supply Chain of which Airbus and Boeing are the ultimate customers.

In the recent years, the aerospace manufacturing has become one of the fastest growing sub-sectors. With the new investment of Spirit AeroSystems in 2009 together with the expansion of CTRM, ACM and Upeca, the sub-sector has recorded a turnover of RM0.9 billion in 2010 with a total employment of more than 4000, almost double compare to 2007. The positive growth is expected to further accelerate with the investment by Singapore Aerospace Manufacturing Group as well as new work packages secured by the existing main players.

Malaysia is actively developing its local supply chain and vendors by establishing local capabilities at tier 3 and tier 4. While encouraging local players to expand their capability and capacity, Malaysia is also aggressively promoting global players to invest in Malaysia or to establish partnership with Malaysian companies. Among the main companies that have established their operation in Malaysia are All Metal Services, Gandtrack Asia, EDAG, Strand Aerospace, Aerotech Malaysia and Composites Testing Laboratory Asia.

In addition, a larger vendor base to supply parts and components is built through the following programs:

- A400M industrial participation programs by CTRM
- The Next Generation Aircraft Program involving major aerospace manufacturing companies

- Trent 900 Offset Program
- EC-725 Offset Program
- FDI projects by Spirit Aerosystems (Europe), Honeywell Aerospace Avionics (USA) and Singapore Aerospace Manufacturing (Singapore) – i.e. leveraging on FDIs to localise the supply chain

As an effort to sustain Malaysia's competitiveness in the global arena, the 7th MAC meeting endorsed the establishment of Aerospace Malaysia Innovation Centre (AMIC) in December 2010; focusing on research & technology activities. AMIC was launched by the Prime Minister in LIMA 2011 as an industry-led collaborative research outfit involving global leaders namely EADS, Rolls-Royce and CTRM. The membership will be offered to other industry players, universities and research institutions. AMIC will focus on developing innovative technology solutions for advanced aerostructures and others involving MRO and Systems Integration. AMIC will also provide the platform for procuring as well as employing top scientists, researchers and engineers.

In addition to the above initiatives, the Government launched a new Entry Point Project known as Growing Large Pure Play Engineering Services led by Strand Aerospace. This EPP aspires to create an aerospace engineering services company that is globally competitive while attracting more high-value engineering services work to Malaysia. It is believed that the EPP has the potential to contribute an additional RM1.75 billion of GNI in 2020 and is expected to create approximately 5,750 jobs.

MIGHT through its MIGHT Interest Group (MIG) platform has established a MIG for the Composites Industry to discuss industrial development issues which subsequently lead to the establishment of Persatuan Industri Komposit (PIK) in 2010. A Composites Procurement Programme is initiated through International Conference on Composite Materials and nano-Structures (IC2MS) 2006 & 2008 (organised by Malaysian Composites Industry) and SAMPE Asia Conference 2010 & 2012 (organised by SAMPE International with the support of MIGHT and PIK). Subsequently, AMIC is anticipated to conduct R&T projects related to composite structures and materials following future procurement needs for Airbus and Boeing Next Generation Aircraft Programs.

In terms of the growth of Advanced Composites industry, Malaysia's key domestic players are now not only limited to those in aerospace, but also those in other industries such as maritime, defence & security and construction. Composite Technology City in Melaka which provides specific area for the industry to cluster is not only occupied by CTRM (aerospace) but also DK Composites (composites domes, marine craft & architectural structure) and The Armour Factory (ballistic vests & helmets).

Malaysian Composites Industry players with the support of PIK have embarked on an R&D initiative known as "Sustainable Material Development Program" that will lead Malaysia to become a Global supplier of Advanced Green Composite.

MAINTENANCE, REPAIR AND OVERHAUL (MRO)

The Blueprint has set a target that Malaysia is to capture about 5% of global MRO market share by 2015. To achieve this, Malaysia International Aerospace Centre (MIAC) was launched in 2005, in line with Malaysia's strategy to strengthen the aerospace industry's position in capturing the growing military, commercial and general aviation MRO businesses and the corporate and private air services market. The transformation of Sultan Abdul Aziz Shah Airport, Subang into an international aerospace park is geared to boost the economic contribution of the aerospace industry to the Malaysian economy.

The MIAC development plan focuses on an effort to cluster the industry as well as broaden and deepen the scope of aerospace activities by building a comprehensive network of supporting industries. Based on this intention, MIAC is ready to accommodate:

- MRO activities
- Helicopter Center
- General Aviation Center
- Aerospace Training Center
- Aerospace Technology Center
- Business Support Center

In addition to the above, MIAC also provides appropriate location for aircraft parts and component manufacturing and assembly activities, in the case where proximity to an airfield is extremely necessary. Realising the increase of interest for potential investment in Subang airport, MIAC is now being extended to include part of the Kuala Lumpur International Airport (KLIA) in Sepang.

Following the establishment of MIAC, coupled with attractive new incentive package developed for the aerospace industry, Malaysia has attracted a number of quality foreign investments in MRO. To date, foreign MRO players operating in Malaysia includes General Electric, Eurocopter, Hamilton Sundstrand, Honeywell Aerospace, Parker Hannifin, MTU, Lufthansa Technik and Agusta Westland.

In terms of commercial MRO, MAS Aerospace Engineering (MAE) has been identified by the Government under EPP1 to anchor the growth of local MRO services industry, thus develop Malaysia into a regional MRO hub. Under EPP1, the action plans include:

- improving the industry structure and regulation;
- expand geographically and into higher value-added services (bring more components and engine repair work to Subang); and
- develop MRO human capital to ensure sufficient supply of talent for the industry.

The EPP1 is targeted to build a RM13.4 billion GNI contributed by the MRO industry in Malaysia by 2020. To achieve these targets, over 20,700 jobs will be created.

In an effort to establish a Regional Aerospace Composites Repair Centre, CTRM Aviation Sdn Bhd is partnering with an MRO company to expand its business into composite component repairs while MAS is collaborating with P&W to establish Composite Repair Facility for nacelle structures.

In terms of aircraft structure upgrade and modification, MAS and AIROD has taken the lead in developing in country capabilities. MAS Engineering arm in partnership with PEMCO had successfully implemented projects on winglet modification and "Passenger to Freighter Conversion (P2FC)". In the military segment, AIROD has successfully developed its capability in stretching of C130 fuselage.

Another key recommendation under this sub-sector is to identify a very small number of selected companies as National Defence Contractors of which were identified through the implementation of RMAF Contractorisation Program in 1998. The Malaysian Industry Council for Defence, Enforcement and Security (MIDES) through MIGHT conducted a study on the RMAF Contractorisation Program in 2011 to further enhance the program. The result of the study is now being analysed by the RMAF.

"The Aerospace Malaysia Innovation Centre (AMIC), an exciting new industry-led research and technology Centre of Excellence that will drive progress in Malaysian aerospace expertise. AMIC has already brought together key global players such as EADS, Rolls-Royce and CTRM to help shape the future of Malaysian aviation, working in close collaboration with the local universities to raise not just the skills but also the global reputation of our researchers, engineers and scientists."

YAB Dato' Sri Mohd Najib Tun Haji Abdul Razak
- LIMA 2011 Opening Ceremony

In developing a National Defence Philosophy which will influence the role of aerospace development; MIDES (formerly Malaysia Defence Industry Council - MDIC) was formed in August 1999 to ensure coordinated and orderly development of the defence industry sector in Malaysia. Through MIDES, the national defence industry blueprint is currently being reviewed by Defence Industry Division of MINDEF. In promoting defence related R&D activities, the National Defence and Security Research Council was established on 11 December 2009.

AVIONICS AND SYSTEMS INTEGRATION

Avionics and Systems Integration is one of the four focus areas identified by the MAC in developing the aerospace industry. This area has the highest technology content compared to other three focus areas. As recommended by the Blueprint, there is a need for the nation to develop an industrial base involving avionics and systems integration. This however, cannot be achieved without Government intervention. Due to the nature of the technology and the cost to develop such capability, Government involvement, both in terms of financial and human resources, is inevitable.

The Government has introduced new initiatives to further develop local capabilities in avionics and systems integration to be at par with the world standard. The first initiative is to organically develop systems integration capability via the establishment of CTRM Systems Integration Sdn Bhd (CSI) in January 2010. CSI is focusing its capability development program on mission systems development and state-of-the-art conceptual models for demonstrator projects.

On another development, the Government established a consortium known as Unmanned System Technology (UST) to develop a national Unmanned Aerial Vehicle (UAV). This program has led to a smart collaboration of 3 main players namely CTRM, System Consultancy Services and Ikramatic. The Government also invested on the development of national satellite program through the establishment of Astronautic Technology Sdn Bhd (ATSB).

The next initiative is developing the avionics sub-sector through FDI. The relocation of US-based Honeywell Aerospace Avionics in Malaysia has given the country a strategic advantage to compete in this area. By securing this investment, Malaysia has the opportunity to development local supply chain and local talent to serve in the avionics sub-sector.

HUMAN RESOURCE DEVELOPMENT

At the early state of the development of Blueprint, it was realised that in order to achieve its target of becoming a Global player by 2015, Malaysia needs to quickly develop its human capital to support the industry requirements. In 2000, Malaysian Institute for Aviation Technology (MIAT) (now under Universiti Kuala Lumpur (UniKL)) was established following the recommendation to establish Aerospace Technology Institute of Malaysia (ASTIM). MIAT since then developed and will soon be expanding to a new campus in MIAC, Subang.

Recognising the need to close the competency gaps of Malaysian graduates, a training program known as Graduate Reskilling Scheme (GRS) was initiated by the Economic Planning Unit (EPU) in 2003. Later in 2005, the GRS program is parked under the Ministry of Finance and renamed as Industrial Skills Enhancement Program (INSEP) with the objective to improve graduates employability, adaptability and marketability by enhancing their skills and knowledge through reskilling program on specific technology/industry. Aviation Maintenance Engineering (AME) is one of the training programs conducted under INSEP.

The Government is also supportive of the foreign investors' need to have competent workforce to support their operations based on new technologies brought into Malaysia. As an example, following the investment of Spirit Aerosystems (a Tier 1 aero manufacturing company), Advanced Composite Training Center (ACTC) was established at UniKL-MIAT in 2009. The purpose of this establishment is to train Spirit's workforce on the required aircraft parts sub-assembly skills. ACTC is now offering specific short courses on composites manufacturing and assembly not only to the aerospace industry players, but also to the composites industry community.

In line with the Council decision to prepare Malaysia for the Next Generation Aircraft Program, a special bridging program known as "Leader in Domain Expertise for Aerospace (LEADER Aerospace)" was launched in July 2010. The main objective is to train engineering graduates to become aerospace structures Stress and Design engineers through industry collaboration between Spirit Aerosystems Malaysia, CTRM and STRAND.

MOVING AHEAD

To date, the Government through MAC has endorsed and approved the implementation of more than 75% of the blueprint recommendations. As the Blueprint is approaching to its end, MIGHT is planning to conduct foresight exercise on aerospace industry to determine the future of the industry beyond 2015. The new initiative is expected to identify new areas to be explored as well as the priority areas for the country in supporting the nation's aspiration on the New Economic Model.

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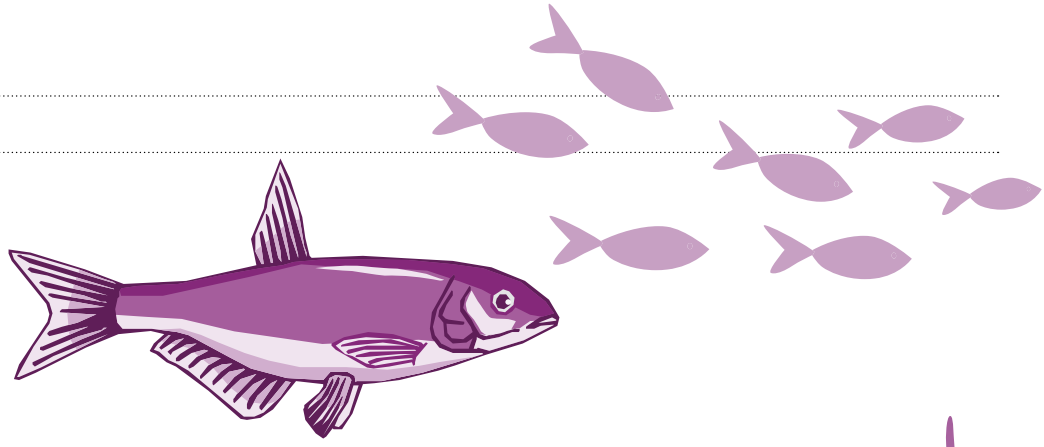
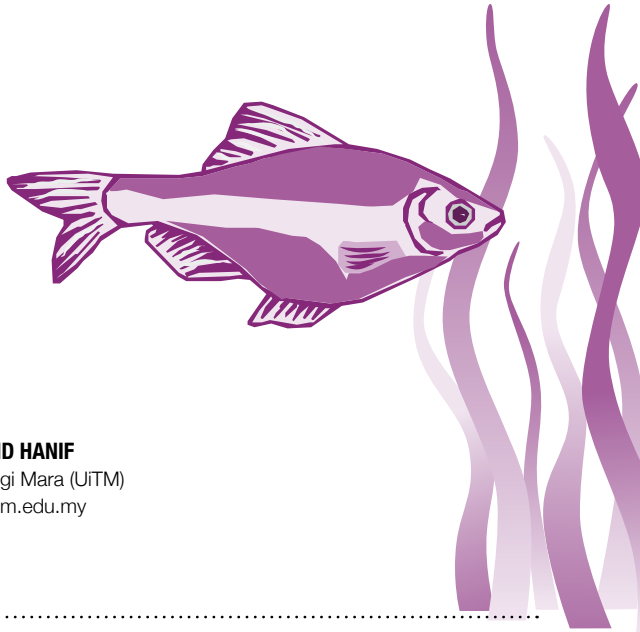
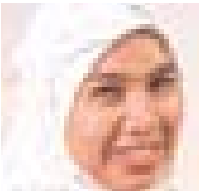


Feeding 34.9 Million People: Is Aquaculture A Good Solution?





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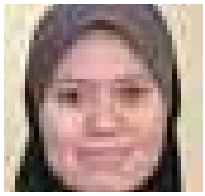

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The rapid growth of population in many parts of the world, particularly in Third World countries have called for greater attention to food security. Malaysia too is not spared from feeling the impact. At present, Malaysia is highly dependent on the imported food products in order to cater the needs of its 28.6 million populations, due to the limited domestic agricultural production and rising demand for many food products. As reported by Food and Agriculture Organization of the United Nations (FAO) (2005), Malaysia is adequate in terms of food production, stable in food supplies; and can be regarded as a low vulnerable country in terms of food security. However, looking towards 2020, the concern arises on our ability to be self-sufficient in most food requirements as well as to reduce dependence on food imports. This is due to fact that the increase in the population of Malaysia to most likely 34.9 million[1] by the year 2020, might poses great challenges to our food systems.

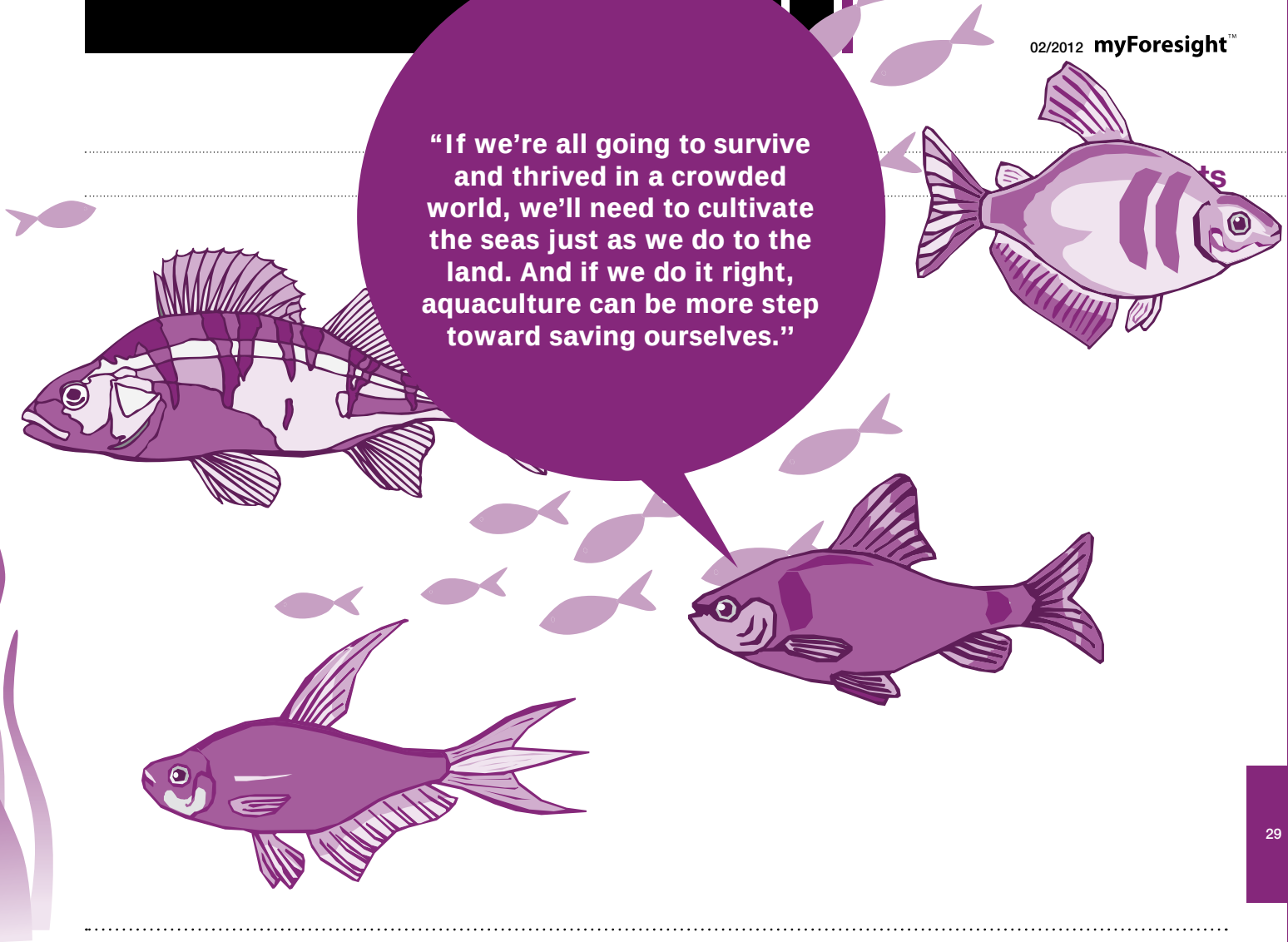
As such, in the race to find food for our rapidly rising populations, fisheries ought to be viewed as the source of food to meet the ever increasing food demand in the future. Producing seafood is a smart decision in the sense that sea covers 70.8 per cent of the earth surface whereas land covers only 29.2 per cent. Land areas have to be utilized for human settlement, forests, wildlife, industry, land-based agriculture among other needs. Unlike land, sea is vast and free from some of these uses, and therefore provides far greater resources for food production (Rahman 2009). According to WWF Malaysia (2010), Malaysian are the biggest consumers of seafood in Southeast Asia with an average consumption of 1.4 billion kg yearly; and it is reported that our demand for seafood has resulted in a rapid decline of our fish supply due to overfishing. With the increase in number of population of the country and increase in health consciousness among people, apparently current local production will not be able to meet the goal of the country being self-sufficient in fish within the coming years. Thus, aquaculture or perhaps sustainable aquaculture might provide an answer to these questions.

AQUACULTURE FOR FOOD SECURITY

The fisheries sector, an important sub-sector in Malaysia, plays a significant role in the national economy. Apart from serve as source of protein supply for the population in the country, it contributes to the national Gross Domestic Product (GDP); and also a source of employment and export earnings. However, with growing population, increasing demand on fish and declining in capture fisheries has 'force' aquaculture to act as a main driver to bridge the gap between supply and demand (Figure 1).

Aquaculture, as defined by National Aquaculture Act (1980) is the propagation and rearing of aquatic organisms in controlled or selected environments for any commercial, recreational or public purpose. In Malaysia, the role of aquaculture was clearly defined under the Third National Agricultural Policy (NAP3) 1998-2010. Aside from giving positive contribution to country's food supply, the industry also is trusted with the task of not only to create income to balance out food import bills (BOT) which had shown deficit for a long time, but also enhance national food security. According

[1]*Department of Statistics Malaysia*
(Projection based on population census in 2000)



to Food and Agriculture Organization (FAO) of the United Nations (FAO,1983) and the United States Department of Agriculture (USDA, 1996), food security exist "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life". Commonly, the concept of food security is basically about availability (Adequacy in food production, stability in food supplies), accessibility (Both physically and economically) and the utilization of the food itself. More recently, the quality and safety aspects of food have also been regarded as important components of food security definition. Hence, how can aquaculture contribute towards food security?

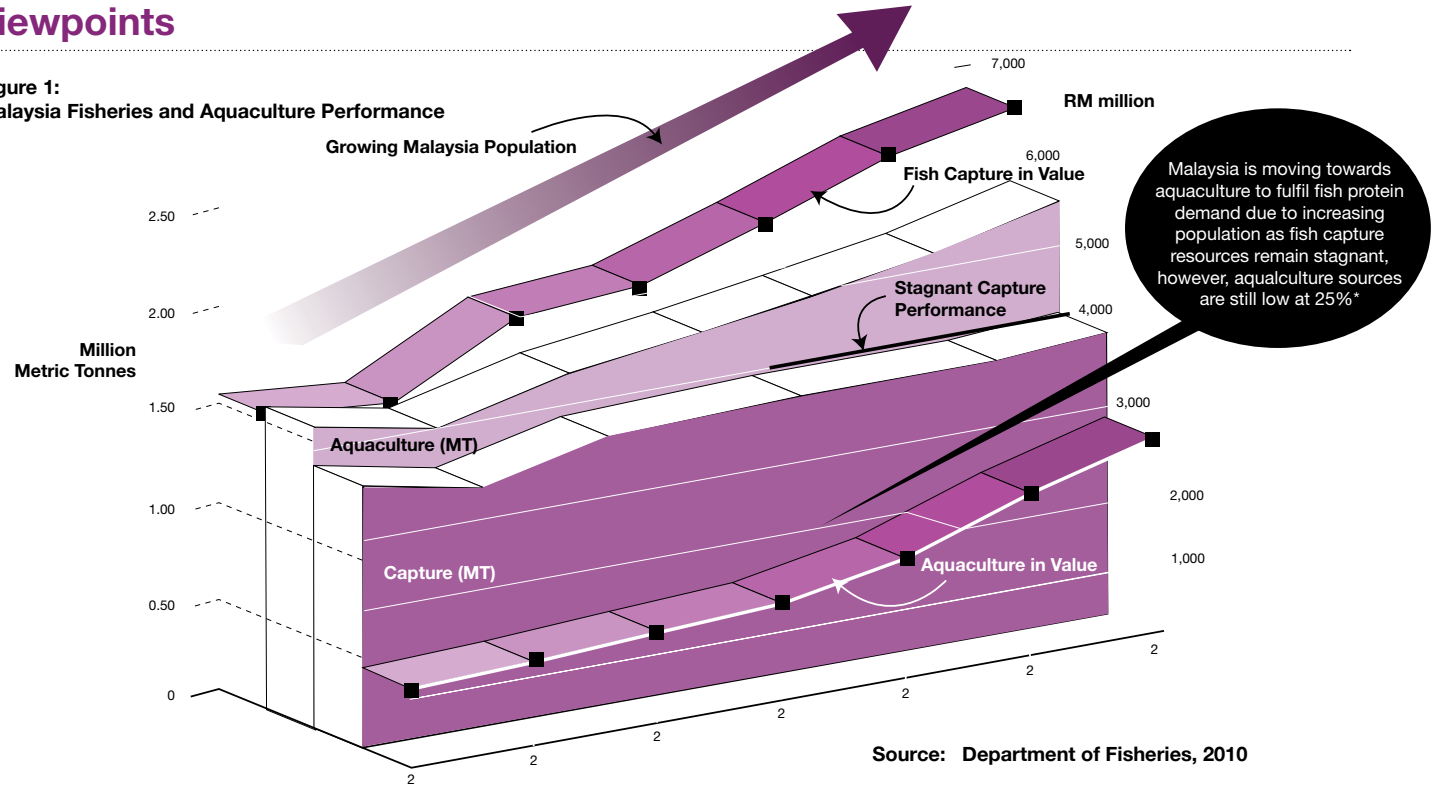
There are several ways which aquaculture can play its role: (i) As a source of essential nutrients and contribute to overall food supplies for the population; (ii) Enhance access to high protein food; (iii) Reduce the price of fish through increasing production of protein supply; (iv) Lessen our dependency on imported food, hence provide safe, high-quality seafood for local consumes; and (iv) Maximize income of the producers and for poverty alleviation. As such, due to its significant contribution towards food security, aquaculture industry in this country need to be further explored and developed. Nevertheless, the existing aquaculture practice is not a great way to take off. Traditional forms of aquaculture can and do make substantial contributions to food supplies, but these need to be sustainable (Greenpeace International, 2009).

SUSTAINABLE AQUACULTURE

Malaysia do recognizes the significance of sustainable aquaculture as an integral part of efforts to develop its natural resources. At present, Malaysia is on its way of putting up efforts to increase its aquaculture production by adopting sustainable approaches. In 1997, FAO has established a Code of Conduct for Responsible Fisheries which emphasizes on the urge for strong, coordinated, effective management and conservation of resources by all users and the need for co-operative research to improve scientific and technical knowledge of fisheries including their interaction with the ecosystem. Since then, government of Malaysia has fully supported the initiative by initiating the Aquaculture Industry Zone (AIZ). The AIZ refers to zone specific areas for aquaculture and developed standards for sustainable aquaculture practice that do not lead to ecological imbalances. This is part of the strategies to increase the production of fish, prawn and shellfish as stated in the Third National Agriculture Policy (NAP3). The aquaculture industrial zone concept is a useful approach to develop the aquaculture sector. The zones are areas equipped with all the necessary support facilities (hatcheries, grow-out aquaculture systems, processing, packaging, and marketing) and infrastructure. The right incentives (e.g., pioneer status, export tax exemptions, etc.) are offered to attract private sector involvement. Small-scale farmer organizations can participate in these ventures. The rural poor can also benefit from the spill-over and other employment opportunities arising from the new growth centers. Additionally, various institutions and government agencies had been given the task to commercialize this sector, get involved in research, training and development (Othman 2008). This also plays a vital role in enhancing the existing aquaculture in the country. Presently, given the fact that most successful national development are resulted from partnerships and alliances between the public and private sector, government has also encourage 'Public Private Partnerships' (PPPs) in strengthening the development of aquaculture in the country.

viewpoints

Figure 1:
Malaysia Fisheries and Aquaculture Performance



Source: Department of Fisheries, 2010

Despite of all the above mentioned initiatives, further improvement and enhancement are required towards developing sustainable aquaculture in this country. Sustainable aquaculture can play a key role in the transition toward safer, more environmentally and economically sustainable seafood production, offering a viable and sustainable alternative to fishing wild stocks and one that can bring strong economic benefits (Cressey 2009). However, the current status of local aquaculture industry is not yet fully sustainable due to several constraint and challenges such as difficulties in land acquisition, rising production costs, lack of skilled labor, minimal technology and threat of diseases. Thus, based on the analysis of current practice, benchmarking and best practice analysis, several themes are identified as being fundamental to the success and growth of aquaculture in Malaysia. The most prominent key success factors are as follows:

Firstly, ability to be productive derives from sound genetics. Genetic is important in breeding into the stock the predisposition to resistance against damaging disease.

Second, enhance control in feeding and by sensing when the fish are satisfied is critical to achieving optimal growth rates and minimizing environmental impact.

Apart from that, there are other several alternatives or guidelines that can suggest a more sustainable future path for aquaculture in Malaysia. These include:

a. Intensifying the existing aquaculture practice through research and developments which emphasized more on:
   - Increasing sufficient amount of high quality seed through hatchery technology, captive breeding, selective breeding, hybridization and larval rearing
   - Automation toward reducing production cost
b. Adopting environmental-compatible techniques such as water recirculation, bio filtration, Integrated multi-trophic aquaculture (IMTA) , integrated rice-fish culture and aquaponics;
c. Exploring the potential of marine aquaculture in order to expand local aquaculture production;
d. Practicing biosecurity method which includes disease exclusion, boosting immunity as far as possible, vaccination, stress reduction and using antibiotic substitutes as well as specific pathogen testing;
e. Strengthening the implementation of Good Aquaculture Practices (GAqP) which comply to EU standard, GMP, HAACCP and Halal Certification. Thus, government need to ensure that the guideline is practiced by culturists, particularly the downstream farmers in order to ensure that the food produced from the aquaculture activity poses no risk to human health and ready for export market; and
f. Embarking in inter-country cooperation can also be a possible way towards sustainable aquaculture. Research conducted by Nicholas School of the Environment at Duke University indicated that this approach will enable the developing countries e.g. Malaysia to receive foreign aid for acquisition of sustainable aquaculture facilities. Hence, developed countries can foster food security and ecosystem health, and strengthen seafood trade, without causing short term hardships to consumers or producers. Moreover, this approach can initiate knowledge transfer activity whereby developing countries can learn and adopt modern practices towards sustainable aquaculture that is successfully being practiced by other countries.

CONCLUSION

In many ways, sustainable aquaculture in Malaysia is still in its infancy. Although achieving sustainable aquaculture requires adhering to a full set of measures and cannot be reached through simply implementing one or two, the potential of aquaculture in securing food security for the next generation cannot be underestimated.

Social benefits of aquaculture trade can accrue to fish farmers in various forms, such as gaining

1) The fisheries sector plays a significant role in the national economy 2) Food production will increase and food prices will be lowered
3) Aquaculture can help safeguard future supply for increasing population

The current status of local aquaculture industry is not yet fully sustainable due to several constraint and challenges such as difficulties in land acquisition, rising production costs, lack of skilled labor, minimal technology and threat of diseases.

social acceptance of fisheries, increased affluence in the rural communities, improved quality of life and contact with the outside world. However, there are also a number of adverse social impacts associated with aquaculture production and trade. The income distribution is highly skewed in favour of big farmers and owners of the business.

An important question is whether this growth in aquaculture production will be sustainable. The evidence so far indicates that the answer depends on the surrounding environment. There is little doubt that most, if not all, species can be farmed on a sustainable basis. In particular, most species do not require feed based on marine inputs and closed systems do not need to have unsustainable impacts on the local environments. However, if they are profitable for the individual fish farmer, unsustainable practices may be observed in the absence of enforced regulations preventing them. Since profitability is the main driver in much of aquaculture development, this is also an area where trade measures can most likely be used to improve production practices. It is also likely that aquaculture will become associated with several positive environmental effects. The most apparent is one is on wild fisheries. As aquaculture production increases, it will limit and possibly reduce the prices paid to fishermen for most species. As this reduces the profitability in fisheries, it will reduce fishing effort and the pressure on the fish stocks. Another positive effect will be increased food production and, therefore, lower food prices. This will lead to increased availability of healthy and affordable food for more people and to a reduction in land-based food production (as this becomes less profitable for farmers) and the environmental pressures associated with it.

Looking towards being a developed country in 2020, sustainable aquaculture appears to be the ideal way to help safeguard future supply for ever increasing population and ensuring the food security in Malaysia. Bryan Walsh in his article, The End of The Line, says "If we're all going to survive and thrived in a crowded world, we'll need to cultivate the seas just as we do to the land. And if we do it right, aquaculture can be more step toward saving ourselves". Hence, in achieving these, there is a need to protect the aquaculture industry as it is important for food production in the country. It is recommended that for better appreciation of the role of sustainable aquaculture, some appropriate and comprehensive methods which can quantify its contribution to food security should be further developed.

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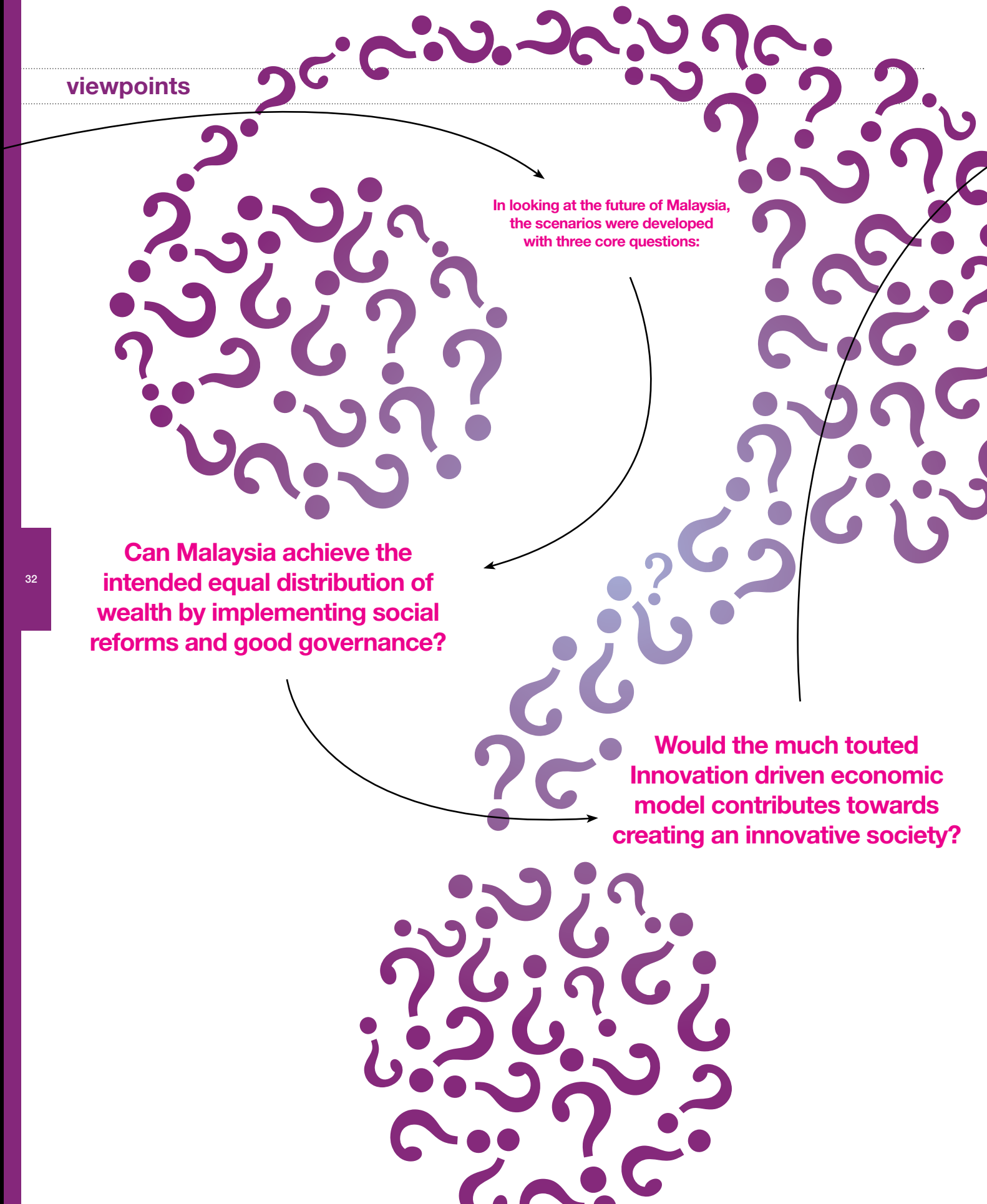

In looking at the future of Malaysia, the scenarios were developed with three core questions:

Can Malaysia achieve the intended equal distribution of wealth by implementing social reforms and good governance?

Would the much touted Innovation driven economic model contributes towards creating an innovative society?

Would Malaysia be able to achieve sustainable growth and become a high income nation within the specific time horizon?

Based on these questions and engagement workshops with stakeholders, four plausible scenarios were foresighted on the possible future of Malaysia:

Malaysia's Different Path Towards 2020 Future Scenarios

A STAR IS BORN

A star is born describes how Malaysia continues on the path of social and economic reforms through the successful implementation of Government & Economic Transformation Plan. The scenario is written reflecting 10 years of progress.

ENTRAPMENT

The scenario entrapment tells of the country's effort of achieving good governance and creation of innovation culture at large. However all this effort does not translate positively as the economy fails to make the transformation to higher value added sectors as expected.

DON'T WORRY, BE HAPPY

Taking the cue from a laid back song title in the 1980s, this scenario depicts Malaysians as a lackadaisical society which is stuck in neutral. The country is moving along on a "business as usual" mode, modest growth with no significant achievement to speak of yet is contended and happy of the way things are.

SEALED IN A TIME CAPSULE

Sealed in a time capsule describes a Malaysia where the desire for economic development is not supported by the necessary reforms. The scenario reflects the sentiment among Malaysians that the promise made to them in terms of inclusive economic development has been largely unfulfilled.

A STAR IS BORN

Socio Economic

Colonial era left Malaysian and Malaysia not without a mark. 446 years of colonial rules – from the day of Portuguese invasion in 1511 until the British rolling down the Union Jack in 1957 – revolutionised the people with the need to sustain themselves, thus the nation. Since independence, various plans were introduced and implemented to build the nation. Today, Malaysia aspires to be a high income nation. The Malaysia Plans, Vision 2020, Economic Transformation Programs with its accompanying New Economic Model and, most importantly, Governance and Social Integrity elements have been implemented successfully through revolutionary Government of Malaysia (GoM) transformation from "Government to Governance" at all levels of society. GoM is now in Perfect Public-Private Partnership Initiative (Successor to PPP). The successful implementation of Government Transformation Program (GTP) has resulted in Malaysia to be rated in the Top 3 in most global Governance and Social indices. The value system for all Malaysians has been changed by participative governance and promotion of meritocracy backed by political maturity.

Economic prosperity is there to be enjoyed with the sectors identified in the National Key Economic Areas (NKEA) ten years ago leading the way in providing continuous growth for the country. Poverty has been eradicated and the annual income for the average household is now more than RM80,000.00 with relatively minimum disparity between the urban and sub urban societies. Initiatives by Economic Corridor developers have contributed much to this by ensuring that the nation's wealth is not centralised and is distributed to other regions within Malaysia. The role of the government in the national economic growth has minimised and changed. The government acts as the guardian, consultant and adviser whilst the population plan and execute projects for economic growth. It is no more the doctor that heals, but the consultant that prescribes.

Results of the country's economic prosperity as well as the democratisation of opportunities are abundantly evident. Statistics such as home ownership is at its highest level at 81.5%, whereas the crime rate is at its lowest for the last 20 years, give credence to such claims. The star is born through a very decisive building process.

viewpoints

Science, Technology & Innovation

The government call of arms, transforming Malaysia towards an innovation driven economy, has borne fruition. Abundance resources with capability and knowledge base utilisation are running on parallel front which boosted the economy. By the year 2020, in terms of innovativeness, Malaysia has remained in the forefront. She is being ranked in the top 10 for the last 5 years in the Global Innovation Index. This is supported by the fact that Malaysia's very own multinational companies continue to contribute up to 40% of the GDP, and are at the forefront of innovation activities of the country.

These positives were derived from the strategic mergers of government linked companies (GLC) initiated a few years ago. The mergers have resulted in consolidated R&D effort by the private sector. It was a conceptualised plan, capitalizing on big players' support which benefits the value and supply chain.

Malaysia has embraced and inculcated the culture of innovation and creativity to all levels of society. It has enacted 'InnovationPlus', which has attracted R&D companies from all over the world to relocate to Malaysia (Green Valley). There is a vibrant venture capital industry with the top 10 global VC companies having their headquarters here. This includes leading Islamic Financing Institutions. The conducive environment with its state of the art IT infrastructure, coupled with its Green Policy implementation, has made Malaysia very attractive and becomes the preferred destination for investment and home of choice. Currently, Malaysia is providing Super K-solutions through collaborative R&D with high IP outputs for global manufacturing entities. Malaysia is expected to maintain the global hegemony in innovation for the next decade and beyond, supported by the global Ivy League universities. Keeping the birth rate of the stars intact and retaining its brightness.

ENTRAPMENT

Socio Economic

Continuing global recession and impending threat on the economy, forces Malaysia to implement a series of policy changes to survive the onslaught. Resource depletion of overused nature's gift left the world economy a tough ride. By 2015, Malaysia becomes largely uncompetitive and starts descending to a low income economy. The country, though, achieves good governance in 2012 by largely eliminating corruption and streamlining the bureaucratic process.

To rectify the situation, the government introduces the Economic Transformation Project (ETP). The ETP is a success. However, the benefits are reaped by a selective section of the business community. They continue to make huge profits for themselves, without making any substantial contribution to the greater good of the economy.

By 2020, the combination of low income and hyperinflation destabilises the government. This situation forces it to become more autocratic in order to maintain political stability. Malaysia becomes increasingly distant from the globalisation process and moves at its own pace.

Stagnating growth of economy and social responsibility are pushing the nation towards development abyss. Depletion of natural resources, like oil & gas, worsen the situation. Due to the increase of daily expenses caused by the continuous increase of prices of goods, cost of living soars. This, in turn, creates social and political instability in the country.

The successful implementation of Government Transformation Program (GTP) has resulted in Malaysia to be rated in the Top 3 in most global Governance and Social indices.

Burn of fossil fuel generates Green-House gasses (GHG) that causes climate changes, destroys our environment and decimates our agricultural products such as palm oil, rubber, and other food source crops. By 2020, the population growth drops due to health reason.

Despite good governance and well-oiled governmental machinery in place, there is a lack of support from the private sector as they feel the government initiatives are still insufficient, thus identifies and leads its own innovation. The lack of trust in each other's competency results in unsuccessful thrive for the same objective. Expenditure on import of unnecessary items that could be produced locally is overwhelming. Influx of imported goods that competes directly with local products threatens the production industry. Economic growth almost grinds to a standstill.

Government strives to maintain political stability as the combination of low income and hyperinflation places stress on the socio-political fabric. There is a tendency to move towards a more autocratic way of managing and governing the country. The tendency brought by increasing pollution manifests itself as industries do not want to mitigate emissions, e.g. water and air pollution, and CO2 emissions. Malaysia backs out of climate change initiatives as it cannot contribute, and suffers a globalisation 'penalty' and increasing isolation. The spin-off of industry such as business tourism and attraction starts to crumble. The country suffers losing economic interest as society is trapped in the midst of unexplored opportunity.

Science, Technology & Innovation

Positive development in STI is important for socio-economic growth. The bases of innovation set-up in the first decade of 2000's help a few entrepreneurs to initially capitalise on government support, but thereafter move forward on their own.

Malaysia is operating in a highly globalised world where borderless transactions and flow of capital and information are highly unrestricted and vibrant. Human capital development is one of the key concerns as high cross border mobility results in brain drain and creates an imbalanced development. The country does not enjoy benefits from the current STI innovations and development because almost all are private enterprises for private interests. The results do not comply with the initial innovation initiative and national objectives, thus do not satisfy the people needs.
The problem that arises need to be address. Malaysian has the brain to strategise, but not the hand to be the conduit. The ideas are not fully utilised to help the nation. Malaysian inventions and innovations are monopolised by private enterprise, but belong or sold to MNCs.

The intellectual properties of Malaysian innovations and inventions are not protected as they are not filed in the global databases. This is due to the fact that Malaysian innovations are commercialised outside of the country because the inability to find local support. The lack of public support and participation results in lost business opportunities. Ideas are not commercialised into products.

DON'T WORRY, BE HAPPY

Over the last decade, Malaysians have proven to be contented and are unlikely to adapt much towards changes. This sense of security with regards to public safety, national security, political and economic stability, reliable healthcare and advance mobility has created the 'business as usual' and lackadaisical attitude. Any attempt to disturb this status quo is generally viewed with contempt.

Socio Economic

The success of Government Transformation Program (GTP) and Economic Transformation Program (ETP) announced ten years earlier in Malaysia are basically mediocre. The results are modest, at most, have no far reaching consequences, and generally fail to achieve the intended target. Most of the initiatives announced in the ETP, through no fault of the program, continue to benefit the privileged few.

Malaysia continues to enjoy a stable economy with an average per capita income of about USD13,000. This figure is achieved through a sustained average economic growth of 6.0% per annum over the last ten years. However, this economic growth has not seen a significant increase of disposable income due to inflation. In general, Malaysia is able to have a balanced economic growth due to the continuing practice of good governance, transparency and social integrity.

Malaysia's landscape in socio politic, technology and economy is almost stagnant. Any improvements and changes that occur have been very marginal as the population seems unwilling to leave their comfort zone.
In spite of the lackadaisical attitude, Malaysia still achieves economic growth. This is due to the fact that Malaysia can continue to depend on its natural resources. However the growth is sporadic and insufficient to support the ambition to make Malaysia a high income nation.

Social integration is no longer an issue as the population has been able to enjoy harmonious racial relationship for the last five years. The 1Malaysia concept, formulated in the last decade, proves its credibility.

Science, Technology & Innovation

In the realm of STI, Malaysia is still a technology follower or user and, to certain extend, an early adopter of imported technology innovation. Due to our laggard attitude in innovation, slow development of human capital and failure to create a knowledge-based society, Malaysia remains a labour dependent country, especially at the lower level of the industry. Malaysia's economy continues to depend on agriculture and resource-based industry, petroleum-related industry, manufacturing and assemblies; and lacks in outsourcing, innovation-led, high-technology, knowledge-based and service industries.

The enhancement of education in science, technology and innovation remains stagnant. This is the major stumbling block for effective development of human capital and knowledge based society. As a result, our economy becomes monotonous and lacks innovation. Statistics on the number of researchers involved in R&D in Malaysia is only 18 out of 10,000 populations, i.e. 0.0018%. This figure is significantly pale in comparison to the Korean situation, i.e. 150 per 10,000 populations or 1.5%.

The Malaysia Plans, Vision 2020, Economic Transformation Programs with its accompanying New Economic Model and, most importantly, Governance and Social Integrity elements have been implemented successfully through revolutionary Government of Malaysia (GoM) transformation from "Government to Governance" at all levels of society.

One contributing factor to the small number of R&D researchers in Malaysia is lack of investment in R&D by the government. Malaysia only spends an average of 0.6% of its GDP in R&D activities for the past ten years.

All our innovations are still government-led and remain in our universities laboratories. We seem no to believe in our own innovations and prefer imported technology and innovations.

Globalisation plays no role in our development – we remain stagnant and have not moved forward since the last decade. Information management and communication technologies have developed leap and bound over last decade, but we continue in our own comfort zone.

SEALED IN A TIME CAPSULE

Socio Economic

Ten years have passed, but Malaysia remains stagnant in social and political fronts while making limited and disjointed success in technology. Collectively, this does not result in the establishment of an innovation-led economy. Though there are some growths in the national economy but, in comparison with other countries in the region, Malaysia is lagging behind significantly. This is the result of continuous plundering of natural resources that causes irreversible damages to the environment.

Malaysians are highly polarised and emotionally charged. It does not help that since the last elections, politicians are still harping on the same issues raised three elections ago. Political instability and the cancellations of several mega projects due to lack of funds without considering their importance for economic growth creates unnecessary uncertainties.

With the population now standing at more than 36 million, the country is facing various socio economic pressures. The ETP and GTP, announced more than a decade ago, remains a tagline and fails to meet its intended impact. The much touted inclusiveness agenda has failed where income disparity between the haves and have-nots is at its highest with the national wealth being dominated by the privileged groups. The 'rakyat' in general lives in uncertain and trying conditions, still trapped in the low-middle income group.

The country is also facing an increased pressure of globalisation. For the past 5 years our businesses and industry has been unable to keep paced with this phenomenon. Businesses and industry are still government driven and are highly dependent on government projects, grants and subsidies. To the world, we are labelled as a low cost OEM producer with limited choice of goods and services to offer.

viewpoints

All our innovations are still government-led and remain in our universities laboratories.

The relatively lack of opportunities and the stagnation of our economy causes acceleration of brain-drain. Incomplete and partial reforms of the education system resulting from inconsistent policies, together with and poor execution of human resource mobilisation, make the remaining workforce in the country poorly equipped with mismatch of skills.

Increase import of most of our essential needs such as food items places a huge burden on the economy. Large foreign expenditure is required to ensure continued sustenance of the country.

Science, Technology & Innovation

Malaysia makes limited and disjointed success in technology. Whatever success that is achieved fails in the effort to change the nation from a resourced-based economy to the innovation-led economy. Previous efforts did not realise the objective and the current strategy is having difficulties to achieve the intended target.

The private sector reaction to the innovation initiatives introduced by the government has been lukewarm. R&D is very much government driven with the number of IP registered in Malaysia has seen a gradual increase during the last ten years. It reflects the number of IP registered by the local universities; an after effect of the government incentives for researchers. However, due to the low rate of commercialisation and our inability to extract value, the R&D being carried out have so far failed to contribute significantly to the economy.
The brain gain program implemented by the government has been reviewed three years ago has seen moderate success. Malaysia is able to attract some of the best minds to come and work in Malaysia. However, there is also a substantial increase in the migration of innovators and brilliant people to foreign countries.

Internationally, Malaysia is perceived to be a dumping ground for technology. We are looked upon as the consumer of expired or outdated technology, always ready to follow and embrace the technology trends. Whatever advancement of technology makes by Malaysian is generally much later than what is already in the marketplace.

The current approach of technology adoption has seen various poor application of technology in many sectors. Poor implementation of these technologies and the inability to upgrade for future needs, as well as mismatching of expectations during its inception, has caused wastage of public funds.

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Malaysian Nature Society
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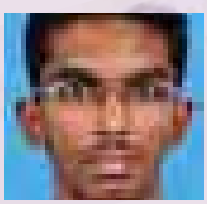
Nasmech Technology
Natural Wellness Holdings Sdn Bhd
RISKK.Com Sdn Bhd
TM Research & Development
TNB Reasearch Sdn Bhd
TTVision Tecnologies Sdn Bhd
Universiti of Malaya
Universiti of Malaya
Universiti of Malaya
United Nation University (UNU-IIGH)
United Nation University (UNU-IIGH)
United Nation University (UNU-IIGH)
Univeristi Putra Malaysia
Universiti Sains Malaysia
VAW Technology Sdn Bhd

Visioning The Future



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I would like to hope that by the year 2060, approximately 50 years from now, Malaysia will be the centre of education for students from around the world. Besides that, I sincerely hope our universities will be the best in the world. Malaysia should be the centre of research and development internationally.

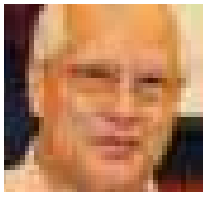
Secondly, in terms of transportation, I would like to imagine the future with motorised hydrogen fuelled vehicles with zero carbon emission.

Thirdly, and most importantly, is an underworld that I've been dreaming of. Due to the massive development that is happening currently, I believe there will be no more land to develop in future. Thus, we should create and develop an underworld which is built underground with sustainable air, shopping complexes and cities build deep in the underground of the earth.

M. KISHENDRAN A/L S. MAGENTHERAN

viewpoints

Youth and Foreign Policy: Insight or Foresight?



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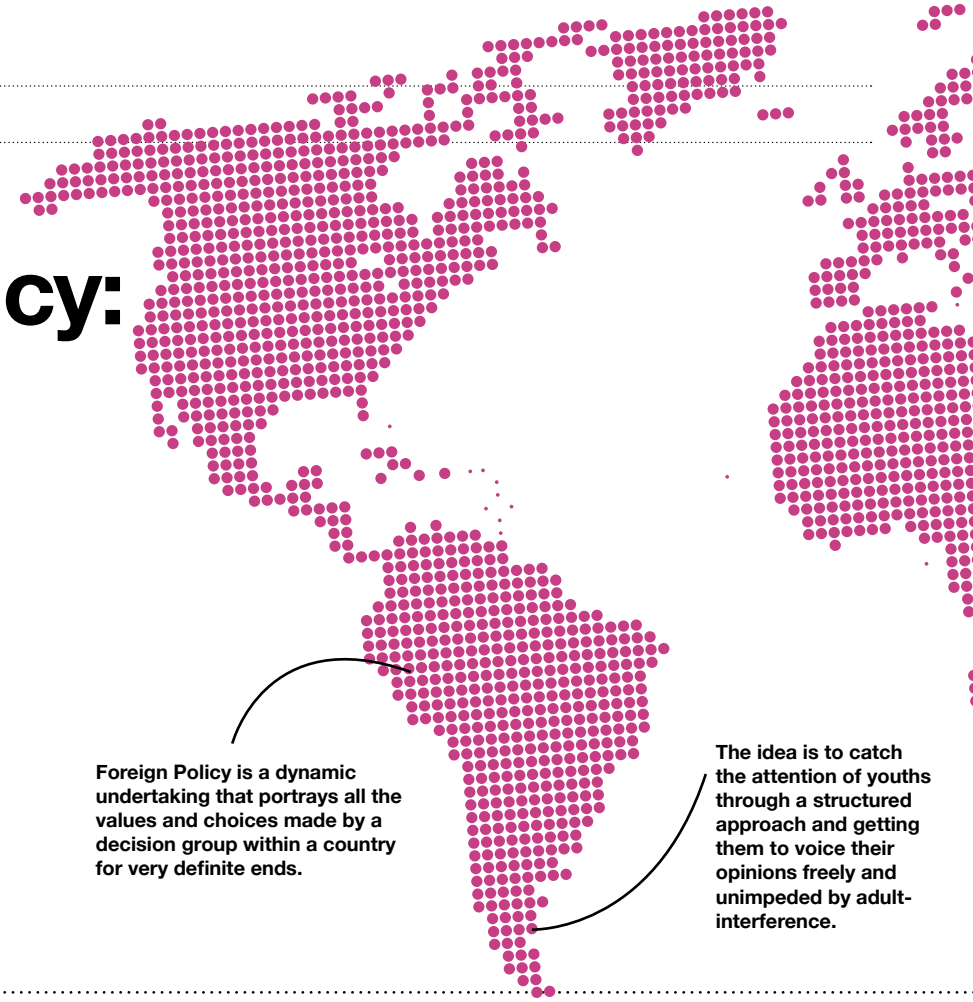


Foreign Policy is a dynamic undertaking that portrays all the values and choices made by a decision group within a country for very definite ends.

The idea is to catch the attention of youths through a structured approach and getting them to voice their opinions freely and unimpeded by adult-interference.

ABSTRACT

This brief paper examines the impact of the Youth Factor in the foreign policy process of the country. The experience of young people engaged in discussion of foreign policy issues is highlighted and analysed against current Government efforts to draw youths into the realm of policy-making. Some preliminary conclusions are offered mainly based on results of questionnaires, working groups and written materials. Theoretically, youth opinions are still raw and undirected. Given the correct stimulation and incentives, however, a lot could be gained from interactions with Youth generally. While the former is insightful, the latter is still very much foresightful.

INTRODUCTION

Youth today seek engagement in all forms of discussion on matters that affect their future. While the most efficient way to raise one's awareness of foreign policy issues, has not been found as yet, their eagerness to find out and to know more about what is going on around them need expression in forums, dialogues and seminars such as the Youth and Foreign Policy Seminar that was organized at the Universiti Sains Malaysia (USM) by the Centre for Policy Research and International Studies (CenPRIS), and supported by the Foreign Policy Study Group (FPSG), a Kuala Lumpur-based foreign policy think-tank from 18 – 20 December, 2011, in Penang.

CONCEPT

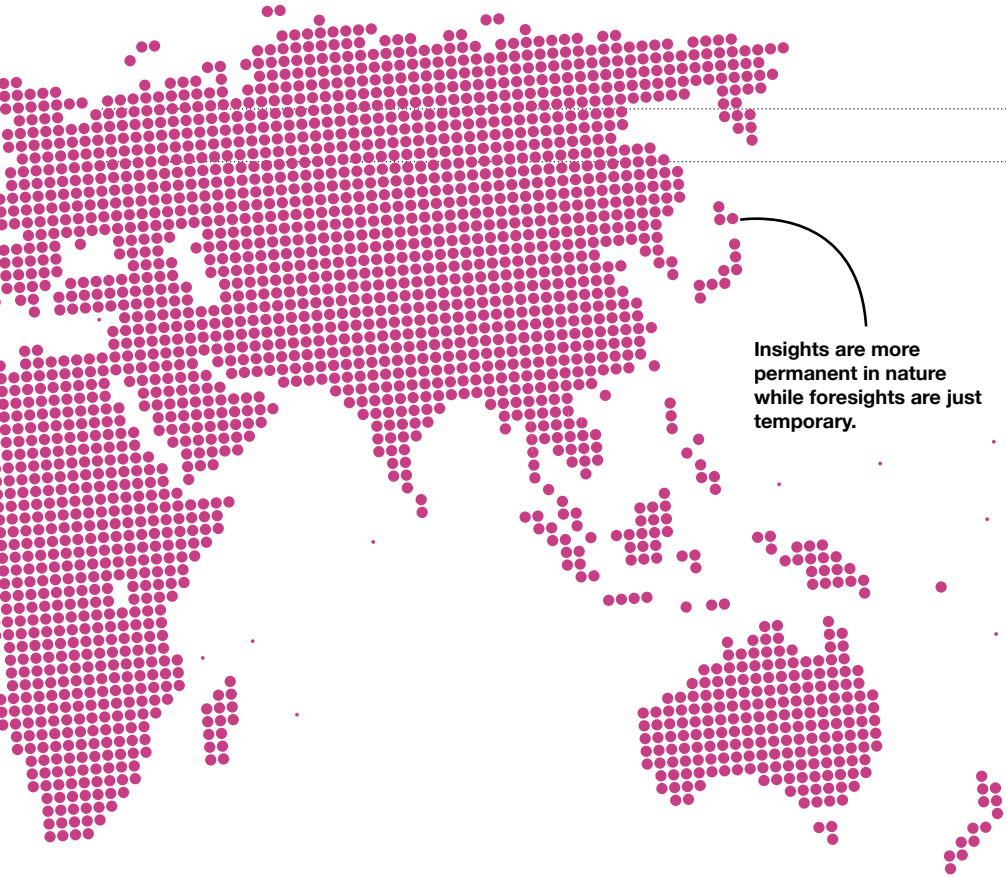
Foreign Policy is a dynamic undertaking that portrays all the values and choices made by a decision group within a country for very definite ends. To serve the needs of youth in raising their awareness of the foreign policy decision making process and the issues within, a format by which issues are introduced following both a thematic and a functional area specific is considered appropriate. For this purpose a subject-expert with a competent practical experience of foreign policy situations has been selected to lead the discussions and moderate the sessions. To stimulate the discussions and energise the sessions participants have been asked to prepare in advance a short paper on an assigned topic for presentation.

OBJECTIVES

1. To raise awareness of foreign policy issues among youth;
2. To involve youth in open discussion and exchange of views on matters concerning foreign policy decision making;
3. To enable youth to become knowledgeable in all aspects of foreign policy;
4. To prepare youth to participate as Youth Ambassadors abroad.

PROGRAMME

The Programme brought together twenty-five participants from eight public universities and one private university in the country. For one and a half-days the participants were given background lectures by several former Malaysian Ambassadors including FPSG's Chairman, Tan Sri Razali Ismail. The topics ranged from ASEAN and the centrality of bilateral relations; the multilateral challenge in foreign policy, the role of public diplomacy and the problems and solutions in the ASEAN Way.



Insights are more permanent in nature while foresights are just temporary.

Prior to the Seminar the participants were required to submit a 500-word essay on the subject of 'What Youth can do for ASEAN". The exercise had been included to gauge their understanding of current issues in foreign policy, in particular Malaysian Foreign Policy and ASEAN. The subject-matters dealt in the essays were wide-ranging and diverse. To reward the participants for their enthusiasm for their essay-writing it was decided to award three prizes for the best-written essays. Following the suggestion from the Vice Chancellor, USM, it was also agreed to have all the essays edited and prepared for publication in a forthcoming web portal to be soon established.

YOUTH ENGAGEMENT

Engagement with the Youth also involved two other related activities. Firstly, a survey questionnaire was administered to the participants requiring them to respond to a set of questions specifically on Malaysian Foreign Policy. The questions covered areas of priorities, determinants, decision-making process, multilateral involvement and range of foreign policy decisions. During the presentation of the survey-analysis, it was observed that participants were able to grasp the basic approaches to foreign policy decision-making in the country.

Secondly, a structured working group session was included to allow for a more general discussion of the issues of foreign policy and the place of ASEAN and the ASEAN Way in the foreign policy milieu. Two such working groups were set up to tackle the issue of problems perceived in the ASEAN Way that has served as a conflict resolution mechanism in ASEAN since its founding. Participants warmed up to the demands of the two sessions: the working session as well as the presentation and discussion that followed. Debate and agreement resulted after the groups presented their probable solutions to the ways that ASEAN could solve the problems faced by the regional grouping. One group advocated for a thick solution of total involvement while the other opted for a combined thick and thin way, i.e., a mixture of nationalism and new regionalism pointing to the advent of the ASEAN Community of 2015.

Generally the Youth Seminar had achieved its purpose of raising awareness of foreign policy issues affecting the country and the larger ASEAN Community among the Youth. The level of participation in the open sessions and in the working groups were very active and the ideas expressed and agreement reached have been most stimulating and energising indeed. Coming from the Youth themselves, they were very honest and frank in their evaluation of their future role in a more structured ASEAN.

The Youth Seminar has greatly benefitted from the presence of high officials from the Malaysian Ministry of Foreign Affairs, including its Secretary General and the Director General of the Institute of Diplomacy and Foreign Relations (IDFR) and its officials; the Vice Chancellor of USM accompanied by its senior academics and the Academic Staff of the Centre for Policy Research and International Studies (CenPRIS). The participants were called upon to take the lead in preparing the country to take a more active role when Malaysia assumed the Chairmanship of the ASEAN Community in 2015. For the future the participants resolved to work towards realising the following:

1. Establish an ASEAN Youth Parliament
2. Initiate ASEAN Youth Centres in member countries
3. Organise ASEAN Youth Exchanges/Networks
4. Participate in future Dialogues and similar Forums

INSIGHT OR FORESIGHT – SOME CONCLUSIONS

Theoretically, the writer takes the position that what is revealed after a comparative study is done concerning any aspect of Youth is rightfully an insightful exercise. However, if the exercise is merely taken in the spirit of seeing something coming alive after the application of certain structured methods for instance as in the results achieved after an intensive working group session, the activity could well be regarded as an exercise in foresight. The difference between the two lies in the duration taken in each respective exercise. In the first case time is allowed to dictate the process. In the second case however, the results are the products really of a spontaneous flow of thoughts and ideas. Thus we may conclude that insights are more permanent in nature while foresights are just temporary. This idea stems from the fact that there is an innate human ability to think and decide on things on the spur of the moment. Foresight thinkers have quoted Slaughter's definition of foresight as a starting point and I agree with this entirely:

"..... a universal human capacity which allows people to think ahead, consider, model, create and respond to future eventualities...."
– (Slaughter, 1995)

This concept comes closest to a finding by Gidley and Inayatullah (2002) that talks about youth being immature, impressionistic and cliquish. The idea, therefore, is to catch the attention of the Youth through a structured approach and getting them to voice their opinions freely and unimpeded by adult-interference such as verbal-proddings and expert-advice. To get an immediate response from youth, it is better to catch them in their unguarded moments. What follows is a discussion on what is insight and foresight from the results of the various exercises the participants were put through in the programme.

QUESTIONNAIRE ON MALAYSIAN FOREIGN POLICY

Participants were requested to fill up the Questionnaire (Please see Attachment) consisting of questions ranging from issues of priorities, determinants and policy decisions concerning Malaysian foreign policy. The aim of the exercise is to gauge the depth and grasp of issues concerning Malaysian Foreign Policy and its domestic and external environment. The detailed results are presented as follows:

Question 1: To the question of the priorities of Malaysian Foreign Policy, 9 participants chose ASEAN as the number one priority for the country. For the interested observer the choice made has been the right one since it is ASEAN that has preoccupied policy-makers in the country since the inception of the Grouping in the region. ASEAN has remained the cornerstone of Malaysia's foreign policy even till the present. This is very insightful surely as it confirmed an already established fact. However looking it as an element of foresight, 5 of the participants had selected the United Nations as their number one priority issue. The rationale is that there exists a pocket of thoughts and knowledge among the participants as to the viability of a larger grouping that citizens could have an appeal for in this context. This is a segment of views that policy-makers will need to take note of.

Question 2: Responses to the issue of the main determinants of Malaysian Foreign Policy however revealed a greater degree of foresight than insight. While a majority had chosen national interest as their first main determinant, others have ranked as their first-choice answers as being in the order of national interest, bilateral cooperation, assistance and bangsa serumpun. The responses could be categorized as both insightful and yet foresightful. But of interest from the foresight point of view is the second-choice answers which is a mix of foreign direct investment, national interest and security pointing to the interesting facts that perhaps the participants have a prior knowledge of the subject and even if this were so, their choices could be an evidence that could be considered by various agencies of the Government in their efforts to see a greater move to reach out to the students in the Universities in terms of raising more awareness of Youth in policy-making. From the answers we could derived a strategic direction in terms of clarifying the sort of information that are passed on to students.

Question 3: On to a final example of an important area in foreign policy which is that of decision-making process, the participants were very much on the spot when they chose the known three main institutions involved in the foreign policy-making process in the country: Prime Minister, Ministry of Foreign Affairs and the Parliament. The results confirmed an already existing insight on the issue. However the foresight issue has to do with how we could square up on the role of the Parliament when it is a well-known fact that very little is public-knowledge on the role of Parliament in this very issue. In a sense more needs to be done to highlight this matter for the public interest. The participants have thus drawn attention to an existing gap in public information as a result.

WHAT YOUTH WANT MALAYSIAN FOREIGN POLICY TO FOCUS ON?

Included in the above-mentioned Questionnaire is a request to have participants list down five things they would like to see in Malaysian Foreign Policy. The purpose of the question is to get the participants to integrate their thinking on the various issues of importance to the future of the country in terms of foreign policy focus. The question this time is really one of foresight determination. In their answers it was hoped that the participants could provide a laundry list of issues that could be evaluated by the policy-makers. They have indeed all responded positively in the exercise as presented in the following **Table 1**.

The question posed was in two parts. In Part One, they were asked to list down five things they would like to see in the country's foreign policy. Part Two required them to list what they would like to do for the country.

In going through the two lists one can see that the selections were very wide-ranging and diverse. They covered geographical areas, issues, concepts, ideology and commitments both bilaterally and globally in foreign policy. This list is definitely a goldmine for the foresight futurist. It helps us

ASEAN has preoccupied policy-makers in the country since the inception of the Grouping in the region, and has remained the cornerstone of Malaysia's foreign policy even till the present.

Table 1 What Youth Want in Foreign Policy?

WHAT YOUTH WANT IN FOREIGN POLICY?
Good country in ASEAN
Good relationship with the world
Be more neutral
More concerned with Islamic matters
Speak louder in international forums
Good relations with Japan and Korea
Improve human rights towards environment
Create peace among ASEAN countries
Initiate integration in OIC
Enhance integration in ASEAN
Be involved in climate change
Improve ASEAN Community as a stage for balancing with hegemonic power
Improve defence and security in all aspects not just military
Implement and strengthen policy that can bring major development in economy
Pursue our interests in the South China Sea
Create a movement to fight for Muslim countries
Cooperate with Islamic Community
Take more action in humanitarian issues
Put more pressure on Myanmar
Be less dependent economically on the United States and China

to identify not only present concerns but also directs us to new areas and focus for foreign policy decision-making. As to knowing that they would like to do the list compiled in the column on the right provided us with a sense of the direction in the future where the youth would like to see some activities taking shape. These include four areas of focus for the future of Youth in foreign policy:

1. Greater use of diplomacy in fighting terrorism;
2. Choosing the right leaders to lead the country;
3. Facing the challenges of the ASEAN Community; and
4. Establishing new avenues to tap Youth Engagement.

WHAT YOUTH WANT IN FOREIGN POLICY?
Be more democratic
Work to gain benefits for both sides in a relationship
Lead in Palestine Issue
Be against extremism
Have strong bonds with Indonesia
More vocal approach towards human rights violations
Continue to champion predicament of the South countries
Strengthen relations with Russia

WHAT YOUTH WANT TO DO FOR COUNTRY?
Stop terrorism with diplomacy not war
Prepare good leaders
Prepare to face ASEAN Community
More humanitarian assistance to the ASEAN countries
Establish ASEAN Youth Parliament
Initiate ASEAN Youth Centres
Organise ASEAN Youth Exchanges/Networks

Youth Survey Analysis

1. PRIORITIES

		FREQUENCY				
		RANKING				
		1st	2nd	3rd	4th	5th
1	ASEAN	9	3	3	0	2
2	NON-ALIGNED MOVEMENT	1	3	2	2	0
3	ASIA-PACIFIC ECONOMIC COOPEARTION	1	2	2	4	2
4	EAST-ASIA SUMMIT	1	2	0	3	3
5	INDONESIA-MALAYSIA-THAILAND GROWTH TRIANGLE	0	1	1	0	3
6	MALAYSIA-INDONESIA RELATIONS	0	1	0	2	1
7	MALAYSIA-AUSTRALIA RELATIONS	0	0	0	0	0
8	UNITED NATIONS	5	1	4	2	0
9	UNESCO	0	0	3	1	0
10	CHINA	1	2	2	2	2
11	INDIA	0	0	1	1	0
12	GROUP OF 20	0	0	1	1	2
13	JAPAN	1	0	0	0	0
14	ANTARCTICA	0	0	0	0	0
15	CLIMATE CHANGE	2	2	1	0	5
16	HUMAN RIGHTS	2	3	0	1	3
17	TERRORISM	0	1	0	0	0
18	OTHERS	0	0	0	1	0
	TOTAL	23	21	20	20	23

2. DETERMINANTS

		FREQUENCY				
		RANKING				
		1st	2nd	3rd	4th	5th
1	NATIONAL INTEREST	12	4	1	2	0
2	BILATERAL COOPERATION	3	1	4	2	4
3	ASSISTANCE	2	0	0	0	1
4	FOREIGN DIRECT INVESTMENT	0	6	2	2	2
5	BANGSA SERUMPUN	2	0	2	0	0
6	FOREIGN WORKERS	0	0	1	0	2
7	STUDENTS	1	1	2	1	1
8	AMBASSADORS	0	1	1	3	0
9	ALLIANCE FORMATION	0	1	2	3	4
10	TECHNICAL	0	0	2	2	1
11	SECURITY	0	4	3	3	4
12	SPORTS	0	0	0	1	0
13	UNIVERSITY	0	2	1	2	1
14	OTHERS	2	0	0	0	1
	TOTAL	22	20	21	21	21

3. DECISION MAKING

		FREQUENCY	%
1	PRIME MINISTER	7	29.2
2	PARLIAMENT	6	25.0
3	CIVIL SERVANTS	0	0.0
4	NON-GOVERNMENTAL ORGANISATIONS	1	4.2
5	UNITED STATES	0	0.0
6	ASEAN	0	0.0
7	MINISTER OF FOREIGN AFFAIRS	1	4.2
8	MINISTRY OF FOREIGN AFFAIRS (WISMA PUTRA)	7	29.2
9	MALAYSIAN CITIZENS	2	8.3
10	CHIEF MINISTERS	0	0.0
11	UNITED KINGDOM	0	0.0
12	OTHERS	0	0.0
	TOTAL	24	100.0

4. MULTILATERAL INVOLVEMENT

		YES	%
1	MR. R. RAMANI	6	9.7
2	TAN SRI RAZALI ISMAIL	18	29.0
3	TUNKU ABDUL RAHMAN	10	16.1
4	AMBASSADOR AJIT SINGH	7	11.3
5	DATO SHAFIE APDAL	13	21.0
6	DATO' P. G. LIM	8	12.9
	TOTAL	62	100.0

5. RANGE OF FOREIGN POLICY DECISIONS

		CORRECT	%
1	ZOPFAN	0	0.0
2	DECLARATION ON CONDUCT IN SOUTH CHINA SEA	5	10.2
3	COMMON HERITAGE OF MANKIND	9	18.4
4	TREATY OF AMITY AND COOPERATION (TAC)	0	0.0
5	BUY BRITISH LAST	10	20.4
6	SMART PARTNERSHIP	5	10.2
7	LOOK EAST POLICY	15	30.6
8	EAST ASIA ECONOMIC CAUCUS (EAEC)	2	4.1
9	COMMONWEALTH ECONOMIC COOPERATION AREA (CECA)	3	6.1
		49	100.0

6. COLOUR YOUR FOREIGN POLICY

		CORRECT	%
1	ORANGE REVOLUTION	0	0.0
2	BLACK SEPTEMBER	0	0.0
3	RED ARMY	1	6.3
4	YELLOW SHIRT	0	0.0
5	RED SHIRTS VS YELLOW SHIRTS	15	93.8
		16	100.0

7. COLOURFUL PHRASES

		CORRECT	%
1	PINGPONG DIPLOMACY	2	12.5
2	SHUTTLE DIPLOMACY	0	0.0
3	FOUR-EYED MEETING	8	50.0
4	COCKTAIL DIPLOMACY	4	25.0
5	TRACK-TWO NEGOTIATIONS	1	6.3
6	ASEAN WAY	1	6.3
	TOTAL	16	100.0

myForesight™ BookClub

COMMUNITY LEADERSHIP 4.0: IMPACTING A WORLD GONE WIKI

By Carolyn Corbin • Publication Date: 2011
ISBN: 1439252888 • Pages: 258

As society changes, so must leadership practices, says Carolyn Corbin, president of the think tank Center for the 21st Century, in Community Leadership 4.0. She describes the skills that a twenty-first-century leader must have to navigate globalization and nonstop technological change.

According to Corbin, cities and towns in the nineteenth century existed in a Community 2.0 phase, in which community life was static and travel was limited. With the rise of railroads, automobiles, and airplanes, Community 3.0 set in: People took to visiting other places frequently.

On the horizon is yet another paradigm shift: Community 4.0, in which technology erases geographic distance altogether and raises social and intellectual capital to all-time highs. People can live where they choose and telecommute for employers near or far, while quality of life surpasses that of any prior era. No community on earth has yet reached Community 4.0, but almost any community can if it adopts a global mind-set that embraces diversity, risk, inclusiveness, and innovation.

For communities that have long operated within the comfort zones of established authority and the status quo, such mind-set represents a transformation. Community leaders must help usher it in by exercising Community 4.0 Leadership. Corbin describes this leadership style as the ability to anticipate tomorrow, to think problems through, to thrive amid chaos, to understand people, and to promote collaboration. She then presents a process that any leader can use to determine if his or her own leadership style is sufficiently 4.0, and how to improve it if it is not.

Corbin writes Community Lead ship 4.0 with aspiring leaders of all kinds in mind. Whether they are heading up businesse s, non-profit groups, cities, regions, or countries, they will likely find much helpful coaching on how they and those whom they lead can stay ahead of the curve.

THE GREAT DISRUPTION: WHY THE CLIMATE CRISIS WILL BRING ON THE END OF SHOPPING AND THE BIRTH OF A NEW WORLD

By Paul Gilding • Publication Date: 2011
ISBN: 9781608192236 • Pages: 292

A global climate crisis — and with it, the end of economic growth — is no longer avoidable. The Great Disruption began in 2008, with spiraling food and oil prices alongside the starkest evidence yet of dramatic ecological change. The mess we're in, however, is not as simple as fossil fuels and carbon footprints. We have come to the end of Economic Growth Version 1.0, a world economy based on consumption and waste, where we lived beyond the means of our planet's resources.

The Great Disruption is a bracing, honest look at the challenge humanity faces, but it also offers a deeply optimistic message. The coming decades will see loss, suffering, and conflict as our planetary overdraft is paid. Yet they will also bring out the best humanity can offer: compassion, innovation, resilience, and adaptability. The crisis will, inevitably, change our economic model and the way we live our lives.

Paul Gilding, an international thought leader in the field of sustainability, goes beyond the hand-wringing prophecies of doom that we have heard countless times. His tough-minded, truly big-picture view reminds us that our greatest triumphs have always come during our darkest times. He outlines how to win what he calls "the one-degree war" against catastrophic climate change — starting today.

THE PRECARIOUS HUMAN ROLE IN A MECHANISTIC UNIVERSE

By John F Brinster • Publication Date: 2011
ISBN-13: 9781456826826 • Pages: 514 pages

Religion's influence upon society has waned in the past century, and it will continue to wane in the years to come, forecasts John F. Brinster, retired Princeton physicist and psychologist. He looks forward to secularism gaining progressively more ground over the next few generations.

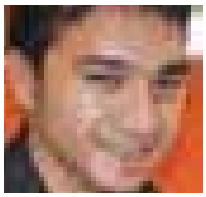
More and more people will practice spirituality, but fewer and fewer will practice religion.

Human thought itself is evolving as people base life decisions less on faith and more on imagination, critical thought, and reason. This could especially be so if, as many commentators anticipate, artificial brain enhancements boost brain power worldwide and accentuate analytical logic in human thinking—i.e., human brains will be aided by computers and thus think more like computers.

Established religious traditions will labor to block secularism's growth at every turn, Brinster says. Secularists will need to build strong, organized civic movements and education reform initiatives if they want to succeed. If they do, the author believes: "We would see the blossoming of science and education, the universal affirmation of women's rights, and the emergence of a peaceful global society freed from ancient sectarian feuds."

Brinster dives into some highly sensitive and controversial topics, but treats them with deep thoughtfulness and respect. While some readers may strongly disagree with some of his premises, almost any honest reader will be impressed.

Green Trends



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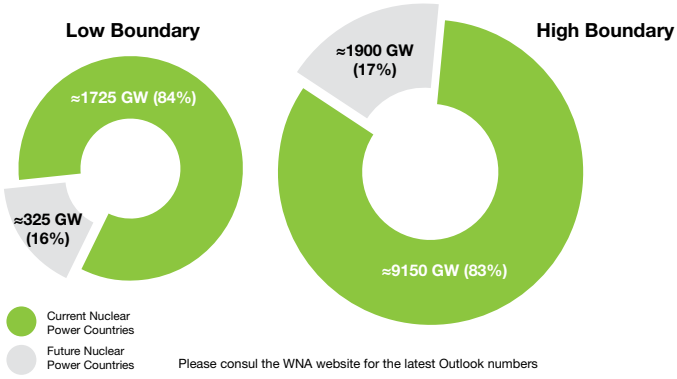
NUCLEAR FEARS

- The federal government announces in May 2010 that Malaysia would build a nuclear power plant by 2021. Serious concerns were raised regarding safety and feasibility.
- Concern on the capability of building a weapon of destruction such as Iran.
- Fukushima incident change the move towards nuclear, Germany plans to shut down all of its nuclear plant by 2022.
- The Swiss government has reacted to the Japanese disaster by suspending plans to build and replace nuclear plants.

Nuclear Capacity in Current and Future Nuclear Power Countries



Please consul the WNA website for the latest Outlook numbers

CLIMATE CHANGE SKEPTICISM

- Some are unconvinced that rising greenhouse gas emissions are the cause of modern-day warming, mainly because the climate had changed naturally before. In addition predicting changes to our climate is very complex and the use of computer models has raised some criticism.
- Rather than combating, adaptation to climate change offer a far more affordable, practical and effective approach.

FIGHTING OLD-FASHIONED AIR POLLUTION

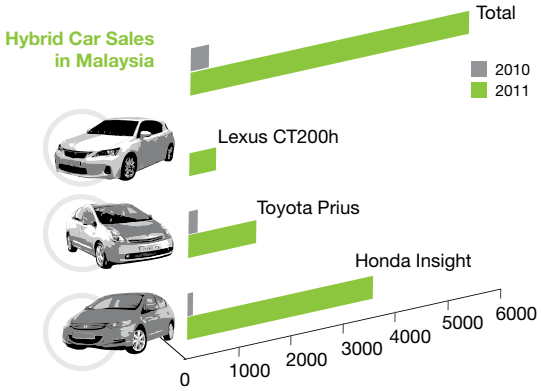
- Carbon dioxide, a greenhouse gas, is the main pollutant that is warming the earth. Gas such as nitrogen dioxide, sulphur dioxide, ozone also contribute to the air pollution.
- Malaysia frequently faced by experienced haze especially during agricultural burning season in Sumatera.
- Cloud seeding has been implemented several times during the 1997 and 2007 haze.
- In the recent Environmental Performance Index, Malaysia showed good performance in terms of air pollution scoring, 97.3% in which Malaysia was position 25th out of 132 country in the total assessment.

NIMBYism

- Term to describe the protests against any development in the human communities.
- The Kuantan rare earth recently encountered the problem as protesters gather around the plant to resist the development.
- Similar protest also occurred during the building of incinerator in Semenyih in 2002.

THE LYNAS PREDICAMENT

- Concerns about the potential toxic and hazardous impacts on the lives and livelihoods of local communities.
- Waste stream containing 106 tonnes of radioactive thorium and 5.6 tonnes of uranium.
- Lynas are unable to provide a long term waste management and safety plan.

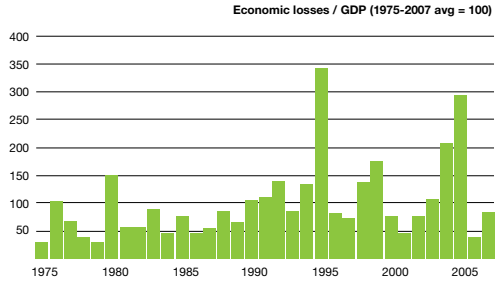


ELECTRIC VEHICLE GO COMMERCIAL

- Transport contributes 23% of carbon emission, the driving force for developing electric vehicle manufacturing.
- Electric motors convert 75% of the chemical energy from the batteries to power the wheels.
- Toyota is the first hybrid maker, now Nissan, GM add some competition.
- Proton plan to introduce its version by 2013, and Modenas already market its Modenas Ctric a full electric bike.
- The government pledge full exemption of import and excise duties for hybrid and electric vehicles in the budget.

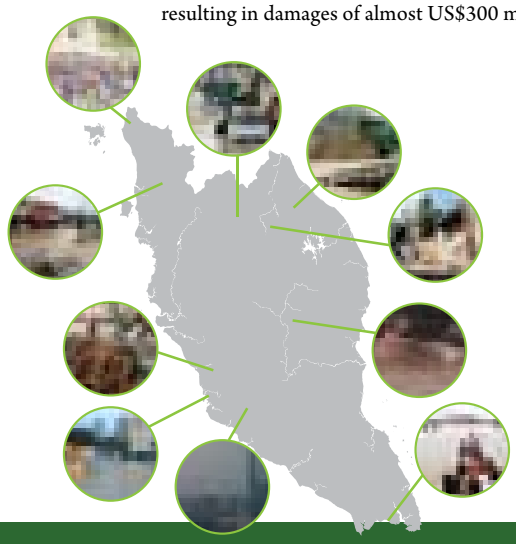
THE DISASTERS

- Massive flood that halt Bangkok businesses and daily life with an estimated US$45 billion in losses.
- Earthquake Japan coastal area, Christchurch NZ and Turkey.
- Malaysia is fortunate to be free from natural disasters such as earth quake, volcanoes and typhoons. The most severe natural disasters experienced in Malaysia are flood, drought and haze.
- According to the World Bank report, an estimated 29,800 sq kms of Malaysia are flooded every year, affecting almost five million people, resulting in damages of almost US$300 million.



(Source: International Monetary Fund, IMF)

Economic loss due to natural disaster around the world



GREEN BUILDING

- The need for better designs that reduce the overall contribution of the sector to climate change. Green building focuses on increasing the efficiency of resource use.
- Malaysia's Green Building Index (GBI), launched in 2009 to promote sustainability in the built environment.
- Energy Commission, Greentech Corp building is an example of certified green building in Malaysia.

greenbuildingindex

LIMA '13
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26 - 30 March 2013

Langkawi, Malaysia

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TIME ZONES

ZONE 1:	2010-2015
ZONE 2:	2015-2020
ZONE 3:	2020-2025
ZONE 4:	2025-2035
ZONE 5:	2035-2050

Notes on time travel

This map is a broad representation of some of the trends and technologies currently visible. Improvement works are carried out at weekends and travellers should check to see whether lines are still operable before commencing any journeys. Helpful suggestions concerning new routes and excursions are always welcome.

If you wish to travel outside of Zone 1 you are advised to bring comfy shoes and a camera. Travellers are also advised to bring their own supplies of food and water although weapons are unnecessary if you keep to well trodden paths. Also note that travel into Zone 5 is not available for people aged over 75 years of age.

A3 and A2 Prints of this map

Full colour prints of this map are available to anyone that asks nicely. A small charge is levied to cover print and postage costs only. Contact < richard@nowandnext.com > stating whether you'd like A3 or A2 size and saying which country the map is to be delivered to. Delivery is available to anywhere in the world. Alternatively, just print this out yourself (A3 minimum recommended)

Sourced

Material for this map has been soured from a number of publications including Future Files and What's Next

www.futuretrendsbook.com

What'sNext
www.nowandnext.com

Acknowledgements

This map was conceived and created by Richard Watson at Nowandnext.com with some help from Benjamin Frazer at Snap. Also thanks to Oliver Freeman, Mike Jackson and Scott Martin.

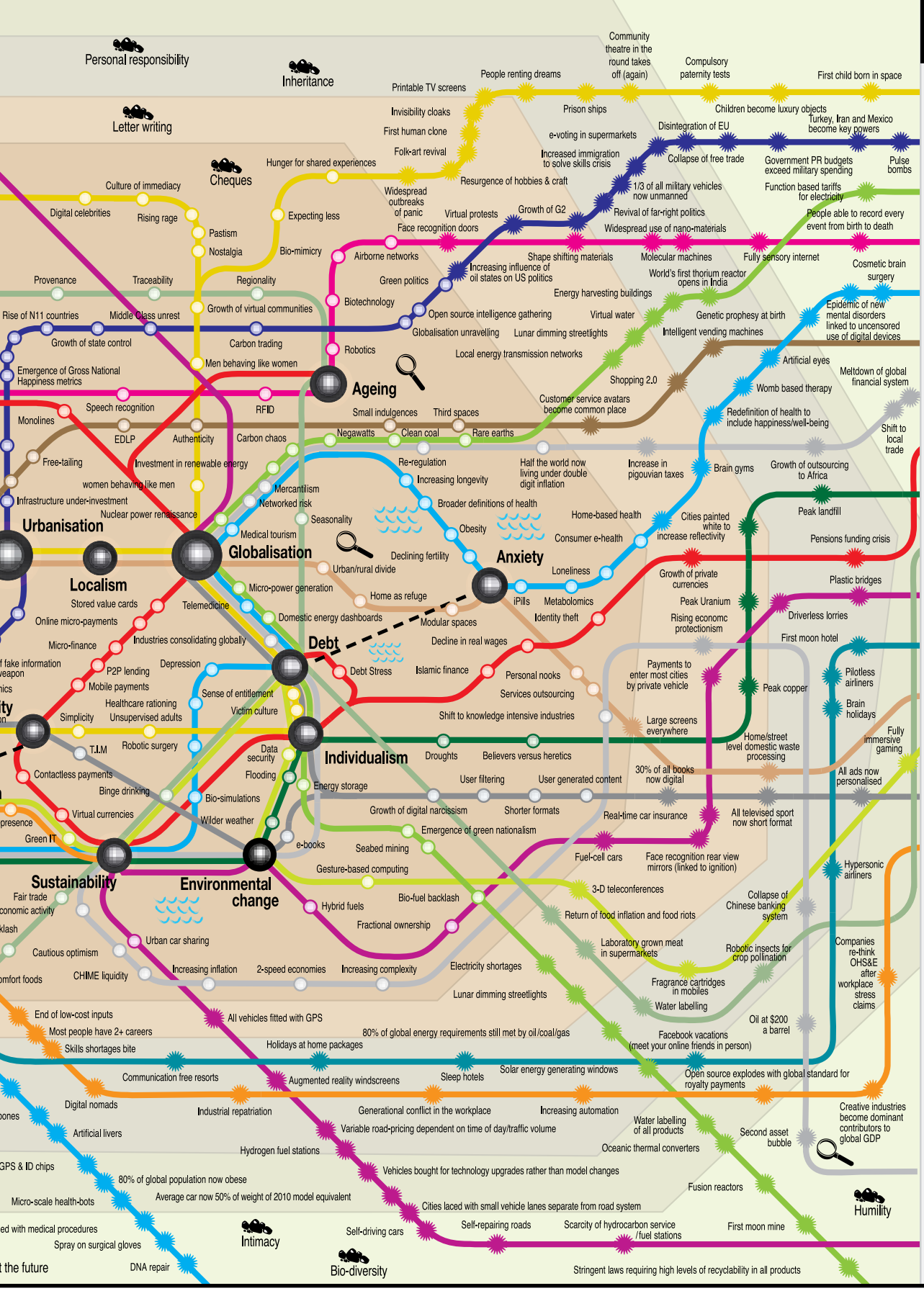
TRENDS & TECHNOLOGY TIMELINE 2010+

A roadmap for the exploration of current & future trends
(+ some predictions to stir things up. More at nowandnext.com)

Global risks*

* Low probability/high impact events that could derail any of the above trends and predictions

- Commodity price spikes
- Raw materials shortages
- Mass migration of population
- Nuclear terrorism
- Internet brownouts
- Electricity shortages
- Rapid increase in cyber crime
- Critical infrastructure attack
- Rogue stakeholder
- WMD Proliferation
- Green energ
- Genetic terr
- Collapse of
- Global supp
- Terrorist att



LEGEND

1. Society & Culture
2. Geopolitics
3. Energy & raw materials
4. Science & technology
5. Healthcare & Medicine
6. Retail & leisure
7. The Economy
8. Financial services
9. Environment & Climate
10. Food & drink
11. Transport
12. Travel & tourism
13. Home & family
14. IT & telecomms
15. News & Media
16. Work & Business

- Mega trend
- Trend
- Prediction
- Dangerous currents
- Poor visibility
- High-speed link
- Partial ruin

- gy bubble
- rorism
- US dollar
- ply chain disruption
- ack on urban water supply
- US/China conflict
- Israel/Iran conflict
- Bisphenol A link to cancer
- Geographical expansion of Russia
- Major earthquake in mega city
- Global pandemic
- Conflict with North Korea
- Political disintegration of Saudi Arabia
- Systemic failure of financial system
- Fundamentalist takeover in Pakistan
- Middle class revolution
- Collapse of China
- Mobile phone link to cancer
- Credit Default Swaps
- Rogue asteroid
- Major nano-tech accident
- Space weather disruption to comms
- Aliens visit earth
- Return of the Messiah
- People taking trend maps too seriously

MAP THE FUTURE

As a strategic policymaker or stakeholder, you can help map out a desired future for Malaysia.

This is an invitation by myForesight™ to build a collective future. Do you find this magazine thought-provoking? Do you think we could have done better? Perhaps you would like us to cover a specific angle in the study of Foresight.

Or maybe, you would like to contribute articles to the myForesight™ magazine? Send your feedback and articles to foresightinternal@might.org.my. Website: www.myforesight.my.

We look forward to hearing from you.

myForesight™ team