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Malaysian Industry-Government Group for High Technology

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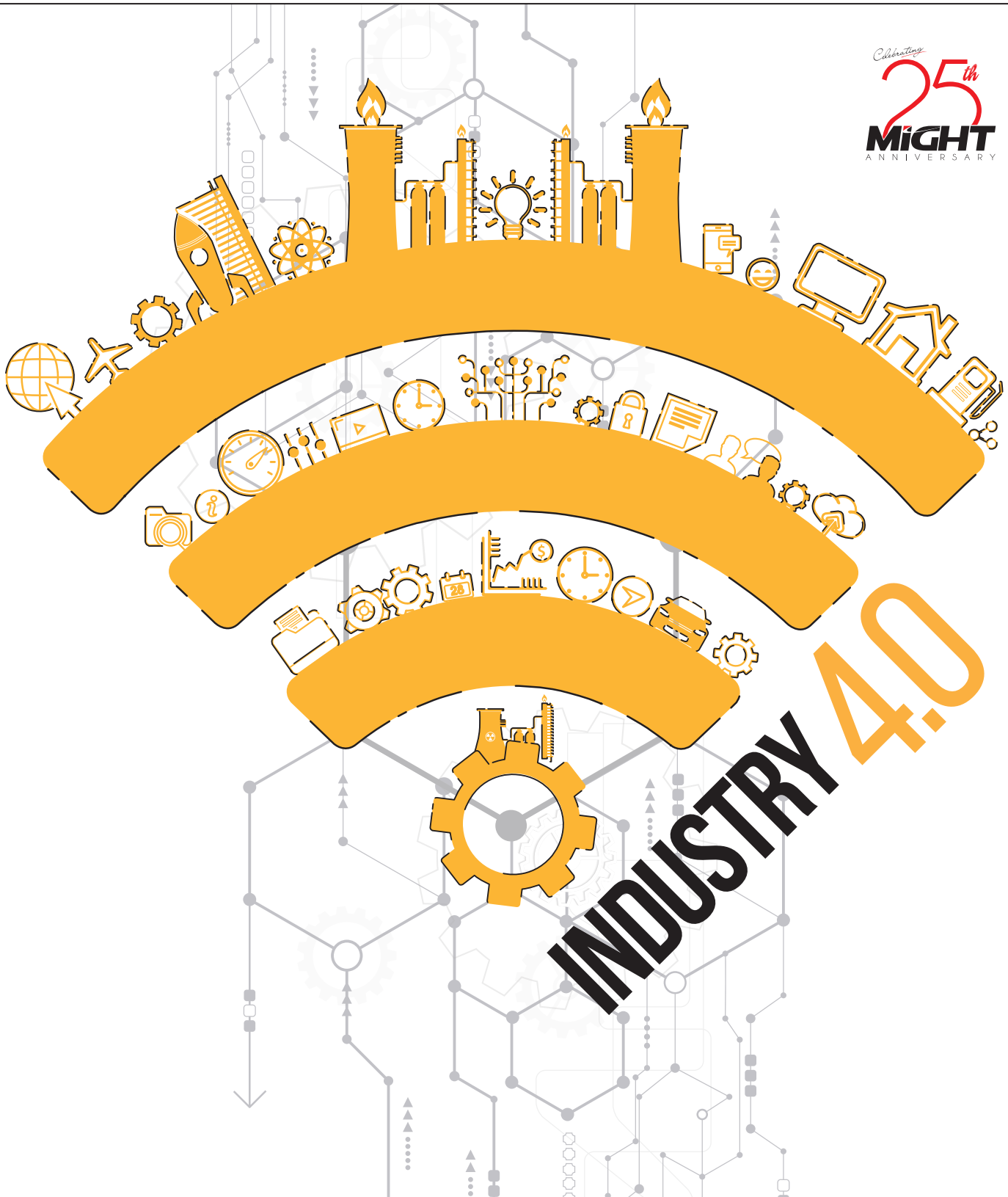

MITI PUBLIC CONSULTATION

IMPLEMENTING GOOD REGULATORY PRACTICE IN MALAYSIA

PUBLIC CONSULTATION ON PROPOSED NATIONAL INDUSTRY 4.0 POLICY FRAMEWORK

The Ministry of International Trade and Industry (MITI) would like to invite all members of the public to participate in the Proposed National Industry 4.0 Policy Framework consultation process and to provide their views and feedback.

FEBRUARY 12, 2018 TO MARCH 2, 2018

A number of initiatives and organisations have been established at the national, state and regional level by both the Government and industry to develop plans and actions to strengthen various manufacturing industries. These initiatives that support and focus on manufacturing firms are important to create a strong industry platform. However, they were mostly organised independently and often have overlapping objectives as well as industry audiences.

To accelerate Malaysia's transformation into a smart and modern manufacturing system there is a need for a greater alignment across government, research and academia regarding priority industries, specific goals, enabling actions, and funding. Germany and Japan provide examples of best practices where government, research and academia are tightly integrated through collaborative Public Private Partnerships (PPP) that develop innovative solutions for specific industry needs.

With this in mind, Malaysia has put in place the National Industry 4.0 Policy Framework – My-i4.0 – that provides a concerted and comprehensive transformation agenda for the manufacturing sector.

Visit and share your feedback at:
http://grp.miti.gov.my/index.php/public_consultation/view/40

YOUR VIEWS MATTER!

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inside myForesight®

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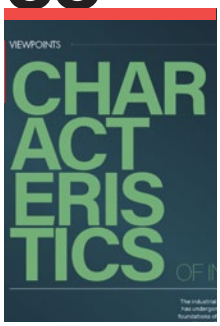

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myForesight® is a pioneering national level initiative dedicated to the prospecting of technology for business through the field of Foresight. It provides a common Malaysian based platform for the Government, Industry and Academia to share experiences, insights and expertise on the strategic futures issues, both at the local and global levels.

Its key components to its mission are intelligence, research, competency and community. **myForesight®** raison d'etre is to accomplish the following:

1. Shaping Malaysia's future possibilities;
2. Promoting and mainstreaming of foresighting in national, sectoral and corporate planning;
3. Identification of key technologies to support sectoral development;
4. Identification of key and potential industries from technology perspective.

PP17630/12/2012(031478)

EDITOR'S NOTE

Initial Thoughts

RUSHDI ABDUL RAHIM
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Greetings & Salutations,

The last 3 months have been an enriching experience for us at MIGHT. In collaboration with the Ministry of International Trade & Industry (MITI), we have been working on the framework for Industry 4.0 technology and processes adoption in Malaysia. Essentially, this framework will outline generic strategies for Malaysia to pursue, and ensuring that the country will remain competitive in the future.

Focusing on the manufacturing sector, the goal for the future the industry is not only to *make better things*, creating better and innovative products as well as services, but to also to *make things better*, improving the design, engineering, management and production processes.

Although for the past few years there have been steady improvements in the manufacturing output and employment in the sector, renewed investments are vital to build the necessary infrastructure and increase resources to support the continuous growth.

To that extent, the transformation of Malaysia's manufacturing industry is required due to the following factors:

Continuous Gross Domestic Product (GDP) growth

- At present Malaysia GDP growth remains resilient, on-track with its targeted annual GDP growth of 5.1 percent under the 11th Malaysia Plan (11-MP);
- The manufacturing sector is still a major contributor to the national GDP. In 2016, it contributed approximately 23 percent to the national GDP; and
- It is acknowledged that Malaysia needs to move from input-driven growth which is more capital-intensive to an innovation led productivity-driven growth.

Increasing National Productivity

- Malaysian productivity remains ranked 44th position in 2016 for Labour productivity per hour worked. This has remain almost unchanged since 2009 where we were also ranked 44th;
- The labour productivity growth from 2011 to 2015 was at 3.2 percent, whereas in 2016 it has risen slightly to 3.6 percent. However this still falls short of our neighbouring countries like Singapore and Thailand; and
- Presently under the 11-MP, the manufacturing industry productivity is targeted to grow approximately 2.6 percent year-on-year. There is a need to boost this growth through automation, digitalisation and smart technology and processes adoption.

Creating Higher Skill Employment Opportunities

- Malaysia is no longer able to rely on cheap labour as a competitive factor hence the focus on the creation of high-skilled jobs;
- There is an urgent need for us to move away from low-skilled/foreign workers dependency particularly for the manufacturing industry;
- The proportion of skilled labour in Malaysia has declined from 27.6 percent of total employment in 2010, to 25.5 percent of total employment in 2015; and

EDITOR'S NOTE

> *According to the Global Manufacturing Competitiveness Index, Malaysia is ranked 17th and is projected to climb four places to 13th by the year 2020.*

- Since there is a focus on high technology and value added manufacturing activities, Malaysia needs to grow the number and diversity of its STEM-educated or TVET-educated workforce, establish greater opportunities for high skill employment.

Remaining Competitive

- To remain competitive and relevant, the manufacturing firms must innovate—investing and adopting new technologies that will enabled more efficiency and increase quality; and
- Anticipate, looking for new business and collaborative model - work hand-in-hand with partners in the ecosystem to generate better products and services.

These factors also identified some gaps in the manufacturing industry that hindered development progress such as—labour intensive with relatively higher labour costs compared to our neighbours, lack of technology adoption and a small domestic market. The move to smart manufacturing processes and systems are seen as steps to stay abreast with the rest of the world and opening up markets where the nation has comparative cost advantages.

According to the Global Manufacturing Competitiveness Index, published in 2016 by the Deloitte Touche Tohmatsu Limited (DTTL) Global Consumer & Industrial Products Industry Group and the Council on Competitiveness, USA, Malaysia is ranked 17th and is projected to climb four places to 13th by the year 2020.

However, this rise is not given, as the report outlined, that in order to succeed in the rapidly evolving global manufacturing landscape industries will need to embrace a targeted approach to some of the key elements of manufacturing competitiveness.

Therefore, it is apt that the overarching strategy for this framework is to ACT—attract, create and transform.

- Attract stakeholders to Industry 4.0 technologies & processes;
- Create the right ecosystem for Industry 4.0 to be adopted; and
- Transform the industry to smart manufacturing, be Industry 4.0 ready and adopt its' technology and business practices.

At present MITI has already put the draft of the framework in public domain to solicit further inputs from the stakeholders.

In this publication, highlight some of the main drivers and trends of Industry 4.0 as well as the technology that has and will enable the manufacturing sector transformation.

I hope upon reading the articles in this publication, you will acquire thoughts and ideas to provide feedback to the Ministry.

As usual we welcome any comments, suggestion and contributions of ideas.

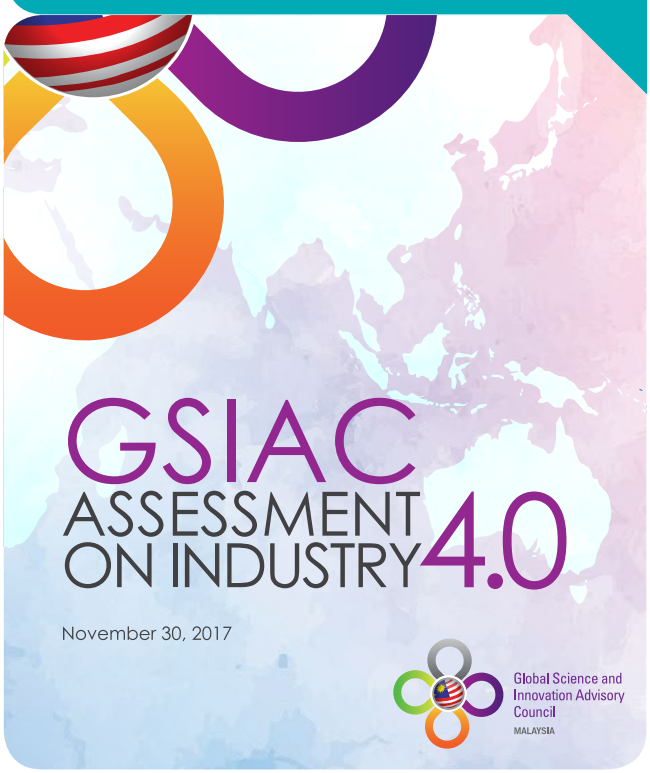
RUSHDI ABDUL RAHIM

INSIGHTS

INDUSTRY 4.0 What They Say

Industry 4.0 brings about sustainable production as it is primarily driven by a fusion of once separate technologies that when joined together are integrating the physical and digital worlds. The scope of its impact applies primarily to manufacturing technologies and industries, and at the same time profoundly transforming our economies and societies.

The Global Science and Innovation Advisory Council (GSIAC) Secretariat aims to provide an alternate perspective of Industry 4.0 through **Assessment on Industry 4.0**, focusing on four main concerns which are Awareness, Talent Supply, Regulations and Potential Industry or Area. Interviews were carried out with relevant stakeholders to gauge the country's level of readiness in facing Industry 4.0. The following are excerpt of interviews from the report.



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SUNWAY®

Dato' Ir. Tan Kia Loke Senior
Managing Director, Chairman's Office
Sunway Group

AWARENESS

KHAZANAH NASIONAL

- Khazanah is completely agreeable that Industry 4.0 could be a game changer for businesses and potentially will bring about disruptive changes to the society at large.
- Khazanah believes that *Awareness* is crucial at this juncture to ensure that all stakeholders are on the same page. For instance, currently within the Government, some ministries do understand the urgency to pursue Industry 4.0, while others are *blissfully aware* of the consequences of not taking cognisant of the potential impact of Industry 4.0.
- Besides awareness, Khazanah and their investee companies are also facing great challenges in integrating Industry 4.0 into their mainstream businesses. For example, banks are finding it difficult to integrate Fintech related technologies (such as Blockchain) and services into their mainstream banking and investment operations.
- With that, Khazanah believes in a 3-phase approach, (i) create overall awareness; (ii) get senior management (of investees) to acknowledge the importance of Industry 4.0; and (iii) determine how to integrate Industry 4.0 into their mainstream businesses.

Honeywell

- The Honeywell Operating System technology is driving Industry 4.0 in their plant's productivity and efficiency.
- Honeywell practices cost-benefit analysis between Human and Robots, before deciding on investments into Industry 4.0.

PETRONAS

- Industry 4.0 represents a new way of doing business and transforming the landscape – it will be a business imperative for all industries.
- Oil & Gas is not far behind in implementing Industry 4.0 related industries. Blockchain technology is already being experimented with to increase efficiency for O&G trading.
- As for PETRONAS, the company is currently leveraging on Industry 4.0 technology to enhance operational excellence.
- CEO of PETRONAS feels strongly that **Going Digital** is important to the company.
- To become a truly digitally enabled organisation, PETRONAS is now initiating steps to advance beyond vertical implementation of Industry 4.0.
- Beyond that, PETRONAS will also continue doing its part to support service providers that employs Malaysians to cultivate local industry and talent.

Cradle

Catalysing Sustainable Technopreneurs

- Large corporations need to get on board, as they are sitting on large pools of data and not leveraging on it.

TALENT SUPPLY

MINISTRY OF INTERNATIONAL TRADE AND INDUSTRY (MITI)

- Talent issues need to be addressed, especially on STEM and English proficiencies, and for schools to inculcate curiosity, problem solving and technology seeking attitudes amongst their students. Efforts should be made to enable public schools to catch up with private schools.

KHAZANAH NASIONAL

- Khazanah believes that in Malaysia, there is a disconnect between the universities and the industries.
- Gaps exist between university researchers and the industries, and these gaps between the interests of researchers and needs of the industries need to be addressed.
- For research to be commercialised, there needs to be a combination of business acumen and technological knowhow. As such, incubator programmes need to address the need to link business partners with researchers in commercialising their research outcome.

Cradle

Catalysing Sustainable Technopreneurs

- Getting the right talent is a challenge now, e.g., in machine learning.
- Start-up entrepreneurs aren't usually from the field that they want to specialise in, and these specialisations are often not hired. But due to limited talents, start-ups lack the depth in understanding the businesses. E.g., Fintech entrepreneurs are not from the banking sector.
- Investees usually outsource their (product) development due to the lower costs and talent limitation internally.
- Hence, the issue is that the knowledge depth of talents is not there to undertake the kind of ventures that are being proposed.

MIMOS

- Developing a pool of Industry 4.0 service provider could be a solution to overcome the CAPEX and talent issues related to Industry 4.0 adoption.

PETRONAS

- To ensure cohesive progress in this aspect, PETRONAS has a Chief Digital Officer for the group, who orchestrates the whole span of Industry 4.0 activities implemented by the group of companies.
- 52% of staff in PETRONAS is below the age of 35. As such, acceptance of Industry 4.0 is very high. Awareness of it is already very high among that peer group.

SME CORP MALAYSIA

- Most SME complaints are from mom and pop shops. The scenario has changed and they need to do their business differently. SME Corp do have training programmes funded through HRDF.

MAJLIS PROFESOR NEGARA

- The industries have on many occasions expressed that local university graduates do not meet their job requirements or the skill sets they desire, but are unwilling to provide on the job training for fear of employees leaving after getting experience and certification.
- Recent initiatives fostering strong university and industry collaborations through programmes such as 2U2I and CEO@faculty can break the barriers.

REGULATIONS

MINISTRY OF INTERNATIONAL TRADE AND INDUSTRY (MITI)

- The Cabinet has decided to establish a high-level task force to develop a framework for Industry 4.0, and MITI is now in the process of formulating the policy framework with relevant inputs from various stakeholders.
- The objective of this policy framework is to position Malaysia as strategic partner for smart manufacturing and related services in Asia Pacific and primary destination for high tech industry offering total solutions for the whole ecosystem by 2030.
- The focus of this policy framework on Industry 4.0 is on manufacturing and manufacturing related services.
- MITI believes that Malaysia's IP regime is relatively good now. However, there is a significant gap between research and commercialisation. One way of addressing this is by having incubators and working with the university eco-system. Commercial funding for research as a percentage of GDP is still low.

KHAZANAH NASIONAL

- Also mentioned were the approach of public research institutions in commercialising their research outcome. Most are currently relying on technology licensing, which is not easily achievable. Instead, they should encourage their researchers to just *run with their research outcome* through some form of start-up venture.

Cradle

- Fintech could be a regulatory challenge, as Malaysia is believed to be less open in Fintech related regulations as compared to Singapore and Indonesia.
- Funding will be an issue that needs to be addressed if the Government is serious about pushing for Industry 4.0.

POTENTIAL INDUSTRY / AREA

MIMOS

- Industry 4.0 may be a bit *far-fetched* for Malaysia with current average industry situation, instead we should focus more on *digitization*.

PETRONAS

- Current Implementation of such technology is vertical in nature:
  - Exploration & Production: focuses on systematic data collection via sensors, using drones for inspection to minimise cost and resources on maintenance activities;
  - Plant Operations: focuses on predictive maintenance;
  - Procurement: using big data to analyse information on Malaysia's O&G service sector to ensure value-for-money for PETRONAS;
  - Talent: beginning to scope and understand the attributes of talented individuals to optimise the filling of positions within the company.

SMECORP MALAYSIA

- SME Corp has exposed the local aerospace companies to Industry 4.0 by bringing them to Berlin & Warwick in UK for an immersion exercise. They have also been provided with up to RM500K of funding to acquire machines and equipment to automate their processes.
- The Agricultural sector is also moving into Industry 4.0, with high precision agricultural practices using IoT technologies. The medical sector too is into Industry 4.0, with 3D printing for prosthetics.

SUNWAY®

- To move towards Industry 4.0, education and healthcare could be the sectors to start with.
- Telemedicine and IBM Watson for healthcare are good examples of Industry 4.0 in the healthcare sector.
- Blockchain enabled crypto currencies is another example in Fintech, where a single currency with the same value could be used across all nations.
- Healthcare is a good sector to start:
  - It touches on common people.
  - The challenge is to get physicians to accept the changes.
  - However, opposition to changes may not be from the physicians but others, such as insurance companies and other peripheral industries.

For more information, please visit www.gsiac.org or reach the GSIAC Secretariat at gsiac@might.org.my

INSIGHTS

Global Driving Trends
of Industry 4.0

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Overview of the Global Trends of Industry 4.0

In 2011, Germany launched a project under the name *Industrie 4.0* to digitalise manufacturing at the Hannover Messe. The government officials, industry leaders and academics who were involved probably had no idea that the project, later known as **Industry 4.0**, carries the concept of a fourth industrial revolution and would later become widely accepted.

This project predicted a confluence of advancements in technology that allows autonomous factories and machine learning to take over manufacturing process. The idea has since grown into many areas outside of manufacturing; it has become a bigger vision to digitise cross-industries and has extrapolated to smart transportation and logistics, smart buildings, oil and gas, smart healthcare as well as smart cities.

The revolution is far from surprising. Megatrends are shaping the future and as for the manufacturing field, Industry 4.0 will enable manufacturers to improve efficiencies whilst reducing costs. In today's fast moving global markets, manufacturers need to respond quickly to changing demands and maximise new market opportunities. From all indications, we are in an era of significant convergence, where information technology, operational technology, and global megatrends are on a collision course. This will certainly drive changes in how we do business and how we interact with customers and suppliers.

Currently, there are ten identified global trends that are influencing Industry 4.0's present activities. A closer look at each trend would provide a better understanding of the future impact each trend brings and how it shapes the vision of Industry 4.0.

1 Demographic Shifts

Significant demographic shifts such as the increasing number of population growth in developing countries, a growing middle class, consumer market shifts and an ageing population are influencing future industrial activities.

For mature economies such as the US and Japan who are dealing with aging populations and baby boomer retirements, there will be a significant vacuum in the workforce. If manufacturers are to retain many valuable workplace skills and institutional knowledge, they will have to create a systematic way to ensure a smooth handoff from one generation to another. More importantly, it is imperative to ensure the sustainability of manufacturing activities to involve fewer humans.

Meanwhile, emerging economies with rapidly growing young populations, present different skill challenges for manufacturers. Many of these countries are still struggling with feeding and educating their people. These issues become magnified as rural populations move into cities in search of work. But since the digitalisation of manufacturing requires human resources with improved skills, it benefits the millennials as they are more digitally attuned. The developing technology continues to make it easier to collaborate and is helping to attract the discerning millennials generation, which is anticipated to account for 75 percent of the global workforce in 2025 and will play an important role in manufacturing as it continues to evolve.

Investing in Industry 4.0 technology that amplifies the current workforce is an important value-add for any factory.

2 Urbanisation

Urbanisation is a megatrend that will significantly shape the economic, political and social transformation of societies and their spatial impacts. The current rising trend of urbanisation indicates that up to 70 percent of the global population will be living in cities by 2050. Future urban growth will thereby almost exclusively take place in developing countries.

Industry 4.0 facilitates more mixed urban development by bringing the factory back to town, even closer to housing areas. This promotes the realisation of the *compact city* and it is made possible because of two features of the Industry 4.0, diminishing lot sizes and environmentally friendly integrated *urban production*. However, such positive consequences of Industry 4.0 for urban development do not come as an automatism. There are numerous bottlenecks and necessary urban-regional framework conditions to be taken into consideration. Smart modern planning also plays an important role.

This proves that strategic planning; integrated policies and interventions are vital to meet the urban infrastructure needs. Growing demands for urban mobility, energy, housing and telecommunication solutions are becoming prominent drivers of new manufacturing requirements. Industry 4.0 is targeted to generate positive economic growth and to contribute to the sustainable development of

cities in developing countries and emerging economies.

Addressing global challenges in a city context through Industry 4.0 is seen as a solution between economic development and urbanisation.

3 Knowledge and Talent Gap

The talent gap in manufacturing is getting larger in part because of external forces that are creating a greater need for skilled labour. Advancements in technology not only require new employee skills, but they also shorten the shelf life of those skills and increase the need for continuous training. For example, robots have had a dramatic impact on the factory floor, and new, computer-based manufacturing techniques such as 3D printing are becoming less expensive and more adaptable to manufacturing uses.

To support new technologies and innovation, manufacturers must attract people with STEM (science, technology, engineering, and mathematics) skills. However, this talent pool is in demand in many other industries as well, and manufacturing is not top-of-mind for young people starting to build their careers.

Adding to this complexity is the reality that demographic changes across the globe make it more difficult to find and retain the workforce of the future. The rapid rise in urbanisation in relatively undeveloped countries often leads to increased poverty and high dropout rates, resulting in a scarcity of talent. This scarcity breeds competition among companies that must compete more aggressively for the talent that does exist, especially at the managerial level. As a result, companies are finding it difficult to attract and retain employees, often losing them to competitors that offer even small increases in pay or slightly more favourable working conditions. This high rate of mobility is likely to become a bigger problem over the next decade as competition for labor continues to increase.

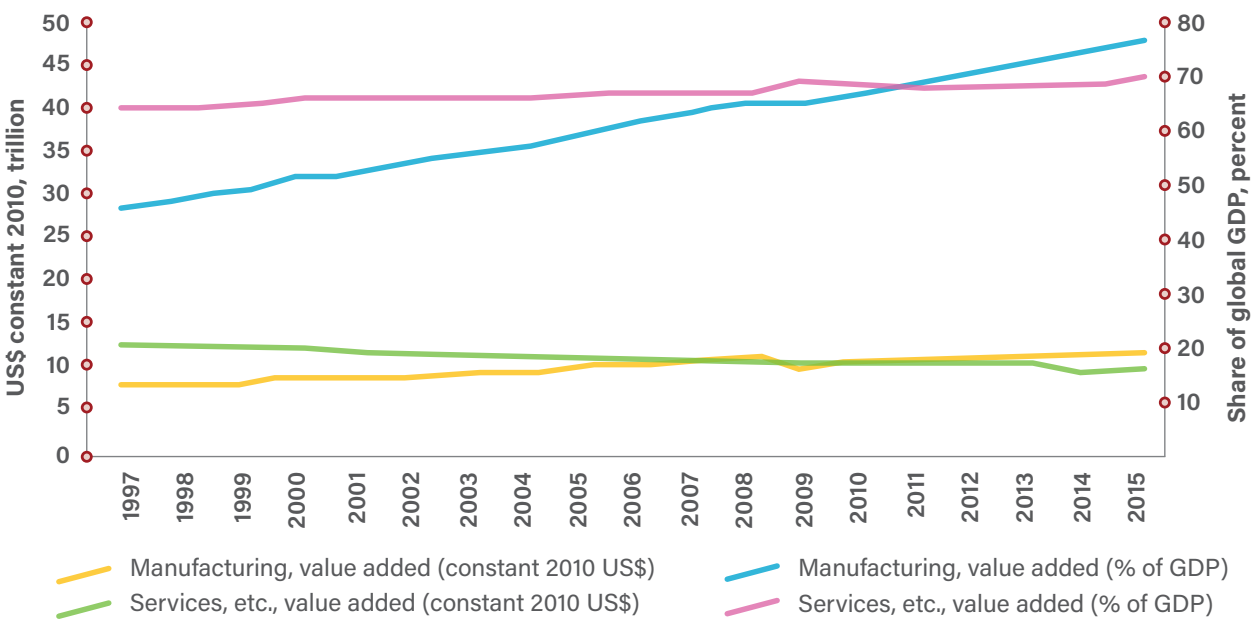
Education providers must look at industry 4.0 transformational needs and how they can supply the required highly skilled talents.

4 Deindustrialisation

Industrialisation is a word synonymous with development while deindustrialisation, a recently-coined term, involves a decrease in the relative size and importance of the industrial sector in an economy. It may involve curtailing the absolute size of industry or the manufacturing industry takes a smaller share of GDP and employs a smaller percentage of the workforce.

Deindustrialisation will invariably involve developed economies moving towards services-based economies. The loss of market share to newly emerging competitors

Global Manufacturing Share of GDP and Absolute Value Relative to Services, 1997 - 2015



Source: World Development Indicators Database

create markets competitiveness as the outsourcing of activities such as logistics, facility management, maintenance and different types of professional services to the service industry. Figure 2 shows that the service industry's share of GDP has accelerated as compared to the manufacturing industry in recent years.

Deindustrialisation is a worldwide trend with a significant impact on our economy and society. It has been driven by the fact that manufacturing output and employment saw a discernible shift towards Asia from Europe due to its lower cost base starting in the 1990s. In fact some countries, notably in the UK, France and Spain, have seen a huge drop in manufacturing activity. Overall, Western Europe's contribution to the European economy has slumped by 10 percent, from around 35 percent of total industrial output in the early 1990s. In India, the manufacturing industry has experienced a decline for a number of years now, contributing around 16 percent only to India's GDP each year and less than two percent of the overall global manufacturing output.

While some countries focus on cost leadership to counter this decline, there is a different and more attractive strategy through Industry 4.0 as the technologies could enable the manufacturing sector to create a sustainable competitive edge. This transformation has the potential to retool global industry and reorder the global economy. The German government has since promoted the concept vigorously as a means to new economic growth with good reasons. Countries that lead this new industrial charge stand to make significant gains in terms of economic productivity. For some, and for Western Europe as a whole, it presents an opportunity to reverse an epic decline that has lasted a generation.

Reviving the manufacturing industry in mature industrial countries, requires efforts be made to implement the innovation and technology advancements that Industry 4.0 brings to the table. Companies should begin by assessing the current status and evaluating readiness for the transformation.

5 Market Globalisation vs Protectionism

Industry 4.0 will create digital networks and ecosystems that in many cases will span across the globe with both developed and developing markets standing to gain dramatically in the value chain across regions. Technology will continue to be a big enabler of globalisation, not only through eCommerce but more specifically the enterprise resource planning (ERP) system that is vital to support cross-border trading multi-country manufacturing processes.

Although most economies are more open to trade today, as countries seek to expand manufacturing employment, a surge in protectionism and the undoing of trade agreements will create an institutional environment less supportive to openness. The phenomenon of nationalism and protectionism is gradually spreading in many countries such as China, Russia, the Brexit in the UK, Duterte in the Philippines or Trump in the US. The double standards in globalisation

are also evident through a variety of WTO agreements such as the General Agreement on Trade in Services (GATS), the Agreement on Agriculture (AoA), and the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS).

Industry 4.0 can potentially offer a better way to circumvent these protectionist actions by introducing smart factories concept to the fore, with worldwide connectivity. For instance, a local factory can be built to cater to trade regulations, but it can be connected to other worldwide factories for more efficient production. Therefore, it benefits all parties—companies ensuring legal compliance with lower headcount costs and local economies benefitting from the employment opportunities that open up.

6 Game-Changing Business Models

From all indications, we are in an era of significant convergence, where information technology, operational technology, and global megatrends are on a collision course that demands business owners adopt new ways of thinking and execution. When you look closely at the rapid pace of digitisation in industry today, it is a signal of sweeping change that is constantly transforming many companies and will cause continued technology disruption.

Under Industry 4.0, product design and development take place in simulated laboratories and utilise digital fabrication models. Technology such as 3D printing enables manufacturers to produce a small batch of customised products. The main advantage of 3D printing methods is the opportunity to create prototypes of conceptual designs and individual components that reduce costs, increase time efficiency and bring more value to the customers.

This technological infrastructure is still in its early stages of development, but it is already transforming manufacturing. Companies that embrace Industry 4.0 are learning mass customisation—the ability to make products in batches of one as inexpensively as they could make a mass-produced product in the 20th century, while fully tailoring the product to the specifications of the purchaser. As the movement develops, these trends will accelerate.

Businesses and manufacturers need to understand the enabling technologies behind Industry 4.0 and revise their business plans to ensure business continuity and sustainability.

7 Convergence of Technologies

The manufacturing landscape has changed rapidly via mechanisation and digitalisation. However, through the convergence of computers and automation in Industry 4.0, we are witnessing a paradigm shift in global production at an unprecedented pace. These new technologies are also known as disruptive technologies that include the use of autonomous robots, Internet of Things (IoT), Big Data, augmented-reality-based systems,

cyber security, cloud computing, additive manufacturing to horizontal and vertical system integration. The convergence of the identified nine pillars of enabling technologies for Industry 4.0 brings a new level of digital manufacturing.

However, many manufacturers are still struggling with how to unlock value from Industry 4.0. For example, traditional engineering companies find it hard to achieve digital transformation, as the main challenge is often the lack of a strong and integrated corporate management. These are critical challenges that must be tackled in order to gain the benefits of Industry 4.0.

8 Robots on the Rise

Building a better manufacturing sector with augmented and virtual reality, robotics and data analysis using smart equipment naturally raises an important question. *What will the Industry 4.0 workforce look like?* Since the bulk of automation is used for works that are currently considered unsafe or impossible for humans, it makes robots a complement to human workers and this scenario will lead to increased productivity.

However, as the cost of robots and other automated technologies continues to decrease while their capabilities continue to expand, more elements of the workforce can be automated. Advancements in information technology (IT), robotics, drones, self-driving cars, machine learning and artificial intelligence (AI) are increasingly allowing machines to take over tasks once performed only by humans and in the process causing economic disruption that will irreversibly change the workforce.

Advances in industrialisation and automation, while reducing or eliminating the need for some workers, has also created new job opportunities that deal with managing and maintaining the machines. There is also the opportunity to design a more advanced and autonomous version of these robots.

9 Cybersecurity

Central to the Industry 4.0 concept is the free flow of information exchange within the value chain, which includes collecting all data generated for a product throughout its lifecycle phases from conceptualisation, design, ordering, customisation, manufacturing, operation, repair and to even recycling. All these data are stored in repositories for future use.

However, network vulnerabilities can lead to criminal hacking incidents which may cause serious breaches that extend beyond financial crime such as access to classified information that could compromise and cripple critical infrastructure. Rising connectivity and standardisation of production protocol increases the importance of protection processes from such cybernetic threats.

The advent of Industry 4.0 has brought along the need to secure these data repositories. Suitable security measures are critical to the Industry 4.0 infrastructure and must be given utmost priority.

10 Global Sustainability

The manufacturing industry has made some progress in recent years on materials, waste management, recycling and energy efficiency initiatives. However, it has not attained the same level of progress on product design and manufacturing processes which can help facilitate better use of materials. Industry 4.0 helps to address this challenge through the invention of new products and services, including innovative methods in tackling today's most pressing issues such as climate change, pollution, energy demand, and urbanisation.

The rise of ethical consumption through Industry 4.0 could also potentially increase consumer awareness on product sustainability and concern on the impact of manufactured products on our environment. According to United Nations Industrial Development Organization (UNIDO), despite the countless opportunities for smarter cities through Industry 4.0 technologies, the goal should always be to improve the quality of life, rather than implement a purely technologically driven process.

The Sustainable Development Goals (SDGs), have set out a shared global agenda for human development based on prosperity, social inclusion and environmental sustainability. Industry 4.0 shared potential linkages to SDG 9 that mention infrastructure-industry- innovation nexus, and further implication to the SDG 11 that underline the need to *make cities and human settlements inclusive, safe, resilient and sustainable* and the other SDGs in general.

The awareness in ethical consumption could potentially bring new market demands that would fuel further change. The technology advancement brought by Industry 4.0 can help to fill this demand and contribute to the betterment of the society as well as the environment.

Opportunities & Challenges

Industry 4.0 will see intelligent machines and smart factories usher in a new era of manufacturing that offers new opportunities in production methods. Undoubtedly, it is going to change the current manufacturing landscape, making factories more productive, more efficient and closer to their customers.

However, the evolving technology poses a few potential risks and challenges that have been identified to minimise unforeseeable impact. Nevertheless, we remain behind the starting blocks of this revolution that has the potential to retool global industry and reorder the global economy. These risks and challenges, and how they are managed, will fundamentally underpin market confidence in the technology. Therefore, these vulnerabilities must be carefully reviewed and addressed with the correct action to ensure it does not eclipse the potential gain brought about by the changes.

For the vision of Industry 4.0 to become a reality, manufacturers will need to evolve along with the technology it plans to leverage by understanding that the right Industry 4.0 solution empowers their current workforce and enables their factory to produce more with less. Major work has still to be done to standardise and apply these new technologies in myriad industrial settings.

Among the opportunities gained and challenges that may rise from Industry 4.0 are as follows:

OPPORTUNITIES

People Related

Education to transform

Academicians must observe Industry 4.0 transformational needs which are knowledge-intensive and require highly skilled talent as part of the opportunity in job creation through re-skilling and up-skilling processes.

Talent as part of value creation

Talent may affect the supply of manufactured goods, especially regarding where production is likely to occur. In the coming years, much of the growth of the global labour supply will depend on low- and middle-income economies. Also, to sustain growth and generate new value, it is important to develop creative human resources who contribute toward innovation.

Provide new jobs

Advances in industrialisation and automation while reducing or eliminating the need for some workers, creates new jobs in parallel. The proliferation of IoT and adoption of Industrial Internet projects has also significantly given security professionals the opportunity to evaluate new risks and vulnerabilities.

Process Related

New market segment

The demographic change in many countries presents abundant opportunities to Industry 4.0. Developing products and services that appeal to this trend can provide attractive revenue potential. Manufacturers should focus on a limited number of Industry 4.0 applications, rather than trying to cover all age groups at once.

Transforming market dynamics

Industry 4.0 developments will fundamentally transform market dynamics across a whole range of industries all around the world, in developed as well as emerging countries. Digitalisation will result in more localised production points nearer to the consumer.

Global markets network with regional flavour

Due to protectionist leanings, many governments are not in favour of international trade, making it harder

for populations and products to move across borders. Industry 4.0 can overcome such barriers by enabling companies to transfer their intellectual property while allowing each country to maintain its own manufacturing networks. In other words, Industry 4.0 is accelerating globalisation, but with a distinctly regional flavour.

New business models transforming industries

Manufacturers that want to not only reap the immediate rewards of Industry 4.0 but also prepare themselves for future market disruptions should start experimenting with new business models. Most Industry 4.0 quick wins will be found in improving operational effectiveness. Change management and cultural transformation hence become important drivers of digitalisation.

Sustainability development

Industry 4.0 has a high potential to positively impact economic growth and to contribute to the sustainable development of cities in developing countries and emerging economies in line with the green economy agenda. Energy efficiency and energy transition toward renewable energy in the process can lead to favourable sustainability practices.

Improve productivity

The digitalisation of the whole product lifecycle will allow companies to use data from production, service and even social media which will lead to faster product improvements. This will impact the producers' entire value chain, from design to after sales service. The automation of manufacturing processes and better use of data to transform operations are all in line with the ambition to create a smart factory. Regardless of their size, companies have no choice but to embrace digitalisation and reduce labour dependency.

> AI will allow faster decision-making, productivity gains, pattern detection and increased data monetisation.

Technology Related

AI to add value to Industry 4.0

Factories are becoming smarter due to new digital production techniques. IDC, a market research company, predicts that 75 percent of all enterprises and independent software vendors will include Artificial Intelligence (AI) functionality in at least one application by 2018. AI will allow faster decision-making, productivity gains, pattern detection and increased data monetisation. The operating structures in the industries will change as machines start coordinating themselves to deliver work.

Leveraging on Cyber-physical System (CPS)

CPS is a machine that is controlled and monitored by computer softwares and connected to an external network such as the Internet. Interoperability allow sensors, devices, machines and people to talk to each other, while data transparency refers to the ability to create virtual copies of the physical world with digital plant models that are connected with IoT or sensor data.

Virtual factories for clients

The use of sensors enabled the development of cyber-physical systems, which in turn has led to the creation of the factory-as-a-service (FaaS) model, by which service providers can provide virtual factories for their clients. Products, production processes and production automation will be designed and commissioned virtually in one integrated process and through the collaboration of producers and suppliers.

Flexibility

Manufacturing processes will have an increase in flexibility and allow economic production of small lot sizes. Robots, smart machines, and smart products that communicate with one another and make certain autonomous decisions will provide this flexibility.

Leveraging from big data analytics

The information generated by the increase of connected devices and machines represents a significant opportunity for manufacturers to unlock big data potential. By determining how to best identify, capture and interpret this increased volume of data, it can help organisations understand their market and customers better, as well as gaining market share.

CHALLENGES

People Related

Shrinking of labour force

As the labour force shrinks dramatically, competition for labour, human capital, and talent will get much tougher. However talented young professionals and business people will increasingly have their pick of jobs in the job market.

Robots creating workforce displacement

Technological innovation will lead to *technological unemployment* with automation displacing or eliminating many manufacturing, agriculture, and service jobs currently held by human workers—initially low-skill and working-class jobs that involve routine and repetitive manual labour. The fast growth of labour intensive manufacturing industries is no longer viable in the developing world.

Talent Issues

Most Gen-Y employees need their jobs to come with a sense of purpose. Connecting with the connected generation, most of whom are accustomed to instant answers and real-time replies online, should be facilitated through constant engagement and feedback that helps them learn and grow along the way. This would go a long way in attracting and retaining young talent. Constraint in finding the right talent and skills shortage could hamper the industry transition.

Income inequality

Income inequality may rise with the adaptation of Industry 4.0, especially in countries where the income gap and disparity in opportunities to access education have been persistent. This is due to the displacement of workers in more sophisticated manufacturing and production sectors, which results in a strong increase in demand for high-skilled engineers and specialists. Higher salaries and perks will be offered to talent and white-collar workers with sought-after intellectual qualities, compared to less educated and low-skilled labourers, intensifying the income gap.

It is vital for the education sector to catch up with technology advancements, as the skill-biased technological transformation will affect people with insufficient or unsuitable education, perpetuating the vicious circle of poverty and inequality.

Process Related

Lack of standards implementation

Lack of standards and different solutions as well as devices means more development and work. This will involve higher costs to implement and scale Industry 4.0 solutions, which could hamper its development.

Business disruption

Lessons from past industrial revolutions have taught us that organisations that are not evolving in their operations or customer service eventually will be less competitive or even obsolete as they face disruptions. Industry 4.0 challenges the old school manufacturing concepts that at its very core is a risk averse sector with centralised and offline systems that are not inter-connected. By not embracing Industry 4.0, it is possible for the middle-income trap to become a declining income trap.

The lack of human touch

Wide-scale adoption of automation in any sector will sometimes push people away due to the missing human element. People expect and continue to want human contact and personal touch as an element in certain jobs.

Technology related

Cybersecurity issues

Cybersecurity issues are one of the threats to Industry 4.0 as the key feature of the industry is the ability to interconnect across environments, making the supply chain more efficient. With digitally connected supply chains, traditional IT security will no longer be enough to protect businesses. Industry 4.0 gives the cybercriminal more opportunity to dig into the top of the supply chain, reaching into the Smart factory through its dependent actors. Only by utilising modern cyber security counter measures, like adaptive authentication and behavioural analysis can be hope to stem the flow of supply chain initiated Industry 4.0 hacks.

Greater distribution of decision making

Manufacturing-system suppliers will have to expand the role of IT in their products. Changes will likely include a greater modularisation of functionality with deployments in the cloud and on embedded devices. With increases in the overall functionality and complexity of systems comes the need for a greater distribution of decision-making.

Lack of awareness

The lack of awareness in developing countries can be considered one of the biggest challenges in facing

Industry 4.0. In Malaysia, a survey suggested that only 30 percent of manufacturers are aware of this latest industrial revolution. As there is a new breed of consumers who are more technologically advanced and have concerns regarding the environmental impact of manufactured products, increased awareness of Industry 4.0 in the manufacturing industry is vital for inclusive and sustainable industrial development (ISID) as well as providing access to know-how, skills, education and technology.

There are developing countries that are already preparing for and adopting strategies regarding Industry 4.0, such as China and India. It is therefore important to take advantage of their experience in addition to government buy-in, both for financial and infrastructure support.

In order for the vision of Industry 4.0 to become a reality, manufacturers will need to evolve along with the technology it plans to leverage by understanding that the right Industry 4.0 solution empowers their current workforce and enables their factory to produce more with less.

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VIEWPOINTS

New Face of Manufacturing: Drivers of Change

Excerpt from Industry 4.0 Policy Framework

A study by

Ministry of International Trade and Industry (MITI), Malaysian Industry-Government Group for High Technology (MIGHT) & Akademi Sains Malaysia (ASM)

The global manufacturing sector seems to be heading towards a major facelift as manufacturing is increasingly shifting towards more technologically complex processes. Technologies such as big data, improved data analytics, machine-to-machine communication, advanced robotics and 3-D printing are currently transforming the fundamentals of production.

Today, it is no longer enough for the manufacturing industry to make better things—creating innovative products and services that will meet customer needs—but this line of business is also in a race to win at running better operations as to facilitate design engineering, service planning and execution as well as management and production processes. Not only that, as despite steady improvements in the manufacturing output and employment in the sector, renewed investments will be needed to build necessary infrastructure as well as to increase resources to support continuous growth.

The new face, being termed as **Industry 4.0** connects systems intelligently within the entire value chain and support activities of manufacturing. Over the next decade, **Industry 4.0** is expected to add $14.2 trillion to the world economy. In this era of manufacturing, data and IT processes to transform conventional plants into small factories. Every process is digitised in all sectors where companies integrate all aspects of manufacturing to technology, thereby improving the entire value chain.

Industry 4.0 offers reduced costs, enhanced efficiency and productivity, increased work speed and scale, smarter and proficient products and services which leads to a newer aspect of improving simple products which can contribute to the growth of the nation. Study on the development of the *National Industry 4.0 Policy Framework 2018* outlines four key competitiveness drivers as a guiding principle for the nation to welcome this new face of manufacturing. This emphasis on ***making better things while making things better*** is driven by these following factors:

DRIVER 1

MAINTAINING GROWTH & PRODUCTIVITY OF MANUFACTURING INDUSTRY

DRIVER 2

ENHANCE NATIONAL COMPETITIVENESS

DRIVER 3

HIGH DEPENDENCY ON FOREIGN LABOUR & CREATION OF HIGH VALUE ADDED JOBS

DRIVER 4

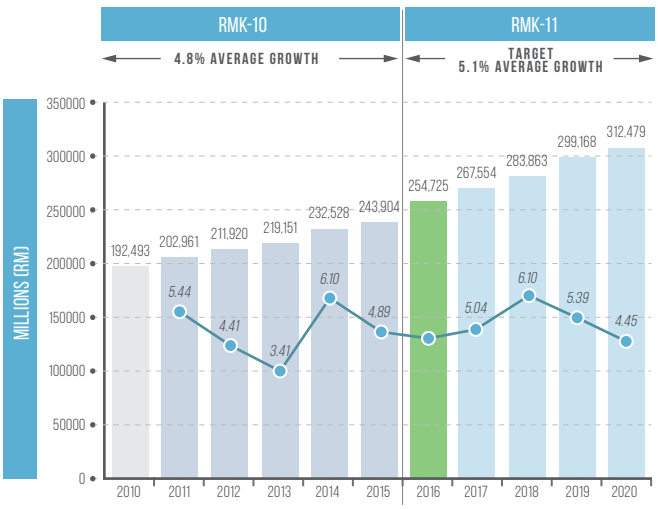
SMEs RISK BEING LEFT BEHIND

DRIVER 1

MAINTAINING GROWTH & PRODUCTIVITY OF MANUFACTURING INDUSTRY

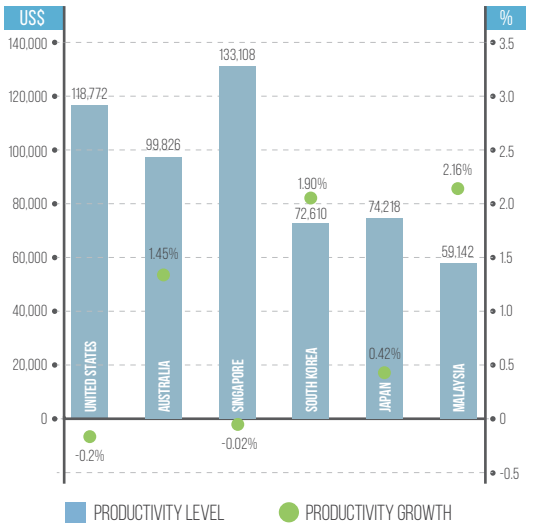
The growth is expected to continue under the 11th Malaysia Plan, with an annual average for the 5-year tenure targeted at 5.1%. The country's achievement of 4.44% in 2016 is still within the threshold.

Manufacturing GDP Performance



Source: DOSM & MITI Analysis

Level of Productivity and Growth (Malaysia and Selected Developed Countries) 2016*

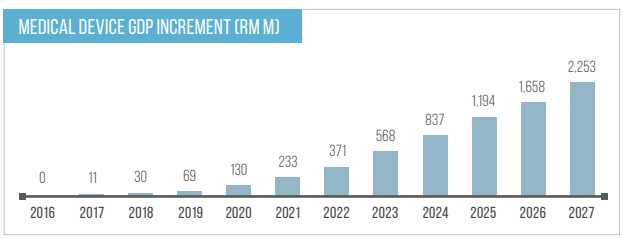


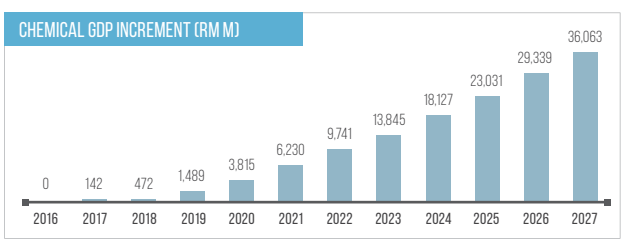
* 2015 price level with updated 2011 PPPs

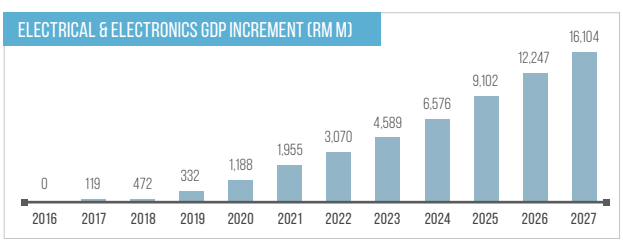
Source: The Conference Board

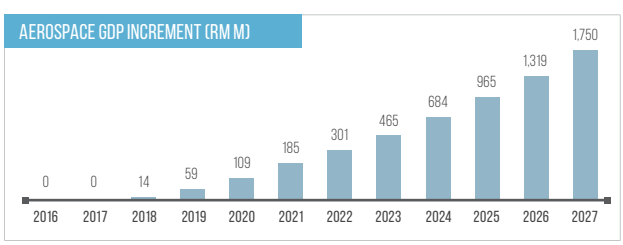
"Industry 3+2" companies are expected to contribute RM 215.1 billion in added value over 10 years up to 2027

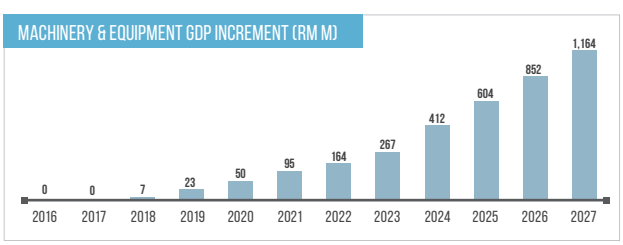
Source: Draft Final Report Study on the Future of Manufacturing: "Industry 3+2" by Roland Berger







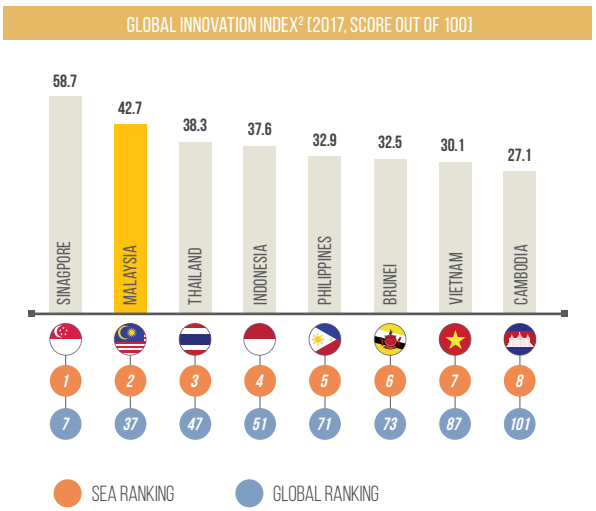




DRIVER 2 | ENHANCE NATIONAL COMPETITIVENESS

Malaysia ranks at 23rd in the World's Economic Forum latest competitiveness ranking and as the 2nd most competitive and innovative nation in SEA, just right behind Singapore. In terms of global standings, the country is ranked within the top 40 both in Global Competitiveness Index and Global Innovation Index.

1) MYANMAR IS EXCLUDED FROM THE RANKING;
2) MYANMAR AND LAOS ARE EXCLUDED FROM THE RANKING

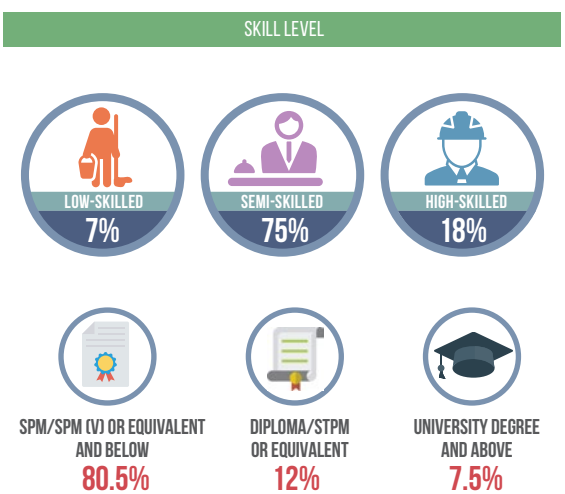


Source: World Economic Forum, INSEAD, Cornell

DRIVER 3 | HIGH DEPENDENCY ON FOREIGN LABOUR & CREATION OF HIGH VALUE ADDED JOBS

Although it is important to create an attractive ecosystem to retain and entice talent to work in Malaysia, Malaysian high-skilled talent overseas provides opportunity for Malaysia to tap onto their experience, connection and expertise in the long run.

SKILLS SPECTRUM IN MANUFACTURING SECTOR



Source: Economic Census 2016 Manufacturing Sector, Department of Statistics, Malaysia

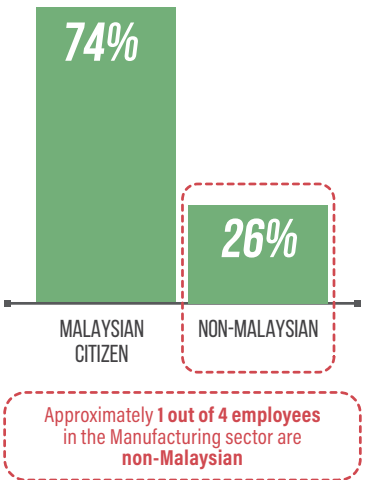
Based on Malaysia Standard Classification of Occupations (MASCO) 2013, referenced by Economic Census 2016

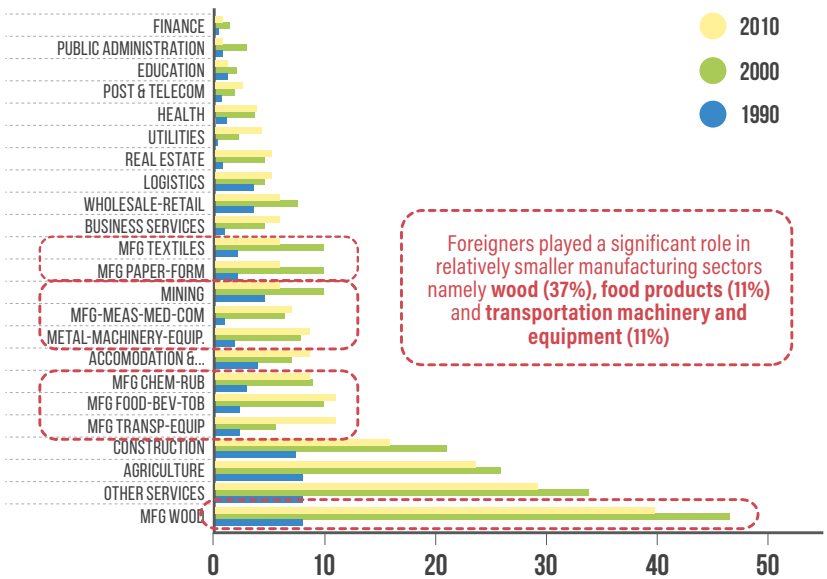
		SALARIES & WAGES	AVERAGE SALARIES & WAGES RECEIVED PER ANNUM
HIGH-SKILLED	MANAGERS & PROFESSIONALS	RM20.2 BILLION (31.0%) 193,655 PERSONS (9.3%)	RM104,425.00
HIGH-SKILLED	TECHNICIANS & ASSOCIATE PROFESSIONAL	RM7.8 BILLION (11.9%) 173,951 PERSONS (8.4%)	RM44,852.00
SEMI-SKILLED	CLERICAL & RELATED OCCUPATIONS	RM6.0 BILLION (9.2%) 227,420 PERSONS (11.0%)	RM26,294.00
SEMI-SKILLED	PLANT & MACHINE OPERATORS & ASSEMBLERS	RM28.7 BILLION (43.9%) 1,332,115 PERSONS (64.2%)	RM21,536.00
LOW-SKILLED	ELEMENTARY WORKERS	RM2.6 BILLION (4.0%) 148,265 PERSONS (7.1%)	RM17,781.00
	TOTAL	RM65.5 BILLION 2,075,446 PERSONS	RM31,478.00

DRIVER 3

HIGH DEPENDENCY ON FOREIGN LABOUR & CREATION OF HIGH VALUE ADDED JOBS

Although it is important to create an attractive ecosystem to retain and entice talent to work in Malaysia, Malaysian high-skilled talent overseas provides opportunity for Malaysia to tap onto their experience, connection and expertise in the long run.





REASONS FOR HIRING FOREIGN LABOUR

1. Critical shortage of labour especially in construction, manufacturing and industrialisation sectors
2. Domestic labour is not interested in 3D works (dirty, dangerous and difficult) and overtime.
3. The salary of foreign labour is cheaper than domestic labour despite the minimum wage practised in Malaysia.

Source: Foreign Workers in Malaysia: Labour Market and Firm Level Analysis in Foreign Labour in Malaysia: Selected Works, Ministry of Higher Education Malaysia, 2017

Source: Analysed by ASM, Economic Census 2016 Manufacturing Sector, Department of Statistics, Malaysia

IMPACT OF INDUSTRY 4.0 ON EMPLOYMENT

PERCENTAGE OF JOBS LOST FROM 2016 TO 2027 DUE TO INDUSTRY 4.0

INDUSTRY	% JOB REDUNDANCY (PROXY FOR JOBS LOST)
ELECTRICAL & ELECTRONICS	17%
MACHINERY & EQUIPMENT	17%
CHEMICALS	15%
MEDICAL DEVICE	14%
AEROSPACE	18%

EFFECT OF INDUSTRY 4.0 ON JOBS LOSTS & JOBS GAINED FROM 2016 TO 2027

2016 - 2027 INDUSTRIES 4.0 ADOPTION

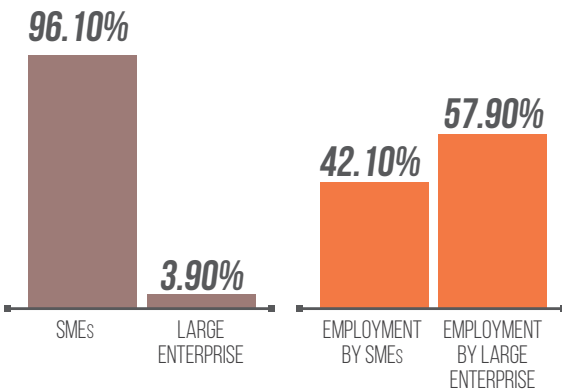
	2016 JOBS ('000)	NET JOBS LOST ('000)	NET JOBS GAINED ('000)	NET AFFECTED BY 2027 ('000)
ELECTRICAL & ELECTRONICS	321	27	65	38
MACHINERY & EQUIPMENT	71	5	12	7
CHEMICALS	435	33	80	46
MEDICAL DEVICE	45	3	8	4
AEROSPACE	20	2	4	2
	891	70	168	98

Source: Draft Final Report Study on the Future of Manufacturing: "Industry 3+2" by Roland Berger

DRIVER 4

SMEs RISK BEING LEFT BEHIND

Industry 4.0 technologies both present opportunities for SMEs and risk that many are left behind. SMEs transformation to more advanced manufacturing processes provides an opportunity for the small companies of today to become giants of tomorrow.

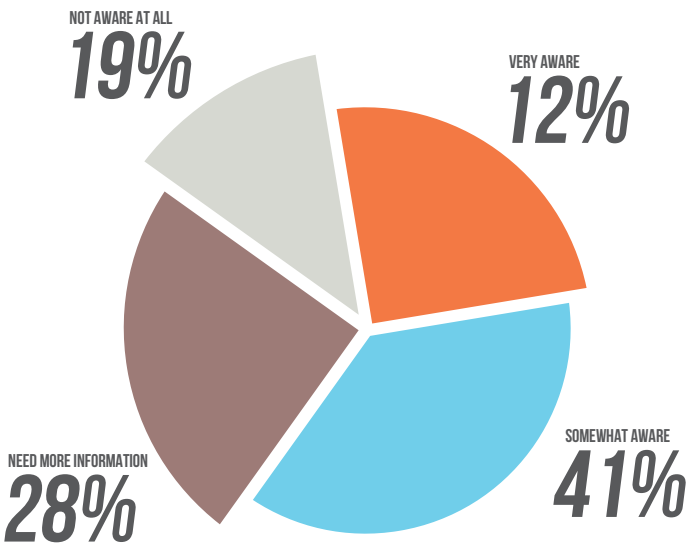


THERE ARE **2,119,158** EMPLOYEES IN THE MANUFACTURING SECTOR.

Although **SMEs has the highest number of establishments** (96.1% or 47,201 establishments), **SMEs employs 42.1% or 892,888 persons** whereas **Large Firms employs most workers in manufacturing sector (57.9% or 1,226,270 persons)** within its 1,900 establishments.

Source: Analysed by ASM, Economic Census 2016 Manufacturing Sector, Department of Statistics, Malaysia

MANUFACTURING SECTOR READINESS TO ADOPT INDUSTRY 4.0



AWARENESS OF INDUSTRY 4.0 OF FMM MEMBER SURVEYED

370
RESPONDENTS

At present, there has been no survey no survey undertaken to gauge national awareness level on Industry 4.0.

However, some indication of the awareness level by the industry players can be seen in the survey by FMM and MIER in their Business Conditions Survey 2016.

Source: Federation of Malaysian Manufacturers (FMM)-Malaysian Institute of Economic Research (MIER) Business Conditions Survey 2016

VIEWPOINTS

INDUSTRY 4.0: The Enabling Technologies and Its Applications

by:

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A combination of several major disruptive technology innovations is expected to significantly shift the landscape of the manufacturing industry.

The advancement of technology has led to greater productivity gain since the start of the Industrial Revolution. It has changed the conventional production relationships, encouraged better collaboration between suppliers, producers and customers as well as improved integration and automation of the industrial environment. The increasing industrial productivity has thus proved to spur economic growth, foster better industrial development and help upskill the workforce.

When Industry 4.0 comes of age within the next decade or so, the key objective is to drive manufacturing forward: to be faster, more efficient and customer-centric while pushing beyond automation and optimisation to discover new business opportunities and models. Companies and countries will engage in a production race that leads to the introduction of disruptive technologies into manufacturing lines.

While a sustaining technology relies on incremental improvements to an already established technology, a disruptive technology, identified as one having a lack of refinement as well as its own set of challenges in performance, can improve production by creating faster, more flexible, and more efficient processes to produce higher-quality goods at reduced costs.

A combination of several major disruptive technology innovations maturing at the same time is expected to significantly shift the landscape of the manufacturing industry. These technologies—advanced robotics, artificial intelligence, sophisticated sensors, internet of things (IoT), cloud computing and big data analytics—already exist in this field today in some form, but as they integrate with one another the physical and virtual world will be able to interlink and transform the industry. These disruptive technologies are anticipated to become the enabler to the applications of Industry 4.0.

The Nine Enabling Technologies of Industry 4.0

The nine disruptive technologies listed in the table are the nine technological advancements that have been identified to be the backbone of Industry 4.0. It is assumed that a fully implemented Industry 4.0 manufacturing system will have most of these nine technological advancements integrated.

Many companies might have already implemented some of these technologies but are only using them in isolation rather than in interconnected autonomous systems where the technologies can cooperate and communicate freely amongst and across each other. To stay competitive in Industry 4.0, it is important to get a clear understanding of these nine technological advancements and start evaluating how they are going to impact any specific industry, and the benefits that can be gained with implementation.

From...	Technology	To...
Data for improving internal operations	Big data	Use customer data to optimise product and pricing strategies
Security on internal network	Cybersecurity	Security on network and IoT devices
Workers operating machines based on information displayed on dials, gauges or screens	Augmented reality	Use sensors, cameras and motion sensors to accumulate information and display the images into real world during work (virtual image on top of real things or devices)
Overproduction of products	Additive manufacturing	Lean manufacturing; cut down on waste and cost
Countless devices running separately, information not being utilised	System integration	Improve overall communication through value chain—vertical (within the industry value chain) and horizontal system (across multiple value chains)
Complicated and time-consuming tools which unable to adapt well enough to the rapidly changing manufacturing techniques	Virtual Reality	Reflecting reality or physical world in virtual form (virtual form of the machines, products and humans)
Leverage on human labour to operate	Autonomous robots	Bringing more effective use of human labour; channelling their energies on value-added activities
Managing hardware and software to operate the system	Cloud computing	Data driven process with intelligence that change the role and function of the system
Disjointed of data all over the system, making it difficult to obtain a real-time view of assets, people and transactions	Internet of things	Enable real-time data sharing between all parts of the system, and all connected parties

Examples of technology disrupt manufacturing sector

Enabling Technologies

1_BIG DATA

Big data has been a popular buzzword for the last few years. It is a platform that brings useful insight to the industrial environment through collective data from multiple sources. There are still massive sets of untapped data in the industrial world and companies have started collecting and extracting valuable information to optimise production quality, save energy and reduce production costs.

The big data platform can collect, store and analyse massive amount of data derived from along the industrial value chain. Information such as trends, patterns, and the relationship between inputs, process, and outputs are gathered and scrutinised to provide insights as to how improvements can be made across the industrial value chain.

Applications

The analytics of data is especially useful in predictive manufacturing and is a major theme for industrial technology development. It assists manufacturers to maintain a competitive edge in operational management control as well as in improving their production efficiency and yield rates.

Subsequently, it helps to improve the whole value chain towards optimising products and pricing strategies. For instance, the data generated can shed light on new trends therefore allowing time for the company to develop strategies to take advantage of the said new trend. The collection and comprehensive evaluation of data from many different sources—production equipment and systems as well as enterprise- and customer management systems—will also become standard to support real-time decision making.

Big Data application can also improve other aspects of whole value chain. Among the possibilities are:

a) Lowering number of defects by correlating all data captured in the operational process. This allows identification of patterns to assist in discharging faulty products early in the process thus improving production quality.

b) Real-time decision making via comprehensive evaluation of data from various sources such as production equipment and systems as well as the enterprise and customer-management.

2_CYBERSECURITY

With the increased connectivity and use of standard communications protocols that come with Industry 4.0, the need to protect critical industrial systems and manufacturing lines from cybersecurity threats escalate dramatically. Most manufacturers will want to protect their most valuable data including intellectual property as well as data on customers and products. As a result, secure, reliable communications as well as sophisticated identity and access management of machines and users becomes essential.

Cybersecurity is crucial in protecting valuable data from being exploited by other parties. The utilisation of new technology such as internet of thing (IoT) and cloud computing may present risks to the overall system in the industrial environment—investments are therefore required to strengthen the security of these environments. Globally, it is estimated that in the year 2021, spending on cybersecurity will surpass $1 trillion. Currently in 2017, the current cybersecurity market is worth at least $120 billion.

The utilisation of new technology such as internet of thing (IoT) and cloud computing may present risks to the overall system in the industrial environment.

Applications

Seeing that current cybersecurity solutions have largely been developed for IT-centric devices and environments, the new challenge is to embed security into the IoT devices that would be residing in these new Industry 4.0 manufacturing ecosystems. Therefore, an ideal cybersecurity system would be a combination of traditional network security and embedded security on the IoT devices to safeguard systems against cyber-attacks. The system should be equipped with advance interaction and visualisation as well as artificial intelligence to build autonomic capability into the security systems for perceptive operations.

3_AUGMENTED REALITY (AR)

Augmented Reality (AR) turns our real-life environment into a digital interface by putting virtual objects in real-time. It deploys the existing environment and overlays new information on top of it—unlike virtual reality which creates a totally artificial environment and can be seen through a variety of experiences.

IDC projects AR/VR spending to climb by almost 95% in 2018, growing to a worldwide total of $17.8 billion from $9.1 billion in 2017.

AR technology brings an added value to the real world by enriching physical objects with virtual information. Between 2015 and 2016, investment in AR and virtual reality (VR) increased by 85 percent and IDC projects AR/VR spending to climb by almost 95% in 2018, growing to a worldwide total of $17.8 billion from $9.1 billion in 2017.

Applications

In a manufacturing environment, human error and inefficient production methods are the biggest pain points that lead to increased operational costs. AR is attempting to address these issues by combining both the virtual and physical world. When combined, users will be provided with real-time information to improve decision-making and work planning.

With the aid of AR devices that use sensors, cameras and motion sensors that accumulate information and display images into real world during work, they can see the planned model as how it will look in real life and will be able to make better adjustments in shorter time span.

By allowing customers to experience products virtually, manufacturers can demonstrate products while highlighting design, function and actual size without creating the physical copy. Based on customers' feedback, new iterations can be made even before the real production versions.

4_ADDITIVE MANUFACTURING

Additive manufacturing, known by the more common name of 3D printing, is a new technology that has limitless applications in many manufacturing phases from preproduction to end products. A process that used to take weeks to accomplish on a small scale, 3D printing can now construct large and complex structures, like housing, in less than a day. To simplify, additive manufacturing techniques are used to create three-dimensional objects based on digital models by layering or printing successive layers of materials. Organic compounds, custom plastics, and a host of other materials can be utilised in the process, harmonising product and nature through innovation.

Additive manufacturing encompasses many technologies including Rapid Prototyping (RP), Direct Digital Manufacturing (DDM), layered manufacturing and additive fabrication. On its own, 3D printers market size is predicted to grow from $2.7 billion in 2016 to $7.7 billion in 2025, at a CAGR of 12 percent.

Applications

This technology makes prototyping so much simpler, allowing modification of approach to meet diverse needs. Additive manufacturing techniques cuts down waste due to overproduction thus leading the way to more efficient manufacturing practices. The advent of additive manufacturing is enabling products to be introduced into the market more efficiently since it not only saves time and money but also enables designers to pay more attention to streamlining product function.

5_SYSTEM INTEGRATION

Most of today's IT systems are not fully integrated. Companies, suppliers, and customers are rarely closely linked and neither are inter-departments of one company such as engineering, production, and service. With Industry 4.0, companies, departments, functions, and capabilities will become much more cohesive. The platform will pave the way to a cross-company approach to use and share data, bringing benefits to the internal business environment as well as producers and suppliers.

This platform integration occurs in vertical systems (within the industry value chain) and in the horizontal systems (across multiple value chains). The vertical integration links the components within the value chain elements such as business processes, ICT systems, communication layer and field layer. Meanwhile, the horizontal integration connects across multiple value chains in various avenues such as the process, data, and companies.

> In 2020, more than 26 billion devices will be able to communicate and signal via the internet.

Applications

This technology allows for different computer systems to be linked together, enabling actual communication and the passing on of data between systems as software can act as a coordinated whole. This is ideal for all manufacturing companies as machinery from across the factory can be linked up together across the production line ensuring everything runs smoothly and efficiently.

In 2020, more than 26 billion devices will be able to communicate and signal via the Internet. Sensors and smart appliances will be everywhere enabling both by M2M (machine to machine) and M2H (machine to human). This statistic highlights the potential in allowing deep integration within the industrial environment.

6_VIRTUAL REALITY (VR)

In a nutshell, VR is computer-generated simulation of a 3D image that leverages real time data to reflect reality or the physical world in virtual form. It is a 100 percent virtual, immersive and digital experience. Recent developments in VR technology, and the release of low cost VR Headsets have opened up a variety of uses that see the technology being integrated into everyday engineering and manufacturing workflows.

There are many benefits of utilising simulation in the industry, especially in plant or factory operation, including allowing major improvement in industrial production. Operators will be able to provide safer environments

There are many benefits of utilising simulation in the industry especially in plant or factory operation including allowing major improvement in industrial production.

for training, allowing workers to understand the risk of working without having to physically be in a dangerous environment.

Integration of VR into manufacturing is still in its infancy, however the trend on total spending on virtual reality products and services is expected to increase from $11.4 billion in 2017 to nearly $215 billion in 2021.

Applications

While the public usually associates Virtual Reality (VR) with gaming, VR has been used in engineering and manufacturing industries for a long time. For product development, designers can build VR prototypes to check for accuracy, improve communication to customers, as well as to teams located in different places physically. Process simulations can also be used to identify bottlenecks, maximise efficiency, fine-tune workflows, and mitigate risks.

7_AUTONOMOUS ROBOTS

Manufacturers in many industries have long used robots to tackle complex assignments, but now robots are evolving for even greater utility. The key idea in Industry 4.0 is for robots to become more autonomous, flexible, and cooperative. Eventually, they will interact with one another and work safely side by side with humans and learn from them. These robots will cost less and will have a greater range of capabilities than those used in manufacturing today.

Applications

Autonomous robots improve the accuracy of routine tasks by reducing the effort and time required for each task. For example, autonomous robots can perform inspections on inbound goods and provide real-time data to suppliers. Efficiency of the industrial processes will be improved as mistakes are expected to be reduced through the adoption of collaborative robots.

A projection echoed by a 2015 Bank of America report stated that by 2025 robots could take over 45 percent of manufacturing jobs, cutting labour costs by $9 trillion. As technology becomes cheaper or is offered in more cost-effective ways, robotics-as-a-service will help to perform dull, dirty, and dangerous tasks and allow humans to channel their energies into other value-added activities.

8_CLOUD COMPUTING

Cloud computing helps business in all industries adapt to today's rapidly changing technology. In simpler terms, cloud computing means storing and accessing data and programmes over the Internet instead of your computer's hard drive. The cloud is just a metaphor for the Internet. With artificial intelligence and automation being integrated in production, cloud computing is a way for businesses to readily change with the times without losing data.

Currently, companies are already using cloud-based software for some enterprise and analytics applications, but with Industry 4.0 more production-related undertakings will require increased data sharing across sites and company boundaries. The need for a cloud-based platform is essential with the escalating data sharing across industrial environments as it offers a network of remote servers to store as well as manage and process data.

At the same time, the performance of cloud technologies will improve, achieving reaction times of just several milliseconds. As a result, machine data and functionality will increasingly be deployed to the cloud, enabling more data-driven services for production systems.

Applications

Cheaper and faster technology is making cloud computing increasingly technically and economically viable. Taking the example of digital storage, the cost has plunged from $300,000 per gigabyte of data in 1981 to $0.03 per gigabyte in 2014. Not to mention the internet speed, files that would have taken days to download over a 28.8 kbps dial-up connection can be transferred in mere seconds over today's broadband connections.

As machine learning techniques matures, the door is opened for prescriptive analytics where cloud computing will have the ability to predict when failures are likely to happen in the future based on historical machine data, usage information, and likely environmental conditions—rather than just flagging that a potential issue has been detected in real-time. Vendors of manufacturing-execution systems are among the companies that have started to offer cloud-based solutions.

9_INTERNET OF THING (IOT)

The Internet of things (IoT) is becoming an increasingly growing topic of conversation. Described as a network of devices that have local intelligence which enables communication between facility, machines, and finished as well as unfinished products it is a concept that not only has the potential to impact how we live but also how we work.

At its core, IoT is simple—it is about connecting devices over the Internet, letting them talk to us, the applications, and each other. It incorporates machine learning, big data technology, sensor data, machine-to-machine communication and automation technologies. Compared to humans, connected intelligent machines have the ability to collect and process large data sets with more accuracy and consistency.

> At its core, IoT is simple—it is about connecting devices over the internet, letting them talk to us, the applications, and each other.

Today, only certain manufacturer's sensors and machines are networked and make use of embedded computing. They are typically organised in a vertical automation pyramid in which sensors and field devices with limited intelligence and automation controllers feed into an overarching manufacturing process control system.

The IoT gained prominence due to the availability of Internet, both wired and wireless. This is coupled with the accelerated decline of cost for sensors, which has reduced by 100 times in last 10 years. It is estimated that IoT applications in manufacturing and factory settings are expected to generate $1.2 to $3.7 trillion of economic value annually by 2025.

Applications

In the context of Industry 4.0, IoT has the potential to create smart factories that would improve overall control in the production process. For example, production facilities that have been equipped with semi-automated control are able to decentralise the production process. Products are identified by radio frequency identification codes, and workstations know which manufacturing steps must be performed for each product and can adapt to perform the specific operation.

With the IoT, more devices—sometimes including even unfinished products—will be enriched with embedded computing and connected using standard technologies. It allows industrial devices to communicate and interact both with one another and with more centralised controllers, as necessary. It also decentralises analytics and decision-making, enabling real-time responses.

The Impact of Adopting Technology Advances

Industry 4.0 will allow manufacturers to bypass current structural constraints and leapfrog into greater efficiency in energy use and value production. It must be noted that such developments will also bring disastrous results to people involved in industries that will be phased out, therefore both the positive and negative sides of the issue must be addressed with the same level of importance.

This new technology adoption can be analysed from four perspectives: digital infrastructure and ecosystem, human capital development, business environment and strategic investment. The focus is not on specific types of technology, but rather how introducing new tools changes how the workforce is put together to deliver goods and services.

i) Digital Infrastructure & Ecosystem

The impact of adopting technologies in the digital infrastructure and ecosystem is evident from the efficiency of the infrastructure itself. Through technology adoption, the digital ecosystem offers better ways of leveraging the information

to unlock its potential values. For example, the combination of big data and cloud computing will be able to change data into useful information that helps decision makers. Groups of technology like 3D printing, augmented reality and simulation technology converts the digital designed data into a tangible workpiece; while the integration of manufacturing system and IoT use captured information to schedule the ideal maintenance times.

ii) Human Capital Development

With the advent of technology comes the demand for employees with higher competencies, especially in software development and IT technologies. New technical, information and communication technologies and the workforce changes associated with them can support and drive innovative work practice, improve processes, and impact on efficiency and productivity.

A different skills set will be required, one that requires developed thinking skills. This will mitigate the impact of automation in the near term which displaces some of the low skilled jobs—the new challenges in human capital development is to ensure how workers can be upskilled to ensure their viability in the Industry 4.0 era.

iii) Business Environment

The introduction of new technologies creates entirely new ways of serving existing needs and significantly disrupts existing value chains. The behaviour of consumers is also changing to adapt with the use of these technology advancements, which in turn generates new ways to design, market and deliver products and services. It will bring innovative opportunities to businesses especially for SMEs to boost revenue growth. SMEs with enhanced equipment and new data application will have an advantage to understand the wide range of consumer behaviour.

iv) Strategic investment

Adopting technologies will certainly improve the companies and people in various ways. One of the most important improvements is helping companies to create a foundation for greater exchange of data and expertise. This will lead to better relationships with international business partners and competitors. It is a perfect opportunity for companies to have strategic investments that will enhance its products, technologies and processes.

Next Emerging Technology on the Horizon

Industry 4.0 and the technology advancements it brings have entered the business mainstream, and it is a hot topic everywhere, from the boardroom to the breakroom. The vigour and influence of these technologies is multiplied by the rapidly burgeoning connectivity between billions of people through enhanced mobility and the ease of accessing the growing nexus of data and knowledge.

Looking ahead, numerous significant trends are expected to take the lead in how the technological advances will begin to integrate into businesses. Listed below are three identified technologies that are rapidly emerging on the horizon and which will bring huge impact to the industry. These technologies are artificial intelligence (AI), blockchain and quantum computing.

i) Artificial intelligence (AI)

Everyone is talking about AI, but what does AI really mean? Even though AI is not really considered as an emerging technology, advancements in technology have improved AI by leaps and bounds. Artificial intelligence (AI) is an umbrella term for *smart* technologies that are aware of and can learn from their environments, enabling them to subsequently take autonomous action.

Advances in machine learning have allowed the development of programmes that can teach themselves to learn, understand, reason, plan, and act when exposed to new data in the right quantities. In a broader definition, AI is a collective term for computer systems that can sense their environment, think, learn, and initiate action in response to what they are sensing and their objectives.

AI technology will supplement the effort to build the smart networked factory, in which data from supply chains, design teams, production lines and quality control are linked to form a highly integrated, intelligent creation engine. AI can also use past information and a preprogrammed system to make proper decisions and execute appropriate actions for usage in E-commerce, smart homes and personal digital assistance fields. It is estimated that by 2020 AI will be a mainstream offering in the market where International Data Cooperation (IDC) predicts the number of AI sales will exceed $10 billion.

ii) Blockchain

There has been a great deal of hype surrounding Blockchain, a distributed electronic ledger that uses software algorithms to record and confirm transactions with reliability and anonymity. The record of events is shared between many parties and information once entered cannot be altered, as the downstream chain reinforces upstream transactions. Blockchain is seen as the heart of the Industry 4.0 where it allows millions of smart devices to perform transparent and frictionless financial transactions, without human intervention but fully autonomous, in the IoT universe.

The blockchain technology will empower people and encourage growth on a large scale as they become their own bank and have full control of their own money. The main global effect on growth will be more liquidity, diversity, and a substantial increase in the number of various participants in all sectors of the economy.

Among the many foreseen uses for Blockchain is enabled smart contracts that allow parties to automatically negotiate terms and conditions (such as price, quality level and delivery date) without the need for a middleman. Blockchain is expected to provide transparency in many transaction processes and is also touted to be secure and safe from hacking due to its large, distributed nature.

It is estimated that the blockchain technology will be mainstream in 2020 starting in the financial industry where 20 percent of finance trade globally will be incorporating blockchain/distributed ledger technology.

iii) Quantum computing

Quantum computing is a new approach to process information by using new types of algorithms in a more holistic approach. In classic computing, information is encoded in bits; which take the value of 1 and 0 (binary) that act as an on or off switch for computer to function. In quantum computing, two properties of quantum computers known as *quantum superposition* and *quantum entanglement* are used to disrupt the binary. The Quantum superposition allows quantum bits (*qubits*) to be a 0 and 1 at the same time. While quantum entanglement entwines multiple *qubits*, allowing for a greater number of calculations.

By using these two principles, qubits can act as more sophisticated switches which enable quantum computers to solve difficult problems that are not viable using current computing technology. Experts have predicted that the quantum computing would be mainstream in 10 to 20 years from now since the hardware development is still a bit premature at this stage.

Among the many envisioned usages of quantum computing is the ability to process the massive amounts of data produced daily (2.5 exabytes of data) since quantum computers can operate 100,000 times faster than the current computers. In the IT security landscape, quantum computers will change the landscape of data security, providing a more secure computing environment.

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VIEWPOINTS

CHARACTERISTICS OF INDUSTRY 4.0

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The industrial revolution that began in the 18th century has undergone a series of evolution that builds upon the foundations of earlier achievements. The first revolution witnessed the emergence of mechanisation such as steam engines and mass extraction of coal. Almost a century later at the end of the 19th century, new technological advancements birthed new sources of energy—electricity, gas and oil, which resulted in the development of the combustion engine alongside the exponential demands for steel.

In the second half of 20th century, the third era of industrial revolution appeared with nuclear energy. This revolution witnessed the rise of electronics, the advent of computers and the beginnings of automation, when robots and machines began to replace human workers on those assembly lines. This new technology gave rise to the era high-level automation in production and manufacturing. These first three industrial revolutions define the contours of a fourth revolution that is unfolding right before our very eyes in this 21st century—the Industry 4.0.

The Industry 4.0 movement started in Germany, with many of that country's leading industrial companies demonstrating strong initiatives. According to the Economist, the list includes BASF, Bosch, Daimler, Deutsche Telekom, Klöckner & Co., and Trumpf. The momentum is rapidly growing elsewhere as well, particularly in the United States, Japan, China, the Nordic countries, and the United Kingdom.

Essentially the industry 4.0 movement is envisioned to bring together humans, robots and automation in ways never before possible. This subsequently will lead to the creation of a *smart factory* where cyber physical machines monitors the processes in the assembly line and make decentralised decisions. The factory is now part of the Internet of Things (IoT) where it communicates and cooperates with both machines and humans in real time via the web.

However, the *smart factory* is just the tip of the iceberg revealing what Industry 4.0 can offer.

The characteristics of Industry 4.0 can be understood from the perspectives of **digital horizontal** and **vertical integration** within the Industry 4.0 ecosystem; which forms four distinctive end-to-end digitalisations in the manufacturing and production sectors.

i) **Demand and Marketing**
- insights of demand and marketing as a predictive consumer analytics which anticipate and understand consumer demand

ii) **Supply Chain and Distribution**
– the linking point where supply, production and digital supply chain is being managed

iii) **Supply and Production**
– digital products and manufacturing services

iv) **Digital Customer Experience**
- includes experience through a digital interface whether its researching a product online or getting support information from a smartphone

Digital horizontal integration *refers to the integration of IT systems for and across the various production and business planning processes. In-between these various processes there are flows of materials, energy and information. Additionally, they cover both the internal and external—i.e partners, suppliers, customers, other ecosystem—members from logistics to innovation stakeholders. Connecting all this is not a minor task. For starters, the challenge for organisations that are involved in productions are disconnected IT systems. The picture becomes even more complex when focus is given*

INDUSTRY 4.0 ROLES IN DEMAND AND MARKETING

While industry 4.0 focuses on the digitalisation of manufacturing and production, embarking on the Industry 4.0 environment will also mean massive amounts of data will be collected and collated for the purpose of understanding consumer behaviour and demand trends. This subsequently will allow the design of marketing strategies and intelligence being carried out in a holistic and intelligent approach.

PREDICTIVE INSIGHTS

Predictive consumer insights help to develop behaviour based on customer profiles and segments. Highly personalised, optimised propositions and other interventions are executed through multiple platforms of engagements based on the insight. Combining decision management, real-time scoring and omni-channel integration will provide decision makers with consistent, continuous and relevant customer engagements.

OMNI-CHANNEL ENABLEMENT

Omni-channel is an evolution of multi-channel retail but with a seamless integration of customer experience through all available shopping channels platforms such as mobile, brick-and-mortar, television, radio and prints. Opportunities are created to exploit rapid sales growth through emerging channels like mobile to promote brand awareness and loyalty.

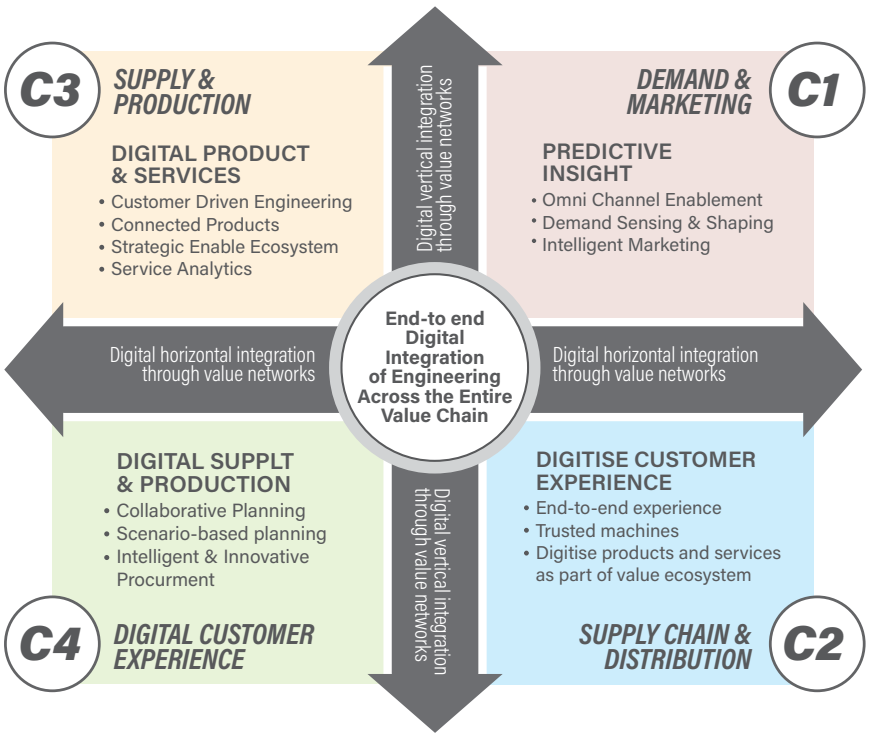
A Deloitte study claimed that Omni-Channel customers spent 93 percent more than online customer and spent 208 percent more than in-store customers. Customer engagement is paramount and the study also observed that customers who liked a retailer on Facebook will likely spend 44 percent more time than customers who do not.

DEMAND SENSING & SHAPING

Demand sensing can be described as a specialised type of monitoring process that focuses on the identification of changes that occur in near real or real time. These incoming signals can come from

on seamless integration and data exchange with suppliers, customers and other external stakeholders.

*Whereas **horizontal integration** is about IT systems and flows in the supply/value chain and the various processes happening across it, vertical integration has a hierarchical element. It is about the integration of IT systems at various hierarchical production and manufacturing levels, rather than horizontal levels, into one comprehensive solution. These hierarchical components includes the field level (interfacing with the production process via sensors and actuators), the control level (regulation of both machines and systems), the process line level or actual production process level (requires monitoring and control), the operations level (production planning, quality management, and manpower resourcing), and finally the enterprise planning level (order management and processing where the bigger overall production planning and supplier resourcing is being identified.*



End-to end Digital Integration of Engineering Across the Entire Value Chain

big data accumulated and analysed, individually or collectively to determine the effect on the current demand plan.

The demand-sensing process uses advanced analytics to support the selection, preparation and transformation of both structured and unstructured data in support of demand and supply synchronisation. Turning data into actionable insights, which include early warning algorithms, predictive models, decision support, workflows and dashboards will allow manufacturers to make fast and accurate decisions throughout the value chain.

Demand-sensing signals that can affect expected demand trends may be used to extend the demand planning process into a demand-management decision support system. Such approach adds credibility and validity to collaborative demand and supply plans by identifying and incorporating structured and unstructured data sources such as, market segment data (e.g., Web, social media and email, collaborative customer data (e.g., demand anomalies), sales and marketing data (e.g., promotions, product lifecycle management and competitive analysis).

INTELLIGENT MARKETING

Manufacturing companies are being driven by a few impactful market trends affecting their business. The expectations of global markets are causing companies to build production processes with greater agility and adaptability to respond to highly variable market demand. Massive amounts of data being produced through social media channels have changed the way manufacturers approach consumers. For example, Artificial Intelligence (AI), an increasingly important technology assists marketers in reducing manual workloads, and enabling rapid personalisation decisions to improve targets. AI-powered predictive analytics traces and records customers' past behaviour, allowing marketers to personalise messaging and take necessary action to meet customers' expectations. The better AI gets, the better personalisation marketing can offer—messages will become more relevant and targeted, resulting in less wastage. According to McKinsey, 35 percent of Amazon.com's revenue is generated by its recommendation engine. This proves the power of analysing data in predicting customers needs and offering it to them.

INDUSTRY 4.0 ROLES IN DIGITAL SUPPLY CHAIN AND PRODUCTION

The digital supply chain as suggested by PWC, consists of eight key elements; integrated planning and execution, logistics visibility, Procurement 4.0, smart warehousing, efficient spare parts management, autonomous and B2C logistics, prescriptive supply chain analytics and digital supply chain enablers. Companies that efficiently consolidate all these pieces into a coherent and fully transparent whole will gain huge advantages in customer service, flexibility, efficiency, and cost reduction. Through the combination of these elements, manufacturers can execute a wholesome collaborative planning.

COLLABORATIVE PLANNING

As Industry 4.0 focuses on the end-to-end digitisation of all physical assets and integration into digital ecosystems with value chain partners, one of the attributes of digital supply chain is the ability to see and understand the activities and events of multiple players. Generating, analysing and communicating data seamlessly underpins the gains promised by Industry 4.0, which networks a wide range of new technologies to create value.

SCENARIO-BASED PLANNING

The IoT is great at using telematics, sensors and geo-positioning signals from devices to pinpoint location and condition of assets, but much of the IoT's value is on applying the awareness to make better decisions. In this digital age, much of the awareness can be achieved from an integration of the different points of information input. A further benefit from this awareness will be scenario-based contingency planning, where manufacturing planners will be able to anticipate future requirements of production.

As part of total logistics solutions, real-time monitoring of trucks, vehicles and goods in transit via the IoT has been around and is becoming more capable as the number and sophistication of sensors and IoT infrastructure improve. Sensors on trucks and trailers are becoming more effective—smarter and more capable of monitoring different conditions of road conditions, weather and activities of vehicles during transit.

INDUSTRY 4.0 ROLES IN DIGITAL PRODUCTS AND SERVICES

In a nutshell, digitalisation is about revolutionising products, productions and services. Usually composed solely of mechanical and electrical parts, products have become complex systems that combine hardware, sensors, data storage, microprocessors, software and connectivity in countless ways.

Industry 4.0 aims to evolve manufacturing and production practices towards the idea of smart factory. Smart factory represents a leap forward from traditional automation to a fully connected and flexible system that can optimise constant stream of data from connected operations and production systems to learn and adapt to new demands.

The idea of smart factory is to integrate data from system-wide physical, operational, and human assets to drive manufacturing, maintenance, inventory tracking, digitisation of operations through the digital twin, and other types of activities across the entire manufacturing network.

CUSTOMER DRIVEN ENGINEERING

Digital tools have changed the ways people work, shop and live. People have also become more demanding, among others with regards to fast responses and timely information. On top of that, consumers prefer a degree of personalisation. To meet these expectations, it is important to ensure efficiency and level of accuracy in production line is fully optimised.

Predictive maintenance is forming a large part of an industry shift to manufacturing services. The efficiency of predictive maintenance is gained by reporting real-time engineering information—including location, running data, and status—to maintenance centres against baseline data sets for fault-modelling and failure analysis.

INTELLIGENT AND INNOVATIVE PROCUREMENT

Data analytics are probably the most important enabler for Industry 4.0 in procurement. Smart technologies and algorithms allow very large volumes of data from varied sources to be aggregated, processed, and analysed. The results can be used to predict market trends, understand suppliers, markets, and customers, as well as examine machine and product failures. They enable employers to make better, informed decisions. In some cases, procurement processes can be completed automatically.

One of the key success factors for companies that want to make the most of the innovative procurement potential is through analysis of data and using it in a smart and intelligent way. For example, suppliers could be utilising field application data analysis to improve the design and performance of their products. Predictive information about where and when to expect the next failure will offer the opportunity to optimise maintenance services and the availability of spare parts.

Modularity and flexible adaptation of smart factories to change requirements by replacing or expanding individual modules in a dynamic market is essential. In a typical case, an average company would probably take a week to study the market and change its production accordingly. On the other hand, smart factories can adapt to new market changes quicker and more seamlessly according to seasonal changes and market trends.

The ability of Cyber-Physical Systems (CPS) to make decisions and to produce locally leveraging on technologies such as 3D printing means greater decentralisation in manufacturing. Such ability to make simple autonomous decisions creates a more flexible environment for production. In cases of failure or having conflicting goals, the issue will be delegated to a higher level. However, even with such technologies implemented, the need for quality assurance remains a necessity on the entire process.

In the Industry 4.0 environment, demand will also evolve qualitatively, driven by trend towards greater mass personalisation. Customer-centric plants are likely to bridge the gap between a global, integrated supply chain already benefiting from economies of scale and a personalised approach to production and service. Leveraging Industry 4.0 technologies platform—such as digital manufacturing, 3D printing, and advanced robotics—these plants will have a range of key features. Such plants will make value chain more responsive, allowing industrial manufacturers to reach end customers more directly and create tailor made business models accordingly. Diversity in products such as aircraft engines and software are increasingly offered as services, often on a subscription basis.

CONNECTED PRODUCTS

Smart, connected products offer expanding opportunities for new functionality, greater reliability, much higher product utilisation, and capabilities that transcend traditional product boundaries. The changing nature of products is also disrupting value chains, forcing manufacturers and businesses to rethink and retool almost all internal processes.

STRATEGIC ENABLE ECOSYSTEM

Industry 4.0 focuses on the end-to-end digitisation of all physical assets and integration into digital ecosystems with value chain partners encompassing a broad spectrum of technologies. A 2016 PwC report found that generating, analysing and communicating data seamlessly underpins the gains promised by Industry 4.0, which networks a wide range of new technologies to create value. Three key attributes of Industry 4.0 include digitisation and integration of vertical and horizontal value chains, digitisation of product and service offerings as well as digital business models and customer access.

SERVICE ANALYTICS

The manufacturing process in Industry 4.0 environment will require analytics based on large amounts of data for decision making actions such as to optimise production quality in the assembly line, detecting the fault or an anomaly in various machines at shop floor, addressing the issues of machine degradation and component wear etc. Both data and analytics are becoming increasingly important in the decision-making process within a smart factory.

INDUSTRY 4.0 ROLES IN DIGITAL CUSTOMER EXPERIENCE

The customer experience plays a crucial role in digital transformation in Industry 4.0 environment. Many digital transformation initiatives arise from pain points where business innovation needs and growth transformation are imperatives of the customer. These digital transformation initiatives are caused by the increasing importance of an end-to-end customer experience improvement approach, which in turn among others, is caused by changing customer expectations and customer experiences offered by the best-in-class.

Sometimes, in a digital transformation context, organisations look mainly at what has become known as the digital customer experience. Companies that transform end-to-end digital journeys can unleash fundamentally different customer experiences. The kind that are driven by a customer-centric vision as well as the digitalisation of underlying processes through smart processing technologies.

END-TO-END EXPERIENCE

It uses technology to capture the intangible value for consumers when they interact with the products, services and brands throughout a period of time. The interaction encompasses three main elements that consist of the customer's point of contact with the brand or product and services, the customer journey and the environments in which the activities take place. By understanding the intangible values from the interaction, the end-to-end approach can be well-modelled towards a customer-focused experience.

TRUSTED MACHINE

Describes an analytic tool, like a learning capable machine, to understand consumer behaviour. By using a trusted machine, it helps in eliminating the need to fill out forms and enter tracking numbers for gathering information about the targeted customers. This creates an opening of new possibilities, delivering information faster and more efficiently than the normal practices.

DIGITISE PRODUCT AND SERVICE

Products and services are being developed from the feedback of customer experience. With the digitalisation of products or services, consumers who are interested in the products/services of a brand may, in their spare time, upload reviews and comments and respond to other reviews and comments about the product. Subsequently helping other users with technical service issues or gaining extra information about the product. These individuals can be very useful sources of product development ideas, or can be incentivised as a low-cost provider of technical service to other consumers.

CONCLUSION

Industry 4.0 is hailed as a revolutionary approach in the manufacturing industry. The concept, technology and techniques will push global manufacturers to a new level of optimisation and productivity. Additionally, customers will also enjoy a new level of personally customised products at a quicker rate, something that has never been achieved before. Not to mention, the economic rewards are simply immense.

However, there are still many challenges that need to be tackled systematically to ensure a smooth transition. This needs to be the focus of large corporations and governments alike. Pushing research and experimentation in such fields are essential.
While speculations regarding privacy, security, and employment need more study, the overall picture is assuring. The Industry 4.0 groundbreaking approach to the manufacturing industry is not only limited to supply chain and production but includes services and customer experience as well.

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VIEWPOINTS

The Evolving Blockchain

by:

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Blockchain is a technological advance with wide-reaching implications that will not only transform the financial services but various other businesses and industries.

New Applications for Business and Government

Blockchain is a technological advance with wide-reaching implications that will not only transform the financial services but various other businesses and industries. It has been said that *blockchain will do for transactions what the Internet did for information—profoundly changing how the world works.*

Although blockchain technology is complex, the idea is actually simple. At its most basic, blockchain is a vast, globally distributed ledger or database running on millions of devices open to anyone—not limited to just the sharing of information but including anything of value such as money, titles, deeds, music, art, scientific discoveries, intellectual property and even votes—that can be moved and stored securely and privately.

On the blockchain, trust is established through mass collaboration and clever codes ensuring integrity and trust between strangers. Simply put, blockchain has made it difficult to cheat.

SIMPLIFYING BLOCKCHAIN

As it is with all new technologies, the public in general may be ill informed regarding what blockchain really does. Indeed, among the main roadblocks to greater proliferation and acceptance of blockchain implementation is the steep learning curve associated with its capabilities and function. Due to this, popular depictions of such technologies have in many cases been less than favourable. Often limited to depictions of transactions between shady Internet accounts for illicit purposes, the true benefits of blockchains for legal everyday use are often glossed over resulting in misplaced fears that inhibit potential users from embracing the technology.

The complexity of blockchain needs to be simplified and generalised for understanding in order for the technology to be widely accepted. It would be easier for the masses to accept the use of blockchain once they have grasped and understood the concept. Trust in the system is crucial, especially when it involves removing intermediaries like banks and financial institutions.

Among the attempt in handling this would be introducing applications with a friendly face on blockchains. This would allay fears and let people see the benefits it brings to their day-to-day activities.

For example, CryptoKitties—an app that uses cats to make the blockchain technology more appealing and accessible—is one of the world's first blockchain games. Although labelled as a cryptocollectable and not cryptocurrency, similar to Bitcoins, users can buy and sell digital cartoon cats as well as breed them to multiply the numbers of cats that they own on the CryptoKitties app.

Source: CryptoKitties

Another example of a bitcoin-made-simple application is the wallet. It is similar to a normal wallet where we store our coins and documents, only this one stores bitcoins. There are many versions of the bitcoin wallet, the most famous ones being Blockchain Wallet and FreeWallet.

A smart contract is another example of how blockchain can be a preferred method of choice. Different from a traditional contract, a smart contract effectively eliminates the need for middlemen in most transactions by creating a logic-based structure that governs the agreement. Since the contracts are hosted on the blockchain, it is immutable—meaning either party will be unable to make any alterations without alerting the network. Smart contracts can be used to facilitate property transfer, record land titles, automate claims processing, issue payments, foster new approaches to financial engineering and much more.

Ethereum emerged as the first blockchain platform that allowed developers to easily create smart contracts. While smart contracts work much like a standard blockchain transaction, it is possible to insert a conditional statement that must be met before a function is executed.

EXAMPLES OF SMART CONTRACT APPLICATIONS

1. A musician can use a smart contract to register their copyrighted works and define usage rights and payment terms. Anytime the entities signing on to the agreement use the registered works for commercial purposes, it will trigger the contract to automatically deliver fees or royalties to the rights holder.
2. Smart contracts can be used in crowdfunding initiatives—one example is Initial Coin Offerings (or ICOs)—which allow startups to issue their own tokens or coins in return for capital. This provides another way for businesses to gather funds besides the share market and fund managers.
3. Governments are studying how to use smart contracts for a wide range of activities from procurement to records management. There are many hurdles to this, especially those related to regulatory functions, but the potential it offers makes it obvious for the need of an initial study to prepare for the future.

TRADITIONAL CONTRACTS	SMART CONTRACTS
1-3 Days	Minutes
Manual remittance	Automatic remittance
Escrow necessary	Escrow may not be necessary
Expensive	Fraction of the costs
Physical presence (wet signature)	Virtual presence (digital signature)
Lawyers necessary	Lawyers may not be necessary

Source: PwC

WHY BLOCKCHAIN IS SECURE

Transactions, especially financial ones, require an army of trusted middleman to ensure information integrity. In a traditional setting, these middlemen are normally centralised and by default becomes high potential targets for attacks. Blockchain reduces this expense significantly while providing a higher degree of security than current practices.

Applications developed for blockchains are categorised as ***decentralised applications***, or 'dapp' for short. Where internet users today connect through centralised servers, dapps use the blockchains' peer-to-peer network of distributed computers to connect users. Each computer does a little bit of work and no one can fully access the data being transmitted because it is distributed among the network.

Due to this inherent feature, dapps proved to be more difficult for attackers to exploit as outages of individual nodes are far less damaging than a successful attack on a singular primary server. Furthermore, dapps usage of the blockchain allows for verifiable record duplication on a massive scale to prevent data loss.

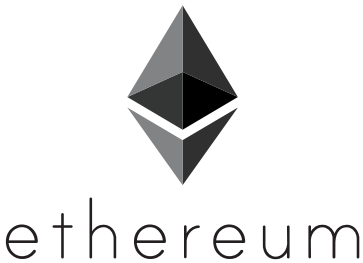
Another security feature of blockchain is that any changes made to the database are immediately sent to all users to create a secure, established record. With copies of the data in all users' hands, the overall database remains safe even if some users are hacked. With the level of security built into blockchain, transactions that occur can never be undone or tampered.

This tamper-proof, decentralised feature has made blockchain increasingly popular beyond its original function of supporting bitcoin digital transactions. Many cutting-edge finance firms, for instance, have used blockchain to expedite processes and cut costs without compromising security.

A TECHNOLOGY FOR A DIGITAL GOVERNMENT

Blockchain offers many advantages but the top features that have caught the attention of the governments' interest are—decentralisation, transparency and immutability. These three components make Blockchain a promising technology that brings solutions to current pressing issues like corruption, bureaucracy and lack of accountability. Many governments around the world are experimenting with Blockchain to further improve their service delivery.

- Sweden is testing the use of blockchain for their land registry.
- The UK is using blockchain to monitor distribution of welfare and benefits.



- In the US, the National Science Foundation is funding research to establish whether blockchain technology can improve the resilience of digital infrastructure.
- Within the Middle East, Dubai Land Department (DLD) has become the world's first government entity to use Blockchain technology. DLD has created its Blockchain using a smart and secure database that records all real estate contracts, including lease registrations and links them with the Dubai Electricity & Water Authority., the telecommunications system and various property related bills.
- Locally, The Malaysian Industry-Government Group for High Technology (MIGHT) has said that Malaysia would be adopting Blockchain by 2025. Additionally, Malaysian banks are already taking proactive steps to encourage its development in the country. CIMB and Maybank are two of Malaysian banking groups that are working with local FinTech companies to explore possible use of blockchain.

RISKS AND CHALLENGES

Change affects us all and we each deal with change differently. The same is applicable with all new technologies including blockchain. There are many ways to implement technology; always the risk is there that for all the dollars we spent on the research and development of technology, there often remains a persistent and troubling gap between the inherent value of the technology developed and our ability to put it to work effectively. What this means is that sometimes we think of the advantages of blockchain use without considering how its implementation can bring unintended consequences as well.

The best example of this is in the the cryptocurrency markets, where it is currently not regulated nor backed by any central bank. As the cryptocurrency market remains highly volatile, the value of an individual currency can fluctuate wildly based on many factors including adoption rates, the value of fiat currencies, government regulations and cybersecurity concerns. Based on this rationale, it would be best for investors and early adopters to focus on other market segments as well when implementing blockchain, rather than focusing on cryptocurrency.

There is also fear that cryptocurrency can be used to assist unlawful activities, although to date there is no conclusive proof that money laundering and terrorism financing goes through the trading of cryptocurrencies. As a prevention, beginning 2018 Bank Negara Malaysia will designate persons converting cryptocurrencies into fiat money currencies as reporting institutions under the

Anti-Money Laundering, Anti-Terrorism Financing and Proceeds of Unlawful Activities Act (Amla) 2001 to ensure the stability and integrity of Malaysia's financial system.

The enactment of the said regulation by Bank Negara raises another challenge for blockchain—the possibility of excessive government regulations. As government agencies are getting more involved in regulating blockchain technology, there will be more rules and regulations set up. Depending on how numerous or invasive the regulations would be, their seemingly noble intentions to protect the larger society could hamper development and innovation.

Transparency is often praised as the hallmark of blockchain technologies. However, the possibility of personal financial records being out in the public may concern potential users and industries that, either by law or preference, hold privacy in high regard. Private blockchain branches may be preferable in those industries (such as healthcare), to help alleviate privacy concerns. Besides, blockchains and their related emerging technologies are not infallible although they offer a high degree of security.

In July of 2017, Parity Technologies' digital wallet was breached resulting in the theft of $30 million in ether. There is an ongoing arms race in the cybersecurity industry as legitimate developers continuously improve upon security measures while increasingly sophisticated criminals seek for vulnerabilities. The blockchain security landscape is no different and the steady innovation of new ways to secure funds will be needed before such technologies will be fully accepted.

BUSINESS IMPLICATIONS

In conclusion, the blockchain technology is revolutionising business and the way people work. It is part of a huge wave of transformational technology change that is already affecting the banking, financial services and payments industries. To move forward, we need to be aware of smart contracts, distributed ledger technology (DLT) and the underpinning technology such as decentralised apps.

With the emerging of blockchain applications, the supply chain industry is predicted to reap great benefits. Oil & gas, food, pharma, and other industries are testing methods of recording and tracking items and transactions with a distributed ledger. Some of the potential benefits will include greater process efficiency (less paperwork), clearer visibility for compliance, reducing fraud (from counterfeiting) and errors (from inaccurately labeled products).

Meanwhile, legal departments are now able to explore the potential role of smart contracts for their organisations and between parties by combining smart contracts with machine learning programmes to accurately predict which users are more likely to uphold their end of a contract. Computer learning can help businesses and lenders avoid making agreements on accounts which have a higher risk of failing by accessing blockchain ledgers and identifying behavioural, financial, and contextual patterns among accounts that have repeatedly failed to uphold their end of smart contracts to form a rating similar to a traditional credit score. Using this information, individuals can either adjust the terms of their contracts to account for increased risks or offer better terms to favourable clients.

Additionally, decentralised apps and smart contracts could be instrumental for autonomous maintenance. For example, a piece of heavy machinery triggers a request for service, negotiates with a list of pre-approved mechanics for the best price, and sends payment after proof of completed service is provided. A Decentralized Autonomous Organization (DAO) could own and manage equipments, vehicles, and other items requiring such autonomous maintenance.

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VIEWPOINTS

Real Time Object Recognition

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Artificial intelligence (AI) no longer exists only in the realm of science fiction, but has been advancing and transforming in real life the way humans interact with machines and how it assists in daily human activities. Today, AI is coming of age and is actively improving business processes and strategies. Many enterprising companies have started using AI through a combination of automated data science, machine learning, as well as modern deep learning approaches like data preparation, predictive analytics, and process automation.

The convergence of new hardware and devices, emerging AI technologies, conventional enterprise IT and related business models like open source, cloud computing, and Software-as-a-Service (SaaS), is covered under the umbrella known as Enterprise AI, a landscape of enabling technologies, key companies and events.

One of the technologies in AI being rapidly applied is object recognition where it continues to evolve combining the science of artificial intelligence, computer vision and cloud based networks providing greater recognition accuracy of objects and entities. It is the area of AI concerned with the abilities of robots and other AI implementations to recognise various things around us.

Object recognition allows robots and AI programmes to pick out and identify objects from inputs like video and still camera images. Methods used for object identification include 3D models, component identification, edge detection and analysis of appearances from different angles. Robots that understand their environments can perform more complex tasks efficiently.

ENTERPRISE AI

HW/Devices

- AI Chips
- UI: Gesture, AR, VR
- Autonomous systems
- Internet of Things

AI

- Neural nets
- Deep learning/machine learning
- Affective computing
- Natural language processing
- Machine vision, image and video analytics
- Bots/virtual personal assistants
- Recommendation engines
- Predictive analytics

Enterprise IT
(OS, Cloud, SaaS, etc)

- ERP
- CRM
- SCM
- etc

Major advances of object recognition stand to revolutionise AI especially in the technologies listed below:

- **Deep learning/machine learning (ML)**
  A subset of neural networks, ML creates statistical models, which are used for future predictions (based on past data or Big Data) and identifying or creating(discovering) patterns in data.

- **Human/machine interaction, via affective computing and natural language processing (NLP)**
  NLP is involved in helping machines understand 00 and emulate human speech and writing, making computers perform useful tasks with the natural languages humans use.

- **Predictive analytics (PA)**
  PA is increasingly applied to forecast sales and affect the predicted outcome for the better via recommendation engines.

THE BIRTH OF OBJECT RECOGNITION

Object recognition has recently become one of the most exciting fields in computer vision and AI. The technology determines what objects are and where it is in a digital image. However, the ability of immediately recognising all the objects in a scene seems to go way back to 1957, when computer vision pioneer and psychologist Frank Rosenblatt successfully created the ***Perception*** machine to simulate natural learning with an artificial neural network. By mimicking the learning patterns of the human brain, the machine could detect the edges of images and categorise them by shape into simple groups such as squares or triangles.

Although the basic tenants of object recognition have existed for decades, modern improvements in computing technologies have greatly improved the speed, accuracy, and versatility of object recognition software.

Machines are now almost as good as humans at object recognition, and the turning point occurred in 2014 during an international competition for object recognition software. The winner yielded one of the first algorithms capable of matching the speed and accuracy of trained human annotators within a 1.7 percent discrepancy.

Over the next decade, such programmes will continue to improve and become more commonplace across a wide range of industries including agriculture, security, and manufacturing. Still, much of the long-term potential of object recognition lies not in static image or video recognition but rather as an enabling technology which helps push the boundaries of emerging autonomous machines and platforms.

OBJECT RECOGNITION: WHERE IS IT GOING?

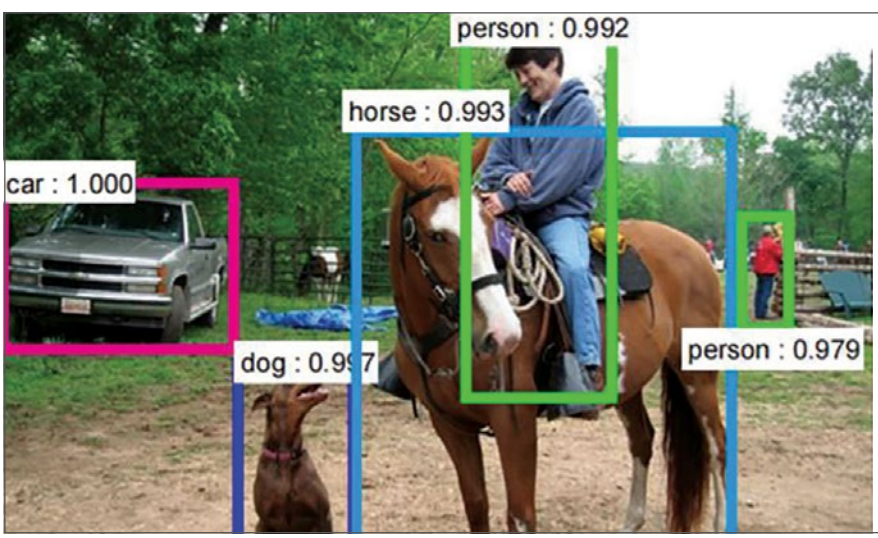
Next generation object recognition will enable autonomous systems to interact naturally with objects in an environment. Machines will not only be able to identify things, but also to understand their importance, purpose, and function. Improvements to object recognition algorithms will enable fully autonomous computer systems and machines.

In March 2017, Google unveiled its latest venture into object recognition with their Video Intelligence API. Most current generation object recognition software focuses on identifying items in still images. However, Google took a step forward by identifying objects present in video form. This advancement will enable search engines (like Google's) to retrieve results based on content, not just titles and descriptions.

Similarly, IBM's flagship machine learning platform, Watson, recently expanded its deep learning algorithms to assist with Visual Recognition. IBM hopes to use this technology to allow developers to create custom item recognition programmes which can be used across a wide range of industries.

Technologies related to object recognition have already begun to give machines an unprecedented degree of autonomy. Using today's technologies, sense and avoidance systems are currently being deployed in self-driving cars, autonomous drones, and next generation air collision avoidance systems.

Focusing on using real-time object recognition to inform the decisions of autonomous computer systems, machines will make sophisticated predictions and recommendations while interacting with their environment instinctively and in ways not currently possible.



The numbers following the object names indicate the model's confidence in its classification of the object.

Source: Shaoqing Ren, Kaiming He, Ross Girshick, Jian Sun, Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks, arXiv:1506.01497

DRIVERS OF EMERGING AI TECHNOLOGIES

Greater visibility across the network infrastructure has never been more vital. With the increased amount of data being created by devices and the network infrastructure itself, new ways of gathering information are required. Among the drivers of emerging AI technologies that are currently gaining a lot of traction in the industry are as below:

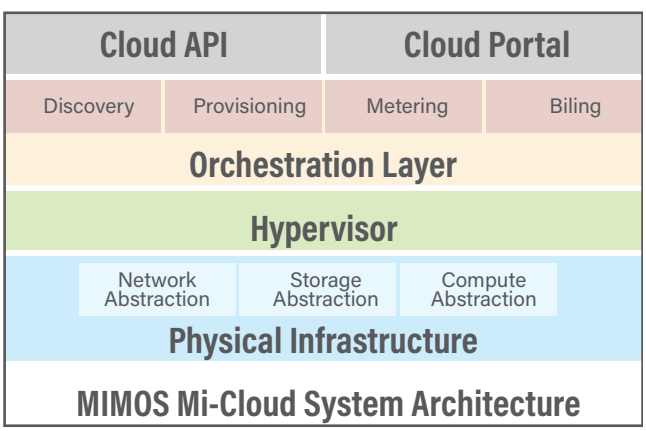
Machines will have access to vast libraries of images and videos with which to cross reference unknown objects as storage and retrieval capabilities continue to expand.

- **Expanded cloud storage and wireless network speed.** Cisco projects that by year 2020, 95 percent of workloads will be processed by cloud data centers with its storage expanding five-fold where cloud storage will account for 88 percent of total storage capacity. Both mobile and broadband average download speeds will also double globally by 2021.

  Machines will have access to vast libraries of images and videos with which to cross reference unknown objects as storage and retrieval capabilities continue to expand. In turn, this will provide greater object recognition capabilities since they no longer need to rely on locally stored data only.

  In Malaysia, MIMOS Berhad has embarked on a cloud infrastructure platform known as Mi-Cloud that is nondependent on any specific cloud hardware or software. The platform leverage on existing operational expenditure and allows complimentary infrastructure to be offered to end-users over the Internet in a simple and flexible way with reduced cost.

  Created to be used across industries, the MI-Cloud is built on open source software thereby reducing the total cost of ownership via cost-effective licensing. Its open and neutral architecture allows easy integration with other systems thus enabling customisation by service providers. It offers secured technology benefits to corporations and end users on a subscription-based as-need basis over the Internet.



TECHNOLOGY SUMMARY | Mi-Cloud

A cloud infrastructure platform that allows virtualisation of physical hardware.

Industries: Enterprise, Government

Features
- Open and neutral architecture
- Comprehensive management modules
- Total service orchestration suite
- Hardware agnostics

Technology Benefits
- On-demand IT infrastructure
- Virtualisation of physical hardware
- Monitored and protected virtual resources

By 2025, the annual disruptive impact from AI could amount from USD14 to USD33 trillion, including a USD9 trillion reduction in employment costs. An outcome of this disruption is the displacement of human jobs by automation. Estimates for jobs at risk of displacement vary by country across the world. In the US, 47 percent of the workforce is estimated to be at risk, 77 percent in China and 69 percent in India.

- **Growing demand for automation.** According to a 2015 study from Oxford University and Deloitte, 35 percent of all jobs in the UK could be automated over the next 10 years. Furthermore, a report from Merrill Lynch found that 45 percent of manufacturing jobs are likely to be automated by 2025, up from only 10 percent of currently automated manufacturing jobs today.

  For machines to function in increasingly complex and sophisticated roles, they will need to have the tools necessary to interact with objects around them in real-time and under unexpected circumstances. A greater reliance on object recognition software will be required to allow machines to not only sense their environment but also to quickly identify previously un-encountered objects and items

- **Advances in machine learning (ML)**. While AI and ML often seem to be used interchangeably, explicitly two different things. AI is the broader concept of machines being able to carry out tasks smart daily tasks and ML is a current application of AI designed for machines to become more autonomous.

  Two important breakthroughs led to the emergence of ML as the vehicle which is driving AI development forward include discovering it is far more efficient to code machines to think like human beings and secondly, emergence of the internet, and the huge increase in the amount of digital information being generated, stored, and made available for analysis.

  According to IBM, by 2020 the amount of digital data stored globally is expected to exceed 44 trillion gigabytes. Increasingly advanced machine learning algorithms are in demand to assist with data management.

EMERGING OBJECT RECOGNITION AI APPLICATIONS

Artificial intelligence (AI) technologies are booming and will put humankind in front of unprecedented breakthrough of opportunities taking place at unprecedented speed. Although huge advancements in AI and ML have been seen, but the future may well deliver even more through new emerging AI applications to look forward to such as below:

- **Simultaneous Localization and Mapping (SLAM)** technologies provide cost-effective software-based solution to object recognition that is uniquely tailored to the needs of mobile robots and vehicles. According to John Leonard, professor of mechanical ocean engineering at MIT, "The goal is for a robot to build a map, and [to] use that map to navigate." SLAM not only might help to lower the costs of object recognition, but its reliance on common hardware coupled with downloadable software could make it easier to apply to a wide range of existing machines.

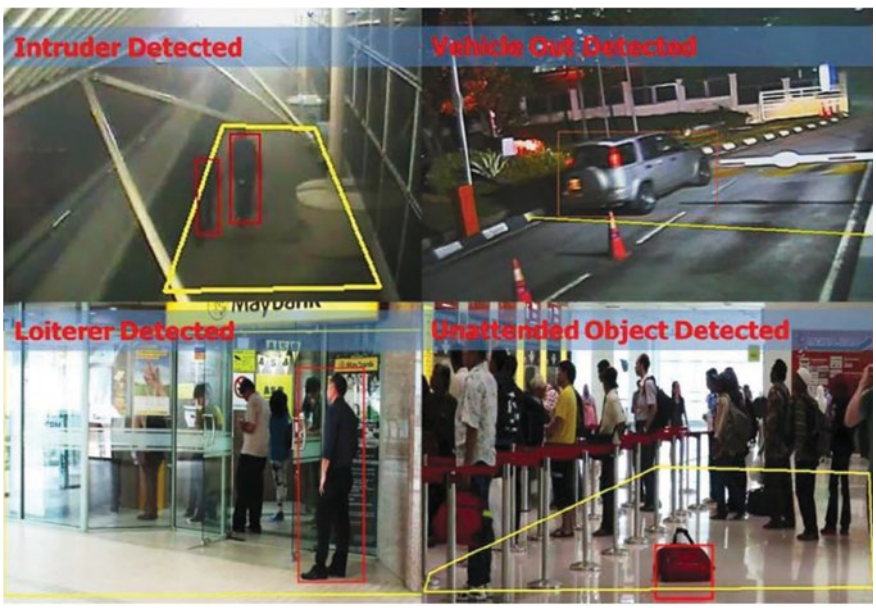
The iRobot Roomba 880

  Roomba, the domestic robot vacuum cleaner, uses SLAM technology to remember where it vacuumed last before heading to its dock to recharge. Researchers at MIT developed a method that uses a single monocular camera and object recognition software to operate at nearly the same level of precision as its more expensive cousins which use a range of purpose built sensors and cameras.

- The US military's growing reliance on **unmanned drones** allows US forces to collect an unprecedented amount of surveillance data. However, the sheer amount of data quickly outstripped the capabilities of teams of human analysts tasked with sorting through all the information available to them. In 2017, the US military began using object recognition algorithms in its Algorithmic Warfare Cross Function Team to rapidly sort through video and images collected by unmanned drones to track ISIS troop movements and weapons

shipments. By adding a mere 75 lines of code to existing programmes, US military officials have successfully been able to use object recognition software to positively identify emplaced weapons and structures.

- **MIMOS Mi-SP** is a versatile video surveillance system that includes intelligent elements of advanced video analytics. With Mi-SP, suspicious events can be detected by video analytics and an alert will be generated to alert the security personnel, thereby increasing the situational awareness of an entire organisation. Mi-SP is efficient, flexible, and can be integrated with existing video surveillance systems.
- The future of the **self-driving vehicle** industry lies in object recognition technologies, as it is the key to success for autonomous cars. Vehicles must not only differentiate between items such as traffic signs, pedestrians, and vehicles but also provide the information necessary to make real-time decisions needed to keep motorists safe. There is currently no industry standard approach to object recognition. Instead, several competing approaches are being explored concurrently. One approach relies on computer-learning techniques collectively known as deep learning which use networks of computer processing nodes to mimic the human mind.



MIMMOS Mi-SP event detection video analytics

TECHNOLOGY SUMMARY | Mi-SP

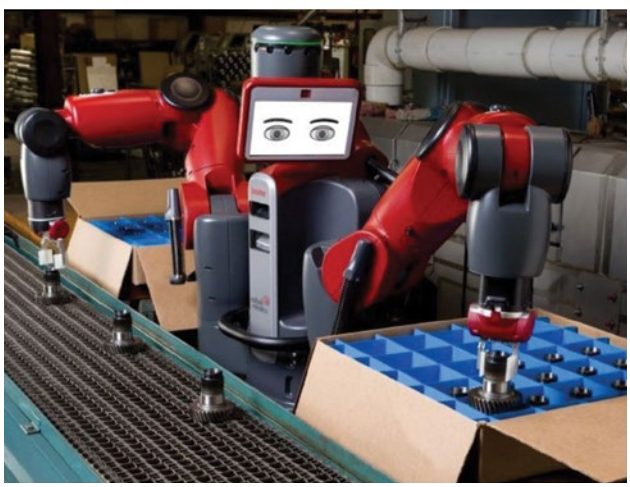
A versatile video surveillance system with advanced video analytics that automatically detects and alerts occurrences of suspicious activity.

Industries: Public Safety, Enterprise, Government

Features
- Event detection video analytics
- Smart client video analytics
- Flexible architecture

Technology Benefits
- Patented algorithm/technology
- Real-time monitoring and offline event detection
- Increased operational efficiency
- Uncompromised quality with reduced cost

- Originally designed for manufacturing purposes, **low cost humanoid *Baxter* robots** are currently being used by the University of Maryland to demonstrate how computer learning pared with object recognition can train robotic assistants. By showing YouTube videos of simple tasks being performed, researchers at the University of Maryland have successfully taught Baxter machines a variety of tasks ranging from pouring water into a moving container to preparing basic meals. By relying on contextual object recognition, Baxter is able not only to identify an item in the video, but to also mimic its use. Although in its early stages, contextual machine learning could allow companies to train robotics through traditional human training methods.



Baxter collaborative robots , Picture Source : generationrobots.com

BUSINESS IMPLICATIONS OF AI

Artificial Intelligence (AI) already plays an important role in our economies. Even robots and algorithms now do most of our stock trading. Numerous startups and the internet giants are racing to invest in the technology. There is a significant increase in adoption by enterprises. This does not come as a shock as surveys have found last year that 38 percent of enterprises are already using AI, growing to 62 percent by 2018. It is estimated that the AI market will grow to more than $47 billion in 2020. Below are among the business implications that are developing parallel with the AI boom.

- Robots and drones will be used to map homes, retail locations, and more to identify what is in them, as well as what is not (potentially creating a treasure trove of marketing data to help companies sell new products and services), the same way Google has driven cars around cities to map streets.
- With the ability to recognise objects and situations, domestic robots (like Roomba) will be able to recognise lost items (such as jewellery or keys) and notify owners when such items are found. By recognising the sound of a glass breaking as it hits the floor (or even seeing a child run with a cookie), such robots would also be able to anticipate the need for clean-up. The global market for personal robots is predicted to reach $34.1 billion by 2022.
- Object recognition technologies are advancing exponentially and will drive new creative AI abilities in fields such as fashion, furniture, and art. Organisations that rely on human creativity for design may find such technologies able to feed and inspire human creatives.

Object recognition technologies are advancing exponentially and will drive new creative AI abilities in fields such as fashion, furniture, and art.

- Enabled with real-time object recognition, autonomous robots may be used in hospitals and healthcare facilities to monitor (or even diagnose) patients in waiting rooms and intensive care units.
- Corporations and governments will increasingly look to use object recognition software for security and surveillance networks. Advanced security systems will not only be able to identify faces, but also learn to recognise suspicious behaviour and allow for real-time passive monitoring and threat categorisation (such as identifying the clothes seen on a reported suspect).
- MIMOS Mi-LPR is a scalable automated licence plate recognition platform that processes and analyses video from vehicle surveillance systems. The platform can be integrated with existing vehicle management systems to provide real-time alerts as well as forensics capability to retrace events. Audit trails can be generated from records on vehicles entries and exits. Mi-LPR also provides instant checks on vehicle registration numbers against watch lists. This enables authorities to intercept and stop vehicles, check them for evidence and, where necessary, make arrest.
- Behaviour recognition will also be used for market research purposes, such as categorising consumer behaviours in retail environments to optimise the retail environment for consumer happiness.
- As artificial intelligence and object recognition technologies continue to improve, autonomous machines will be used in search and rescue operations, especially where conditions are hazardous for human beings.
- Despite using more than half a million tons of pesticide each year, insects and other pests continue to destroy 37 percent of potential food production in the United States. Passive monitoring of crops can be used to identify pests and fungus in an agricultural setting while crops are growing, as well as during storage or transport. By specifically targeting the fields or rows that are at-risk, companies can reduce costs and environmental impacts associated with pesticide use. Further, computer learning can be leveraged to target specific species identified in a location without human interaction.
- The ability of robots to recognise objects and interact with them will also drive adoption of more service robots in commercial and industrial workplaces. In retail, such robots will be used to audit inventory, restock shelves, and deliver items to customers.

TECHNOLOGY SUMMARY | Mi-LPR

A highly accurate licence plate recognition engine that allows integration with existing video surveillance systems.

Industries: Enterprise, Government

Features

Mi-LPR addresses licence plate recognition through:

- High accuracy recognition
- Multiple video source acquisition
- Standalone and integration modes

Technology Benefits

- Automated vehicle plate recognition
- Increased operational efficiency
- Flexible installation and configuration

RISKS AND CHALLENGES OF OBJECT RECOGNITION

There are certainly many business benefits gained from AI technologies today, but there are also obstacles to AI adoption that can be further explored. For example, cameras and sensors needed suffer the same challenges as human eyes to identify objects in real-time when visibility is reduced due to poor lighting, dust, rain, or when viewing a scene from an unexpected angle. Infrared and night vision cameras can help to mitigate some of these limitations. However, there will be times when conditions are too poor for machines to operate autonomously.

Object recognition has improved accuracy rates in computer vision and even enabled machines to write surprisingly accurate captions to images but still stumble in plenty of situations, especially when more context, backstory, or proportional relationships are required. Autonomous machines currently rely heavily on onboard hardware for processing, memory, and energy storage. Miniaturising these systems will require dramatic improvements to network speeds and cloud computing capabilities.

Computers struggle when only part of an object is in the picture—a scenario known as occlusion—and may have trouble telling the difference between a statue of a man on a horse and a real man on a horse. Also, computers are unable to identify some images that may seem simple to humans. Pictures such as a picture of yellow and black stripes, may appear to a computer to be a school bus.

Furthermore, object recognition systems in AI are vulnerable to manipulation. Researchers have found that by altering specific pixels in images, they can intentionally change what the system sees. In the real world, it could mean altering a stop sign in a way that would be nearly imperceptible to a human, but an autonomous vehicle might see it as something else or not see it entirely.

What computers are better at is sorting through vast amounts of data and processing it quickly, which comes in handy when a radiologist needs to narrow down a list of x-rays with potential medical maladies or a marketer wants to find all the images relevant to his brand on social media. Computers may be able to only identify simple and basic images (such as a logo) but they are identifying them from a much larger pool of pictures and doing it at a speed faster than humans are capable of (and not getting bored of it).

In the end, the promise of object recognition and computer vision at large is massive, especially when seen as part of the larger AI pie. Computers may not have common sense, but they do have direct access to real-time big data, sensors, GPS, cameras and the internet to name just a few technologies.

Kangaroos are responsible for about 90 percent of collisions between vehicles and animals in Australia – although most are not serious. Photograph: Paul Kane/ Getty Images

Volvo's self-driving car is unable to detect kangaroos because hopping confounds its systems, the Swedish carmaker says.

The company's "Large Animal Detection system" can identify and avoid deer, elk and caribou, but early testing in Australia shows it cannot adjust to the kangaroo's unique method of movement.

Computers may not have common sense, but they do have direct access to real-time big data, sensors, GPS, cameras and the internet to name just a few technologies.

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ICT Conference & Hackathon 2017 – Energy Industry Futures – Trends & Disruptions

Connexion@Nexus, Bangsar South, KL

14th November 2017

Technology advances are enhancing customer experience across a range of industries and raising customers' expectations of their service providers. This statement not only offers opportunity for new platforms and ideas of commercialisation, but also post challenges from various perspectives. Highlighted issues were discussed in the ICT Technical Conference 2017, where MIGHT-myForesight® enlisted top 10 megatrends and technology disruptions that will shape the future of energy during the Keynote Presentation.

Urbanisation and digitalisation are part of the megatrends. It is estimated that approximately 70 million people will join the urban population, dramatically increasing the need for houses, transport, food, water, sanitation care, education and energy. This will result in energy storage market expand from USD30 Billion today to surpass USD100 billion by 2025 and the global market for digitalisation in the energy sector to grow up to USD64 billion. Focus of the event is while addressing megatrends and anticipating future challenges, it is equally important to explore on the responses to strategically plan the way forward as well.

Foresight in Government

10th October 2017

Demographic shifts, usage of complex technology, economic volatility, cyber security threats and climate change are among the global challenges faced by the Public Service of the future. Governments are expected to transform towards faster and more agile administration by, among others, changing their daily operation style, and positioning the Public Service at the forefront of service excellence.

Acknowledging these facts, Jabatan Kebajikan Masyarakat (JKM) planned to foster Foresight understanding and methodologies into the upcoming JKM's Strategic Plan. A two-day workshop was held in Penang involving top management, State Directors and Division Directors of JKM, whereby myForesight® presented for the Scene Setting slot.

In the presentation, it was clearly emphasised that there are multiple factors to consider in exploring the future through scenarios; among which are changing trends, addressing the right issues and challenges, exploring uncertainties and considering drivers of change. By doing so, scenarios building exercise will be an effective tools to pave the way forward strategically.

School of International Futures Summer Retreat

Hartwell House, Buckinghamshire, UK

7th -11th August 2017

As part of enhancing the internal capacity and capability initiative, myForesight® participated in the School of International Futures Summer Retreat. The main objective of the participation is to enhance knowledge on current foresight methodologies and increase exposure on best practices through interaction with renowned experts, establish relationship with participants as well as sharing of experience with respective countries and to further strengthen relationship with and explore potential collaboration opportunities.

HAPPENINGS

ASEAN at 50 – Is Our Governance Future Ready?

Kuala Lumpur Convention Centre (KLCC)

22nd August 2017

The success of ASEAN as a regional grouping is attributed to the commitment and diligence of the public officers of the member countries. The Putrajaya Joint Declaration signed by the respective ASEAN Heads of Civil Service in November 2015 stipulates concrete actions to be taken by ASEAN Member States collectively and individually. Among the initiatives include strengthening good governance, integrity and cooperation in civil service, capacity building, technical cooperation, prioritising good regulatory practices and promoting the highest standards of professionalism, efficiency, effectiveness, participatory approach, responsiveness, transparency and accountability in the civil service.

It is timely to look at the progress made and what is in store for the future. MIGHT-myForesight® as the session's moderator, explored questions regarding 4th Industrial Revolution impacts and responses as well as roles of the civil service and youth involvement in shaping the future of ASEAN. The panelists are Ambassador Jojie Samuel M C Samuel, Director General of ASEAN-Malaysia National Secretariat, Ministry of Foreign Affairs Malaysia, and YBhg. Tan Sri Rastam Mohd Isa,Chairman and Chief Executive of ISIS Malaysia.

The International Risk Assessment and Horizon Scanning Symposium 2017 (IRAHSS 2017)

Singapore

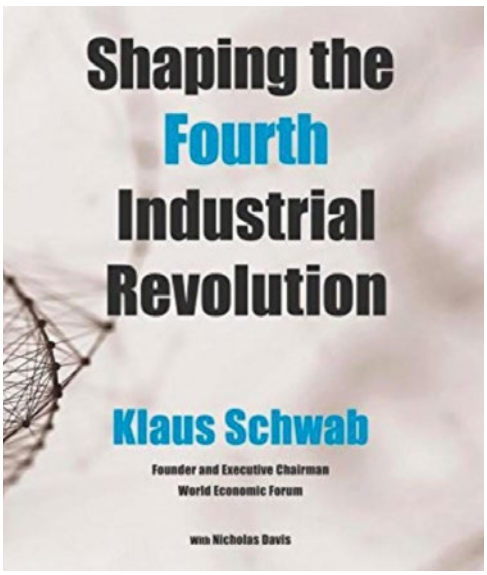
18th - 19th July 2017

Subsequent to the train the trainers programme for Egyptian STI Observatory (ESTIO) representatives at MIGHT, Cyberjaya, myforesight® was invited to Cairo to advise and facilitate a two-day workshop on 16th and 17th August 2017. An initiative by the Academy of Scientific Research and Technology (ASRT) of Egypt, the workshop aims to develop Egypt Energy 2030 scenarios in support of Egypt Vision 2030. Apart from applying the scenario planning methodology into a real case, the initiative is to inculcate future thinking to the stakeholders especially the policy makers in a systematic and structured manner. The scenarios produced by the workshop will be used to test robustness of current roadmap and strategies formulated for energy sector.

Scenario Training for Egypt Energy 2030

Cairo, Egypt **17th to 18th August**

Subsequent to the train the trainers programme for Egyptian STI Observatory (ESTIO) representatives at MIGHT, Cyberjaya, myforesight® was invited to Cairo to advise and facilitate a two-day workshop on 16th and 17th August 2017. An initiative by the Academy of Scientific Research and Technology (ASRT) of Egypt, the workshop aims to develop Egypt Energy 2030 scenarios in support of Egypt Vision 2030. Apart from applying the scenario planning methodology into a real case, the initiative is to inculcate future thinking to the stakeholders especially the policy makers in a systematic and structured manner. The scenarios produced by the workshop will be used to test robustness of current roadmap and strategies formulated for energy sector.



Shaping the Fourth Industrial Revolution

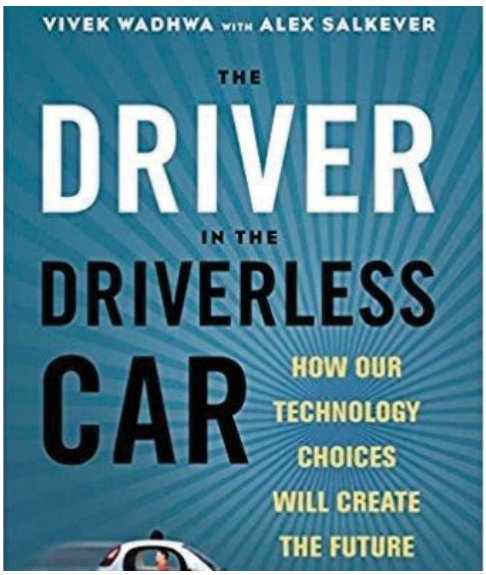
ISBN-10 : 1944835148
ISBN-13 : 978-1944835149
Author : Klaus Schwab with Nicholas Davis
Publisher : World Economic Forum, 2018

Professor Klaus Schwab, Founder and Executive Chairman of the World Economic Forum has been at the centre of global affairs for over four decades. He is known to be well versed in technological and economic trends and published The Fourth Industrial Revolution in 2016—the book looks deeply at how we might take collective responsibility to ensure what lies ahead in the future would be a positive one for all of us.

Shaping the Fourth Industrial Revolution is a continuation that builds on ideas to demonstrate how people from all backgrounds and sectors can influence the way technology transforms our world.

It draws on contributions by more than 200 of the world's leading technology, economic and sociological experts to present a practical guide for citizens, business leaders, social influencers and policy-makers. Emerging technologies are not predetermined forces out of our control, nor are they simple tools with known impacts and consequences.

By connecting the dots across domains and exploring the practical steps that individuals, businesses and governments can take, this book looks to bring all stakeholders together to actively shape an inclusive and sustainable future.



The Driver in the Driverless Car:
How Our Technology Choices Will Create the Future

ISBN-10 : 1626569711
ISBN-13 : 978-1626569713
Author : Vivek Wadhwa with Alex Salkever
Publisher : Berrett-Koehler Publishers, 2017

Breakthroughs such as self-driving vehicles, drones, and artificial intelligence could make our lives healthier, safer, and easier. But the same technologies raise the spectre of a frightening, alienating future—a jobless economy, complete loss of privacy, and ever-worsening economic inequality.

Astonishing technological advances like these are arriving in increasing numbers. Scholar and entrepreneur Vivek Wadhwa uses this book to evaluate the potential impact of any new technology by asking three simple questions to ask about every emerging technology; 1) Does the technology have the potential to benefit everyone equally? 2) What are its risks and rewards? 3) Does the technology promote autonomy or dependence?

These are good questions to ask, and Wadhwa sets out to ask them of several new technologies—among them are artificial intelligence (AI), education and medicine powered by AI, robotics, drones, genetic engineering (and precision medicine), and autonomous vehicles including selfdriving planes.

Looking at a broad array of advances in this light, he emphasises that the future is up to us to create.

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