

myForesight®

MALAYSIA'S NATIONAL FORESIGHT MAGAZINE

Commemorating
MiGHT **20** years
of Forward Looking



Commemorating
MiGHT **20** **years**
of Forward Looking

PLAYING A ROLE IN THE GROWTH OF NATIONS



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MALAYSIA'S NATIONAL FORESIGHT MAGAZINE

03/2013

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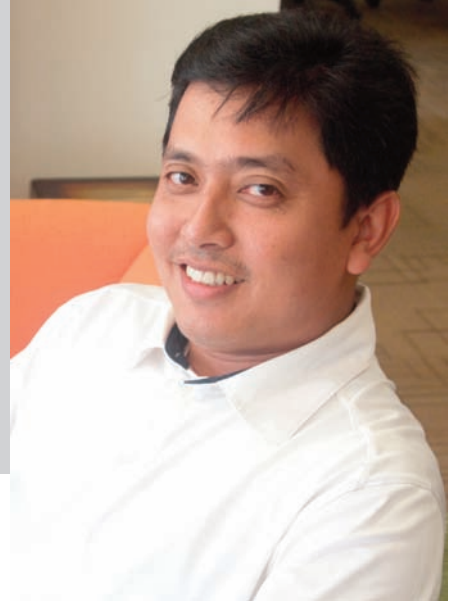
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Initial Thoughts

BY

RUSHDI ABDUL RAHIM
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Greetings & Salutations,

It is my pleasure to bring you the latest edition of myForesight® magazine, it is a special one because this particular edition is a bumper issue in conjunction with MIGHT's 20th Anniversary.

Therefore, for this particular edition, we are dedicating a major part of the magazine to the focus areas of MIGHT as well as insights from both our joint chairs and CEO. We've also reproducing experts' insights from our collaborators and leave enough room for trends and issues that is worth discussing.

20 years is a long time. Looking back, I join MIGHT in 2007 and duly learned on what the organization is all about and how they go about things. And I've found out that although the personnel have change and the methodology has evolved, the way MIGHT does things remain the largely intact; consensus building through partnership & networking, providing strategic input to policy making and planning. If you refer to the diagram attached, it is very much in line with how MIGHT does things.

Therefore MIGHT has been undertaking foresight since inception, continuously undertaking it and building it to what it is now. The reasoning is by looking ahead further than the conventional norms would enable MIGHT to assist the Government to strike the right balance between long-term thinking & tackling issues that need immediate attention.

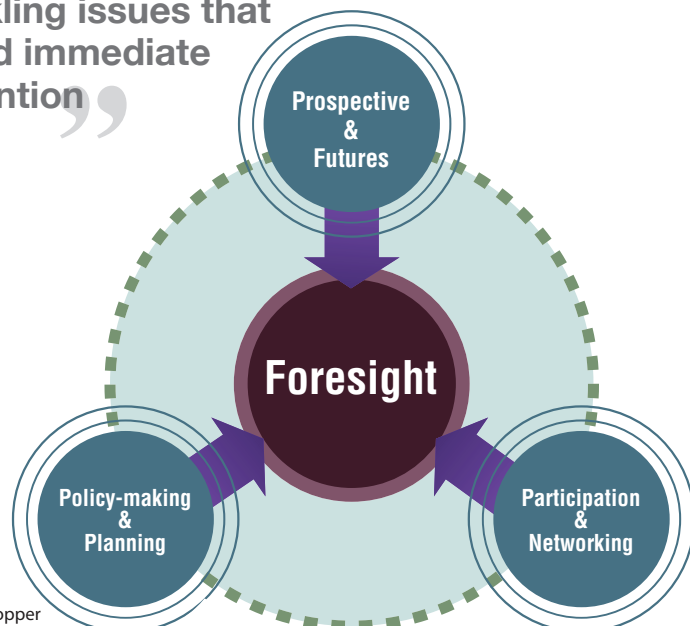
I have mentioned in this space how in doing foresight and looking at the future there is a need to also learn from the past and your

“... by looking ahead further than the conventional norms would enable us to assist the Government to strike the right balance between long-term thinking & tackling issues that need immediate attention”

predecessors. Therefore I am also taking this space to acknowledge those who undertook and contributed to the process as well as those who were responsible to build the required competencies and understanding of foresight.

As usual, we hope you find the magazine beneficial and thought provoking.

We expect you to have your opinion on certain matters. We want to hear them if you are willing to share. We welcome your feedback and contributions.



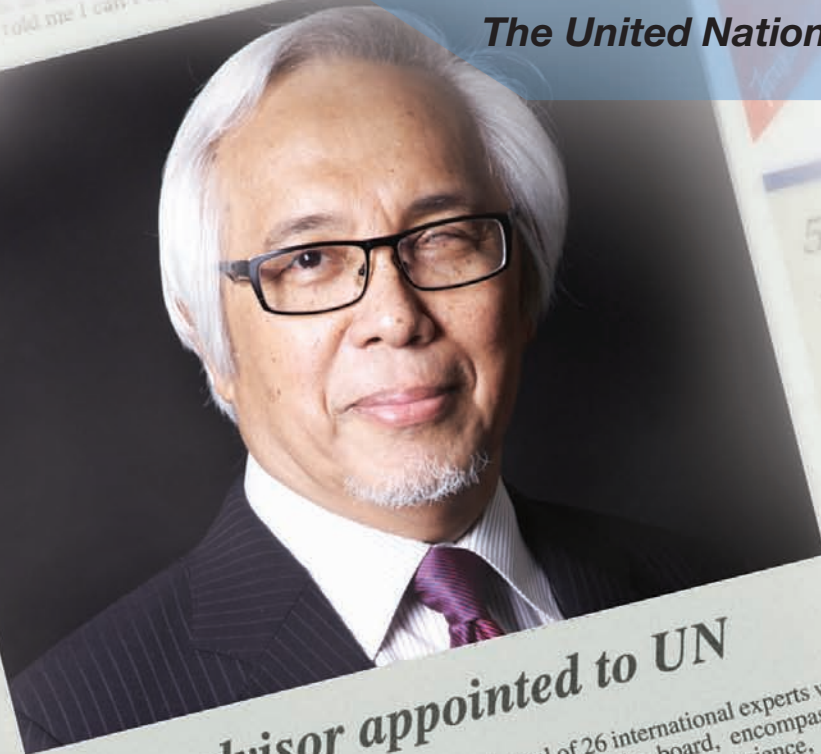
Source: R. Popper

We would like to

Congratulate

**PROFESSOR EMERITUS
DATO' SRI DR ZAKRI ABDUL HAMID**

*on his appointment to the
Science Advisor Board to
The United Nations (UN) Secretary-General*



PM's advisor appointed to UN

PUTRAJAYA: The science advisor to the prime minister is among seven Asian figures appointed as members of the Science Advisory Board to United Nations secretary-general "Ban Ki-Moon. In a statement yesterday, the Malaysian Industry-Government Group for High Technology said Professor Emeritus-Dato' Sri Dr Zakri Abdul Hamid would join the new board to advise Ban and the chief executives of UN agencies on science, technology and innovation relating to sustainable development.

A total of 26 international experts were appointed to the board, encompassing various backgrounds in science, engineering and technology, social sciences and humanities, ethics, health, economics, behavioural science, agriculture and environmental sciences relating to sustainable development. Zakri was appointed science advisor to Prime Minister Datuk Seri Najib Razak in 2010.

Bernama

leader's insights

Time to Reignite A Science Renaissance

BY

PROF. EMERITUS DATO' SRI DR ZAKRI ABDUL HAMIDScience Advisor to the Prime Minister of Malaysia /
Joint Chair MIGHT

Experience has shown that countries that grow rich are not necessarily those well-endowed with natural resources but those that invest wisely in building their human capital and allocating a reasonable percentage of their gross domestic product to research and development.

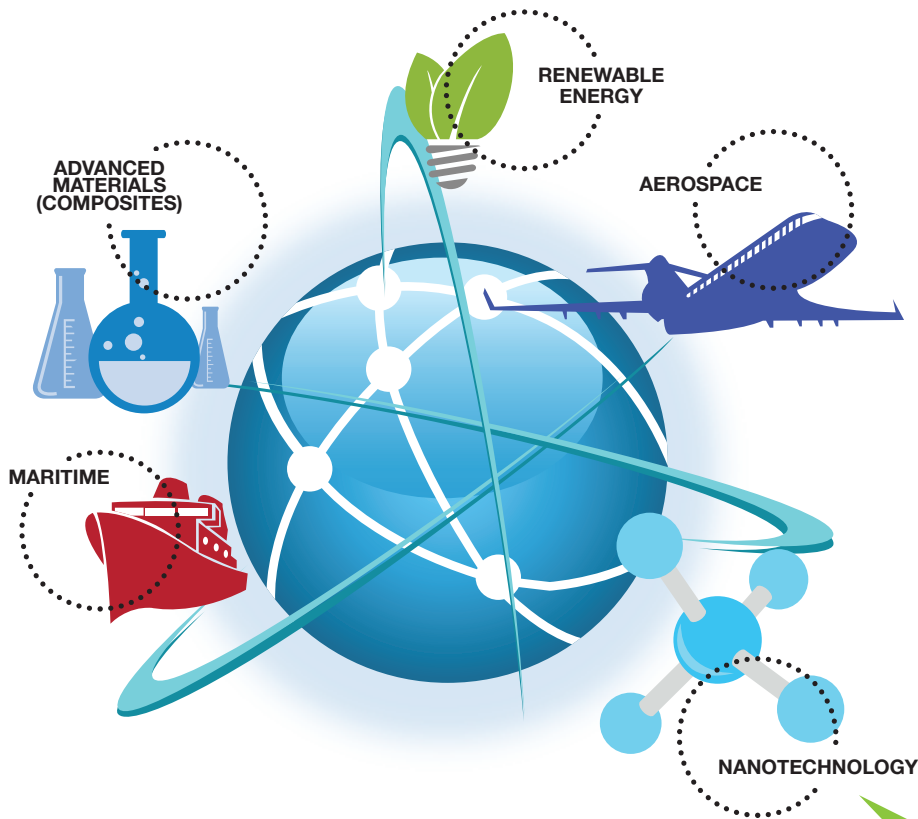
There used to be a time when science flourished in this country and contributed to wealth creation, although it was misdirected and catered to a different stakeholder. During the colonial era, several research institutions were established to enrich the British empire or to take care of the well-being of our then political masters. The Institute of Medical Research was established in 1901 to address the hazards posed by tropical diseases prevailing at that time, malaria being one of them.

To meet the needs of an increasing population due partly to an influx of immigrant labourers, and to fill the coffers of the colonial government through export of agricultural produce, the Department of Agriculture was founded in 1905. To help exploit our abundant and pristine biological diversity at that time, especially the extraction of timber, the Forest Research Institute of Malaya was launched in 1926.



“Malaysia needs an economy where science, technology and engineering are integrated into the production process and where creativity, imagination, knowledge and design capability are embodied in well-educated skilled workers who are the main source of national prosperity and wealth.”

leader's insights



In one of the earliest episodes of bio-piracy, in 1876, Henry Wickham, an Englishman, smuggled 70,000 rubber seeds out of Brazil to be germinated at Kew Gardens near London, a despicable act but still deserving of a knighthood from Queen Victoria. Some of the seedlings were despatched to the Far East for large-scale planting.

To support the fledgling rubber industry, the Rubber Research Institute of Malaya (RRIM) was founded in 1926. The then Malaya and later Malaysia was the top rubber producing country in the world for many years, because of the excellent research and development conducted at RRIM. Rubber remained a top revenue earner for the country in the early years after Merdeka.

Oil palm, originally from West Africa, was first introduced to Malaya in 1910 by Scotsman William Sime and English banker Henry Darby. The first plantations were established by colonial owners such as Sime Darby. These companies were "Malaysianised" in the 1970s.

Science had a hand in creating wealth through oil palm cultivation. Research, which was earlier conducted by the plantation houses, received a boost with the establishment of the Palm Oil Research Institute of Malaysia (PORIM) in 1979. PORIM (renamed Malaysian Palm Oil Board in 2000) is a public-private-coordinated institution with an impressive rate of technology commercialisation at 30.6 per cent (compared with 3.4 per cent among local universities).

Time and circumstances have changed. Agro-based economic activities no longer constitute the bulk of our national prosperity. The export-oriented electrical and electronics industries located in the free trade zones brought a lot of revenue in the 1970s and 1980s but may not be tenable much longer, given the increasing competition from our cheaper-cost neighbours. Petroleum is a major source of income but this source of wealth is finite.

It is time to venture into other wealth-creating pursuits. The dawn of the 21st century has brought with it advances in information and communication technology and emerging technologies such as biotechnology, nanotechnology and the green technologies. However, these are all knowledge intensive activities.

We need to prepare and equip our people well. Experience has shown that countries that grow rich are not necessarily those well-endowed with natural resources but those that invest wisely in building their human capital and allocating a reasonable percentage of their gross domestic product to research and development.

Indeed, a 2007 World Bank Report suggested that "Malaysia needs an economy where science, technology and engineering are integrated into the production process and where creativity, imagination, knowledge and design capability are embodied in well-educated skilled workers who are the main source of national prosperity and wealth".

Vision 2020 and the New Economic Model cannot be premised on low-cost, low-tech mass production but need to be driven by cutting-edge technologies underpinned by a strong R&D and innovation base.

We have embarked on that road. However, it has been a halting start. Notwithstanding that our policymakers are aware of the potential of science, technology and innovation in wealth creation, and national targets have been well set, these targets are somewhat off the mark for the moment.

There is an urgent need for a revamp of our science governance and research priority-setting. For example, although R&D spending of 1.5 per cent of gross domestic product was targeted in the Ninth Malaysia Plan, the gross expenditure on R&D in 2008 was a low 0.21 per cent, a dismal figure compared with the R&D spending of countries like Japan (3.32 per cent), South Korea (3.22 per cent) and Singapore (2.77 per cent).

There is an urgent need for a revamp of our science governance and research priority-setting

Our efforts to increase the number of researchers to 50 per 10,000 workers were also not realised: the current figure stands at 20.3 per 10,000, compared with South Korea's 89.8 and Singapore's 103.

It is timely, therefore, as recently announced in the 10th Malaysia Plan, that the government intends to establish the National Science and Research Council, an apex body mandated to provide advice, set priorities and streamline R&D activities.

This is a strong signal to researchers in the public sector and partners in the corporate world that the government recognises the crucial role that science in general and R&D, in particular, play in building a prosperous and peaceful nation.

Let us work together to reignite the fire for a science renaissance in this country.

leader's insights

In person with ...

Tan Sri Datuk Dr. Ahmad Tajuddin Ali

On The Future...

Foresight is not just about tomorrow, but years to come. We have to look at 20-50 years from today – what trends are going to happen and to make necessary adjustments today. The future is bleak ... and this is not the 'feel good' time because my view of the future – 20 to 50 year's time – is indeed bleak for this country. I have my own reasons, but I really hope that when the time comes, I'm proven wrong.

There are many factors and indicators that show we are not heading in the right direction. Let's start with the global challenges. There are big issues being debated in all international forums, for instance Rio +20. During Rio +20, The International Institute for Applied System Analysis (IIASA) presented the global energy assessment which shows that the world is facing challenges, namely in energy, climate change, food security, food production, poverty and equity. All these challenges are interrelated and each one feeds the other.

We certainly cannot extract ourselves from being in that predicament as part of the global community. For example, food crisis, energy crisis and poverty issues in Africa will become even more critical as we go forward. Continuous consumption of energy due to growing population is impacting the food prices and distribution.

Energy prices will continue to escalate and Malaysia is currently importing much of our energy. Although we produce palm oil, the plantation will be competing with the growing population for land. Soon, those agricultural lands will be converted into housing and industrial area. At the same time we are facing the global demand and pressures to preserve our rainforest and greenery, hence, preventing further conversion of our virgin jungles into palm oil plantations.

I'm quoting a few known challenges in terms of rising population, increase cost of food production, distribution, and storage – the whole line of food security. Water scarcity is another global problem that is being faced in Malaysia too. If we look forward to 20 to 30 years from now, the water problem will be acute. All these issues – food shortages, energy crisis, water scarcity, etc.



Foresight is not just about tomorrow, but years to come. We have to look at 20-50 years from today – what trends are going to happen and to make necessary adjustments today.

– will have an impact on us and hamper our growth. However, we are very lucky to be where we are today. We have exploited and make good use of our existing resources – labour, land and technology so far. But we know that it is not adequate. For instance, the labour cost in Malaysia is not as competitive as it is in China. Land scarcity and increasing land prices limit our ability to offer foreign businesses to open their plants here. When Malaysia aims for Knowledge Economy and moves towards higher income society there are also hindrances such as inadequate investment in R&D, small GDP etc.

“At this point I am pessimistic. But I hope my pessimism will lead to actions being taken, actions that will prove 30 - 50 years from now - although I may not be around to see it - that I'm wrong... then I will be happy.”

leader's insights

On competitiveness...

In the context of global competition, Malaysia is, at the moment, too dependent on imported or foreign technologies and the people. This includes experts and their expertise, ownership of patent right, etc. – as the basis of our manufacturing and production. We need to extract more value from the resources that we have today. In palm oil, for instance, we need more than what we already have now. By going downstream we can produce higher quality products range across the value chain; from the raw materials to the end products. This can be done with the aid of our own scientists in our own laboratories, by generating new sources of intellectual property rights on products and processes. We can boost our production, locally or abroad, but hold the IP rights. We should try to reverse the current scenario where laboratories abroad use our raw materials for their productions but hold the IP rights, and sell back the end products to us at higher prices.

On Socio Economic vs. Technology

Basically, there are two types of people in this world that generate and create wealth. First, the agriculturists, planters, and farmers – they plant fruits or cereals, and create or generate fine chemicals from minerals in soil, air and water. Second, the technicians, be it chemists, engineers and so on. Through the use of S&T, they create a process that leads to higher value produces. While others – the accountants, lawyers etc. – help in managing the wealth created along the pipeline. The political system in Malaysia has evolved, enabling us to maintain harmony and peace. In spite of the other ingredients of instability, the basic ingredients are multi-racial, multi-cultural, multi-religion, and multi-lingual. People are contented and they are now looking at the next phase – environment, equal rights, etc.

The political statements are correct, but the will to carry through by the system such as funding for R&D and emphasis on science education system is vital. In an effort to produce the 'breed' that we want – a society that is scientifically literate – teaching science and mathematics should be made compulsory.

Beyond any shadow of doubt, we are enjoying political harmony and stability. This is because of the size of our economic cake is big enough and have continue to expand. However, if we are not able to keep this cake from expanding continuously, the basis of our harmony and stability may be shaken or even erode.

The strive to put food on the table for the family is paramount. We are talking about the whole society in general, about the masses. If our economy is not able to expand and compete on the global stage, that is if we are unable to export high value



added products, we will lose out. Eventually, although the cake may not shrink, but it may also not expand as fast as needed to satisfy the growing demands and expectations of the community.

We must always remember that other countries are also trying and succeeding, possibly at a faster rate compared to ours. We must do something to maintain our competitive edge because we are sharing the same world market. We have to be ahead of the curve, ahead of the pack, if we want to sustain our competitive position. It is sad to say, the way I see it, the ingredients for achieving that competitive edge is not there.

On Theory of Abundance ...

The greatest danger to humanity is complacency. As for the theory of abundance, I would prefer to look from the opposite end. When we say there are pockets of abundance, there are also pockets of poverty. When I see towards 20 to 30 years in the future, I see regions in the world that will be very unstable due to poverty, hunger, overpopulation, etc. It has happened – in Somalia and Sudan.

Inequity is the main cause of the instability, and the impact could be cross-borders. For example, the needs – rather than the demand – for water. Water is one example on competing demand for resources. Water source, may come from an upstream in one country and flow to a downstream in another country with the latter depending very much on what is coming from the former. There could be diversion of water resources in order to optimise the use by the upstream country, thus depriving the supply to the downstream country. This will cause the supply-demand conflict.

On Innovation Ingredients ...

Our education system aims to have 60:40 ratio of science to art students. Sadly, today we only have less than 30% students in the science stream. If this trend continues, future Malaysians will be pure consumers of technology. Only a small percentage of our population will engage in S&T, especially R&D thus, decreasing the chances of Malaysia to be a producer of technology that can contribute more to wealth.

Greater challenges are faced by teachers today compared to yesteryears. Continuous use of traditional teaching methods are no longer conducive as students are now sometimes ahead of their teachers and become less interested to be in school. Unless the interest in technology amongst students is inculcated, nourished and developed, future Malaysians will be technology consumers, not producers. Only through strong foundation of science and mathematics in our education system, are we able to groom future researchers, scientist and innovators.

Talent is a key resource to move up in the technological scale in terms of ability and capacity. There is no point in allocating so much money in R&D if we don't have the human capital. Yes, we can open up our economy to outsiders, but indigenous capacity is vital. We cannot rely on foreigners as they will come and go within the context of their own analysis. For instance, if they find another country which is better and more competitive, they will move out. They may not fully translocate, but instead of expanding here, they will expand elsewhere. Therefore, our system and infrastructure need to be conducive enough to support and continue generating growth into the future.

On Regeneration of New Talent ...

One of the things that worry me is that we failed at regeneration of talents in the management of STI and R&D. There are several institutions that fail to leap forward from the foundations that were set by earlier founders. Somehow, these foundations have gone into some sort of oblivion.

Some of the institutions and organizations that were vibrant before are not moving forward because they are trapped in their cocoon. They are not creative and innovative to face current changes and challenges.

Staying in the same trajectory is fine, but if we stay at that level while everybody else is moving forward, we are actually moving backwards. The pessimism in me is for a good reason, and I would like to help. Through NSRC, for instance, we intend to reorganise things in order to redirect the ships that are already afloat to face stormy waters ahead.

There are so many other things that we can do to create and generate interest of the younger generation in S&T. Real innovation is the one that will really create value and has to be based on S&T, knowledge and strong foundation in science, engineering and mathematics.

At this point I am pessimistic. But I hope my pessimism will lead to actions being taken, actions that will prove 30 -50 years from now - although I may not be around to see it - that I'm wrong... then I will be happy.

leader's insights

The Foresight To Do Mighty Things

BY

MOHD YUSOFF SULAIMAN

President & Chief Executive Officer, MIGHT

“Malaysia is 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.”





leader's insights

SOLUTIONS

STRATEGY

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 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".

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, 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 greenfield 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

"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."

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.

experts' insights

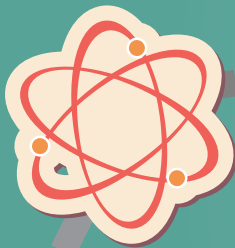


KEY ENVIRONMENTAL CHANGES FOR THE FUTURE OF KOREA

Intensified Environmental & Resource Issues
Advancement of Knowledge-based Society and Globalization



Changes in the Population Structure



Acceleration in Convergence of Science & Technology

VISION

Build a society which makes dreams come true to enhance the quality of life



Emergence of New Security Issues

GOAL

One of the world's top 5 advanced nations in S&T



Future Critical Technologies



Policy Technologies

experts' insights

Healthy world

Convenient world

Science and Technology Vision for the Future Toward The Year of 2040 "A South Korea Perspective"

Eco-friendly world

Affluent world



Future worlds
to be realized



BY
YIM, HYUN Ph.D.

experts' insights

The creation and acceptance of new technologies has accelerated in modern times. In future, science and technology will be a key driver of social change. While the convergence of science and technology will speed up the creation of new technologies and industries. Admittedly, there are significant uncertainties about the future shape of markets, governance and social values. These will impact organizations and influence their capacity to meet their objectives.

In order to prepare for these rapid changes and uncertainties, we should actively respond to future society by establishing a national science and technology vision that incorporates changes in the global environment and the unique conditions of Korea. It has been also more than ten years since the 1st Korean S&T vision, 'Dream, Opportunity and Challenge of S&T

Toward the Year 2025 (1999)' was devised. There is thus a need to formulate a new science and technology vision for the future in Korea. The vision will provide a new guideline for scientific and technological development in order to actively respond to the sharp changing future society. This is also expected to present citizens with dreams and hope, and scientists and engineers with a future direction and goals for the development of science and technology. This vision has been formulated through the following process.

Firstly, we have analyzed changes in the global environment and unique conditions of Korea to define a direction for changes in the future environment. Five megatrends are presented, which are meaningful for Korea in 2040. The five megatrends are (1) Intensified environmental and resource issues, (2) Globalization and the advancement of the knowledge-based society, (3) Changes in the population structure, (4) Acceleration in the convergence of science and technology, and (5) Emergence of new security issues. In-depth analysis of the relevant issues for each megatrend is conducted to identify a direction of change. Based on these analyses, we derive a vision and goal in the area of science and technology.

Secondly, the future society of 2040, when the vision is achieved, is concretized into four

Incurable and terminal diseases can be treated, state-of-the-art medical services can be provided, and there are no concerns related to security or safety in daily life.

types of worlds such as natural world, affluent world, healthy world, and convenient world. Natural world takes place by developing clean energy and maximizing the reuse of resources. In the affluent world, a new industrial/ economic structure is formed, owing to materials and production methods that are based on a new concept and green revolution. For a healthy world, incurable and terminal diseases can be treated, state-of-the-art medical services can be provided, and there are no concerns related to security or safety in daily life. For convenient world, there is unrestricted information exchange, resulting from the establishment of a ubiquitous ICT environment, and convenience in daily life is substantially improved through robot services.

Finally, future key technologies and policy directions are proposed to achieve the vision and goal, i.e., to create the four types of worlds. In order to identify future key technologies, candidates that had a high possibility of contributing to building the vision were collected from existing science and technology plans. The final list of 25 future key technologies is selected from the candidates through SWOT analysis and expert surveys. The 25 future critical technologies are divided into 2 groups according to the investment strategy. For the short to mid-term investment, we should focus on acquiring technological competitiveness by making concentrated investments over the next ten years and make continuous investments afterwards. Technologies related to resolving pending issues, such as new types of infectious diseases, parts and materials, and energy-related measures are included in this group. The green technology that requires the country to preoccupy an advantageous position in the world market and new growth engines that can generate added value are also included. For the long-term investment, we should prepare for the future and contribute to the maintenance of national competitiveness by making continuous investments. For this group, technologies that prepare for the aging society and that realize a safe society are included. World-leading advanced technologies, original green technologies, and new growth engines whose markets have not been fully formed but have great future growth potentials are also added.



Seoul Plaza,
South Korea 2



Myeong Dong Shopping
Streets, Seoul

Five policy directions represent the general directions for S&T policy that the government should continually focus on to lead the future. The first policy direction is to expand creative and leading R&D. A support for challenging and adventurous research as well as multidisciplinary research should be strengthened to identify new growth engines. The government should make concentrated investments in basic research that has a high risk of failure in the market, encourage expansion of private sector investments, and establish an environment for the startup of innovative venture companies that develop new technologies. The second one is to cultivate science and technology experts and strengthen the knowledge system. The education and research system should be reformed so that researchers' creativity and autonomy is respected. The government should also put more emphasis on soft power such as standards and knowledge capital. The third one is to advance S&T innovation system through international cooperation. Open innovation through strategic international cooperation in science and technology should be promoted in order to overcome the issue of limited resources in Korea and to strengthen global science and technology competencies. The government should facilitate strategic joint research with advanced countries and strengthen reciprocal support with developing nations. The fourth one is to move forward with green growth-based technology innovation.

improvement of the quality of life, including citizens' health, safety, and environment. The government also has to enhance the social responsibilities of science and technology and disseminate the culture of science and technology.

Once the vision is realized in 2040, Korea will be one of the world's top five nations in science and technology that performs as a global leader. Korea is also expected to be a society that raises the value of life and that makes the dreams come

true through the development of science and technology. The Korean government is currently working to spread dreams and hope among citizens by presenting a developed image of Korea of 2040 that will be realized through science and technology.

Open innovation through strategic international cooperation in science and technology should be promoted in order to overcome the issue of limited resources in Korea and to strengthen global science and technology competencies.

Green technology innovation capabilities should be facilitated for the virtuous cycle of economic development and environmental preservation. The government has to strengthen the system for encouraging private sector investments in the development of green technologies and products. The last one is to strengthen the roles of science and technology in contributing to citizens and society. The roles of science and technology should be facilitated in resolving social issues. The government should increase roles of government R&D in contributing to the



Key Technologies

Category	Short to mid-term	Long-term
Overview	<p>Technologies that require the nation to secure technological competitiveness by making concentrated investments over the next ten years and make continuous investments afterwards.</p>	<p>Technologies that require the nation to prepare for the future by making continuous investments and that will contribute to maintenance of national competitiveness</p>
Natural world	New and renewable energy technology	
	High efficient energy technology, Waste resource recycling and mineral resource technology	Technology involved with monitoring and responding to climate change, Technology involved with preventing and managing pollution resources and assessing ecological risks, Technology used to reduce the emission of greenhouse gases
Affluent World	Cutting-edge, functional material technology	
	Manufacturing/production technology that converges new technologies, Technologies related to the knowledge service industry, Production robot technology for the manufacturing industry,	Advanced agricultural biotechnology Advanced, environmentally friendly logistics technology
Healthy world	Technology used to respond to new types of infectious diseases, Technology used to manage dangerous substances, Technology to build a safe living environment	Pharmaceutical technology based on a new concept, Brain research and brain disease treatment technology, Silver-industry and u-health technology, Military technology to prepare for future war
Convenient world	Ubiquitous computing technology, New media content technology, Virtual reality technology, New transportation technology.	Service robot technology, Technology used to develop safe and pleasant spaces.

experts' insights

TOWARDS A FORWARD LOOKING INSIGHTFUL POLICY **COMBINING COMPETITIVE INTELLIGENCE AND FORESIGHT**

BY



JONATHAN CALOF



JACK E. SMITH



experts' insights

It is an honour for us to have an article in the inaugural issue of the myForesight magazine. The launch of this publication is important for Malaysia as it brings together best practices on how to conduct foresight. The two of us have been fortunate to witness Malaysia's commitment to forward looking policy as we work towards increasing foresight literacy in Malaysia under the Brain Gain program, and in being part of many other foresight and insight related initiatives in this country.

The two of us Jack Smith (as the former Chief Foresight Officer for Canada), and Dr. Calof (as recipient of Frost and Sullivan's life time achievement award for his work in foresight and intelligence and fellow of the society for Strategic and Competitive Intelligence Professionals) have been fortunate to view foresight around the world, both in our capacity as academics studying it and consultants helping governments and companies benefit from it. We have created foresight leader forums, discussion groups, helped plan conferences and conducted numerous workshops. It is the knowledge we have gained from these experiences that we wish to share with you in this your inaugural issue.

Why is (true) foresight so important?

“Foresight is a set of strategic tools that support government and industry decisions with adequate lead time for societal preparation and strategic response by assessing the external environment.”

(Smith and Calof, 2010).

Why foresight? A government's or a company's success depends on factors that are outside their direct control. For example, as a government, Malaysia could look at developing a program designed to encourage the development and growth of nanotechnology companies (similar to what Russia is doing). Among the instruments of this program could be a loan guarantee or other financial instruments. The intent of the policy would be to create and support a viable and successful nanotechnology sector. While the government can certainly create the program and provide the loan guarantees, success hinges on a few factors beyond a government's control:

- 1 The actual nanotechnology industry globally being a profitable/attractive one. If the industry becomes unattractive, Malaysian companies may not do well in it.
- 2 Malaysian companies developing appropriate innovative products/services that would require loan guarantees.
- 3 That the companies apply for loan guarantees.
- 4 That the banks accept proposals with loan guarantees.

If any one of these four does not occur, then the program will fail – and the government will not control directly any of these prerequisites. So they need tools that will enable them to understand these four elements and their associated drivers.

Foresight is a tool to help understand these elements of the external environment. In fact with proper understanding, programs can be designed that would address these concerns. For example, scenario analysis would help the government identify key drivers for nanotechnology over the next 20 years, thereby pointing the way to more attractive areas to focus the policy on. Perhaps given Malaysia's strengths, the focus should be on materials nanotechnology? Maybe it should be on health-related nanotechnology? There are many different areas in nanotechnology that could be focused on and as a country you do need to focus. Foresight looks long term, recognizing that for the Malaysian nanotechnology industry to grow and thrive requires looking not at today's markets but tomorrows as it will take time to do the research, design the products, build the capacity. Russia's time frame for their nanotechnology policy was 20 years. We get industry ready for the environment of tomorrow, not the environment of today.

experts' insights

Foresight and its sister field, competitive intelligence also recognizes the need to better understand the specific "players" in the environment. This is a more short term focus than classic foresight but is generally more in depth. So, for the nanotechnology program, the intelligence component would be to profile the banks to see what type of guarantee would encourage them to accept nanotechnology proposals. For the company, it would be profiles to see what technologies are competitive, whether companies would be willing to be participants in the program, and so forth. Canada set up a technology intelligence unit within the National Research Council to assist these types of enquiries.

So by use of foresight and competitive intelligence, a nanotechnology program would be designed that in understanding the drivers of how the banks and companies operate (competitive intelligence) and where technology is going (competitive intelligence and foresight), sets out a program of financing and research that positions Malaysia for the future of the industry (foresight).

For a program or strategy to succeed therefore requires not only a fundamental understanding of the forces that can affect it, but also what are likely to be the most uncertain aspects of these forces and how they might change the game. If you are a company this means understanding the likely reactions of customers, competitors, governments and regulators for example. If you are a government, it is about understanding how the intended audience of the policy will react.

Foresight and competitive intelligence, are both fields that focus on providing depth of insight and a forward orientation – key attributes required to deal with this dilemma. These fields use a variety of profiling and environmental assessment techniques to understand companies, markets, technology trends etc. They have proven to be very useful for providing the insight required to understand these external forces. Policy which is based on analysis of the environment of today will rarely succeed unless the environment of tomorrow is identical to it. Policy which is not based on analysis of the players that it is intended to impact can also not succeed.

Foresight has been used by organizations to provide numerous benefits to decision makers and stakeholders to:

- Reveal prospective new issues, challenges-threats, stakeholders, or shifts in alignments of influential players;
- Identify needs for new skills, knowledge and capabilities;
- Highlight new, weak signals that can become pivotal in the future, and signal potentially disruptive surprises, emerging technologies that will be critical for the organization's future;

- Demonstrate current regulatory weaknesses – zones where failure to prepare can bring severe consequences;
- Determine S&T, R&D priorities, strategic technology investment domains and critical sectors;
- Expose the limits of current policies and gaps that should be filled;
- Deliver intelligence on emerging business and market opportunities, new foreign strengths and players;
- Provide alerts about threats, complex situations and organizational vulnerabilities – allowing time to adapt

In short, foresight contributes to better decisions, more robust policies, precision in research choices and insightful analysis. Further, as we have noted, many of the most prosperous countries in the world have used foresight as a tool to enhance their policy making.

What are the keys to successful foresight?

We have been working on a research program designed to identify the requirements for successful foresight programs. We did a study on this question two years ago by interviewing the directors of the top foresight programs in the world. Last year, we gave the list of these success

factors to a roundtable of foresight program directors that had gathered in the United Kingdom. The list starts with an assumption that your foresight program has used the appropriate methodologies. This is what we learned from the successful units.

Focus(es) on a clearly identified client:

Successful functions were housed within a ministry responsible for innovation. In Ireland this was the Industry Ministry while in Thailand it is the National Science and Technology Development Agency (NSTDA). In Finland, the Parliamentary Committee on the Future is supported by a national fund for R&D (SITRA- government investment, augmented by a significant Nokia share sale in the 1990s) as well as by government science and technology focused agencies such as the TEKES, VTT, (Ministry of Trade and Industry) and the Academy of Finland, part of the Ministry of Education. Not only were they housed within the correct ministry, this was identified as the primary client for the foresight results.

Clear link between foresight and today's policy agenda:

A key requirement is to develop foresight capacity amongst senior decision makers so that they can integrate the important tools of technology foresight into advice to government. The UK seems to have developed this capacity the most where the Science Advisor has repeatedly been able to engage key ministries as joint sponsors and receptors for the results. However all interviewees talked about the link between what they were doing (foresight exercises) and actual policy.

Future is not necessarily continuation of the past What happens when humans predict their future?



London 1867



In 1867, a British scientist predicted that London's population would grow very fast over the next 100 years...



...because of the population growth, he argued, also many more house carriage would be needed...



...and knowing about the horses' public bathroom habits, he concluded:



By 1967, London would be buried six feet deep in horse dung!

Source: 2007 World Economic Forum/Roland Berger Strategy Consultants

experts' insights

Direct links to senior policy makers:

To have a better understanding of policy needs, to get much needed budgetary resources and so forth, the foresight capacity and stakeholder organizations must be linked with and provide regular briefings to senior policy makers. This also helps in getting recommendations implemented. Many reported that this was either a normal practice or an ongoing challenge and that indicated progress was being made. A recent Canadian foresight project had over a dozen Deputy Ministers and Assistant Deputy Ministers as sponsors and mentors for the project. It's no wonder that the projects results are being integrated into new policy and programs.

Public-private partnerships:

Most program experts extolled the good relationships they had developed with industry leaders, advanced technology firms or private sector advisors connected in some way to the national policy agenda and/or senior decision makers. The actual form of the linkage varied from collaborative to cooperative to consultative, but the clear message was that a successful foresight had to connect in some meaningful manner to private sector actors. Foresight must be outside in, that is starting with the private sector perspective and translating it to government requirements. After all, the policy being developed is designed to impact the external environment.

To have a better understanding of policy needs, to get much needed budgetary resources and so forth, the foresight capacity and stakeholder organizations must be linked to provide regular briefings to senior policy makers.

Develops and employs methodologies and skills that are not always used in other departments:

For example, Forfas came into being to address a government gap – i.e. there was a recognized need to use new and more forward looking approaches to help in policy setting. Thus, they brought to the table intelligence and foresight methodologies. APEC CTF in Thailand has had its strategy planning and scenario approaches used by their host department to help the Government



itself establish its longer term strategies. In all cases, the new function was bringing much needed methodologies that had previously not been fully exploited within the mainstream Departments of the government.

Clear communication strategy:

A strategy is needed that serves to keep key stakeholders aware of ongoing projects and activities. Excellent foresight is both time sensitive and attractive to those motivated to detect change ahead of its appearance - hence it has significant media value and communications reach – but also must be well described so the context of change, including both its challenges and opportunities, can be appreciated. All of the Agencies contacted realized how critical this aspect of forward readiness has become. There was a range of creative communication approaches ranging from newsletters and websites devoted to key stakeholders to an approach of getting in the elevator with key decision makers to give them 60-second elevator speeches.

Integration of stakeholders into programs:

The agencies investigated all made use of key stakeholders in processes such as project selection, information gathering and assessment, and provision of key recommendations. This factor while obvious has not always been easy to fully accomplish, and so many experts indicated that this presented constant hurdles to creating the levels of appreciation and support necessary to assure

strong policy impacts. Furthermore, many indicated that it was necessary to retain these involvements beyond the period of the actual projects or initial foresight program – because they were an important part of validating the value of foresight to new clients and new topic areas.

Existence of a national-local academic receptor and training capacity:

A clear need at the start is a national-local academic receptor capability for foresight skills and training – hiring from abroad is fine for the start up phase, but participants consistently stated that one needs a local sounding board that can be aligned with the policy needs- capacities, through providing training, intelligence and policy ideas relevant to future challenges; (PREST-MIoIR as an example). Academics that can connect with stakeholders, provide legitimacy and know the methodology are a distinctive asset, and they provide a steady source of new ideas, intelligence and international foresight connections. These skills are needed to build a country's foresight literacy and includes training decision makers to understand the importance and use of foresight.

Our involvement in Malaysia's foresight is limited. We have provided training to personnel from various departments as well as reviewed foresight project plans. It is based on these limited views that our preliminary opinions are formed. Using the previous critical success factor framework as the analytical methodology, we have identified several strengths in the Malaysian foresight program and a few areas that need to be worked on.

experts' insights

Our observations from being in Malaysia and our hope for your future foresight initiatives

Strengths:

We were impressed by how attune the Malaysian government is to the concept of forward looking policy. This is evidenced by recent developments in Malaysia. Having the unit housed in MOSTI makes sense as it is responsible for providing innovation and science-based advice. By looking at the projects currently under way, there is no question that foresight in Malaysia is focused on the government priorities. We also saw a commitment to developing methodology and skills not in evidence at other departments. In fact, while we were providing our initial training for MIGHT, SIRIM and MOSTI, we noted that they were also getting training in scenario analysis, a very important foresight method. Further, the Department had sponsored a foresight conference in the previous year that focused on developing foresight skills.

The weaknesses: Rather than highlight the weaknesses directly, we instead choose to offer a few carefully chosen recommendations designed to enhance Malaysia's foresight capacity.

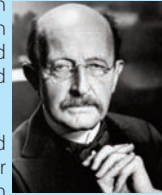
- 1** Integrate other government departments, private sector and academia in each foresight project. Today's policy issues are too complex to have foresight only generated within the framework of only one department. We would like to see more stakeholders being brought into the foresight process.
- 2** Bring foresight to the senior management level. In companies and top government agencies, foresight reports to Presidents, Ministers, Deputy Ministers or vice presidents. Make sure that there is a direct link between foresight and senior decision makers.
- 3** Make sure you have a relevant time frame for foresight. While the government talks about 20-year time horizons, it appears to us that policy making around foresight results is but a 2-year horizon. While some foresight can be short term oriented, some must -- by definition -- focus on laying in the decisions today which will not bear results for 10+years.
- 4** Increase foresight literacy amongst senior managers. To help foresight grow will require acceptance and understanding from key ministers. In Canada, each Deputy Minister has been challenged to develop forward-looking policy using the tools we have talked about in this paper.
- 5** Enhance the countries foresight capacity. It would be useful to sponsor the development of University curriculum in this area. This is how China and the United States has been growing capacity.
- 6** Take advantage of unique collection opportunities such as conferences, workshops and tradeshows. The personnel at our training programs attend a significant number of events. Yet, there appears to be no coordinated collection plan for these events. Several foreign countries use these events to collect the information needed for foresight and intelligence initiatives and we strongly encourage Malaysia to similarly embark on an event intelligence program.

We look forward to sharing more of our insights with Malaysia in the years to come. Yours is a wonderful country with much potential. We are amazed with your innate competitive advantages including geographic and cultural proximity to key markets, resource strength and knowledge base. Foresight provides an important tool for using this potential.

S&T PIONEERS

Max Planck

Planck was born in Kiel on April 23, 1858 into a Swabian family that had produced important theologians and lawyers.



In 1879 Planck was awarded his doctorate in Munich for his thesis "Über den zweiten Hauptsatz der Wärmetheorie [On the Second Law of the Mechanical Theory of Heat]". He earned a senior post-doctorate qualification at the young age of 22, and lectured unpaid as a reader at the University in Munich, where he continued working on the theory of thermodynamics. Later, he became a tenured professor in 1892 and in 1894 became a full member of the Prussian Academy of Sciences. His scientific career received significant momentum with the publication of his award-winning work "Das Prinzip der Erhaltung der Energie [The Principle of Energy Conservation]". His most important scientific achievement was the discovery in 1899 of the natural constant, "Planck's constant", from which he developed his law of radiation and founded quantum theory, which revolutionized modern Physics. He received the Nobel Prize for this in 1918.

(Source: www.archiv-berlin.mpg.de/MaxPlanck)

Joseph von Fraunhofer

Joseph von Fraunhofer Gesselschaft takes its name from Joseph von Fraunhofer (1787-1826), the illustrious Munich researcher, inventor and entrepreneur. Born of a family of modest means, Joseph von Fraunhofer was



a glass-grinding apprentice when discovered by the privy counsellor Joseph von Utzschneider. He took up employ in the latter's Optical Institute and, at the age of 22, became the director of glass manufacturing. He was responsible for the development of new methods of glass production and processing.

The optical instruments he himself developed, including the spectrometer and the diffraction grid, allowed Fraunhofer to conduct fundamental research in the fields of light and optics. He was the first to measure the spectrum of sunlight and characterize the dark absorption strips it contains: the »Fraunhofer lines«.

His independent, autodidactic work won him great acclaim from industry and government. The former apprentice became a full member of the Bavarian Academy of Sciences.

(Source: [Fraunhofer Gesselschaft](http://FraunhoferGesselschaft))

The Siemens logo is displayed in a white rectangular box in the top left corner of the advertisement. The word "SIEMENS" is written in a bold, blue, sans-serif font. Below the logo box, there is a thin blue horizontal line.

SIEMENS



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globe, Siemens has answers to keep economies moving: from hardworking commuter rail to one of the fastest series production trains on earth. Because wherever there are tough mobility questions, we're answering them.

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MILITARY AVIATION

"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

RESEARCH, DESIGN AND DEVELOPMENT

MANUFACTURING AND ASSEMBLY

MRO

industry insights



Taking The Industry to Greater Heights



BY

SHAMSUL KAMAR ABU SAMAH

Head, Aerospace / Advance Material, MIGHT Industry Intelligence
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industry insights

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 on 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 biennial 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.

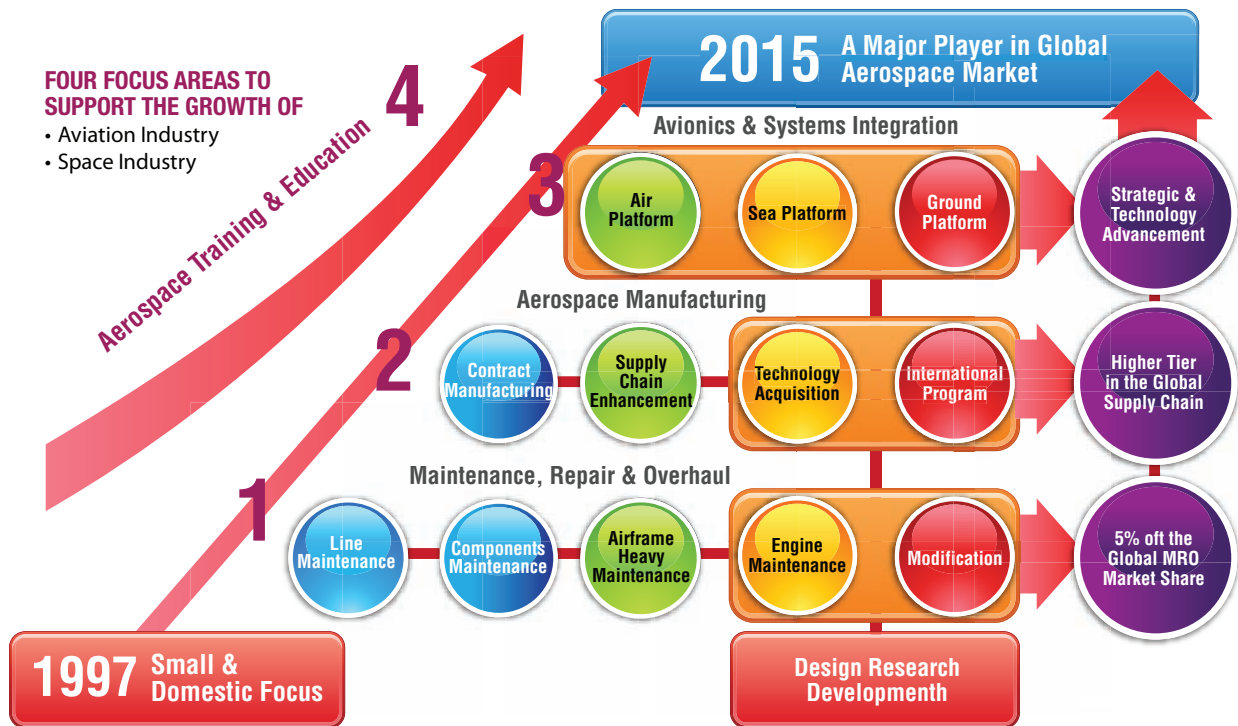
Transformation of DCA

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.

industry insights

Table 1 Aerospace niche areas



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

industry insights

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.

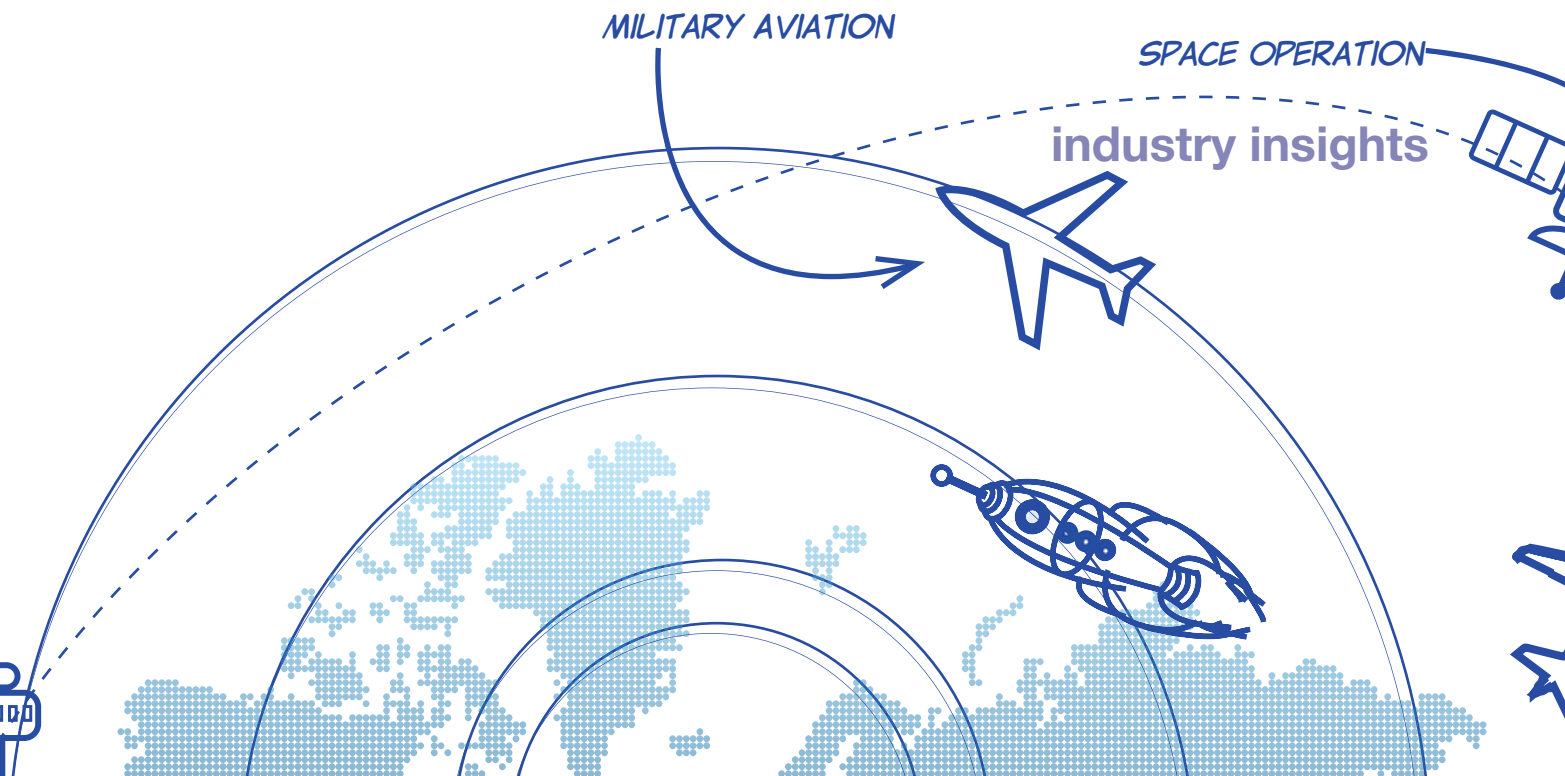
In terms of aircraft structure upgrade and modification, MAS and AIROD has taken the lead in developing in country capabilities. MAS Engineering arm in partnership with PEMCO had successfully implemented projects on winglet modification and "Passenger to Freighter Conversion (P2FC)". In the military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

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

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 CT RM 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



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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Malaysia's Shipbuilding Industry

– Shifting Toward Sustainability



BY

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Introduction

The shipbuilding industry in Malaysia can be defined as those enterprises that are involved in designing, building and constructing, converting and upgrading of vessels as well as marine equipment manufacturing. In this case, 'vessels' means various types of ships such as ocean going, near coastal, government, passenger, offshore and fishing vessels, whereas 'marine equipment' means parts and components that are fitted and integrated to form the sub-systems and systems of a vessel.

The shipbuilding industry, as addressed in the Third Industrial Master Plan (IMP3), is part and parcel of the marine transport sub-sector of the larger transport equipment industry. Structurally, the shipbuilding industry serves the shipping industry in terms of building and supplying new vessels to vessels operator or ship owners. In ensuring the safety of maritime operations as well as seaworthiness, the shipbuilding activities are regulated in accordance with the international standards and the local regulations.

Global Scenario

Globally, the industry has seen an emerging giant vis-a-vis China taking over Korea as the world's largest shipbuilding nation in terms of the number of vessels produced. It is interesting to observe that percentage wise, China together with Korea and Japan represent 85% of the world's total order book of new shipbuilding.

Year 2009 recorded the lowest number of demand for new vessels, understandably in response to the global economic crisis. Prior to the slowdown, order for new vessels peaked in September 2008 with 11,661 ships in the pipeline. Two thirds of the new build demands were made by corporations operating ocean going vessels such as tankers, bulkers and containers, followed by liquefied natural gas (LNG) carriers or liquefied petroleum gas (LPG)

carriers and cruise ships. However, when the recession hit hard on businesses, the global shipbuilding industry recorded a 40% decline, leaving only 6,914 ship orders to fulfil. With economic recovery plans taking the right course, the global demand for new vessels is expected to grow by 26% in the next few years. The case is however, not the same with large container ship and the LNG sectors.

The growth of the fleets around the world has a direct impact on the global demand for ship repair services since the more ships are in operation, the higher repair and maintenance work will be in demand. In fact, the five year statutory dry dock repairs cycle for big ships with sizes longer than ship repair and ship conversion businesses have 300m are already taking up dock spaces through to 2015. This can only mean that ship repair sector is enjoying an upward trend steadily.

With offers of business incentives mainly in the form of cheap but skilled labour, the Philippines and India are rising to become shipbuilding nations in South East Asia. In their bid to climb up the ranks, they have been actively engaging different approaches to develop their shipbuilding industries. As a clear result of its foreign direct investment, the Philippines

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Table 1 Benchmarking Malaysia vs. selected countries

Ranking	Countries	Number of Vessels	In thousands of DWT	Total as a % of World total
		Total	Total	
1	Greece	3150	186 095 162	15.96
2	Japan	3751	183 319 680	15.73
3	China	3633	104 452 389	8.96
4	Germany	3627	103 895 669	8.91
5	Republic of Korea	1200	44 883 318	3.85
6	United States	1865	41 290 755	3.54
7	Norway	1968	40 518 790	3.48
8	China, Hong Kong	680	34 441 871	2.95
9	Denmark	940	33 198 421	2.85
10	Singapore	985	32 609 444	2.8
22	Malaysia	480	12 439 130	1.07

Source: Review of Maritime Transport, 2010
Vessels of 1,000 GT and above

recorded USD420 million in its shipbuilding export in 2009. The Government of Philippines has laid down investor-friendly laws with attractive incentives to lure investors such as Hanjin of South Korea, Tsuneishi of Japan and Keppel of Singapore.

In India, domestic investors play a major role in developing its shipbuilding industry with USD5 billion worth of business dealings in 2009. This figure represents 250 new vessels built in 27 shipyards where eight of them are owned by the government while the rest belongs to the public sector. The Indian Government offers a 30% subsidy on all sales closed on foreign buyers and on local sales of ocean-going vessels of longer than 80 meters.

Singapore is riding high on its world class reputation for being the provider of choice for a broad spectrum of marine services which generates a turnover of SGD10 billion (USD7.7 billion) annually. Out of this, the island nation's thriving steadily contributed more than half of the total marine industry revenue. Apart from the well-known Keppel, Sembcorp Marine is expected to also significantly contribute to Singapore's shipbuilding revenue once the new Sembawang Integrated Shipyard in Tuas is in operation from mid 2012.

Local Scenario

Shipbuilding industry in Malaysia has existed since the 1900s. The earliest Malaysian shipyard was built at Kuching, Sarawak. It evolved from under-the-tree along Rajang River to a modern purpose-built yard in clusters near Sungai Bidut and Rantau Panjang in Sibu and Kuala Baram in Miri. In Peninsular Malaysia the shipyards are located in Lumut, Perak; Port Klang, Selangor; Kemaman, Terengganu and Pasir Gudang, Johor. Currently there are about 120 registered shipyards in Malaysia

Despite the fact that the industry is not widely known and vessels made by local shipbuilders are

sold world-wide, shipbuilding is actually a strategic industry due to its numerous spills over effects. It is recognized by the Organization for Economic Co-operation and Development (OECD) as having strategic importance in terms of employment generation, industry capacity and technological capability. Its technological content is directly linked to application in national security and defence. Shipbuilding is a highly capital intensive and technologically driven industry.

Briefly, the Malaysian shipbuilding cluster can be described as follows:

East Malaysia Cluster – Specializes in steel vessel building of offshore supply, tug, and barge and river ferry. These shipyards were developed most cost-effective, dynamic and viable exporter due to its proximity to its market which is the oil and gas sector. Most of the yards are quite innovative in term of design, building process and material sourcing due to its isolated locations.

Peninsular Malaysia Cluster – Specializes in both steel and aluminium vessel buildings for government and oil and gas. A great number of them have no experience outside government

projects, thus becoming less competitive. Compared to their East Malaysia counterparts, most builders in Peninsular Malaysia have not developed as cost-effective and viable exporter.

In terms of product, Malaysia's small vessel buildings normally involve simple low cost fiberglass boats mainly for the fishing and tourism industries. The medium-sized vessel building includes offshore support vessels (OSV), tugs, barges, patrol crafts and the likes. Large vessel building on the other hand, has seen better days and is fast ceasing in business. This is mainly due to the Malaysian Marine and Heavy Engineering (MMHE) strategy to focus only on repair and conversion which leaves Boustead as the last standing large vessel builder. If large vessel building is relying heavily on government projects, companies in this category may lose their capability to compete healthily in the global market.

Last year, the shipbuilding industry in Sarawak was highly vibrant. It contributed RM762 million in external trades. Sarawak shipyards are responsible for putting Malaysia in the world map as an effective low cost shipbuilder with products accepted worldwide. Most of the shipyards are in the form of family business runs by their second or third generation family members. Compared to their counterpart in Peninsular Malaysia, Sarawak shipyards are more organized but most of them do not market the vessels they make themselves. They rely on brokers from Singapore to market and export their products to Indonesia, Australia and European countries.

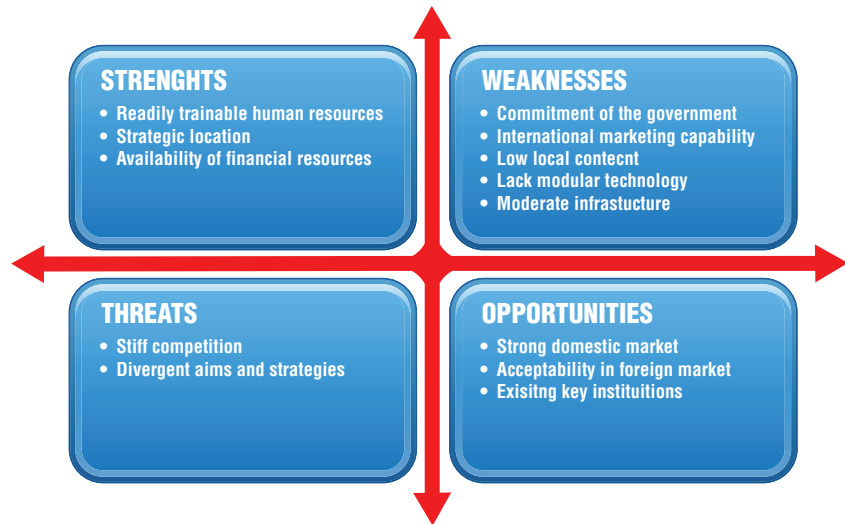
The capacity of shipyards and marine equipment manufacturers in Malaysia ranges from construction and maintenance of steel, aluminium or composite vessels with medium to complex sub-systems. They also have the capability to design simple small and medium size vessel. For vessel with complex designs such as Anchor Handling Tug with Dynamic Positional (DP), Offshore Supply Vessel of more than 50 meter length, and Hopper Dredger etc., the shipyards still have to acquire the platform and system designs from foreign countries. In Oil and Gas sector, Malaysia shipyards have the capability to offer a one-stop-centre for marine conversion that



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Table 2 SWOT Analysis of Malaysia Shipbuilding Industry



includes modification and upgrading design like Floating Production Storage & Offloading (FPSO), FSO, MOPU and MODU.

Strategic Analysis

The shipbuilding industry in Malaysia does not evolve by itself. For it to grow and be competitive, a comprehensive development plan would have to be formulated and implemented. The factors for consideration would be: Policy, Institutional Framework, Regulatory Framework, Design and Technology, Human Capital, Finance and Incentives.

Policy – Although the policy to develop Malaysia as a maritime nation is in place, it does not really address the growth of the local shipbuilding industry.

Malaysia need to take advantage of the opportunity to enlarge the industry as Malaysia is situated near major shipping lanes and 95% of

the country's trade is transported by sea. For the shipbuilding in the industry to grow, it may be wise to review the restriction of domestic waterborne trade by extending the rules from only 'own flagged' to 'build by local' vessel.

Institutional Frameworks – There are several Government agencies established to look into maritime related matters. However, none of these agencies are concerned with the well-being of shipbuilding industry. A division within Ministry of International Trade (MITI) which is tasked to formulate policies and strategies for the development of Transport and Equipment sector is the closest one can get.

Currently, there is no inter-ministerial at national level platform that discuss matters concerning the development of the shipbuilding industry. The two councils, namely National Maritime Council and National Shipping Council, are

having a Term of Reference that does not cover the shipbuilding activities. To-date, the only Government platform that discusses the interest of shipbuilding industry is the Maritime Working Group of Malaysian Industry for Defence, Enforcement and Security (MIDES) under the Ministry of Defence. However, there are non-government agencies (NGOs) that represent their interests of the shipbuilders. They are the Association of Marine Industry of Malaysia (AMIM), Miri Shipyard Association and Sibul Shipyard Association.

Regulatory Frameworks – The framework that regulates the industry has to be strengthened. At the same time it has to be industrial friendly. The marine department should be empowered to regulate safety measures, encourage innovation, ensures the maximum usage of local content and design in vessels built use on domestic routes and inland waterways. Non-convention rules and

Malaysia shipbuilding industry will and can be globally competitive and contribute substantially to the nation's economy if right policy and strategy is formulated and implemented with all stakeholders working together and unite behind a bold vision.

local regulations may be formulated and regulated for newly built vessels for such routes and waterways.

Design / Technology – Malaysia has sufficient local design houses to support the shipbuilding industry. With the existence of Ship Model Testing Laboratory at University Technology Malaysia, Malaysian designers can satisfy the needs of ship owners as well as increase local content in Malaysian-built vessels.

is good for Malaysia's high income agenda, other alternatives for shipbuilding industry are necessary. An immediate solution to fill the vacuum created by migration of workers is necessary. nonsolutions is to employ foreign workers. Some of the yards in East Malaysia have started doing it. However, due to some rigid rules on work permit for certain nationalities, some yards have employed them illegally.

Finance – Continuous availability of funds to finance new build projects is key to the growth of this industry. Global Maritime Ventures under Bank Pembangunan is the only government incentive available to develop the national shipping sector by jointly acquiring vessels with local partners. However a control mechanism needs to be put in place to minimize the use of Malaysian funds to build vessels in foreign yards as well as encourage indigenous design.

Incentive – It is unfortunate for shipbuilding industry as it is no longer classified as the 'promoted activities' under Promotion of Investment Act 1986. Not being classified as 'promoted activities' under this Act means players, either local or foreign are not eligible for tax holiday when they initiate a new investment project or re-invest in an existing project. The only tax incentive currently enjoyed by the shipbuilders is the tax exemption

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the domestic demands for small to medium-sized vessels less than 120m. In achieving this, there is a requirement for the enforcement of appropriate policies to protect the local players so that the home market is effectively used as a catalyst to increase the rate of industrial growth and its strategic agenda to capture more international market.

As far as cost is concerned, local players have to be able to offer competitive price. This can be achieved if the shipbuilding industry maximizes the local contents in 3 aspects of shipbuilding i.e. design and engineering, raw materials/sub-systems/equipment and labour. And finally, to improve on delivery, the industry must have the ability to meet the expected lead time and turn-around time. To make these possible, the government have to remove non value add bureaucratic barriers while at the same time the industry should adopt new processes and technologies to increase productivity and speed.

It is essential for shipbuilding industry to uphold its competitiveness if it is to survive through 2020 due to fierce competition from other countries in the region such as Vietnam, Indonesia, Singapore and Philippines as well as China. For shipyard to survive they should have the ability to satisfy ship owners' demand for quality, cost and delivery expectations are the main factors for survival.

In our quest to uphold the importance of the shipbuilding industry as a strategic contributor to the nation's economy, the direction that the industry moves will be guided by the following seven strategies:

- Establishment of business-friendly policies that support the growth of the industry
- Strengthen of the institutional framework
- Reinforcement of the regulatory framework to assure the integrity of the shipbuilding local companies and the quality of their products
- Attracting and preparing adequate and capable workforce
- Applying local design and adopting new shipbuilding technologies
- Improving financial and incentive packages in addition to promote of inward investments
- Upgrading competency and the level of sophistication of the industry



Launching of Malaysian Shipbuilding/Ship Repair Industry Strategic Plan 2020
By YAB Dato' Sri Mohd Najib Tun Abdul Razak on 6th December during LIMA 2011

Another aspect that needs to be stressed on the shipbuilding technology is the migration into modular building method. By doing this, shipyards in Malaysia will have the capability and capacity to undertake to build large and complex vessel.

Human Capital – With the continuous uptrend of Oil and Gas (O&G) sector development, the migration of trained engineers and skilled workers e.g. welders and fitters to this sector have affected severely the workforce needs of the shipbuilding industry. Although workforce migration into O&G

of import duties and sale tax, provided the company is awarded Bona Fide status. The exemption covers the import of raw materials, components, machineries and equipment directly used in shipbuilding activities.

Way Forward

Moving forward, the shipbuilding industry must aimed at capturing bigger world's new build market whilst maximizing all opportunities from

Malaysia shipbuilding industry will and can be globally competitive and contribute substantially to the nation's economy if right policy and strategy is formulated and implemented with all stakeholders working together and unite behind a bold vision. It is not impossible that by 2020, Malaysia's shipbuilding industry will be a major player, particularly in small to medium-sized shipbuilding market, renowned for quality and high technology products and services.

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FUTURE RAIL 2030: SHAPING THE FUTURE OF MALAYSIAN RAIL INDUSTRY



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Background

Future Rail 2030: The National Rail Industry Roadmap is a joint initiative between the National Foresight Institute (NFI), an organisation under Malaysian Industry-Government Group for High Technology (MIGHT), and Land Public Transport Commission (SPAD) to chart the way forward for the rail industry development in Malaysia until 2030. The initiative is timely for Malaysia as there is an increasing concern globally on megatrends such as climate change, urbanization and population growth, congestion, oil scarcity and hike of energy price, to name a few. The debates on these trends have created a strong feeling that rail is going to be an important mode of transport in the future.

The rail industry in Malaysia is currently small in terms of rail track networks and number of related organisations although its operation started way back in 1885. Lack of a clear policy, vision and direction of its development has been one of the major factors contributing to the current state of the industry. The Government of Malaysia has invested more than RM50 billion in rail related equipment since 1990s and the number will continue to grow until 2020 through committed investments under Greater Kuala Lumpur initiative of Economic Transformation Programme (ETP). Therefore, local rail support industry must leverage on upcoming investments to strengthen required capabilities for future sustainability. "A journey of a thousand mile begins with a single step" (Lao Tzu); nevertheless, there is a need to pull and consolidate all fragmented hopes and wills of stakeholders to revitalise the rail industry in Malaysia.

SHAPING THE FUTURE OF MALAYSIAN RAIL INDUSTRY

Foresight methods – namely road mapping, were used in developing the plan which generally answers three (3) major questions: (1) Where are we now? (2) Where do we want to go? and (3) How can we get there? Scenario building process was used in answering the second question.

All related parties (Government, Industry and Academia) were consolidated through a structured process to produce a consensus view on desired state of Malaysian Rail industry in 2030. A series of workshops, which consists of more than 50 participants from various organisations, had been conducted to identify 15 drivers that will shape the future of the local rail industry. However through consolidation, only nine (9) drivers of change were selected as follows:

- i. Policy and Institutional Framework.** Similar to other industries (such as aerospace and maritime), rail industry involves cross-ministerial/agencies. There is need for a mechanism to effectively coordinate, facilitate and monitor the growth of the industry based on consensus vision, goals and development strategies at national level.
- ii. Technology and Human Capital Development.** It relates to current and future workforce that will be supporting the local industry development. Apart from manpower, technology is one of the critical means to ensure sustainability and competitive advantage of the industry in the future.
- iii. Multimodal and Integrated Transport.** It is about enhancing efficiency of national transportation leveraging on rail



Panel discussion during Future Rail 2030 session

- iv. Market Competition and Value Added Products / Services.** Survival of local players to face intense competition in the same playing field with other established international competitors from both domestic and global rail market. The need to grow sense of innovativeness and climb up in supply chain to produce high value products.
- v. Connectivity and Tourism.** Train as a preferred mode of transport by the public is also affected by the available connectivity. In Malaysia, it is just an option but not in other developed countries where it has become a necessity.
- vi. Safety and Security.** Train is a medium used for transporting a mass number of people and goods which involve high risk, either due to external factors e.g. terrorism or internal factors e.g. derailment, collision. Nowadays, train is getting faster than before and able to reach more than 350 km/hr which requires reliable systems in place.
- vii. Localisation and Globalisation.** The growth of the industry is fuelled by a number of business opportunities secured in domestic and global market. Sizable investment has been made by the Government imposed the element of local content. There is a need to develop local capabilities and reduce heavy dependency on foreign products for future sustainability.

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viii. Sustainability.

As energy scarcity continues to dominate the discussion around the globe (so as climate change due to green gas emission), urbanisation growth proportionate with the increase in population and congestion in cities. These are megatrends that will affect the existing policy and sentiment of people to move towards greener alternatives.

Development, Multimodal & Integrated Transport, Market Competition and Value Added Products/Services and Localisation & Globalisation. Each of these five (5) key drivers forms a main framework to develop a desire scenario (best case scenario). The remaining drivers other than mentioned above will be a part of the narration wherever it is related.

and maintenance, repair and overhaul (MRO). Development opportunities were identified in terms of capabilities enhancement, technology development, potential market and critical skills required by local workforce. Strategies and key initiatives were developed and later tested against the above scenarios.



viii. Geopolitical.

The idea of Trans-Asia networks will give a significant impact to the way current logistics are working. Malaysia as a part of the network need to prepare itself and capitalise on potential opportunities resulted from this initiative.

Through the process of cross-impact analysis, the highest influence among the drivers rated by the workshop participants are Policy and Institutional

THE WAY FORWARD

Beside the above "Best Case Scenario", a list of potential surprises were identified that could become the wild cards or lead to other alternative futures. Subsequent to the scenario building workshops, the stakeholders were grouped based on major composition of the rail industry – rolling-stocks, signalling & train control, electrification, rail tracks and infrastructure, human capital development

In order to finalise the plan as well as to facilitate the implementation of the key initiatives, a committee known as Future Rail 2030 Committee was established. It consists of selected representatives from major rail operators, manufacturers, MRO services, related Government agencies, academia and regulators. The roles of the Committee among others are to provide strategic advice, monitor the progressive achievement of the roadmap recommendations, and share of information on the latest and future rail related initiative.



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Scenarios of Key Drivers

• Policy and Institutional Framework

In 2030, a total of RM180 billion worth of new rail infrastructure was invested by the Government since it was announced by the Chairman of SPAD in 2012. This explains the Government's commitment to provide the best rail transportation service on par with other developed countries. Recently, the regulator unveiled additional upgrading and expansion programmes of existing networks that will improve accessibility and capacity in several destinations for both passengers and cargos.

In order to support the growth of the industry, the Government through SPAD has developed and adopted set of rail standards. This was resulting from past joint initiative with Standard Malaysia and SIRIM. These standards are applied to strengthen the technical specifications which are currently being used in various procurement exercises. To date, there are already technical specifications developed by the regulator for different type of rolling-stocks e.g. light, heavy and high speed rail. As a result, all new systems, equipments and components, regardless of which operator owns them, are common in terms of technical specification. The remaining legacy assets that are still mixed of standards and specifications will go through refurbishment and upgrading program.

Road-mapping initiative back in 2012 has provided a clear vision, direction and laid down various programmes for the implementation of the key initiatives. To date, more than 90 per cent of the recommendations have been implemented. This is due to an effective coordination and implementation by a central organisation through the National Rail Industry Council. All programs or proposals which are successfully implemented have been supported by various ministries, Government agencies with active participation by the industry and the academia.

• Technology and Human Capital Development

In 2030, Malaysian rail industry has expanded from about 50 to more than 100 related organisations. In addition to the growth of the industry, a sizeable investment made by the Government has also created huge job opportunities for Malaysian workers. High technology, sophisticated, and sleek design of current trains compared with the past 20 years has presented a new image to the public. These will serve as "feel good" factors that largely drive a huge number of young graduates of today to choose a career path in this industry. Besides, the attrition rate will remain very low for a long time as workers tend to stay in the industry when it is being constantly fuelled by a wealth

of projects. Nevertheless, migration of local experts to abroad is something that is inevitable. An outpour of job openings in Middle East requires various types of manpower with different levels of skills to fill vacancies urgently. This has not detriment the industry, instead Malaysia has been exporting the skilled manpower all over the world.

In ensuring sufficient supply of workforce in the industry, there are several skills training institutes established by the Government that continuously produce semi-skilled workers. This is on top of training institutions which are owned by major train operators. A look at white collar jobs show some universities are offering rail engineering as an optional major for final year and as full course post-graduate studies at Master and PhD levels respectively. However, there are avenues for graduates in general engineering fields who are interested to find jobs in the rail industry as well as opportunities for semi-skilled workers keen on furthering studies at a higher level within the same gamut. The Centre of Excellence for Rail which came into fruition from the enhancement of a training institute under KTMB back in 2013 has provided such an avenue for industry hopefuls. It is equipped with the latest facilities and provides students with the most updated knowledge on train technologies which are recognised by most of the global rail companies and associations. This is achieved through continuous

All related parties (Government, Industry and Academia) were consolidated through a structured process to produce a consensus view on desired state of Malaysian Rail industry in 2030.

partnership with foreign technology providers and experts from various rail organisations in Malaysia. All of the syllabuses used are reviewed by a panel of experts in order to ensure that they meet the current and future need of the industry.

The technology development initiative since 2012 has not yielded many discoveries through research and development (R&D) activities. However, new technologies have been acquired through a procurement mechanism called Offsets and reverse engineering. Almost all of the procurements endeavoured by the Government with a total value at RM180 billion imposed the offset program as a mean to

expedite the industry growth and further to achieve the aims as stated in the national rail industry development roadmap. Local rail industry players and operators enjoy the healthy benefits derived from the Government investment programs. Besides that, offsets also result in several joint technology development projects between local universities, local industry players and foreign technology partners on certain key areas. Correspondingly, reverse engineering ventures have been undertaken on critical parts. Funding for R&D is not an issue as it is now being allocated and coordinated under National Science & Research Council (NSRC) which also registers rail-related technology development under one of the R&D priority list. Some of the technologies acquired have contributed towards the improvement of energy efficiency, speed and comfort, interoperability, as well as enhance the reliability of current rail operation.

• Multimodal and Integrated Transport

In 2030, the rail networks that are formerly converged within Klang Valley have expanded nationwide to cover other states in Malaysia. Upgrading and adding lines from the main trunk of KTMB tracks from north to south have now stretched from west coast to east coast of Peninsular Malaysia. There are also a number of spur lines that connect major ports with major industrial parks in East Coast Economic Corridors (ECER), the North Coast Economic Corridors (NCER) and Iskandar Malaysia in the south. Parallel to the existing trunk line, high speed rail which is operated by a private company is fast gaining popularity. Currently, the train is serving Singapore – Johor – Kuala Lumpur route and it plans to expand up to Bangkok. Based on rapid urbanisation progress especially in Selangor, Johor, Penang, Melaka, Perak and Negeri Sembilan, the intra-city or light rail networks soon start to face the same situation as Klang-Valley fifteen years ago. In East Malaysia, there are also on-going projects developing railway tracks in Sarawak and expansion of existing tracks in Sabah. The train will be a medium to transport raw materials for energy sectors and passenger transportation especially for eco-tourism.

The idea of "seamless journey" which seems to be almost impossible to implement in the past has now become a reality. The train has been conveniently integrated with most public transportations such as buses and taxis linking all major hubs in Peninsular Malaysia. Today, a passenger is able to swiftly travel from one destination to another, even embarking on trains by different operators with the purchase of only one ticket or using a dedicated travel prepaid card (subjected to conditions). This facility is now expanded to other states in Malaysia outside Klang Valley. The Government investment on upgrading

industry insights

Similar to other industries such as aerospace and maritime, rail industry involves cross-ministerial/agencies and is need for a mechanism to effectively coordinate, facilitate and monitor the industry growth based on consensus vision, goals and development strategies at national level.

and expansion of rail infrastructure has changed public perception and preference on train over other types of transportation. This is largely due to improvement in punctuality, comfort and duration taken to reach a destination.

Apart from passenger transportation, rail freight has made a significant impact on being the choice of businesses to transport massive cargos to their final destinations. The effective cargo distribution benefits wide upgrading and expansion undertaken by the Government in the previous decades. Raw materials, customized cargo containers, semi-finished and finished products can be transported from various seaports such as Port Klang, Port Tanjung Pelepas, the Kuantan Port, the Penang Port as well as major airports in the country. All of these will have been impossible to achieve had it not been for the efficient clearance process by the Royal Custom. In anticipation of this, Malaysia will have gradually become the preferred regional distribution hub for freight transported from eastern and western regions.

- **Market Competition and Value Added Products/Services**

The year 2030 witnesses upgrading and building rail infrastructure activities mushrooming worldwide, driven by the need to address rapid urbanisation in major cities (such as in China, India and Middle-East), climate change, congestion, to name a few. Malaysia is not excluded from this trend as a sizeable investment in rail has been committed by the Government of Malaysia since 2012 to stretch a span of two decades to enhance the social and economic activities in the country. A number of rail projects in the pipeline has lured local and foreign rail

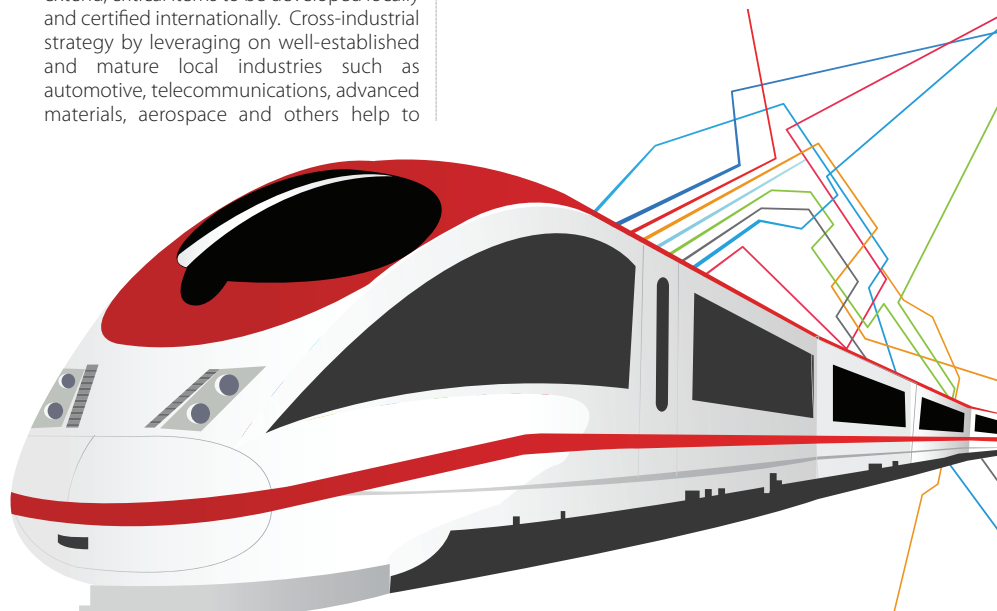
suppliers to bid a piece of the contracts. Flashback to fifteen years before, intense competition is seen only among foreign suppliers where local industry players have almost no chance to compete directly due to unattractive track record, limited capability and product credibility. Today, the situation has changed. Local champions identified, groomed and developed for the past 20 years have positioned Malaysia as one of the respectable competitors in global rail market. Strong grasp over design & development and system integration capabilities have enabled local players to enhance their products competitiveness and support life-cycle of the asset more effectively. The local rail industry widened its offering from monorail to heavy rail products has successfully secured contracts in South East Asia, Brazil, India and Middle East as it is dubbed to have 'Japanese quality, China price'. In view of this, most of the recent contracts tendered by the Government are awarded to players either for new purchases or refurbishment of existing assets. Track records are no longer an issue and the competitive advantages are due to its cost, quality of products and after sale services. Even more important is the multiplier effects to the country's economy as well as achieving national aspirations.

- **Localisation and Globalisation**

In 2030, the Government's enforcement on local content in the procurement of rail assets has yielded positive impact to long-term industry development. Although a small percentage has been committed during the previous procurement back in 2010, the strategies employed since then have generated significant increase in figure from 5 to 10 per cent to more than 40 per cent today. The identification of strategic areas to be developed through road mapping exercise in 2012 have been fully completed that it enables all non-critical and to certain extend, critical items to be developed locally and certified internationally. Cross-industrial strategy by leveraging on well-established and mature local industries such as automotive, telecommunications, advanced materials, aerospace and others help to

further expedite the growth of the rail industry. Besides that, initiative to enforce common technical specification and adoption of dedicated standards have an impact in terms of creating critical mass of rail components which indirectly justify local players especially small, medium enterprises (SMEs) to invest or diversify in this business. Moreover, the situation has mitigated trade imbalance where the export has moved slightly above than the import figure. Most of MRO activities are no longer carried out by train operators, instead by a third party to improve train availability. Recent study showed that serviceability of train operation is at more than average of current best practices around the world. Local MRO players have expanded its ability to fully perform Level 3 maintenance and to certain extend modification, upgrading and testing without intervention from OEMs. Malaysia is now being one of the authorised maintenance centres in the region certified by most top train producers.

In view of pressure being cost effective and high demand of rolling-stocks in Asian region, western train and equipment manufacturers were searching for a suitable location to setup their new production line. Apart from cost and market driven, easy access to pool of skilled workforce, raw materials, IP protection, strong IT facilities and being geographically strategic have tremendous influence on selection of the location. Malaysia fulfils most of the criteria especially being located at the heart of South East Asia, thus making the country one of the attractive destinations for investors. Furthermore, the Government have launched target FDI on selected foreign rail suppliers to fill the critical gap in the local and regional supply chain. Today, most of components, parts and systems made by world top rail producers/suppliers are distributed from Malaysia.



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Figure 3 Top 5 changes from 2012 to 2013 by likelihood*

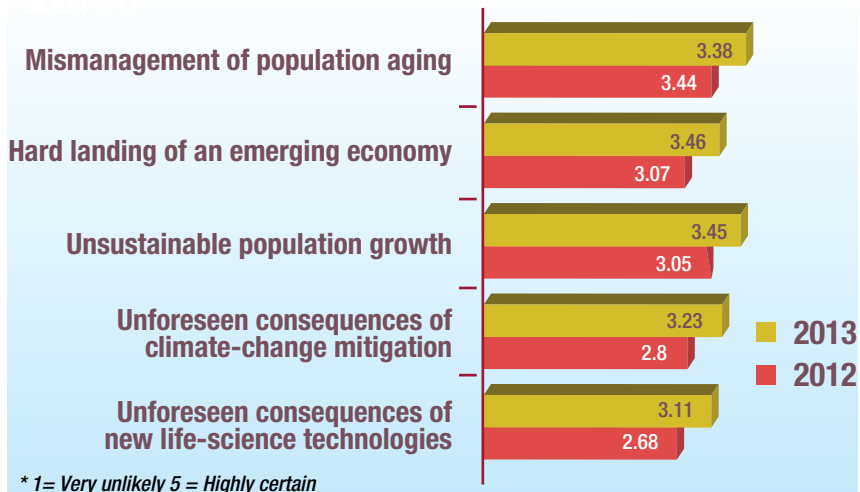
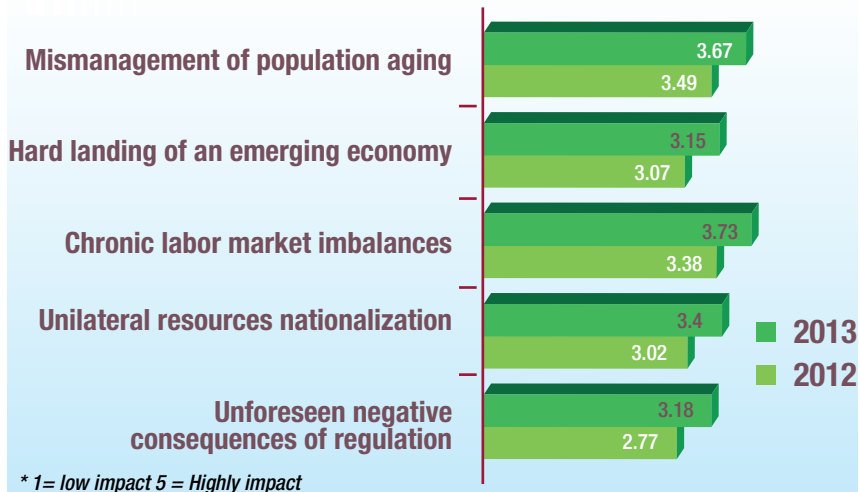


Figure 4 Top 5 changes from 2012 to 2013 by impact*

Source: Global Risks 2013, World Economic Forum.⁵

Managing Population Aging

This global risk has moved into the top five in terms of likelihood. The WEF defines it as “Failure to address both the rising costs and social challenges associated with population aging.”³

While the report doesn’t discuss this risk in detail, it does note that among the survey respondents, NGOs tended to rate impacts of the risks higher than businesses did. Mismanagement of population aging was an exception: both NGOs and businesses gave high ratings to the potential impacts of this risk.

Three Risk Cases

To help leaders make sense of the complex picture of global risks, many of which are interconnected and/or mutually reinforcing, the WEF has winnowed from the data three constellations of risks that “warrant urgent attention and action by global leaders.”

Risks that Have Decreased

In 2013, very few risks on the global top 50 list received lower scores for either likelihood or impact than in 2012. But a few did, and these are interesting to note.

Risks that decreased in likelihood are:

- Recurring liquidity crises
- Vulnerability to geomagnetic storms
- Proliferation of orbital debris

And one decreased in estimated impact: food shortage crises.⁴

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Challenges of Climate Change

Even with the best of will, leaders who want to move decisively to tackle climate change are faced with a daunting set of challenges:

- **Persistent economic fragility limits the availability of public resources.**
- **No consensus exists on how fast or how much global climate is changing.**
- **Like all complex systems, Earth's climate is non-linear and unpredictable, so both the effectiveness and unintended consequences of mitigation strategies are highly uncertain.**
- **Adaptation efforts are by definition local, but data on likely local impacts is very limited.**
- **Constraints on computational power severely limit effective forecasting.⁶**

Unlike typical scenarios, these three risk cases do not set out a range of possible outcomes. Rather, they are “an exercise in sense-making,” which the WEF urges leaders to use to refine their understandings and develop their own scenarios.

The three risk cases can be summarized as:

- The economy vs. the environment
- Digital connectivity vs. digital duplicity
- Human innovation vs. bacterial mutation

Risk Case 1. Economy vs. environment

Economic and environmental risks dominate the Top 5 lists, together comprising four of the five top risks by both likelihood and impact.

Both of these major systems—the global economy and the global environment—are in grave need of strategic and structural reforms. But even more important than their individual fragility is their interdependence: each system's problems are exacerbating the other's and stalling effective problem-solving. As a result, a “daunting negative feedback loop” has begun:

- Strained economies are allowing climate change and its potential impacts to worsen by failing to finance mitigation and adaptation efforts.

- Climate change is burdening economies with colossal new expenses due to extreme weather events, shifting agricultural zones and seasons, growing numbers of climate migrants, etc.

The WEF sums it up: “A sudden and massive collapse on one front is certain to doom the other's chance of developing an effective long-term solution.”

For nation-states and organizations seeking to manage risk, this situation presents a Gordian knot of choices, none of which promise clear benefits and all of which could carry unintended consequences. Yet the need for decisive action is urgent: without mitigation, the cumulative costs of climate change to just the health sector, food security, and the physical environment are estimated to be \$2 trillion to \$4 trillion by 2030.⁷ Thus, leaders must “embrace the need to make a decision without complete assurance that they are making the best decision.” Leaders of all kinds of organizations, public and private, need to adopt a “climate-smart” mindset—one that factors climate-change analysis into both strategic and operational decision-making.⁸

How To Think About Risk

Writing in the Harvard Business Review, Robert Kaplan and Anette Mikes have proposed a simple, practical taxonomy for helping business leaders think about risk. Organizations face three kinds of risks, they say:

- **Preventable risks—Internal risks that can be controlled, such as employees' illegal or unethical actions**
- **Strategy risks—Risks that a company voluntarily assumes in pursuit of its strategy**
- **External risks—Risks that the WEF calls global risks: those that are complex and go beyond the company's ability to manage or mitigate**

“Companies should tailor their risk-management processes to these different categories,” write Kaplan and Mikes. Preventable risks can be handled with compliance-based approaches, for instance, but management of external (global) risks requires “open and explicit risk discussion” as well as analytical approaches beyond the normal course of strategy development.⁹

Risk Case 2. Digital connectivity vs. digital duplicity

The possibility of rapid, viral spread of misinformation over the Internet could trigger a plethora of serious risks, from online terrorism to cyber-attacks,

disruption of life-supporting infrastructure, and even government breakdown. These misinformation memes could turn into “digital wildfires” that wreak havoc in the real world.

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The WEF suggests that viral misinformation can be most dangerous in three kinds of circumstances:

- First, in “situations of high tension” false information can do serious damage before it’s corrected—something like yelling “Fire!” in a crowded theater. For example, in 2012 the BBC reported that a British politician may have been involved in child abuse; although the politician wasn’t named, his identity was uncovered and spread via some 10,000 Twitter tweets. In fact, the case had already been dismissed as an instance of mistaken identity. The politician, in reaction, sued not only the BBC but all the people who had re-tweeted the false report.¹⁰
- Second, misinformation can trigger explosive situations when it “circulates within a bubble of like-minded people who may be resistant to attempts to correct it.” This occurred, for instance, during the November 2012 clashes in Gaza between Israel and Hamas, in which the two sides propagated competing versions of events inside their groups’ online echo chambers, impervious to more objective reports.¹¹

- Third, misinformation is, of course, often deliberately transmitted by parties who stand to benefit from it. A July 2012 tweet that Syrian President Bashar al-Assad had been “killed or injured” caused oil prices to rise by more than a dollar before traders realized it was false.¹²

How might digital wildfires be prevented or contained? The WEF points to a number of possible approaches:

- Legal restrictions on online speech might be adapted from current laws against inciting panic or violence in the real world—but such laws could bump into freedom-of-speech protections, which are tightly held in many places. A “global ethos of responsibility and healthy skepticism” may already be emerging, as suggested by the way false tweets were handled during Hurricane Sandy. Bogus reports that the NYSE trading floor was flooded were re-tweeted much less often than doctored photos of sharks swimming in the streets of New Jersey or of monstrous clouds bearing down on the Statue of Liberty. Even these latter images may have been circulated more

because they were entertaining than because they were believable; and most people may have deemed the NYSE-flooding story too sensitive to pass on without verification.¹³

- Infotech that helps people evaluate the credibility of online info, such as the browser extensions LazyTruth, Truthy, and TEASE, is emerging to help counter digital misinformation. In the future such programs could trace rumors to their source and—without necessarily revealing the source—reveal their trustworthiness. Eventually such programs might become as ubiquitous as antivirus software, the WEF suggests.
- Online reputation software that rates the trustworthiness of users could become a standard part of people’s digital identities—especially if the movement to have people own their personal data gains momentum.

Risk Case 3. Human innovation vs. bacterial mutation

The rise of “superbugs” that are resistant to both existing and emerging antibiotic drugs could spell the end of an era of security against killer bacteria. The WEF observes, “Experts are starting to take seriously a scenario in which all antibiotics are rendered ineffective for treating even common infections.”

The consequences could be massive. Antibiotics are not just about treating infections; they are crucial to a wide range of surgeries, organ transplants, the survival of premature babies, and even some chronic diseases. And they are also vital to livestock and fish production, where the end of antibiotics would mean drastic reforms to food and livestock production and trade.

What can be done to curb the rise of antibiotic-resistant bacteria? A number of ideas are being tried:

- Pharmaceutical companies could be incentivized to develop more antibiotics via advance-purchase commitments, in which governments or foundations commit to buying a certain quantity of a new drug if it can meet stated criteria of effectiveness.
- Public-private partnerships can play an important role; e.g., the Innovative Medicines Initiative, a €2 billion joint effort between the European Commission and Europe’s pharmaceutical federation, earmarks funds for antibiotic development.
- An “open lab” approach is being pioneered by large pharmaceutical company like GlaxoSmithKline in partnership with the Bill & Melinda Gates Foundation to pool knowledge among private companies, academic labs, and government regulators in support of finding new antibiotics.

- Demand-side approaches are important too, since antibiotic use continues to escalate in agriculture, aquaculture, and animal husbandry. Nordic countries have achieved the lowest levels of agricultural antibiotic use in Europe and may be able to provide models.



Why Antibiotic Resistance is Like Climate Change

The late Nobel laureate Elinor Ostrom once compared the problem of antibiotic resistance to climate change—because “both phenomena involve non-renewable global resources, both are caused by human behavior... and [both] can only be addressed by international cooperation.”¹⁴ However, the WEF adds that—unlike climate change—with antibiotic resistance, “we know what actions are required. The challenge is to create the will and mechanisms to take them.”¹⁵

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Business Implications

- The WEF's Global Risks reports have emerged as a vital input to organizational strategy, providing an authoritative perspective on key uncertainties that affect every organization's operating environment. The WEF's approach is also valuable in its support for practical solutions, via its associated Risk Response Network and Leading Practice Exchange, which support businesses in working with each other and with experts and governments to build resilience across the full panoply of global risks.¹⁶
- While so much about climate change is unknowable, two things are clear: (a) adaptation is by nature local and (b) businesses, like nation-states and individuals, will be responsible for funding their own adaptation efforts. This is why the WEF says, "For some businesses, investing in climate change mitigation now could be as much about enterprise risk management as about mitigating a global risk." Even though the worst effects of climate change may not manifest for a decade or more, local impacts are already abundantly visible. Companies have a window of opportunity now to look seriously at how climate change could affect the regions where they operate—or plan to operate in the future—and they should begin to do so.

For some businesses, investing in climate change mitigation now could be as much about enterprise risk management as about mitigating a global risk.

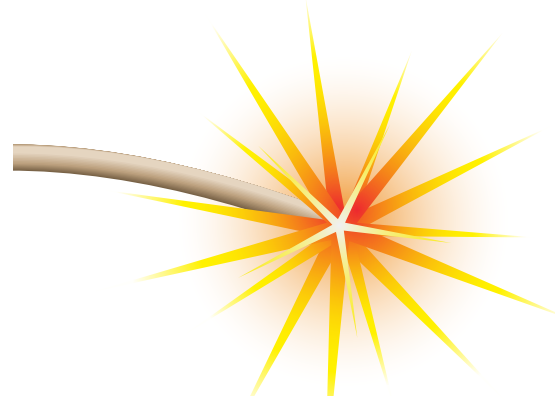
- Many countries are making significant progress in preparing for climate change within their own borders, which is opening up opportunities for mitigation and adaptation innovation and partnerships. For example, at the 2012 G20 summit in Mexico, over 50 large companies—including Samsung, Walmart, Swiss Re, and Deutsche Bank—partnered with public agencies to form the Green Growth Action Alliance (G2A2) aimed at unlocking private investment for building green infrastructure.¹⁷
- Addressing climate change effectively will require massive structural reforms to the core systems underpinning human society: food, agriculture, water, transportation, etc. IBM has sketched out a "system-of-systems" approach

that would help optimize 11 major world systems in a cross-sector, and therefore much more efficient, fashion.

- Severe income disparity is unfortunately considered the most likely global risk over the next 10 years.
- Opportunities exist in the IT sector to develop both enterprise-level and consumer-level tools for guarding against viral misinformation. Also, all kinds of companies can recognize that digital wildfires are to some extent a "preventable risk"—in the sense that their impacts are often at the operational level, and rules and norms can be put in place to guard against them. Companies should take a concerted look at ways they can embed awareness and behaviors into organizational guidelines, ranging from the mission statement to values statements to codes of conduct, in order to counter viral misinformation.
- Risk management is non-intuitive and "runs counter to many individual and organizational biases," as Robert Kaplan and Anette Mikes observe in their Harvard Business Review piece.¹⁸ Doing it effectively in this era of unprecedented global risk, when so many problems transcend organizational and national boundaries yet are difficult to predict

or delineate, requires going beyond normal strategy processes. Approaches such as stress tests, scenarios, and war-gaming (three tools recommended by Kaplan and Mikes) should be used to help leaders identify their organizations' weaknesses and develop resilience strategies.

- The WEF is right to highlight the risks associated with the aging global population, but the challenges this trend brings about will also present the opportunity to create age-appropriate solutions in areas ranging from food to urban planning.



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Emerging Environmental Issues

21 Issues for the 21st Century

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The UNEP foresight program had executed a process to identify the most important emerging issues for the environment in the early part of the new century. This was done in support of its mandate for 'keeping the global environment under review and bringing emerging issues to the attention of governments and the international community for action.' The results of this work were presented in the 2012 publication entitled *21 Issues for the 21st Century: Results of the UNEP Foresight Process on Emerging Environmental Issues*.¹

This Technology Foresight brief summarizes the 21 issues identified by UNEP, critically analyzes them and the four alternative futures they suggest, and examines the business implications of these issues and futures.

IDENTIFYING THE ISSUES

UNEP followed a multi-step process to identify the 21 emerging environmental issues. First, a panel of 22 experts from developing and industrialized countries identified and proposed a preliminary set of issues, working from input gathered from the entire UNEP community. During two facilitated meetings, the expert panel debated, combined, redefined, and ranked the issues. In addition, feedback was gathered on the issues from more than 400 scientists via an electronic survey.

In the context of this study, UNEP defines emerging issues as issues that will have 'global environmental impact' and are recognized by scientists as 'very important to human well-being' but not yet getting enough attention from policymakers. The issues are classified as emerging because there is new scientific information, an accelerated rate of change, new awareness, and/or new possible responses.

Generally, the timeframe of analysis for this report is 10 to 20 years, though the selected issues are ones that should receive priority attention within UNEP or other international institutions in the next one to three years. UNEP plans to produce such a list of issues every two years.

CROSS-CUTTING ISSUES

Many of the most important issues identified address questions about human and systemic capacity for change. These issues cut across the traditional boundaries of environmental categories.

Governance for sustainability (ranked #1)

- **Issue.** There are many international efforts to promote sustainability, but these efforts are generally not well integrated into national and

local economies. In addition, international efforts lack coordination, authority, foresight, accountability, and leadership. Fundamental change in international governance mechanisms may be needed.

- **Options for action.** Needed actions include raising public awareness, strengthening decision-making (e.g., by instituting a qualified majority voting process), agreeing on a 'constitutional framework for sustainable development,' and formalizing the involvement of NGOs and other stakeholders in governance.

Human capabilities for sustainability (ranked #2)

- **Issue.** Society's ability to manage environmental change and attain sustainability is hindered by lack of the necessary job skills, modes of learning, management approaches, and research efforts.
- **Options for action.** Needed are training for green jobs; specific training for managers in the green economy and managers in the sustainability programs of organizations of all kinds; and interdisciplinary training for all students to prepare them for a green economy. Scientific research will need to move from curiosity-driven agendas to interdisciplinary and regional agendas more closely influenced by all stakeholders.

Reconnecting science and policy (ranked #4)

- **Issue.** Scientific results do not impact public opinion or public policy as they should because they are difficult to access and sometimes poorly communicated to a lay audience, and because there is growing mistrust of environmental science. Science is seldom driven by the needs of policymakers and seldom used to make policy decisions.
- **Options for action.** Opportunities for direct communication between scientists and

KEY FINDINGS

- *In 2010, a worldwide expert process identified 21 global emerging environmental issues for the next one to two decades. These issues interact strongly and must be addressed in an integrated way.*
- *Man and society are not users of the environment but rather an integral part of the global system.*
- *The preferred future implicit in this work is one in which society commits to building the governance structures, human resources, stakeholder engagement, and scientific understanding to anticipate future developments and to create the universal behavioral change, building a sustainable society.*

policymakers should be intentionally created, e.g., through joint assessment of the state of scientific knowledge in key areas or the creation of future scenarios based on that knowledge. This will be useful in rebuilding the interfaces among science, policy, and society.

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Inaction will exacerbate the fissures between the science and policy communities; repairing those cracks will motivate policymakers to seek needed input and scientists to contribute needed research, conclusions, and implications.

Transforming human behavior (ranked #5)

• **Issue.** Technology developments and improved efficiency may not be adequate to achieve global sustainability. It will also require that people move away from high consumption and polluting lifestyles. Recent changes in attitude toward, e.g., tobacco use or recycling suggest that public policy can drive such 'tipping point' change.

• **Options for action.** While research is needed to understand the most effective approaches to public policy that induces broad behavioral change, both well-structured incentives and public-private partnerships are likely part of the solution.

Slow change and thresholds (ranked #18)

- **Issue.** Many environmental issues resulting from human activity are 'creeping changes' that start slowly but eventually reach a tipping point with major impact. Familiar examples include acid rain or tropical deforestation. These issues are most easily addressed early on in their development.
- **Options for action.** Most 'creeping changes' are predictable; to get ahead of these issues will require a shift from crisis intervention to a more strategic approach that includes monitoring, predictive modeling, and effective communication of forecasts to policymakers.

Migration (ranked #20)

- **Issue.** Though most major migrations are caused by a combination of factors, changes in the environment (e.g., changes in sea level, desertification, or more frequent weather-related natural disasters) can be a major contributing factor.
- **Options for action.** Addressing environmentally driven migration will require adapting to climate change so as to reduce the need for migration, as well as improved resettlement policies in affected nations and immigration policies in nations that may receive refugees. 'There is also a need to improve the prediction of environmental migration.'

FOOD, BIODIVERSITY, AND LAND

Food security is closely connected to issues of land management and the preservation of biodiversity.

Food safety and security (ranked #3)

- **Issue.** Food safety and security will be challenged by population growth; increasing affluence and the changes in diet that it drives; degradation of agricultural land; competition for agricultural land (e.g., from bioenergy production or urbanization); water shortages; possible phosphorus fertilizer shortages; climate change; and foodborne diseases including zoonotic diseases. The USDA estimates that 861 million people in 77 developing nations were 'food insecure' as of 2010. As many as 30% of the population of developed nations may suffer foodborne illnesses each year.
- **Options for action.** Addressing the issue will require short-term emergency assistance, help for smallholders, changes to international agricultural markets, and international agreements on biofuels. In the longer term, the environmental sustainability of agriculture and fisheries must be improved.

Integrated biodiversity agenda (ranked #7 in a tie with two other issues)

- **Issue.** The preservation of biodiversity is intimately linked to environmental and economic success. Recent research highlights the role of biodiversity in supporting ecosystem services, including climate regulation and food production, as well as the negative economic impact of biodiversity loss.
- **Options for action.** Biodiversity should be an integral consideration in environmental and food security management. The true cost of ecosystem services should be accounted for in national economies and, over time, paid for by public users of those services.

Urban sustainability and resilience (ranked #11)

- **Issue.** Cities often offer a polluted environment to their residents and have a large environmental footprint (out of proportion to the fraction of the global population they host). In general, cities need to be more resilient to changes in the global environment.
- **Options for action.** Increasing density and encouraging mixed-use development can reduce resource demands, especially dependence on private autos. Urban greening and careful land-use strategies for urban and surrounding land can maintain and increase ecosystem services available to cities.

Grabbing land (ranked #12)

- **Issue.** Since 2001, tens of millions of hectares of land in developing nations have been leased or sold to more developed nations, much of it for use in growing food or biofuels. In some cases, the rights of native peoples have not been adequately protected and the promised economic benefits have not always materialized. Also, when undeveloped land is converted to cropland, ecosystem services may be lost.
- **Options for action.** More information on the extent of land sales and their impact is needed. Several organizations have proposed guidelines for such transactions to ensure that rights are protected and that projects are viable and create shared value; whether adequate guidelines can be created is a matter of dispute.

FRESHWATER AND MARINE

Aquatic systems are linked not only to one another but also to what happens on land. Water also intersects with core social issues.

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Integrating land and water management (ranked #6)

- **Issue.** Land and water resources are usually managed separately, but recent science is uncovering strong and sometimes-unexpected interactions. For example, researchers have postulated that deforestation in the Amazon and Central Africa impacts rainfall in the lower US Midwest.
- **Options for action.** Some have argued that joint land and water management may belong 'at the center of the global development debate.' Strategies for managing land and water together include reducing the amount of water required to produce a given crop yield and instituting ecosystem service payments, where, for example, those who maintain an upstream ecosystem are paid by those downstream who reap the benefits in the form of reduced flooding, higher water quality, etc.

Inland waters in developing countries (ranked #15)

- **Issue.** In developing countries, economic growth is leading to pollution of inland waterways. This puts stress on inland fisheries, increasing food insecurity; threatens incomes from fishing; and reduces biodiversity. It also makes it more difficult to supply clean drinking water.
- **Options for action.** Developing nations have the opportunity to address inland water pollution issues with modern technology and management practices before they grow even more serious.

Potential ocean collapse (ranked #13)

- **Issue.** Oceans provide an extensive list of social, economic, and ecosystem services—including food, livelihood, carbon sequestration and oxygen generation, and climate regulation. But decades of pollution, overfishing, and other stressors threaten to drive oceans beyond a tipping point of ecosystem collapse.
- **Options for action.** Ocean management is shared across a complex network of governments, agencies, laws, and agreements. Action first and foremost requires an improved governance structure that could, for example, harmonize fishing laws or establish protected marine areas.

Coastal ecosystems (ranked #19)

- **Issue.** Like oceans, coastal ecosystems are threatened by human activities including fishing, pollution, and the effects of climate change. Coastal ecosystems provide food,

Early attention to 'creeping changes' has the potential to nip problems in the bud before they reach a tipping point. This would be more effective than remaining in crisis management mode for environmental issues, which passes expensive problems from one generation to the next.

economic benefits from fishing and recreation, and climate regulation via carbon sequestration.

- **Options for action.** One option is called 'adaptive governance,' a system that encourages cooperation among stakeholders as well as learning, experimentation, and innovation in management.

CLIMATE CHANGE

Key issues include not only the forecast increase in extreme weather events but also the potential for unintended consequences from adaptation and mitigation efforts.

Managing unintended consequences (ranked #7 in a tie with two other issues)

- **Issue.** Efforts to mitigate and adapt to climate change could have unintended scale-up effects (e.g., large concentrations of wind generators might hinder bird migration); economic effects (e.g., increased energy costs); and social consequences (e.g., competition of energy crops and food crops for agricultural resources). In addition, these efforts could themselves reduce ecosystem services (e.g., sea walls might harm coastal wetlands) or alter climate in undesirable ways (e.g., through unanticipated consequences of geoengineering).
- **Options for action.** Sound strategy practices – considering multiple strategies to reach any given goal – and sound analysis using existing tools and processes can help to minimize surprises.

Extreme events (ranked #16)

- **Issue.** The predicted increase in the frequency of extreme weather events as a consequence of anthropogenic climate change is beginning to show up in observational data.
- **Options for action.** Early warning systems for extreme events need to cover all types of

disasters and all geographic regions, and need to communicate effectively to all users.

Glacier retreat (ranked #21)

- **Issue.** Many glaciers appear to be shrinking at an accelerating rate, threatening sudden floods when glacial lakes collapse, long-term changes to local water availability, regional water disputes, and disruptions to ecosystems.
- **Options for action.** Improved monitoring and better understanding of the mechanisms and consequences of glacial melting could lead to improved disaster warning and better management of affected ecosystems.

ENERGY, TECHNOLOGY AND WASTE

Energy and waste issues are key to mitigating climate change and maintaining a clean environment.

Renewable energy (ranked #7 in a tie with two other issues)

- **Issue.** Renewable energy has a key role to play in mitigating climate change, improving environmental quality, and increasing energy security – but a variety of economic, institutional, social, and technical barriers' hinder its implementation.
- **Options for action.** There is a multitude of policy options to encourage the adoption of renewable energy technology. These include direct economic incentives; policies that encourage renewable energy as a solution to related priorities (e.g., biofuels for transportation, or cap-and-trade policies for carbon emission reductions); workforce training; technology development; and local government integration efforts.

Risk of novel technologies (ranked #10)

- **Issue.** New chemicals and technologies have improved the quality of life in the 1st World, but pose the risk of unintended side effects (e.g.,

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dioxins) or misuse (e.g., chemical weapons). Several analysts suggest that new materials and technologies are generally created and distributed before, not after, careful assessment of potential risks. Responsibility for assessing new chemicals and technologies is fragmented both within and among nations.

- **Options for action.** Addressing this issue will likely require the creation of a new governance structure that is global in scope, assesses technologies before they are distributed, is impartial, and considers interactions among technologies.

Rare minerals and electronic waste (ranked #14)

- **Issue.** New electronic, battery, and display technologies require materials, especially rare earth elements that are currently in short supply. Disposal of consumer electronics leads to environmental contamination and exposure of workers to toxic substances, especially in developing countries, where much of the processing and disposal takes place.
- **Options for action.** Taken together, the rising demand and dwindling supply of many key resources and the large-scale creation of waste suggest a strategy of recovering key materials from waste streams. This will likely require carefully crafted regulations to stimulate action. Manufacturers can help by designing products for upgrading rather than obsolescence and for easy recovery of valuable materials at end-of-life.

Decommissioning nuclear reactors (ranked #17)

- **Issue.** Many existing nuclear power plants are nearing the end of their design lifetimes and will need to be decommissioned over the next two decades. Accomplishing this will present many challenges: storing or disposing of large volumes of nuclear waste, risk of accidents and radiation exposure, and a potential shortage of trained workers.
- **Options for action.** Advance planning for funding, waste processing, public involvement, and worker training will be key to successfully addressing this issue.

LOOKING ACROSS THE REPORT

A high-level view of the UNEP report notes a variety of interactions among issues, raises a variety of questions, and suggests several possible scenarios for the future of global environmental policy.



Costly Disasters

Malaysia has experienced losses of approximately RM185 million (USD60 million) per year with 1239 total average number of people killed in 58 events of natural disasters.

Source: EM-DAT: The OFDA/CRED International Disaster Database, University catholique de Louvain, Brussels, Belgium

Interactions

An overarching theme of the report is the need to examine not only issues within traditional environmental categories (e.g., food and agriculture, or energy), but also linkages between issues in different categories, as well as additional issues that span traditional categories. Mankind has become a major driver of the global ecosystem; man and society must be regarded 'as integrated parts of the biosphere.' Change is accelerating, environmental domains are closely interconnected, and 'more changes are non-linear, abrupt, and irreversible.' Environmental stewardship means building resilience in a rapidly changing situation with many uncertainties.

- Both food insecurity and slow environmental changes can provoke population migration.
- Maintaining biodiversity helps to maintain food security, while destruction of inland watersheds and potential ocean-system collapse threaten food supplies. On the other hand, the need for food security is a primary driver of the rush for land.
- Examples of the negative impact of current international governance mechanisms are available in many of the more specific issues cited, for example, the issue of potential collapse of ocean systems or the need for renewable energy sources, both of which can only be addressed with the aid of government action that spans nations and regions.
- Lack of a trained workforce has the potential to hinder implementation of renewable energy technologies and the timely decommissioning of nuclear power plants.

- In addition, clearly the other cross-cutting issues interact with many of the more specific ones. For example, reconnecting science and policy will make it easier to address climate change and to create sound policy and process for evaluating new materials and technologies in advance of deployment.

In addition to noting interactions among environmental issues, the report also highlights the close linkages among the environment and resources; the economy, employment, and economic development; social issues such as trust in science and environmentally friendly behaviors; and government laws, regulations, and policies.

Possible futures

The report looks at the potential results of addressing or failing to address each of the 21 issues listed, as well as opportunities for action. Taken together, these sections suggest at least four possible futures.

- **Business as usual.** The report makes clear that failure to address the 21 issues identified in the report in new and effective ways will create a situation in which or exacerbate the current situation in which these issues are dealt with via 'crisis management.' Environmental issues will be dealt with individually in an ad hoc fashion, and only the most urgent or popular issues will be addressed properly. For example, only 'charismatic' species will be saved from extinction, while overall biodiversity is significantly compromised. Nuclear power plants that have outlived their design life will be entombed in containment structures

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Exploited Fisheries

In 2011, Department of Fisheries Malaysia has indicated Marine capture fisheries of 1,373,105 tonnes (82.43%), valued at RM6,939.47 million (73.98%) respectively decreasing by 3.90% in terms of quantity and 4.32% increase in terms of value compared to 2010. However, there are serious concerns about over fishing as declining fishing stock is indicative that the catches are above the maximum sustainable yield of the fish populations.

Source: Department of Fisheries Malaysia

rather than properly decommissioned based on careful planning set in motion today. Climate change will drive an increase in extreme weather events, forcing ever more frequent responses to human crises.

- **Passing the tipping point(s).** A more ominous potential result of a 'business as usual' approach to environmental issues is that one or more of these issues cross tipping points that create crises that are difficult or impossible to manage. For example, key habitats might be irretrievably lost; food security could be severely compromised for a large fraction of the population; or the planet could lose its capacity to support the projected human population.
- **Addressing the issues.** On the other hand, doing the work of mitigation and adaptation specified in the report can help to avert tipping points and make progress in addressing these 21 environmental issues. The report contains a wealth of specific suggestions and recommendations for addressing food, land, water, biodiversity, climate, energy, technology, and waste issues.
- **Building capacity.** The 'preferred future' envisioned in the report goes beyond addressing the known issues to build capacity for addressing both already-identified and as-yet- unidentified issues. To build the global capacity to manage environmental issues and achieve sustainable economic development will require:

- **Reforming governance**, for example by creating new frameworks and structures with streamlined processes for decision making
- **Engaging all stakeholders**, for example by building stronger relationships between scientists and policymakers or by strengthening and formalizing the role of NGOs in policy and decision-making
- **Developing scientific understanding** and models that make it possible to anticipate issues as early as possible and that can guide mitigation and adaptation strategies
- **Learning how to create behavioral change** across the population so that sustainable behaviors become part of the global culture
- **Anticipating new issues** so that they can be addressed before they reach a crisis, create serious or irreversible consequences, or become unmanageable

Challenges

The capacity-building 'preferred future' implicit in the report raises a number of difficult questions.

- Each of the issues raised in the report has global scope and the potential for significant negative outcomes, and will require substantial resources for proper management. Is it realistic that all of these issues can be addressed simultaneously?
- It has been frequently pointed out that there is a fundamental mismatch between the global nature of environmental issues, where activities

in one location can impact the entire planet, and the national and local scope of governments. Will it be politically feasible to create stronger international governance mechanisms? Nations are often reluctant to commit fully to such institutions, fearing a loss of sovereignty.

- Who will take responsibility for the various capacity-building activities that are needed in order to ensure that society has the processes and resources to address these issues over the long term?
- This discussion of inland watersheds points out that developing nations have an opportunity to avoid environmental mistakes made by many developed nations, mistakes that required decades to reverse. Where else are there opportunities for developing nations to leapfrog developed ones in their sustainability practices?
- Several times the report explicitly mentions the need for foresight activities that will help to anticipate future issues and the consequences of various responses. Will the various stakeholders commit to disciplined foresight processes?

Without specific action to stem the flow of migrants, their numbers are likely to increase. Advanced planning has the potential to reduce migration and mitigate the hardships faced by those who must relocate.

BUSINESS IMPLICATIONS

- Businesses should view themselves not only as users of ecosystem services or even as stewards of the environment, but as an integral part of the global system.
- Similarly, if the ecosystem is liable to cross various tipping points in the next decade or two, and to experience 'shocks and surprises that arise as emergent properties of the dynamics of the Earth system', then it is in the best interest of organizations of all kinds to support research efforts to identify and anticipate such changes; to invest resources to mitigate and adapt to them; and to build internal systems

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Declining Concern?

According to a 2011 Gallup poll, between 2008 and 2011 the number of Americans who worry 'a great deal or a fair amount' about global warming fell from 66% to 51%; this number appears to be leveling off.²

According to the finding of a regional GE Energy-commissioned poll in 2011, global warming is the top concern among Malaysians where 70% of Malaysians were worried about the issue.

Source: <http://www.thestar.com.my>

(e.g., supply chains, logistics and distribution systems) that are resilient to such changes.

- Non-governmental organizations should anticipate and work toward a more formal role in environmental decision-making.
- Both academic and industrial researchers should seek to build bridges with policymakers in order not only to influence future laws, regulations, and policies, but also to shape their own research agendas to the needs of policymakers and society at large.
- Similarly, academic and industrial researchers have an opportunity to work locally and globally to repair and sustain appropriate trust in scientific results and the scientific enterprise among members of the public. Learning how to communicate scientific findings effectively to a non-technical audience will be essential to this task.
- Businesses can play a leading role in training researchers, managers, and others to work in the emerging green economy.
- Businesses can serve as key partners in efforts to drive 'tipping point' change in public attitudes and behaviors regarding environmental issues. In the long run, taking leadership in this area will build trust with customers and consumers.
- Businesses should anticipate that users of ecosystem services may eventually be required to pay the full replacement cost of those services. In the long term, this could cause significant change to the cost of raw materials, manufacturing, and other phases of operations.
- Businesses building operations in less developed economies should look for ways to establish

state-of-the-art sustainability practices early on, to avoid repeating the cycle of pollution and cleanup experienced in past decades in many developed nations.

- If the regulatory structure for evaluating new materials and technologies before they are introduced into the marketplace develops as recommended in the report, businesses will want to work closely with policymakers on the development of these new, potentially global regulatory processes.

Business of Biodiversity

In a 2009 survey of global business executives, 27% were 'extremely' or 'somewhat' concerned about the loss of biodiversity as a threat to business prospects. About half (53%) of Latin American CEOs and 45% of African CEOs were 'extremely' or 'somewhat' concerned, but just 14% of those from North America and 18% of those from Europe.³ Malaysia rainforest is home to some 15,000 species of higher plants, 300 species of wild mammals, 700 to 750 birds, 350 reptiles, 165 amphibians and more than 300 freshwater fishes that valuable to business. However, analysis by Food and Agriculture Organization of the United Nations (FAO) has indicated that Malaysia lost an average of 140,200 hectares which is 0.65% of its forest area per year since 2000 as resulted from deforestation towards urbanization, agricultural fires, and forest conversion for oil-palm plantations and other forms of agriculture activities.

Source: <http://www.cbd.int>, Malaysia- Status and Trends of Biodiversity

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Disruptive Technologies 2025

Emerging Technologies and Economic Impacts

A study conducted by the McKinsey Global Institute (MGI), a research arm of consulting firm McKinsey & Company, entitled *Disruptive Technologies: Advances That Will Transform Life, Business, and the Global Economy* concluded that twelve rapidly developing technologies hold the potential for massive economic impacts that could disrupt businesses, transform lives, and fundamentally change the global economy. In the study report, McKinsey presents analysis of a dozen technologies that it views as having the potential to cause widespread economic disruptions by 2025.

The report estimates that the potential combined economic impacts of these technologies could be between \$14 trillion and \$33 trillion a year in 2025, suggesting that business leaders must remain abreast of these changes. The 12 technologies also hold the potential to change the nature of work and possibly displace millions of workers, implying significant public policy impacts.

MGI'S METHODOLOGY

More than 100 potential technologies were identified using information drawn from academic journals, business and technology publications, published venture-capital portfolios, and interviews with experts in a variety of fields.

To select the top 12 disruptive technologies, MGI used four criteria:

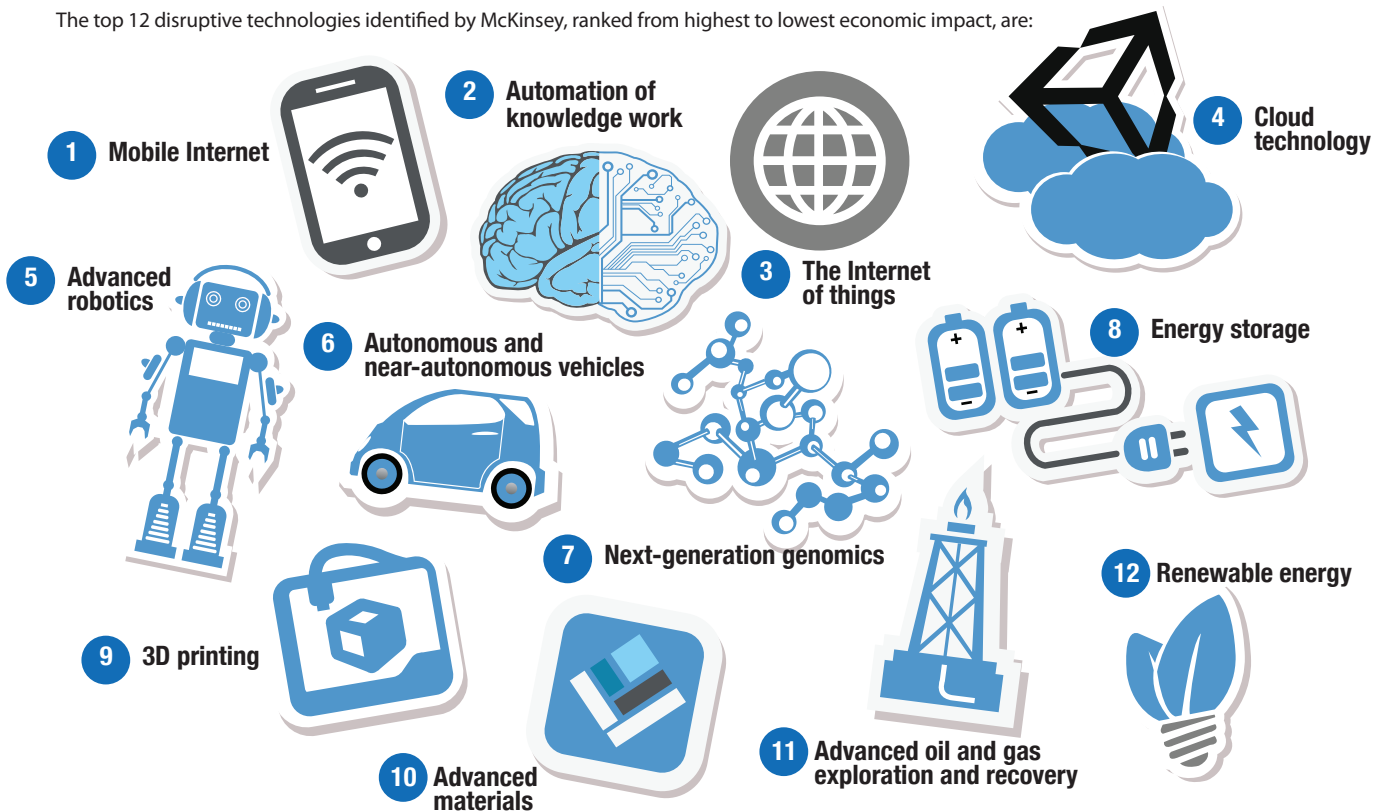
- **Pace of change.** The most disruptive technologies often show either accelerated or discontinuous improvement in capability, or rapid changes in their price/ performance relative to substitute and alternative technologies.
- **Breadth of potential impact.** MGI looked for technologies that will impact or spur innovation across a wide range of products, services, and industries.
- **Impact on economic value.** To be considered, the technology had to have the potential for significant economic impact — e.g., disrupting current profit pools, adding to GDP.
- **Disruptive potential.** The technology had to have the potential to 'transform how people live and work' and to alter the economic status quo.



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Top 12 Disruptive Technologies

The top 12 disruptive technologies identified by McKinsey, ranked from highest to lowest economic impact, are:



1. Mobile Internet

The mobile Internet is made up of mobile computing devices, high-speed wireless connections to the Internet, and a wide variety of applications. And while mobile adoption has proceeded rapidly, MGI forecasts that 'the full potential of the mobile Internet is yet to be realized; [and] over the coming decade, this technology could fuel significant transformation and disruption.' Businesses should anticipate a variety of changes.

- Devices will become smaller and more powerful, integrate more-intuitive interfaces (e.g., gesture), and be 'packed with many types of sensors.'
- Mobile will make up a rising share of Internet connections. MGI forecasts that by 2025, some 80% of all Internet connections could be made using mobile devices.
- An additional 2 billion – 3 billion people may come online and gain access to the global economy thanks to the mobile Internet. This will give global product and service providers 'a new channel to reach the fastest-growing markets.'
- The commercial sector will not be the only beneficiary of the shift to a mobile Internet. Public and social services (education, healthcare) will also see improved delivery and productivity.

Economic impacts

The global economic impacts of mobile Internet technology could range from \$3.7 trillion to \$10.8 trillion annually by 2025, across a range of applications including healthcare, education, the public sector, retail and payments, and worker productivity. For example, governments may see cost savings of some 50 – 75% on administrative tasks as mobile Internet technologies are more universally adopted.

2. Automation of knowledge work

Advances in computing architecture, artificial intelligence (AI), and interfaces will allow computers to 'perform tasks that rely on complex analyses, subtle judgments, and creative problem-solving.' As this happens, machines will take on more tasks that previously were reserved for people, and automation will shift into knowledge work.

In general, these tools will extend people's capabilities and let them offload certain lower-level tasks and focus on higher-level activities. This will lead to increased productivity. For example, McKinsey estimates productivity gains of 40 – 50% by 2025 as emerging

automation tools are applied to business functions such as customer service and administrative support.

Applications will extend well beyond administrative functions, however, and could impact sectors and functions including:

- Healthcare, e.g., helping doctors with diagnoses
- Education, e.g., grading papers, self-guided learning
- Professional services, e.g., law, finance
- Research, e.g., drug discovery, software development
- Management, e.g., business analytics

Economic impacts

The global impacts of knowledge-work automation could reach between \$5.2 trillion and \$6.7 trillion annually by 2025.

3. The Internet of things

The physical and digital worlds are being connected as sensors, actuators, and data communications technology are built into all types of physical objects. Some 9 billion devices are already connected to the Internet – and billions more will come, from bridges, to shipping containers, to hospital beds.

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Wearable Future

Device formats will continue to change, and in many cases, mobile Internet devices will be wearable. Already, wearable devices like The Galaxy Gear which is a smartwatch that not only tells time but also alerts the user when the user receives a call or text message on their smartphone goes for RM999.00 in Malaysia. Currently, the Gear works with the Note 3 but Samsung has plans to support more smartphones soon. The Gear integrates smart technology even deeper into the lives of consumers by makes their daily lives to be easier and more enjoyable.

Several underlying drivers are helping to propel the IoT forward. These include the declining cost (and size) of sensors, better power-management systems for digital devices, and the spread of high-speed wireless data networks, which IoT devices use to communicate.

As more objects are connected, it will become possible to monitor, track, coordinate, and control these devices across the Internet. This will, for instance, allow organizations to move toward more preventive maintenance in order to avoid downtime and disruption, e.g., in factories.

It will become more common for IoT devices that include actuators to take action without human intervention; e.g., an embedded heart sensor might alert a healthcare professional automatically if a heartrate grows erratic.

Economic impacts

The Internet of things is expected to have a potential global economic impact of between \$2.7 trillion and \$6.2 trillion per year by 2025. The largest impacts will be in the healthcare and

manufacturing sectors. For example, the IoT could lead to a 10 – 20% reduction in cost of managing chronic disease. Other sectors that will be significantly impacted by the Internet of things will be electricity production and transmission, resource extraction, agriculture, urban infrastructure, and security.

McKinsey acknowledges that there will be job losses from this latest round of automation, but suggests that 'knowledge-work jobs generally consist of a range of tasks, so automating one activity may not make an entire position unnecessary.'

Top 10 Disruptive Innovations in the Internet World

IT Application / Device	Disruptive Innovations	Killed which business?
Apple iPod	The idea is to carry all your favourite songs in your iPod	iPod captured the market because of inability of Sony's Walkman to store amount of music and its bulky size. Moreover, carrying cassettes was an additional headache.
Email	Email has become such an integral part of our lives to and makes connecting with friend and official communication easy.	Email has indeed hit the postal service system across the globe
Smart phones / Apple iPhone	Smartphone is a device that lets you make telephone calls, but also adds in features that, in the past, you would have found only on a personal digital assistant or a computer--such as the ability to send and receive e-mail and edit Office documents.	With the advent of high-end mobile phones, landlines and cordless phones have literally been pushed to the back.
Netflix	Netflix has altered the face of online video viewing. Its subscription-based services, offering ease, convenience and the capacity to rent movies for as long as one wanted without any extra charges, have no precedents.	Netflix's entrance into the market led to Blockbuster filing for bankruptcy in September 2010.
Digital word processing	Inventions like Microsoft Word has started the ball rolling for the next wave in maintaining documents. As MS Word is a user friendly software and still dominates the market, other digital word processors-even Apple iWorks -have struggled to capture a decent market share.	Microsoft gain a foothold in the market ad it was preferred over typewriters.

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IT Application / Device	Disruptive Innovations	Killed which business?
Computer Generated Imagey (CGI)	CGI has witnessed an incredible upsurge in the past few movie making such as Ice Age, Monsters Inc, Avatar and Toy Story. Its also has replace role of stunned man in some movie.	Although and-made drawing are still used in storyboards, they are not utilized in mainstream cinema.fxc
e-Commerce	A booming online shopping gave customer freedom to choose and compare item online with help of review and comment from other users without leaving their comfort homes.	This is affecting the physical stores these days. Physical store need to have online option to compete.
Apple items	Apple had monopoly online music through its iTunes store. Apple users can only go to Apple websites and nowhere else.	As the number of Apple product users is huge, the music industry has faced a tough challenge. Physical music stores in US, like Virgin Megastores, Sam Goody and Tower Records had to be shut down in 2009 as a result of monopoly by Apple products.
Online travel agencies	Travel online services has benefited conumers and create emergency by their offers e.g. Expedia.com, Air Asia and Groupon.	As a result, traditional travel agents are not able to compete against such convenience along with value for money and had gone out of business.
Amazon Kindle	E-readers like Amazon Kindle by Amazon are so popular and sold more e-books than physical books in the last quarter of 2010.	Only time can tell if e-readers will oust physical books from competition. Although the majority of the population still prefers solid books, increase in e-book sales suggests that this trend is gradually changing.

Still, changes could be profound: McKinsey estimates that automated systems could perform the work of 110 million – 140 million full-time equivalents (FTEs) in 2025.

4. Cloud technology

Cloud technology allows computing to be performed remotely. The past five years have seen explosive growth in the use of the cloud for storage of video, music, e-books, photographs, and other digital content. Increasingly, software such as office productivity applications (word processing, spreadsheets, presentation software, etc.), learning management systems (LMS), and that used in stock analysis and trading is available via the cloud.

McKinsey foresees the cloud becoming the dominant computing paradigm, stating that 'by 2025 most IT and Web applications and services could be cloud-delivered or -enabled, and most businesses could be using cloud facilities and services for their computing resources.' This will:

- Give rise to new 'asset-light, highly mobile, and flexible' ways of doing business and disrupt traditional business models
- Make IT a pay-as-you-go service, whereas it previously required large capital investments
- Level the playing field, letting entrepreneurs and small companies compete more ably against large organizations

Cloud technology will also be closely linked with, and a key enabler of, other key disruptive technologies identified by McKinsey—including the mobile Internet, the IoT, and the automation of knowledge work.

Economic impacts

By 2025, the economic impact of cloud technology could be between \$1.7 trillion and \$6.2 trillion per year. The vast majority of this will come from cloud-based Internet services (\$1.2 trillion – 5.5 trillion). A much smaller share (\$500 billion–700 billion) will come from productivity improvements to enterprise IT.

More users, bigger cloud

One element driving growth of the cloud will simply be the fact that the number of users is rising. By 2025, there could be 5 billion Internet users, up from 2.5 billion today. Most of these will connect via mobile devices and will rely on the kind of 'off-device processing, storage, and applications' the cloud provides. Microsoft in 2012 released the results of a study into cloud computing in APAC countries, of which Malaysia was one of the territories studied. The research showed that small and medium sized enterprises (SMEs) are gaining significant IT security benefits from using the cloud.

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Companies that use cloud computing in Malaysia say that they are enjoying higher levels of security, spend less time managing their security and as a direct result, have reduced what they spend on managing security previously.

Among other benefits, the cloud takes the hassle of managing security away from the SMEs, which then gives them the freedom to focus on innovating and growing their business.

It is also interesting to note that 38% of the SMEs reported that they were able to employ more staff because of such savings, while 70% of the respondents said that they increased investment in product development and innovation.

More than half those surveyed said that using the cloud enabled them to add new products and services to their business in a manner that was quicker and more secure.

5. Advanced robotics

Many tasks once thought to be too delicate, too complex, or not cost effective to automate will likely see increased use of robotic systems. This new wave of automation will be driven by:

- **Advances in enabling technologies.** This includes progress in AI, machine vision, sensors, motors, and advanced materials.
- **Costs reductions.** Prices for robotic systems fall about 10% per year and may decline at a similar or faster rate through 2025.

In general, robots are becoming more adaptable – able to deal with unstructured environments and complex problems. This portends a future when they will likely work alongside people, rather than being sectioned off and confined to a smaller set of clearly defined tasks (e.g., welding) as is the case with industrial robots today. This will open the door for automation in additional applications in manufacturing, as well as in the service sector (cleaning, maintenance, food preparation), medicine (surgical robots), and the home (home and personal care robots).

Economic impacts

The impact of advanced robotics could be between \$1.7 trillion and \$4.5 trillion annually by 2025. Part of this economic impact will come from robots substituting for and working alongside people:

- Industrial robots could perform the work of 30 million – 60 million full-time equivalents (FTEs) by 2025.
- Commercial service robots could perform the work of 10 million – 15 million FTEs by 2025.

Economic impact will also come from robotic applications that help restore function to people with disabilities. The need for these so-called 'robotic augmentation' applications is great: There will be 50 million people with impaired mobility (amputees, the elderly) in 2025.

Courier Robots

About 20% of a nurse's shift is spent wheeling or waiting for carts of equipment. Rather than replace nurses, courier robots will work alongside nurses, relieving them of this task and letting them focus on care—rather than ferrying equipment.

6. Autonomous and near-autonomous vehicles

Cars, trucks, aircraft, and ships that can completely or partially operate and navigate themselves are already a reality. As machine vision, artificial intelligence, and sensor and actuator technologies continue to advance over the next decade, autonomous and near-autonomous vehicles will become more reliable, less expensive, and more sophisticated. If adopted, this technology could help:

- Increase safety and reduce injuries and loss of life and property
- Reduce CO2 emissions through more efficient vehicle operation (e.g., with optimized braking and acceleration)

Autonomous vehicle technology has, according to McKinsey, 'evolved at lightning speed' and the primary factors that will determine its future are social, not technological. For autonomous vehicles to have widespread impact, there will need to be changes in regulatory frameworks, and the public will need to believe in and embrace these systems.

Economic impacts

If regulatory and cultural barriers fall, the potential economic impact of autonomous cars and trucks could be between \$200 billion and \$1.9 trillion a year by 2025.

- Self-driving cars could account for \$100 billion to \$1.4 trillion of this amount.
- Long-haul trucking could account for between \$100 billion and \$500 billion.
- McKinsey estimates that 30,000 to 140,000 lives would be saved each year by 2025 if 10–20% of the world's 1.2 billion privately owned cars gain 'the ability to self-drive in at least half of all traffic situations.'

Autonomous Cars

Autonomous cars from companies like Google and Audi are in field trials. By 2020, the technology will be integrated into most high-end vehicles. BMW anticipates this timeline for self-driving cars:

- **2016. Partially automated cars, e.g., in stop-and-go traffic at low speeds**
- **2020. Highly automated cars in which drivers no longer need to monitor the system at all times and be prepared to take over the driving situation given lead time.**
- **2025. Fully automated cars in which the driver does not need to monitor or be able to take over the driving in any situation.**

7. Next-generation genomics

The field of genomics is at the cusp of a 'new era of innovation' thanks to:

- The declining cost of sequencing
- Advances in infotech, to better analyze genomic data
- New capabilities in modifying organisms – through both recombinant techniques and the emerging tools of synthetic biology

This should 'accelerate the process of biological discovery,' lead to novel treatments for disease, and yield new types of genetically engineered products (e.g., biofuels).²⁵

Economic impacts

McKinsey forecasts that next-generation genomics technologies will have an economic impact of \$700 billion to \$1.6 trillion per year by 2025.

- Uses in disease prevention and treatment will have an impact of
- \$500 billion to \$1.2 trillion a year. Agriculture and related industries like ethanol and biodiesel production will see a \$200 billion to \$400 billion impact.

Faster, Cheaper DNA

It costs between \$1,000 and \$4,000 to sequence a person's genome as of 2013, but costs are falling fast. Data from the National Institutes of Health (NIH) suggests that costs are in a 'free-fall' and have decreased by as much as 90% for several years in a row. This is giving companies such as 23andMe confidence that a \$100 price tag to sequence a person's entire genome won't be out of reach for long.²⁷

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8. Energy storage

According to McKinsey, diverse drivers are converging to make energy storage technologies more important:

- Demand for electricity is rising in developing economies, including in places out of reach of the grid.
- World 1 economies seek ways to overcome peak demand issues without adding capacity, and to integrate renewables into the grid.
- Concerns about CO2 emissions and climate change are driving the search for 'less harmful' ways to meet global energy needs.
- The cost of energy storage technologies, especially lithium-ion batteries, is dropping.

These forces will make energy storage more important in coming years, and advances in the technology could lead to a range of outcomes—from increased adoption of electric and hybrid vehicles, to more use of distributed solar power.

Economic impacts

The economic impact of more efficient energy storage technologies is forecast to range from \$90 billion to \$635 billion per year by 2025.

9. 3D printing

3D printing is attracting increased attention, and early adopters are beginning to use the technology in sectors such as healthcare, aerospace, and consumer electronics. Over a million 3D-printed hearing aid earpieces were sold in 2011, and personal 3D printers now cost as little as \$1,000.

McKinsey takes a balanced view of 3D printing technology – neither dismissing its potential nor proclaiming it 'the next industrial revolution' as some analysts have. Instead, it suggests that in the long term it holds significant, disruptive potential in areas ranging from healthcare to fashion, but that 'it could take years before [3D printing's] impact is felt beyond a limited range of goods.' Still, McKinsey forecasts that 'it is possible that most, if not all, consumers... could have access to 3D printing by 2025, whether by owning a 3D printer, using a 3D printer in a local store, or ordering 3D-printed products online.'

Economic impacts

The economic impacts of 3D printing could be \$230 billion – \$550 billion per year by 2025. The largest share of this would come from consumer applications, followed by direct product manufacturing of complex, low-volume items.

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3D Printing

Desktop 3D printers like the MakerBot Replicator can produce a wide variety of finished products and parts for more complex machines. 3D printing will have major impact on manufacturing, logistics, and retail operations. On June 4th 2013, for the first time in Malaysia, Dr. Ranjit Singh Gill from Pantai Hospital Kuala Lumpur and the 3D Printing experts at Materialise had used virtual surgical planning and 3D printed surgical guides for complex case for reconstruction of the patient's bones based on a CT scan of the patient's arm. It turned out that the patient's arm needed to be surgically broken again and the bone fragments precisely repositioned in order to restore normal arm movement.

10. Advanced materials

A variety of so-called 'smart materials' are being developed with novel properties—such as being self-cleaning, or self-healing. Advances in nanotech point to even more sophisticated smart materials that could be applied in a broad range of industries, e.g., electronics, energy, and construction. McKinsey's analysis suggests, though, that 'medicine could be the most promising area for adoption of advanced nanomaterials' in the near term, given the state of technology development and the 'willingness of consumers to pay for potentially life-saving treatments.'

Advanced materials are also seen as an enabling technology and could be applied to achieve new capabilities in other key disruptive technologies identified by McKinsey, including advanced robotics and the Internet of things.

Economic impacts

Advanced nanomaterials in medicine are expected to have economic impacts totaling between \$150 billion and \$500 billion per year by 2025, according to McKinsey. This is within the range provided by other forecasts. For example, market research firm Cientifica forecasts that the market for nanotech-enabled drug delivery products will be \$136 billion by 2021.

11. Advanced oil and gas exploration and recovery

The combination of horizontal drilling and hydraulic fracturing (more commonly known as fracking) has dramatically increased production of so-called unconventional reserves of natural gas and 'light tight' oil (LTO). This presents the opportunity to 'unlock both newly discovered reserves and previously known deposits that could not be economically extracted using conventional methods.'

McKinsey foresees a range of trajectories in unconventional oil and gas:

- Development of unconventional oil and gas resources—and the technical proficiency to exploit these resources—is most mature in the US and Canada, but other countries are moving quickly to develop reserves.
- New technologies will be deployed to reduce cost and improve well output. For example, predictive modeling could reduce the time required to map and understand the characteristics of a given shale deposit. The amount of water needed for fracking could be reduced by 50% based on emerging treatment and reuse technologies.
- The amount of gas and LTO produced will increase the world over, driven by rising populations and economic development in World 2. McKinsey forecasts that production of shale gas in North America will rise from 350 billion cubic meters (Bcm) annually today to 496 Bcm in 2025. LTO production could rise from 1.5 million barrels a day, to 7 million–10 million barrels a day during the same timeframe.
- Widespread development of unconventional energy supplies could have a variety of secondary and manufacturing, change the 'geopolitical posture' of a variety of countries, and reduce investments in renewables by making fossil fuels relatively less expensive.

Economic impacts

The direct economic impact of advanced oil and gas technologies could be between \$95 billion and \$460 billion per year by 2025, based on McKinsey's forecasts for production across six locations (Canada, the US, China, Argentina, Australia, and Europe)

Fracking: Big Potential, Big Controversy

Fracking has the potential to unlock vast new supplies of natural gas, but is controversial and is the focus of sustained protests in parts of the US.

As fracking has spread, so have the protests. Exploratory drilling in the UK has sparked large protests in the English countryside.

12. Renewable energy

McKinsey forecasts that renewable energy could see 'rapidly accelerating growth in the next decade, driven by both technological advances that could narrow the cost gap with fossil fuels, and a growing desire to find energy sources that reduce human impact on the environment.'⁴² Solar and wind power have the potential to be especially disruptive, according to McKinsey, as the technologies advance. Indeed, solar cell prices have fallen dramatically, from \$8 per watt of capacity in 1990 to less than \$0.80 today, and further advances are expected. Use of new materials and production techniques could yield solar panels that cost only \$0.10 to \$0.20 per watt of capacity.

Economic impacts

The annual global impact of solar and wind energy technologies could range from \$165 billion (if technology 'remains frozen' and doesn't improve) to \$275 billion (if there are 'significant breakthroughs') by 2025. This includes direct impacts of \$145 billion to \$155 billion, and societal impacts through reduced CO₂ production of \$20 billion to \$120 billion annually.

OVERARCHING TRAITS OF DISRUPTIVE TECHNOLOGIES

Organizations dealing with the impacts of these and other emerging technologies will need to consider these common characteristics of the technologies.

- **Infotech-enabled.** Most of the technologies identified by McKinsey are enabled by advances in information technology. Information

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technologies typically advance at a quick pace and often exhibit exponential improvements in cost/performance. They also have strong network effects, meaning that their value increases rapidly as the number of users rises.

- **Synergies could magnify impacts.** The disruptive impact of individual technologies could be magnified by synergistic effects among technologies. For example, cloud technology will be a key enabler of the automation of knowledge work and could magnify its disruptive potential.
- **Consumers could see big benefits.** McKinsey expects that these 12 emerging technologies 'have the potential to deliver the lion's share of their value to consumers.' For example, improved healthcare technologies could improve patient outcomes while also reducing healthcare costs.
- **The nature of work will change, forcing millions to acquire new skills.** The emergence of new technologies will change the kinds of work people are employed to do. While this is not a new phenomenon, the changes resulting from these new technologies will be profound. This could result in social and political pressures if business and political leaders are unable to create innovative ways of providing new skills to the workforce and jobs in which to apply those skills.
- **Innovators and entrepreneurs have enormous opportunities.** Many of the technologies profiled by McKinsey require little or no capital investment, and therefore present unprecedented opportunities for innovators and entrepreneurs. In its estimation, 'a new wave of unprecedented innovation and entrepreneurship could be in the offing as a result.'
- **Uneven technological impacts between advanced and developing economies.** These technologies will have different impacts depending on where they are applied. For example, 3D printing and advanced robotic manufacturing could help revitalize the manufacturing sector in developed nations. But these same technologies could reduce demand for low-cost labor and adversely affect development in emerging economies.
- **Uneven distribution of technology benefits.** The benefits of these emerging technologies are unlikely to reach all nations or people equally, and could therefore widen income inequality.
- **Leaders must beware of hype.** Emerging technologies are subject to a great deal of hype, which makes it difficult to fully assess significance and impact. Leaders in business and government must be aware of this hype and 'make their own assessments based on a structured analysis involving multiple scenarios of technology advancement and potential impact.'
- **Surprises are inevitable.** The complex relationships between current and emerging

technologies, as well as the impacts of new innovations and scientific discoveries, make it extremely difficult to predict precisely how these new technologies will play out. Breakthroughs will likely come in discrete areas of technology, which could lead to secondary and tertiary impacts on other parts of the technology landscape.

- **Troubling challenges on the horizon.** While new technologies can have significant benefits, many can have unwanted and unanticipated side effects. The risks of emerging technologies need to be carefully considered so society can 'navigate a path that maximizes the value of these technologies while avoiding their dangers.'

BUSINESS IMPLICATIONS

- McKinsey notes that the rise of mobile technology signals more than just another way to access the Web. Instead, it will be an empowering force that lets people 'go about their daily routines using new ways to understand, perceive, and interact with the world.' Businesses need to re-imagine their products and services in light of these new capabilities—and the new consumer expectations for immediacy, transparency, and increased convenience that mobile technology is creating.
- McKinsey forecasts that the mobile Internet will connect some 2 billion – 3 billion new consumers to the global economy. This implies that any organization expecting to grow by targeting emerging-market consumers will likely need to take a 'mobile first' approach. Building a competency today in mobile advertising, m-commerce, m-payments, and mobile data analytics could determine competitive advantage in emerging markets in the future.
- Several of the technologies highlighted by McKinsey (the cloud, 3D printing, automation of knowledge work) will help level the playing field for smaller organizations. This implies a more varied competitive environment wherein competitive power is based on agility and the ability to implement new technologies, rather than on size and geographic location. Established players should expect that competition will increasingly come from Worlds 2 and 3. Already, it is estimated that 143,000 Internet-related businesses are founded annually in the developing world.
- Several technologies in McKinsey's list imply that cycle times for decisions, product development, communication, etc., will continue to accelerate. The Internet of things and automation of knowledge work suggest business decision-making will happen more quickly and will increasingly be based on real-time information, while 3D printing will let products be continually refined and redesigned.

Organizations that simply brace themselves for these changes may survive, but those that revamp structures and processes to actually take advantage of the faster pace to compete more effectively will thrive.

- Businesses of all types need to anticipate, and develop strategies to deal with, changes in the competitive environment as the impacts of these disruptive technologies ripple through the economy. For instance, McKinsey notes that advanced robotics will offer early adopters the opportunity for quality, cost, and speed advantages – but also raise the spectre of lowering the barriers of entry for new, nontraditional competitors. Firms should enlist stakeholders from competitive intelligence, foresight, and strategy groups to assess how the disruptive technologies might reshape the competitive environment and to recommend a roadmap for adapting to these changes.
- While these technologies will have some cross-cutting impacts, many will also have industry-specific consequences. For example, the automation of knowledge work will likely impact the legal profession sooner and more intensely than it does the counseling/psychology profession. This makes careful assessment of industry-specific impacts crucial. Trade and industry associations could provide a useful forum for such assessments.
- Policymakers will need to deal with the social and political impacts of these and other disruptive technologies – ideally before those impacts cause significant problems. The social, political, and ethical implications of McKinsey's disruptive technologies all deserve further study.
- The technologies outlined in this report suggest a very different kind of economy in 2025. Secondary and tertiary education will need to be revamped to deliver the necessary skills for this future – and existing workers will need to be retrained so they can remain relevant.

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